APPENDIX A

ProUCL Calculation Sheets

Appendix A - UCL Calculations

Appendix A - UCL Calculations

Appendix A-1a
UCL Evaluation - ProUCL Input
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_CLOSURE	EA_REFERENCE	EA_DEFAULT	ID	DATE	Mercury	D_Mercury	UOM
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT001_091317_LOB_01_TA	9/13/2017	154	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT001_091317_LOB_02_TA	9/13/2017	149	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT001_091317_LOB_03_TA	9/13/2017	407	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT001_091317_LOB_04_TA	9/13/2017	231	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT001_091317_LOB_05_TA	9/13/2017	212	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT002_091317_LOB_06_TA	9/13/2017	267	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT002_091317_LOB_07_TA	9/13/2017	216	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT003_091317_LOB_08_TA	9/13/2017	193	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT003_091317_LOB_09_TA	9/13/2017	573	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT003_091317_LOB_10_TA	9/13/2017	386	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT004_091317_LOB_11_TA	9/13/2017	229	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT004_091317_LOB_12_TA	9/13/2017	925	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT044_091517_LOB_19_TA	9/15/2017	120	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT044_091517_LOB_20_TA	9/15/2017	183	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT047_091517_LOB_15_TA	9/15/2017	291	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT047_091517_LOB_16_TA	9/15/2017	358	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT047_091517_LOB_17_TA	9/15/2017	457	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT047_091517_LOB_18_TA	9/15/2017	114	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT048_091517_LOB_13_TA	9/15/2017	151	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CJ_17LT048_091517_LOB_14_TA	9/15/2017	150	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_01_TA	9/24/2016	142	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_02_TA	9/24/2016	186	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_03_TA	9/24/2016	183	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_04_TA	9/24/2016	98.8	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_05_TA	9/24/2016	155	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_06_TA	9/24/2016	289	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_07_TA	9/24/2016	140	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_08_TA	9/24/2016	179	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_09_TA	9/24/2016	147	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_19_TA	9/24/2016	222	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_20_TA	9/24/2016	391	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_14_TA	9/24/2016	259	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_15_TA	9/24/2016	337	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_16_TA	9/24/2016	255	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_17_TA	9/24/2016	180	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_18_TA	9/24/2016	150	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_10_TA	9/24/2016	166	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_11_TA	9/24/2016	159	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_12_TA	9/24/2016	207	1	NG/G
2016 CLOSURE	NON-REF	Cape Jellison	CPJL-092416_LOB_13_TA	9/24/2016	136	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT024_091417_LOB_01_TA	9/14/2017	38.9	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT024_091417_LOB_02_TA	9/14/2017	28.8	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT024_091417_LOB_03_TA	9/14/2017	40.6	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT024_091417_LOB_04_TA	9/14/2017	45.4	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT025_091417_LOB_05_TA	9/14/2017	37.5	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT025_091417_LOB_06_TA	9/14/2017	35.2	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT026_091417_LOB_07_TA	9/14/2017	57.5	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT026_091417_LOB_08_TA	9/14/2017	46.2	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT026_091417_LOB_09_TA	9/14/2017	26.8	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT026_091417_LOB_10_TA	9/14/2017	34.1	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT027_091417_LOB_11_TA	9/14/2017	46.9	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT027_091417_LOB_12_TA	9/14/2017	38.4	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT027_091417_LOB_13_TA	9/14/2017	35.5	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT027_091417_LOB_14_TA	9/14/2017	64.8	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT027_091417_LOB_15_TA	9/14/2017	38.1	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT027_091417_LOB_16_TA	9/14/2017	35.4	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT027_091417_LOB_17_TA	9/14/2017	39.2	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT028_091417_LOB_18_TA	9/14/2017	43.3	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT028_091417_LOB_19_TA	9/14/2017	43.8	1	NG/G
FB	REFERENCE	chman Bay - Refer	FBJR_17LT028_091417_LOB_20_TA	9/14/2017	36	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT019_091317_LOB_01_TA	9/13/2017	74.2	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT021_091317_LOB_02_TA	9/13/2017	99.8	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT022_091317_LOB_03_TA	9/13/2017	123	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT022_091317_LOB_04_TA	9/13/2017	66.3	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT022_091317_LOB_05_TA	9/13/2017	62.7	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT023_091317_LOB_06_TA	9/13/2017	64.8	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT034_091517_LOB_07_TA	9/15/2017	184	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT034_091517_LOB_08_TA	9/15/2017	149	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT034_091517_LOB_09_TA	9/15/2017	82.8	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT036_091517_LOB_10_TA	9/15/2017	113	1	NG/G

Appendix A-1a
UCL Evaluation - ProUCL Input
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_CLOSURE	EA_REFERENCE	EA_DEFAULT	ID	DATE	Mercury	D_Mercury	UOM
HB	NON-REF	Harborside	HB-01_17LT036_091517_LOB_11_TA	9/15/2017	123	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT036_091517_LOB_12_TA	9/15/2017	83.3	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT036_091517_LOB_13_TA	9/15/2017	85.6	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT049_091517_LOB_14_TA	9/15/2017	108	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT049_091517_LOB_15_TA	9/15/2017	50.3	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT050_091517_LOB_16_TA	9/15/2017	138	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT052_091517_LOB_17_TA	9/15/2017	59.4	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT052_091517_LOB_18_TA	9/15/2017	264	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT052_091517_LOB_19_TA	9/15/2017	85.9	1	NG/G
HB	NON-REF	Harborside	HB-01_17LT052_091517_LOB_20_TA	9/15/2017	99.4	1	NG/G
HB	NON-REF	Harborside	HBI-01_092416_LOB_08_TA	9/24/2016	82.9	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_18_TA	9/26/2016	108	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_19_TA	9/26/2016	122	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_20_TA	9/26/2016	107	1	NG/G
HB	NON-REF	Harborside	HBI-01_092416_LOB_07_TA	9/24/2016	103	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_12_TA	9/26/2016	96.7	1	NG/G
HB	NON-REF	Harborside	HBI-01_092416_LOB_06_TA	9/24/2016	92.7	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_09_TA	9/26/2016	44.4	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_13_TA	9/26/2016	98.4	1	NG/G
HB	NON-REF	Harborside	HBI-01_092416_LOB_04_TA	9/24/2016	68.7	1	NG/G
HB	NON-REF	Harborside	HBI-01_092416_LOB_05_TA	9/24/2016	100	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_11_TA	9/26/2016	129	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_17_TA	9/26/2016	127	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_14_TA	9/26/2016	128	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_15_TA	9/26/2016	119	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_16_TA	9/26/2016	54	1	NG/G
HB	NON-REF	Harborside	HBI-01_092416_LOB_01_TA	9/24/2016	139	1	NG/G
HB	NON-REF	Harborside	HBI-01_092416_LOB_02_TA	9/24/2016	76.9	1	NG/G
HB	NON-REF	Harborside	HBI-01_092416_LOB_03_TA	9/24/2016	46.9	1	NG/G
HB	NON-REF	Harborside	HBI-01_092616_LOB_10_TA	9/26/2016	117	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT006_091317_LOB_01_TA	9/13/2017	194	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT006_091317_LOB_02_TA	9/13/2017	153	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT006_091317_LOB_03_TA	9/13/2017	321	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT006_091317_LOB_04_TA	9/13/2017	309	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT006_091317_LOB_05_TA	9/13/2017	128	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT006_091317_LOB_06_TA	9/13/2017	178	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT007_091317_LOB_07_TA	9/13/2017	1730	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT007_091317_LOB_08_TA	9/13/2017	193	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT007_091317_LOB_09_TA	9/13/2017	542	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT008_091317_LOB_10_TA	9/13/2017	237	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT008_091317_LOB_11_TA	9/13/2017	267	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT008_091317_LOB_12_TA	9/13/2017	141	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT009_091317_LOB_13_TA	9/13/2017	241	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT040_091517_LOB_18_TA	9/13/2017	519	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT040_091517_LOB_19_TA	9/13/2017	654	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT040_091517_LOB_20_TA	9/13/2017	278	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT041_091517_LOB_14_TA	9/13/2017	174	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT041_091517_LOB_15_TA	9/13/2017	212	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT041_091517_LOB_16_TA	9/13/2017	250	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_17LT042_091517_LOB_17_TA	9/13/2017	181	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_01_TA	9/24/2016	169	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_02_TA	9/24/2016	152	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_03_TA	9/24/2016	149	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_04_TA	9/24/2016	527	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_05_TA	9/24/2016	159	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_13_TA	9/24/2016	254	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_14_TA	9/24/2016	438	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_15_TA	9/24/2016	418	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_16_TA	9/24/2016	201	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_17_TA	9/24/2016	200	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_18_TA	9/24/2016	142	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_19_TA	9/24/2016	212	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_20_TA	9/24/2016	786	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_06_TA	9/24/2016	185	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_07_TA	9/24/2016	158	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_08_TA	9/24/2016	364	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_09_TA	9/24/2016	365	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_10_TA	9/24/2016	263	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_11_TA	9/24/2016	161	1	NG/G
2014 CLOSURE	NON-REF	Odom Ledge	L10-52_092416_LOB_12_TA	9/24/2016	772	1	NG/G

Appendix A-1a
UCL Evaluation - ProUCL Input
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_CLOSURE	EA_REFERENCE	EA_DEFAULT	ID	DATE	Mercury	D_Mercury	UOM
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT015_091317_LOB_01_TA	9/13/2017	317	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT015_091317_LOB_02_TA	9/13/2017	549	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT015_091317_LOB_03_TA	9/13/2017	139	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT015_091317_LOB_04_TA	9/13/2017	359	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT015_091317_LOB_05_TA	9/13/2017	257	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT015_091317_LOB_06_TA	9/13/2017	263	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT015_091317_LOB_07_TA	9/13/2017	384	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT015_091317_LOB_08_TA	9/13/2017	591	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT016_091317_LOB_09_TA	9/13/2017	65.6	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT016_091317_LOB_10_TA	9/13/2017	272	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT016_091317_LOB_11_TA	9/13/2017	120	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT016_091317_LOB_12_TA	9/13/2017	247	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT016_091317_LOB_13_TA	9/13/2017	220	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT016_091317_LOB_14_TA	9/13/2017	286	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT017_091317_LOB_15_TA	9/13/2017	223	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT017_091317_LOB_16_TA	9/13/2017	179	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT017_091317_LOB_17_TA	9/13/2017	114	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT017_091317_LOB_18_TA	9/13/2017	177	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT018_091317_LOB_19_TA	9/13/2017	117	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_17LT018_091317_LOB_20_TA	9/13/2017	240	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_20_TA	9/24/2016	195	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_17_TA	9/24/2016	218	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_18_TA	9/24/2016	166	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_19_TA	9/24/2016	173	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_15_TA	9/24/2016	129	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_16_TA	9/24/2016	150	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_12_TA	9/24/2016	171	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_13_TA	9/24/2016	157	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_14_TA	9/24/2016	155	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_07_TA	9/24/2016	162	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_08_TA	9/24/2016	242	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_09_TA	9/24/2016	155	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_10_TA	9/24/2016	74	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_11_TA	9/24/2016	219	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_01_TA	9/24/2016	108	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_02_TA	9/24/2016	191	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_03_TA	9/24/2016	254	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_04_TA	9/24/2016	101	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_05_TA	9/24/2016	152	1	NG/G
2016 CLOSURE	NON-REF	Turner Point	L9-45_092416_LOB_06_TA	9/24/2016	194	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT011_091317_LOB_01_TA	9/13/2017	303	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT011_091317_LOB_02_TA	9/13/2017	290	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT011_091317_LOB_03_TA	9/13/2017	397	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT011_091317_LOB_04_TA	9/13/2017	191	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT011_091317_LOB_05_TA	9/13/2017	180	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT011_091317_LOB_06_TA	9/13/2017	244	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT011_091317_LOB_07_TA	9/13/2017	343	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT011_091317_LOB_08_TA	9/13/2017	468	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT012_091317_LOB_09_TA	9/13/2017	433	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT012_091317_LOB_10_TA	9/13/2017	165	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT012_091317_LOB_11_TA	9/13/2017	167	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT013_091317_LOB_12_TA	9/13/2017	279	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT013_091317_LOB_13_TA	9/13/2017	291	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT013_091317_LOB_14_TA	9/13/2017	533	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT013_091317_LOB_15_TA	9/13/2017	290	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT013_091317_LOB_16_TA	9/13/2017	526	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT014_091317_LOB_17_TA	9/13/2017	574	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT014_091317_LOB_18_TA	9/13/2017	390	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT014_091317_LOB_19_TA	9/13/2017	260	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_17LT043_091517_LOB_20_TA	9/15/2017	168	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_01_TA	9/24/2016	344	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_02_TA	9/24/2016	265	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_03_TA	9/24/2016	277	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_04_TA	9/24/2016	222	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_05_TA	9/24/2016	512	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_06_TA	9/24/2016	523	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_07_TA	9/24/2016	181	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_08_TA	9/24/2016	278	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_09_TA	9/24/2016	512	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_10_TA	9/24/2016	167	1	NG/G

Appendix A-1a
UCL Evaluation - ProUCL Input
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_CLOSURE	EA_REFERENCE	EA_DEFAULT	ID	DATE	Mercury	D_Mercury	UOM
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_11_TA	9/24/2016	450	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_12_TA	9/24/2016	227	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_13_TA	9/24/2016	272	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_14_TA	9/24/2016	388	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_15_TA	9/24/2016	674	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_16_TA	9/24/2016	459	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_17_TA	9/24/2016	308	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_18_TA	9/24/2016	395	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_19_TA	9/24/2016	747	1	NG/G
2014 CLOSURE	NON-REF	South Verona	SVE-01_092416_LOB_20_TA	9/24/2016	1320	1	NG/G

Appendix A-1b
UCL Evaluation - All Areas
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/15/2017 10:33:57 AM
From File	2017-11-14 PEN_BI21 BERA_lobster.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_Hg(ng/g) (non-ref)

General Statistics

Total Number of Observations	200	Number of Distinct Observations	162
		Number of Missing Observations	0
Minimum	44.4	Mean	251.5
Maximum	1730	Median	191
SD	201.9	Std. Error of Mean	14.28
Coefficient of Variation	0.803	Skewness	3.366

Normal GOF Test

Shapiro Wilk Test Statistic	0.732	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.187	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0631	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	275.1	95% Adjusted-CLT UCL (Chen-1995)	278.6
		95% Modified-t UCL (Johnson-1978)	275.7

Gamma GOF Test

A-D Test Statistic	2.562	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.763	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0965	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.0643	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.484	k star (bias corrected MLE)	2.45
Theta hat (MLE)	101.3	Theta star (bias corrected MLE)	102.7
nu hat (MLE)	993.4	nu star (bias corrected)	979.9
MLE Mean (bias corrected)	251.5	MLE Sd (bias corrected)	160.7
		Approximate Chi Square Value (0.05)	908.2
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	907.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	271.3	95% Adjusted Gamma UCL (use when n<50)	271.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.983	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.545	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.055	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0631	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.793	Mean of logged Data	5.313
Maximum of Logged Data	7.456	SD of logged Data	0.634

Assuming Lognormal Distribution

95% H-UCL	270.2	90% Chebyshev (MVUE) UCL	284.2
95% Chebyshev (MVUE) UCL	300.7	97.5% Chebyshev (MVUE) UCL	323.6
99% Chebyshev (MVUE) UCL	368.5		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	275	95% Jackknife UCL	275.1
95% Standard Bootstrap UCL	274.4	95% Bootstrap-t UCL	278.7
95% Hall's Bootstrap UCL	279.2	95% Percentile Bootstrap UCL	275.8
95% BCA Bootstrap UCL	278.3		
90% Chebyshev(Mean, Sd) UCL	294.3	95% Chebyshev(Mean, Sd) UCL	313.7
97.5% Chebyshev(Mean, Sd) UCL	340.7	99% Chebyshev(Mean, Sd) UCL	393.6

Suggested UCL to Use

95% H-UCL	270.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

resuse_Hg(ng/g) (reference)

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	26.8	Mean	40.62
Maximum	64.8	Median	38.65
SD	8.837	Std. Error of Mean	1.976
Coefficient of Variation	0.218	Skewness	1.217

Appendix A-1b

UCL Evaluation - All Areas

American Lobster

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.164	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.192	Data appear Normal at 5% Significance Level	

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	44.04	95% Adjusted-CLT UCL (Chen-1995)	44.44
		95% Modified-t UCL (Johnson-1978)	44.13

Gamma GOF Test

A-D Test Statistic	0.5	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.143	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.193	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	24.39	k star (bias corrected MLE)	20.76
Theta hat (MLE)	1.666	Theta star (bias corrected MLE)	1.957
nu hat (MLE)	975.4	nu star (bias corrected)	830.4
MLE Mean (bias corrected)	40.62	MLE Sd (bias corrected)	8.915
		Approximate Chi Square Value (0.05)	764.5
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	759.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	44.12	95% Adjusted Gamma UCL (use when n<50)	44.41

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.129	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.288	Mean of logged Data	3.684
Maximum of Logged Data	4.171	SD of logged Data	0.205

Assuming Lognormal Distribution

95% H-UCL	44.21	90% Chebyshev (MVUE) UCL	46.22
95% Chebyshev (MVUE) UCL	48.77	97.5% Chebyshev (MVUE) UCL	52.31
99% Chebyshev (MVUE) UCL	59.25		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-1b

UCL Evaluation - All Areas

American Lobster

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	43.87	95% Jackknife UCL	44.04
95% Standard Bootstrap UCL	43.81	95% Bootstrap-t UCL	45.01
95% Hall's Bootstrap UCL	46.82	95% Percentile Bootstrap UCL	44.1
95% BCA Bootstrap UCL	44.33		
90% Chebyshev(Mean, Sd) UCL	46.55	95% Chebyshev(Mean, Sd) UCL	49.23
97.5% Chebyshev(Mean, Sd) UCL	52.96	99% Chebyshev(Mean, Sd) UCL	60.28

Suggested UCL to Use

95% Student's-t UCL 44.04

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-1c
UCL Evaluation - Sample Areas
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/14/2017 3:38:20 PM
From File	2017-11-14 PEN_BI21 BERA_lobster.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_Hg(ng/g) (cj)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	98.8	Mean	243.7
Maximum	925	Median	189.5
SD	151.8	Std. Error of Mean	24
Coefficient of Variation	0.623	Skewness	2.747

Normal GOF Test

Shapiro Wilk Test Statistic	0.729	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.208	Lilliefors GOF Test
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	284.1	95% Adjusted-CLT UCL (Chen-1995)	294.3
		95% Modified-t UCL (Johnson-1978)	285.9

Gamma GOF Test

A-D Test Statistic	1.404	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.152	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.143	k star (bias corrected MLE)	3.849
Theta hat (MLE)	58.82	Theta star (bias corrected MLE)	63.31
nu hat (MLE)	331.5	nu star (bias corrected)	307.9
MLE Mean (bias corrected)	243.7	MLE Sd (bias corrected)	124.2
		Approximate Chi Square Value (0.05)	268.3
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	266.9

Appendix A-1c
UCL Evaluation - Sample Areas
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	279.7	95% Adjusted Gamma UCL (use when n<50)	281.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.936	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.121	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.593	Mean of logged Data	5.37
Maximum of Logged Data	6.83	SD of logged Data	0.47

Assuming Lognormal Distribution

95% H-UCL	277	90% Chebyshev (MVUE) UCL	295.1
95% Chebyshev (MVUE) UCL	320.3	97.5% Chebyshev (MVUE) UCL	355.3
99% Chebyshev (MVUE) UCL	424.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	283.2	95% Jackknife UCL	284.1
95% Standard Bootstrap UCL	281.6	95% Bootstrap-t UCL	307.8
95% Hall's Bootstrap UCL	329.7	95% Percentile Bootstrap UCL	285.7
95% BCA Bootstrap UCL	292.1		
90% Chebyshev(Mean, Sd) UCL	315.7	95% Chebyshev(Mean, Sd) UCL	348.3
97.5% Chebyshev(Mean, Sd) UCL	393.6	99% Chebyshev(Mean, Sd) UCL	482.5

Suggested UCL to Use

95% Student's-t UCL	284.1	or 95% Modified-t UCL	285.9
or 95% H-UCL	277		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Appendix A-1c

UCL Evaluation - Sample Areas

American Lobster

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

resuse_Hg(ng/g) (fb)

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	26.8	Mean	40.62
Maximum	64.8	Median	38.65
SD	8.837	Std. Error of Mean	1.976
Coefficient of Variation	0.218	Skewness	1.217

Normal GOF Test

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.164	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	44.04	95% Adjusted-CLT UCL (Chen-1995)	44.44
		95% Modified-t UCL (Johnson-1978)	44.13

Gamma GOF Test

A-D Test Statistic	0.5	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.143	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.193	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	24.39	k star (bias corrected MLE)	20.76
Theta hat (MLE)	1.666	Theta star (bias corrected MLE)	1.957
nu hat (MLE)	975.4	nu star (bias corrected)	830.4
MLE Mean (bias corrected)	40.62	MLE Sd (bias corrected)	8.915
		Approximate Chi Square Value (0.05)	764.5
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	759.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	44.12	95% Adjusted Gamma UCL (use when n<50)	44.41

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.129	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.288	Mean of logged Data	3.684
Maximum of Logged Data	4.171	SD of logged Data	0.205

Assuming Lognormal Distribution

95% H-UCL	44.21	90% Chebyshev (MVUE) UCL	46.22
95% Chebyshev (MVUE) UCL	48.77	97.5% Chebyshev (MVUE) UCL	52.31
99% Chebyshev (MVUE) UCL	59.25		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	43.87	95% Jackknife UCL	44.04
95% Standard Bootstrap UCL	43.84	95% Bootstrap-t UCL	44.93
95% Hall's Bootstrap UCL	46.21	95% Percentile Bootstrap UCL	43.78
95% BCA Bootstrap UCL	44.37		
90% Chebyshev(Mean, Sd) UCL	46.55	95% Chebyshev(Mean, Sd) UCL	49.23
97.5% Chebyshev(Mean, Sd) UCL	52.96	99% Chebyshev(Mean, Sd) UCL	60.28

Suggested UCL to Use

95% Student's-t UCL	44.04

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (hb)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	44.4	Mean	101.9
Maximum	264	Median	99.6
SD	40.35	Std. Error of Mean	6.38
Coefficient of Variation	0.396	Skewness	1.709

Normal GOF Test

Shapiro Wilk Test Statistic	0.884	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.126	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Normal at 5% Significance Level

Appendix A-1c
UCL Evaluation - Sample Areas
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	112.7	95% Adjusted-CLT UCL (Chen-1995)	114.3
		95% Modified-t UCL (Johnson-1978)	113

Gamma GOF Test

A-D Test Statistic	0.322	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0892	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.525	k star (bias corrected MLE)	6.977
Theta hat (MLE)	13.55	Theta star (bias corrected MLE)	14.61
nu hat (MLE)	602	nu star (bias corrected)	558.2
MLE Mean (bias corrected)	101.9	MLE Sd (bias corrected)	38.59
		Approximate Chi Square Value (0.05)	504.4
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	502.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	112.8	95% Adjusted Gamma UCL (use when n<50)	113.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0914	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.793	Mean of logged Data	4.556
Maximum of Logged Data	5.576	SD of logged Data	0.371

Assuming Lognormal Distribution

95% H-UCL	113.8	90% Chebyshev (MVUE) UCL	120.3
95% Chebyshev (MVUE) UCL	128.6	97.5% Chebyshev (MVUE) UCL	140.2
99% Chebyshev (MVUE) UCL	162.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	112.4	95% Jackknife UCL	112.7
95% Standard Bootstrap UCL	112.5	95% Bootstrap-t UCL	115.4
95% Hall's Bootstrap UCL	120.3	95% Percentile Bootstrap UCL	112.3
95% BCA Bootstrap UCL	114.1		
90% Chebyshev(Mean, Sd) UCL	121.1	95% Chebyshev(Mean, Sd) UCL	129.7
97.5% Chebyshev(Mean, Sd) UCL	141.8	99% Chebyshev(Mean, Sd) UCL	165.4

Suggested UCL to Use

95% Student's-t UCL 112.7

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (ol)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	128	Mean	324.4
Maximum	1730	Median	224.5
SD	284.6	Std. Error of Mean	45
Coefficient of Variation	0.877	Skewness	3.455

Normal GOF Test

Shapiro Wilk Test Statistic	0.627	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.245	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	400.2	95% Adjusted-CLT UCL (Chen-1995)	424.7
		95% Modified-t UCL (Johnson-1978)	404.3

Gamma GOF Test

A-D Test Statistic	2.136	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.187	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.141	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

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UCL Evaluation - Sample Areas

American Lobster

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	2.584	k star (bias corrected MLE)	2.407
Theta hat (MLE)	125.5	Theta star (bias corrected MLE)	134.8
nu hat (MLE)	206.7	nu star (bias corrected)	192.6
MLE Mean (bias corrected)	324.4	MLE Sd (bias corrected)	209.1
		Approximate Chi Square Value (0.05)	161.5
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	160.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	386.9	95% Adjusted Gamma UCL (use when n<50)	389.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.892	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.147	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.852	Mean of logged Data	5.576
Maximum of Logged Data	7.456	SD of logged Data	0.581

Assuming Lognormal Distribution

95% H-UCL	376	90% Chebyshev (MVUE) UCL	402.2
95% Chebyshev (MVUE) UCL	443.5	97.5% Chebyshev (MVUE) UCL	500.7
99% Chebyshev (MVUE) UCL	613.3		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	398.4	95% Jackknife UCL	400.2
95% Standard Bootstrap UCL	396	95% Bootstrap-t UCL	456
95% Hall's Bootstrap UCL	704.7	95% Percentile Bootstrap UCL	399.6
95% BCA Bootstrap UCL	436.5		
90% Chebyshev(Mean, Sd) UCL	459.4	95% Chebyshev(Mean, Sd) UCL	520.6
97.5% Chebyshev(Mean, Sd) UCL	605.4	99% Chebyshev(Mean, Sd) UCL	772.2

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	520.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-1c
UCL Evaluation - Sample Areas
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

resuse_Hg(ng/g) (sv)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	165	Mean	375.3
Maximum	1320	Median	305.5
SD	211	Std. Error of Mean	33.36
Coefficient of Variation	0.562	Skewness	2.502

Normal GOF Test

Shapiro Wilk Test Statistic	0.788	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.159	Lilliefors GOF Test
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	431.5	95% Adjusted-CLT UCL (Chen-1995)	444.3
		95% Modified-t UCL (Johnson-1978)	433.7

Gamma GOF Test

A-D Test Statistic	0.581	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.122	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.491	k star (bias corrected MLE)	4.171
Theta hat (MLE)	83.58	Theta star (bias corrected MLE)	89.99
nu hat (MLE)	359.3	nu star (bias corrected)	333.6
MLE Mean (bias corrected)	375.3	MLE Sd (bias corrected)	183.8
		Approximate Chi Square Value (0.05)	292.3
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	290.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	428.4	95% Adjusted Gamma UCL (use when n<50)	430.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.958	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0948	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.106	Mean of logged Data	5.812
Maximum of Logged Data	7.185	SD of logged Data	0.468

Assuming Lognormal Distribution

95% H-UCL	430.1	90% Chebyshev (MVUE) UCL	458
95% Chebyshev (MVUE) UCL	497	97.5% Chebyshev (MVUE) UCL	551.1
99% Chebyshev (MVUE) UCL	657.4		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	430.2	95% Jackknife UCL	431.5
95% Standard Bootstrap UCL	428.1	95% Bootstrap-t UCL	454.1
95% Hall's Bootstrap UCL	488.8	95% Percentile Bootstrap UCL	434.8
95% BCA Bootstrap UCL	449.4		
90% Chebyshev(Mean, Sd) UCL	475.4	95% Chebyshev(Mean, Sd) UCL	520.7
97.5% Chebyshev(Mean, Sd) UCL	583.7	99% Chebyshev(Mean, Sd) UCL	707.3

Suggested UCL to Use

95% Adjusted Gamma UCL	430.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (tp)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	65.6	Mean	212.1
Maximum	591	Median	185
SD	109.7	Std. Error of Mean	17.34
Coefficient of Variation	0.517	Skewness	1.835

Normal GOF Test

Shapiro Wilk Test Statistic	0.841	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.146	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Appendix A-1c
UCL Evaluation - Sample Areas
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	241.4	95% Adjusted-CLT UCL (Chen-1995)	246
		95% Modified-t UCL (Johnson-1978)	242.2

Gamma GOF Test

A-D Test Statistic	0.485	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.087	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.769	k star (bias corrected MLE)	4.428
Theta hat (MLE)	44.48	Theta star (bias corrected MLE)	47.91
nu hat (MLE)	381.5	nu star (bias corrected)	354.3
MLE Mean (bias corrected)	212.1	MLE Sd (bias corrected)	100.8
		Approximate Chi Square Value (0.05)	311.6
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	310.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	241.2	95% Adjusted Gamma UCL (use when n<50)	242.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0791	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.184	Mean of logged Data	5.249
Maximum of Logged Data	6.382	SD of logged Data	0.464

Assuming Lognormal Distribution

95% H-UCL	244.1	90% Chebyshev (MVUE) UCL	259.9
95% Chebyshev (MVUE) UCL	281.9	97.5% Chebyshev (MVUE) UCL	312.3
99% Chebyshev (MVUE) UCL	372.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	240.7	95% Jackknife UCL	241.4
95% Standard Bootstrap UCL	240.7	95% Bootstrap-t UCL	250
95% Hall's Bootstrap UCL	255.7	95% Percentile Bootstrap UCL	243.5
95% BCA Bootstrap UCL	245.8		
90% Chebyshev(Mean, Sd) UCL	264.2	95% Chebyshev(Mean, Sd) UCL	287.7
97.5% Chebyshev(Mean, Sd) UCL	320.4	99% Chebyshev(Mean, Sd) UCL	384.7

Appendix A-1c

UCL Evaluation - Sample Areas

American Lobster

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Suggested UCL to Use

95% Adjusted Gamma UCL	242.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-1d

UCL Evaluation - Closure Areas

American Lobster

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/14/2017 3:41:51 PM
From File	2017-11-14 PEN_BI21 BERA_lobster.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_Hg(ng/g) (2014 closure)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	74
		Number of Missing Observations	0
Minimum	128	Mean	349.9
Maximum	1730	Median	277.5
SD	250.2	Std. Error of Mean	27.98
Coefficient of Variation	0.715	Skewness	3.076

Normal GOF Test

Shapiro Wilk Test Statistic	0.717	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.189	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	396.4	95% Adjusted-CLT UCL (Chen-1995)	406.2
		95% Modified-t UCL (Johnson-1978)	398

Gamma GOF Test

A-D Test Statistic	1.842	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.127	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.1	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.219	k star (bias corrected MLE)	3.107
Theta hat (MLE)	108.7	Theta star (bias corrected MLE)	112.6
nu hat (MLE)	515.1	nu star (bias corrected)	497.1
MLE Mean (bias corrected)	349.9	MLE Sd (bias corrected)	198.5
		Approximate Chi Square Value (0.05)	446.4
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	445.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	389.6	95% Adjusted Gamma UCL (use when n<50)	390.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.942	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.00225	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0906	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0991	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.852	Mean of logged Data	5.694
Maximum of Logged Data	7.456	SD of logged Data	0.537

Assuming Lognormal Distribution

95% H-UCL	384.7	90% Chebyshev (MVUE) UCL	408.2
95% Chebyshev (MVUE) UCL	437.9	97.5% Chebyshev (MVUE) UCL	479.1
99% Chebyshev (MVUE) UCL	560.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	395.9	95% Jackknife UCL	396.4
95% Standard Bootstrap UCL	396.3	95% Bootstrap-t UCL	415.7
95% Hall's Bootstrap UCL	430.6	95% Percentile Bootstrap UCL	399.1
95% BCA Bootstrap UCL	406.5		
90% Chebyshev(Mean, Sd) UCL	433.8	95% Chebyshev(Mean, Sd) UCL	471.8
97.5% Chebyshev(Mean, Sd) UCL	524.6	99% Chebyshev(Mean, Sd) UCL	628.3

Suggested UCL to Use

95% H-UCL	384.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

resuse_Hg(ng/g) (2016 closure)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	71
		Number of Missing Observations	0
Minimum	65.6	Mean	227.9
Maximum	925	Median	188.5
SD	132.5	Std. Error of Mean	14.82
Coefficient of Variation	0.581	Skewness	2.599

Appendix A-1d
UCL Evaluation - Closure Areas
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.779	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.172	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0991	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	252.6	95% Adjusted-CLT UCL (Chen-1995)	256.9
		95% Modified-t UCL (Johnson-1978)	253.3

Gamma GOF Test

A-D Test Statistic	1.661	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.111	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.1	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.347	k star (bias corrected MLE)	4.193
Theta hat (MLE)	52.43	Theta star (bias corrected MLE)	54.36
nu hat (MLE)	695.6	nu star (bias corrected)	670.8
MLE Mean (bias corrected)	227.9	MLE Sd (bias corrected)	111.3
		Approximate Chi Square Value (0.05)	611.8
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	610.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	249.9	95% Adjusted Gamma UCL (use when n<50)	250.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.319	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0811	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0991	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.184	Mean of logged Data	5.31
Maximum of Logged Data	6.83	SD of logged Data	0.469

Assuming Lognormal Distribution

95% H-UCL	248.7	90% Chebyshev (MVUE) UCL	262.5
95% Chebyshev (MVUE) UCL	279.3	97.5% Chebyshev (MVUE) UCL	302.6
99% Chebyshev (MVUE) UCL	348.5		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	252.3	95% Jackknife UCL	252.6
95% Standard Bootstrap UCL	252.7	95% Bootstrap-t UCL	259.4
95% Hall's Bootstrap UCL	262.9	95% Percentile Bootstrap UCL	253.1
95% BCA Bootstrap UCL	255.9		
90% Chebyshev(Mean, Sd) UCL	272.4	95% Chebyshev(Mean, Sd) UCL	292.5
97.5% Chebyshev(Mean, Sd) UCL	320.5	99% Chebyshev(Mean, Sd) UCL	375.4

Appendix A-1d
UCL Evaluation - Closure Areas
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	252.6	or 95% Modified-t UCL	253.3
or 95% H-UCL	248.7		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

resuse_Hg(ng/g) (fb)

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	26.8	Mean	40.62
Maximum	64.8	Median	38.65
SD	8.837	Std. Error of Mean	1.976
Coefficient of Variation	0.218	Skewness	1.217

Normal GOF Test

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.164	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	44.04	95% Adjusted-CLT UCL (Chen-1995)	44.44
		95% Modified-t UCL (Johnson-1978)	44.13

Gamma GOF Test

A-D Test Statistic	0.5	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.143	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.193	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	24.39	k star (bias corrected MLE)	20.76
Theta hat (MLE)	1.666	Theta star (bias corrected MLE)	1.957
nu hat (MLE)	975.4	nu star (bias corrected)	830.4
MLE Mean (bias corrected)	40.62	MLE Sd (bias corrected)	8.915
		Approximate Chi Square Value (0.05)	764.5
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	759.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	44.12	95% Adjusted Gamma UCL (use when n<50)	44.41

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.129	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.288	Mean of logged Data	3.684
Maximum of Logged Data	4.171	SD of logged Data	0.205

Assuming Lognormal Distribution

95% H-UCL	44.21	90% Chebyshev (MVUE) UCL	46.22
95% Chebyshev (MVUE) UCL	48.77	97.5% Chebyshev (MVUE) UCL	52.31
99% Chebyshev (MVUE) UCL	59.25		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	43.87	95% Jackknife UCL	44.04
95% Standard Bootstrap UCL	43.73	95% Bootstrap-t UCL	45.11
95% Hall's Bootstrap UCL	46.44	95% Percentile Bootstrap UCL	43.85
95% BCA Bootstrap UCL	44.37		
90% Chebyshev(Mean, Sd) UCL	46.55	95% Chebyshev(Mean, Sd) UCL	49.23
97.5% Chebyshev(Mean, Sd) UCL	52.96	99% Chebyshev(Mean, Sd) UCL	60.28

Suggested UCL to Use

95% Student's-t UCL	44.04

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (hb)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	44.4	Mean	101.9
Maximum	264	Median	99.6
SD	40.35	Std. Error of Mean	6.38
Coefficient of Variation	0.396	Skewness	1.709

Appendix A-1d

UCL Evaluation - Closure Areas

American Lobster

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.884	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.126	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	112.7	95% Adjusted-CLT UCL (Chen-1995)	114.3
		95% Modified-t UCL (Johnson-1978)	113

Gamma GOF Test

A-D Test Statistic	0.322	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0892	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.525	k star (bias corrected MLE)	6.977
Theta hat (MLE)	13.55	Theta star (bias corrected MLE)	14.61
nu hat (MLE)	602	nu star (bias corrected)	558.2
MLE Mean (bias corrected)	101.9	MLE Sd (bias corrected)	38.59
		Approximate Chi Square Value (0.05)	504.4
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	502.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	112.8	95% Adjusted Gamma UCL (use when n<50)	113.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0914	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.793	Mean of logged Data	4.556
Maximum of Logged Data	5.576	SD of logged Data	0.371

Assuming Lognormal Distribution

95% H-UCL	113.8	90% Chebyshev (MVUE) UCL	120.3
95% Chebyshev (MVUE) UCL	128.6	97.5% Chebyshev (MVUE) UCL	140.2
99% Chebyshev (MVUE) UCL	162.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	112.4	95% Jackknife UCL	112.7
95% Standard Bootstrap UCL	112.2	95% Bootstrap-t UCL	115.6
95% Hall's Bootstrap UCL	118.6	95% Percentile Bootstrap UCL	112.6
95% BCA Bootstrap UCL	113.6		
90% Chebyshev(Mean, Sd) UCL	121.1	95% Chebyshev(Mean, Sd) UCL	129.7
97.5% Chebyshev(Mean, Sd) UCL	141.8	99% Chebyshev(Mean, Sd) UCL	165.4

Appendix A-1d
UCL Evaluation - Closure Areas
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	112.7

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-2a
UCL Evaluation - ProUCL Input
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_AA	EA_SA	ID	DATE	Mercury	D_Mercury	UOM
ES-03	NON-REF	ES-03_17HC001_091917_BLM_01_WB	9/19/2017	75	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_02_WB	9/19/2017	111	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_03_WB	9/19/2017	116	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_04_WB	9/19/2017	123	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_05_WB	9/19/2017	97.6	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_06_WB	9/19/2017	63.5	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_07_WB	9/19/2017	95.6	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_08_WB	9/19/2017	104	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_09_WB	9/19/2017	103	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_10_WB	9/19/2017	89.2	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_11_WB	9/19/2017	160	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_12_WB	9/19/2017	92.3	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_13_WB	9/19/2017	72.8	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_14_WB	9/19/2017	88.7	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_15_WB	9/19/2017	68.9	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_16_WB	9/19/2017	207	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_18_WB	9/19/2017	79.6	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_19_WB	9/19/2017	86.1	1	NG/G
ES-03	NON-REF	ES-03_17HC001_091917_BLM_20_WB	9/19/2017	75.9	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_01_WB	9/27/2016	80.4	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_02_WB	9/27/2016	57.8	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_03_WB	9/27/2016	60.4	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_04_WB	9/27/2016	77.7	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_05_WB	9/27/2016	81.9	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_06_WB	9/27/2016	118	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_07_WB	9/27/2016	71.4	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_08_WB	9/27/2016	69	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_09_WB	9/27/2016	107	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_10_WB	9/27/2016	71	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_11_WB	9/27/2016	61.1	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_12_WB	9/27/2016	77.3	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_13_WB	9/27/2016	81.4	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_14_WB	9/27/2016	51	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_15_WB	9/27/2016	116	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_16_WB	9/27/2016	138	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_17_WB	9/27/2016	76	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_18_WB	9/27/2016	88.9	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_19_WB	9/27/2016	87.5	1	NG/G
ES-03	NON-REF	ES-03_092716_BLM_20_WB	9/27/2016	68.6	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_01_WB	9/14/2017	80.3	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_02_WB	9/14/2017	86.5	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_03_WB	9/14/2017	48.4	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_04_WB	9/14/2017	144	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_05_WB	9/14/2017	71.9	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_06_WB	9/14/2017	109	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_07_WB	9/14/2017	110	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_08_WB	9/14/2017	122	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_09_WB	9/14/2017	106	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_10_WB	9/14/2017	61.8	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_11_WB	9/14/2017	80.5	1	NG/G

Appendix A-2a
UCL Evaluation - ProUCL Input
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_AA	EA_SA	ID	DATE	Mercury	D_Mercury	UOM
ES-13	NON-REF	ES-13_17HC001_091417_BLM_12_WB	9/14/2017	55.7	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_13_WB	9/14/2017	86.4	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_14_WB	9/14/2017	86.8	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_15_WB	9/14/2017	125	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_16_WB	9/14/2017	73.2	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_17_WB	9/14/2017	111	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_18_WB	9/14/2017	90.7	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_19_WB	9/14/2017	76.2	1	NG/G
ES-13	NON-REF	ES-13_17HC001_091417_BLM_20_WB	9/14/2017	79.3	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_01_WB	9/30/2016	63	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_02_WB	9/30/2016	53.9	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_03_WB	9/30/2016	106	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_04_WB	9/30/2016	48.9	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_05_WB	9/30/2016	76.9	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_06_WB	9/30/2016	70.8	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_07_WB	9/30/2016	48.4	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_08_WB	9/30/2016	54.8	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_09_WB	9/30/2016	73.5	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_10_WB	9/30/2016	63.5	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_11_WB	9/30/2016	59.2	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_12_WB	9/30/2016	66.4	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_13_WB	9/30/2016	59.6	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_14_WB	9/30/2016	58.5	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_15_WB	9/30/2016	69	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_16_WB	9/30/2016	48.9	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_17_WB	9/30/2016	56.5	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_18_WB	9/30/2016	56.7	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_19_WB	9/30/2016	75.2	1	NG/G
ES-13	NON-REF	ES-13_093016_BLM_20_WB	9/30/2016	62.1	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_01_WB	9/14/2017	77.1	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_02_WB	9/14/2017	71.6	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_03_WB	9/14/2017	66.5	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_04_WB	9/14/2017	71.2	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_06_WB	9/14/2017	78.4	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_07_WB	9/14/2017	60.6	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_08_WB	9/14/2017	65.9	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_09_WB	9/14/2017	97.6	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_10_WB	9/14/2017	66.1	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_11_WB	9/14/2017	64.5	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_12_WB	9/14/2017	78.9	1	NG/G
ES-15	NON-REF	ES-15_17HC001_091417_BLM_13_WB	9/14/2017	85.9	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_01_WB	9/27/2016	46.9	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_02_WB	9/27/2016	77	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_03_WB	9/27/2016	55.3	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_04_WB	9/27/2016	55.5	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_05_WB	9/27/2016	65.6	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_06_WB	9/27/2016	65	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_07_WB	9/27/2016	96	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_08_WB	9/27/2016	67.4	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_09_WB	9/27/2016	58.2	1	NG/G

Appendix A-2a
UCL Evaluation - ProUCL Input
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_AA	EA_SA	ID	DATE	Mercury	D_Mercury	UOM
ES-15	NON-REF	ES-15_092716_BLM_10_WB	9/27/2016	68	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_11_WB	9/27/2016	48.1	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_12_WB	9/27/2016	55.4	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_13_WB	9/27/2016	44.8	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_14_WB	9/27/2016	64.8	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_15_WB	9/27/2016	45.6	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_16_WB	9/27/2016	49.7	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_17_WB	9/27/2016	49.8	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_18_WB	9/27/2016	62.7	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_19_WB	9/27/2016	64.1	1	NG/G
ES-15	NON-REF	ES-15_092716_BLM_20_WB	9/27/2016	51.1	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_01_WB	9/19/2017	48.8	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_02_WB	9/19/2017	58.1	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_03_WB	9/19/2017	81.9	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_04_WB	9/19/2017	112	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_05_WB	9/19/2017	53	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_06_WB	9/19/2017	114	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_07_WB	9/19/2017	115	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_08_WB	9/19/2017	39.1	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_09_WB	9/19/2017	73.4	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_10_WB	9/19/2017	140	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_11_WB	9/19/2017	168	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_12_WB	9/19/2017	96.7	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_13_WB	9/19/2017	87	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_14_WB	9/19/2017	181	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_15_WB	9/19/2017	122	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_16_WB	9/19/2017	55.9	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_17_WB	9/19/2017	91.5	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_18_WB	9/19/2017	82.1	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_19_WB	9/19/2017	72	1	NG/G
ES-FP	NON-REF	ES-FP_17HC001_091917_BLM_20_WB	9/19/2017	97.3	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_01_WB	9/26/2016	55.4	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_02_WB	9/26/2016	86	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_03_WB	9/26/2016	48.5	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_04_WB	9/26/2016	62.4	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_05_WB	9/26/2016	40	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_06_WB	9/26/2016	55.8	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_07_WB	9/26/2016	45.2	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_08_WB	9/26/2016	80.4	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_09_WB	9/26/2016	111	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_10_WB	9/26/2016	74.1	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_11_WB	9/26/2016	79.3	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_12_WB	9/26/2016	73.4	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_13_WB	9/26/2016	41.3	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_14_WB	9/26/2016	52	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_15_WB	9/26/2016	45.4	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_16_WB	9/26/2016	59.1	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_17_WB	9/26/2016	63.7	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_18_WB	9/26/2016	64.3	1	NG/G
ES-FP	NON-REF	ES-FP_092616_BLM_19_WB	9/26/2016	55.7	1	NG/G

Appendix A-2a
UCL Evaluation - ProUCL Input
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_AA	EA_SA	ID	DATE	Mercury	D_Mercury	UOM
ES-FP	NON-REF	ES-FP_092616_BLM_20_WB	9/26/2016	58.6	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_01_WB	9/13/2017	5.52	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_02_WB	9/13/2017	6.18	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_03_WB	9/13/2017	11.7	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_04_WB	9/13/2017	8.51	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_05_WB	9/13/2017	7.09	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_06_WB	9/13/2017	5.46	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_07_WB	9/13/2017	11.9	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_08_WB	9/13/2017	13	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_09_WB	9/13/2017	7.19	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_10_WB	9/13/2017	7.74	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_11_WB	9/13/2017	9.2	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_12_WB	9/13/2017	7.44	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_13_WB	9/13/2017	10.5	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_14_WB	9/13/2017	6.45	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_15_WB	9/13/2017	10.3	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_16_WB	9/13/2017	7.17	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_17_WB	9/13/2017	8.36	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_18_WB	9/13/2017	6.85	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_19_WB	9/13/2017	7.68	1	NG/G
FRB-REF	REFERENCE	FRB-01_17HC001_091317_BLM_20_WB	9/13/2017	7.02	1	NG/G

Appendix A-2b
UCL Evaluation - All Areas
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.111/15/2017 10:38:05 AM
From File	2017-11-14 PEN_BI21 BERA_mussel.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_Hg(ng/g) (non-ref)

General Statistics

Total Number of Observations	151	Number of Distinct Observations	135
		Number of Missing Observations	0
Minimum	39.1	Mean	78.42
Maximum	207	Median	72.8
SD	27.97	Std. Error of Mean	2.276
Coefficient of Variation	0.357	Skewness	1.613

Normal GOF Test

Shapiro Wilk Test Statistic	0.879	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.136	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0725	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	82.19	95% Adjusted-CLT UCL (Chen-1995)	82.49
		95% Modified-t UCL (Johnson-1978)	82.24

Gamma GOF Test

A-D Test Statistic	1.544	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0899	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.0762	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.496	k star (bias corrected MLE)	9.312
Theta hat (MLE)	8.258	Theta star (bias corrected MLE)	8.422
nu hat (MLE)	2868	nu star (bias corrected)	2812
MLE Mean (bias corrected)	78.42	MLE Sd (bias corrected)	25.7
		Approximate Chi Square Value (0.05)	2690
Adjusted Level of Significance	0.0484	Adjusted Chi Square Value	2689

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	81.99	95% Adjusted Gamma UCL (use when n<50)	82.02

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0387	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0665	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0725	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.666	Mean of logged Data	4.309
Maximum of Logged Data	5.333	SD of logged Data	0.319

Assuming Lognormal Distribution

95% H-UCL	81.85	90% Chebyshev (MVUE) UCL	84.43
95% Chebyshev (MVUE) UCL	87.25	97.5% Chebyshev (MVUE) UCL	91.18
99% Chebyshev (MVUE) UCL	98.88		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	82.17	95% Jackknife UCL	82.19
95% Standard Bootstrap UCL	82.11	95% Bootstrap-t UCL	82.49
95% Hall's Bootstrap UCL	82.51	95% Percentile Bootstrap UCL	82.2
95% BCA Bootstrap UCL	82.67		
90% Chebyshev(Mean, Sd) UCL	85.25	95% Chebyshev(Mean, Sd) UCL	88.34
97.5% Chebyshev(Mean, Sd) UCL	92.64	99% Chebyshev(Mean, Sd) UCL	101.1

Suggested UCL to Use

95% Student's-t UCL	82.19	or 95% Modified-t UCL	82.24
or 95% H-UCL	81.85		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

resuse_Hg(ng/g) (reference)

Appendix A-2b
UCL Evaluation - All Areas
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	5.46	Mean	8.263
Maximum	13	Median	7.56
SD	2.166	Std. Error of Mean	0.484
Coefficient of Variation	0.262	Skewness	0.852

Normal GOF Test

Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.195	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	9.1	95% Adjusted-CLT UCL (Chen-1995)	9.158
		95% Modified-t UCL (Johnson-1978)	9.116

Gamma GOF Test

A-D Test Statistic	0.532	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.172	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	16.56	k star (bias corrected MLE)	14.11
Theta hat (MLE)	0.499	Theta star (bias corrected MLE)	0.586
nu hat (MLE)	662.5	nu star (bias corrected)	564.5
MLE Mean (bias corrected)	8.263	MLE Sd (bias corrected)	2.2
		Approximate Chi Square Value (0.05)	510.4
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	506.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9.139	95% Adjusted Gamma UCL (use when n<50)	9.212

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.156	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.697	Mean of logged Data	2.081
Maximum of Logged Data	2.565	SD of logged Data	0.25

Appendix A-2b
UCL Evaluation - All Areas
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Lognormal Distribution

95% H-UCL	9.176	90% Chebyshev (MVUE) UCL	9.652
95% Chebyshev (MVUE) UCL	10.28	97.5% Chebyshev (MVUE) UCL	11.16
99% Chebyshev (MVUE) UCL	12.89		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	9.06	95% Jackknife UCL	9.1
95% Standard Bootstrap UCL	9.026	95% Bootstrap-t UCL	9.249
95% Hall's Bootstrap UCL	9.186	95% Percentile Bootstrap UCL	9.064
95% BCA Bootstrap UCL	9.187		
90% Chebyshev(Mean, Sd) UCL	9.716	95% Chebyshev(Mean, Sd) UCL	10.37
97.5% Chebyshev(Mean, Sd) UCL	11.29	99% Chebyshev(Mean, Sd) UCL	13.08

Suggested UCL to Use

95% Student's-t UCL	9.1

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-2c
UCL Evaluation - Sample Areas
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.111/14/2017 4:07:50 PM
From File	2017-11-14 PEN_BI21 BERA_mussel.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_Hg(ng/g) (es-03)

General Statistics

Total Number of Observations	39	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	51	Mean	91.02
Maximum	207	Median	81.9
SD	29.86	Std. Error of Mean	4.782
Coefficient of Variation	0.328	Skewness	1.917

Normal GOF Test

Shapiro Wilk Test Statistic	0.851	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.939	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.165	Lilliefors GOF Test
5% Lilliefors Critical Value	0.14	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	99.08	95% Adjusted-CLT UCL (Chen-1995)	100.4
		95% Modified-t UCL (Johnson-1978)	99.32

Gamma GOF Test

A-D Test Statistic	0.702	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.13	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.141	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.82	k star (bias corrected MLE)	10.93
Theta hat (MLE)	7.697	Theta star (bias corrected MLE)	8.326
nu hat (MLE)	922.3	nu star (bias corrected)	852.7
MLE Mean (bias corrected)	91.02	MLE Sd (bias corrected)	27.53
		Approximate Chi Square Value (0.05)	785.9
Adjusted Level of Significance	0.0437	Adjusted Chi Square Value	783.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	98.75	95% Adjusted Gamma UCL (use when n<50)	99.07

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.939	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.109	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.14	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.932	Mean of logged Data	4.468
Maximum of Logged Data	5.333	SD of logged Data	0.286

Assuming Lognormal Distribution

95% H-UCL	98.63	90% Chebyshev (MVUE) UCL	103.4
95% Chebyshev (MVUE) UCL	109.1	97.5% Chebyshev (MVUE) UCL	117
99% Chebyshev (MVUE) UCL	132.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	98.88	95% Jackknife UCL	99.08
95% Standard Bootstrap UCL	98.82	95% Bootstrap-t UCL	101.5
95% Hall's Bootstrap UCL	103.5	95% Percentile Bootstrap UCL	99.5
95% BCA Bootstrap UCL	100.3		
90% Chebyshev(Mean, Sd) UCL	105.4	95% Chebyshev(Mean, Sd) UCL	111.9
97.5% Chebyshev(Mean, Sd) UCL	120.9	99% Chebyshev(Mean, Sd) UCL	138.6

Suggested UCL to Use

95% Adjusted Gamma UCL	99.07

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (es-13)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	48.4	Mean	76.91
Maximum	144	Median	72.55
SD	23.67	Std. Error of Mean	3.743
Coefficient of Variation	0.308	Skewness	1.013

Normal GOF Test

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.14	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	83.22	95% Adjusted-CLT UCL (Chen-1995)	83.71
		95% Modified-t UCL (Johnson-1978)	83.32

Gamma GOF Test

A-D Test Statistic	0.713	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.108	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	12.06	k star (bias corrected MLE)	11.17
Theta hat (MLE)	6.379	Theta star (bias corrected MLE)	6.885
nu hat (MLE)	964.6	nu star (bias corrected)	893.6
MLE Mean (bias corrected)	76.91	MLE Sd (bias corrected)	23.01
		Approximate Chi Square Value (0.05)	825.2
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	822.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	83.29	95% Adjusted Gamma UCL (use when n<50)	83.53

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0982	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.879	Mean of logged Data	4.301
Maximum of Logged Data	4.97	SD of logged Data	0.288

Assuming Lognormal Distribution

95% H-UCL	83.47	90% Chebyshev (MVUE) UCL	87.45
95% Chebyshev (MVUE) UCL	92.28	97.5% Chebyshev (MVUE) UCL	98.99
99% Chebyshev (MVUE) UCL	112.2		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	83.07	95% Jackknife UCL	83.22
95% Standard Bootstrap UCL	83.01	95% Bootstrap-t UCL	84.31
95% Hall's Bootstrap UCL	83.62	95% Percentile Bootstrap UCL	83.06
95% BCA Bootstrap UCL	83.81		
90% Chebyshev(Mean, Sd) UCL	88.14	95% Chebyshev(Mean, Sd) UCL	93.23
97.5% Chebyshev(Mean, Sd) UCL	100.3	99% Chebyshev(Mean, Sd) UCL	114.2

Suggested UCL to Use

95% Adjusted Gamma UCL	83.53

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (es-15)

General Statistics

Total Number of Observations	32	Number of Distinct Observations	32
		Number of Missing Observations	0
Minimum	44.8	Mean	64.85
Maximum	97.6	Median	64.9
SD	13.48	Std. Error of Mean	2.382
Coefficient of Variation	0.208	Skewness	0.648

Normal GOF Test

Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.93	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.126	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.154	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	68.89	95% Adjusted-CLT UCL (Chen-1995)	69.06
		95% Modified-t UCL (Johnson-1978)	68.94

Gamma GOF Test

A-D Test Statistic	0.378	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0991	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.155	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-2c

UCL Evaluation - Sample Areas

Blue Mussel

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	24.8	k star (bias corrected MLE)	22.49
Theta hat (MLE)	2.615	Theta star (bias corrected MLE)	2.883
nu hat (MLE)	1587	nu star (bias corrected)	1440
MLE Mean (bias corrected)	64.85	MLE Sd (bias corrected)	13.67
		Approximate Chi Square Value (0.05)	1352
Adjusted Level of Significance	0.0416	Adjusted Chi Square Value	1348

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	69.03	95% Adjusted Gamma UCL (use when n<50)	69.26

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.93	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.111	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.154	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.802	Mean of logged Data	4.152
Maximum of Logged Data	4.581	SD of logged Data	0.204

Assuming Lognormal Distribution

95% H-UCL	69.17	90% Chebyshev (MVUE) UCL	71.91
95% Chebyshev (MVUE) UCL	75.11	97.5% Chebyshev (MVUE) UCL	79.55
99% Chebyshev (MVUE) UCL	88.28		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	68.77	95% Jackknife UCL	68.89
95% Standard Bootstrap UCL	68.67	95% Bootstrap-t UCL	69.23
95% Hall's Bootstrap UCL	69.07	95% Percentile Bootstrap UCL	68.68
95% BCA Bootstrap UCL	68.89		
90% Chebyshev(Mean, Sd) UCL	72	95% Chebyshev(Mean, Sd) UCL	75.24
97.5% Chebyshev(Mean, Sd) UCL	79.73	99% Chebyshev(Mean, Sd) UCL	88.55

Suggested UCL to Use

95% Student's-t UCL	68.89

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-2c
UCL Evaluation - Sample Areas
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

resuse_Hg(ng/g) (es-fp)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	39.1	Mean	78.51
Maximum	181	Median	72.7
SD	33.51	Std. Error of Mean	5.298
Coefficient of Variation	0.427	Skewness	1.345

Normal GOF Test

Shapiro Wilk Test Statistic	0.877	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.139	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	87.44	95% Adjusted-CLT UCL (Chen-1995)	88.43
		95% Modified-t UCL (Johnson-1978)	87.62

Gamma GOF Test

A-D Test Statistic	0.605	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.118	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.653	k star (bias corrected MLE)	6.17
Theta hat (MLE)	11.8	Theta star (bias corrected MLE)	12.72
nu hat (MLE)	532.2	nu star (bias corrected)	493.6
MLE Mean (bias corrected)	78.51	MLE Sd (bias corrected)	31.61
		Approximate Chi Square Value (0.05)	443.1
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	441.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	87.46	95% Adjusted Gamma UCL (use when n<50)	87.82

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.961	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.103	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.666	Mean of logged Data	4.286
Maximum of Logged Data	5.198	SD of logged Data	0.388

Assuming Lognormal Distribution

95% H-UCL	87.85	90% Chebyshev (MVUE) UCL	93
95% Chebyshev (MVUE) UCL	99.71	97.5% Chebyshev (MVUE) UCL	109
99% Chebyshev (MVUE) UCL	127.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	87.22	95% Jackknife UCL	87.44
95% Standard Bootstrap UCL	87.15	95% Bootstrap-t UCL	89.31
95% Hall's Bootstrap UCL	89.11	95% Percentile Bootstrap UCL	87.54
95% BCA Bootstrap UCL	88.38		
90% Chebyshev(Mean, Sd) UCL	94.4	95% Chebyshev(Mean, Sd) UCL	101.6
97.5% Chebyshev(Mean, Sd) UCL	111.6	99% Chebyshev(Mean, Sd) UCL	131.2

Suggested UCL to Use

95% Adjusted Gamma UCL	87.82

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (frb-ref)

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	5.46	Mean	8.263
Maximum	13	Median	7.56
SD	2.166	Std. Error of Mean	0.484
Coefficient of Variation	0.262	Skewness	0.852

Normal GOF Test

Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.195	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Appendix A-2c
UCL Evaluation - Sample Areas
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	9.1	95% Adjusted-CLT UCL (Chen-1995)	9.158
		95% Modified-t UCL (Johnson-1978)	9.116

Gamma GOF Test

A-D Test Statistic	0.532	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.172	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	16.56	k star (bias corrected MLE)	14.11
Theta hat (MLE)	0.499	Theta star (bias corrected MLE)	0.586
nu hat (MLE)	662.5	nu star (bias corrected)	564.5
MLE Mean (bias corrected)	8.263	MLE Sd (bias corrected)	2.2
		Approximate Chi Square Value (0.05)	510.4
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	506.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9.139	95% Adjusted Gamma UCL (use when n<50)	9.212

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.156	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.697	Mean of logged Data	2.081
Maximum of Logged Data	2.565	SD of logged Data	0.25

Assuming Lognormal Distribution

95% H-UCL	9.176	90% Chebyshev (MVUE) UCL	9.652
95% Chebyshev (MVUE) UCL	10.28	97.5% Chebyshev (MVUE) UCL	11.16
99% Chebyshev (MVUE) UCL	12.89		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	9.06	95% Jackknife UCL	9.1
95% Standard Bootstrap UCL	9.045	95% Bootstrap-t UCL	9.285
95% Hall's Bootstrap UCL	9.126	95% Percentile Bootstrap UCL	9.058
95% BCA Bootstrap UCL	9.136		
90% Chebyshev(Mean, Sd) UCL	9.716	95% Chebyshev(Mean, Sd) UCL	10.37
97.5% Chebyshev(Mean, Sd) UCL	11.29	99% Chebyshev(Mean, Sd) UCL	13.08

Appendix A-2c
UCL Evaluation - Sample Areas
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	9.1

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-3a
UCL Evaluation - ProUCL Input
Soft-shell clam

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

ID	Date	Mercury	UOM
ES-FP_092309_SSC_01_WB	9/23/2009	30.8	NG/G
ES-FP_092309_SSC_02_WB	9/23/2009	31.2	NG/G
ES-FP_092309_SSC_03_WB	9/23/2009	24.4	NG/G
ES-FP_092309_SSC_04_WB	9/23/2009	27	NG/G
ES-FP_092309_SSC_05_WB	9/23/2009	24.5	NG/G
Penobscot-08-04-B_060108_SSC_04_WB	6/1/2008	467	NG/G

ID	DATE	Methyl Mercury	UOM
ES-03_082609_SSC_01_WB	8/26/2009	31.3	NG/G
ES-03_082609_SSC_02_WB	8/26/2009	39	NG/G
ES-03_082609_SSC_03_WB	8/26/2009	49.4	NG/G
ES-03_082609_SSC_04_WB	8/26/2009	45.4	NG/G
ES-03_082809_SSC_05_WB	8/28/2009	41.8	NG/G
ES-04_082709_SSC_01_WB	8/27/2009	16.9	NG/G
ES-04_082709_SSC_02_WB	8/27/2009	16.9	NG/G
ES-04_082709_SSC_03_WB	8/27/2009	15.9	NG/G
ES-04_082709_SSC_04_WB	8/27/2009	21.5	NG/G
ES-04_082709_SSC_05_WB	8/27/2009	13.6	NG/G
ES-04_082709_SSC_05_WB PR1	8/27/2009	14.2	NG/G
ES-13_082609_SSC_01_WB	8/26/2009	99.5	NG/G
ES-13_082609_SSC_02_WB	8/26/2009	55.6	NG/G
ES-13_082609_SSC_03_WB	8/26/2009	86.1	NG/G
ES-13_082609_SSC_04_WB	8/26/2009	95.3	NG/G
ES-13_082609_SSC_05_WB	8/26/2009	97.7	NG/G
ES-15_082609_SSC_01_WB	8/26/2009	38.5	NG/G
ES-15_082609_SSC_02_WB	8/26/2009	22.2	NG/G
ES-15_082609_SSC_03_WB	8/26/2009	14	NG/G
ES-15_082609_SSC_04_WB	8/26/2009	23.7	NG/G
ES-15_082609_SSC_05_WB	8/26/2009	21.8	NG/G
ES-15_082609_SSC_05_WB PR1	8/26/2009	19.5	NG/G
ES-FP_092309_SSC_01_WB	9/23/2009	27.6	NG/G
ES-FP_092309_SSC_02_WB	9/23/2009	20.9	NG/G
ES-FP_092309_SSC_03_WB	9/23/2009	21.8	NG/G
ES-FP_092309_SSC_04_WB	9/23/2009	19.9	NG/G
ES-FP_092309_SSC_05_WB	9/23/2009	16.7	NG/G
ES-FP_092309_SSC_05_WB PR1	9/23/2009	16.4	NG/G
Penobscot-08-04-B_060108_SSC_04_WB	6/1/2008	358	NG/G

Appendix A-3b
UCL Evaluation - Mercury
Soft-shell clam

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.19/12/2017 12:46:45 PM
From File	HH_Soft_Shell_Clam_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hg (ng/g)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	24.4	Mean	100.8
Maximum	467	Median	28.9
SD	179.4	Std. Error of Mean	73.25
Coefficient of Variation	1.78	Skewness	2.448

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.511	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.484	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	248.4	95% Adjusted-CLT UCL (Chen-1995)	299.5
		95% Modified-t UCL (Johnson-1978)	260.6

Appendix A-3b
UCL Evaluation - Mercury
Soft-shell clam

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	1.523	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.722	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.496	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.344	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.725	k star (bias corrected MLE)	0.474
Theta hat (MLE)	139	Theta star (bias corrected MLE)	212.8
nu hat (MLE)	8.701	nu star (bias corrected)	5.684
MLE Mean (bias corrected)	100.8	MLE Sd (bias corrected)	146.5
		Approximate Chi Square Value (0.05)	1.481
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	0.84

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	387	95% Adjusted Gamma UCL (use when n<50)	682.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.579	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.45	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.195	Mean of logged Data	3.784
Maximum of Logged Data	6.146	SD of logged Data	1.162

Assuming Lognormal Distribution

95% H-UCL	990.5	90% Chebyshev (MVUE) UCL	177.1
95% Chebyshev (MVUE) UCL	223.7	97.5% Chebyshev (MVUE) UCL	288.4
99% Chebyshev (MVUE) UCL	415.4		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	221.3	95% Jackknife UCL	248.4
95% Standard Bootstrap UCL	212.2	95% Bootstrap-t UCL	5409
95% Hall's Bootstrap UCL	3968	95% Percentile Bootstrap UCL	246.2
95% BCA Bootstrap UCL	248.3		
90% Chebyshev(Mean, Sd) UCL	320.6	95% Chebyshev(Mean, Sd) UCL	420.1
97.5% Chebyshev(Mean, Sd) UCL	558.2	99% Chebyshev(Mean, Sd) UCL	829.6

Suggested UCL to Use

Appendix A-3b
UCL Evaluation - Mercury
Soft-shell clam

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

95% Hall's Bootstrap UCL 3968

Appendix A-3b
UCL Evaluation - Mercury
Soft-shell clam

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Recommended UCL exceeds the maximum observation

In Case Bootstrap t and/or Hall's Bootstrap yields an unreasonably large UCL value, use 97.5% or 99% Chebyshev (Mean, Sd) UCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-3c
UCL Evaluation - Methyl Mercury
Soft-shell clam

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.19/12/2017 12:49:47 PM
From File	HH_Soft_Shell_Clam_e.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

MeHg (ng/g)

General Statistics

Total Number of Observations	29	Number of Distinct Observations	27
		Number of Missing Observations	0
Minimum	13.6	Mean	46.93
Maximum	358	Median	22.2
SD	65.45	Std. Error of Mean	12.15
Coefficient of Variation	1.394	Skewness	4.126

Normal GOF Test

Shapiro Wilk Test Statistic	0.496	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.926	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.305	Lilliefors GOF Test
5% Lilliefors Critical Value	0.161	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	67.61	95% Adjusted-CLT UCL (Chen-1995)	76.88
		95% Modified-t UCL (Johnson-1978)	69.16

Gamma GOF Test

A-D Test Statistic	2.156	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.765	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.217	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.166	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.397	k star (bias corrected MLE)	1.276
Theta hat (MLE)	33.59	Theta star (bias corrected MLE)	36.79
nu hat (MLE)	81.04	nu star (bias corrected)	73.99
MLE Mean (bias corrected)	46.93	MLE Sd (bias corrected)	41.55
		Approximate Chi Square Value (0.05)	55.18
Adjusted Level of Significance	0.0407	Adjusted Chi Square Value	54.21

Appendix A-3c
UCL Evaluation - Methyl Mercury
Soft-shell clam

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	62.93	95% Adjusted Gamma UCL (use when n<50)	64.06

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.865	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.926	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.195	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.161	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.61	Mean of logged Data	3.45
Maximum of Logged Data	5.881	SD of logged Data	0.777

Assuming Lognormal Distribution

95% H-UCL	58.89	90% Chebyshev (MVUE) UCL	61.98
95% Chebyshev (MVUE) UCL	71.01	97.5% Chebyshev (MVUE) UCL	83.55
99% Chebyshev (MVUE) UCL	108.2		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	66.93	95% Jackknife UCL	67.61
95% Standard Bootstrap UCL	66.62	95% Bootstrap-t UCL	97.44
95% Hall's Bootstrap UCL	138.1	95% Percentile Bootstrap UCL	67.57
95% BCA Bootstrap UCL	80		
90% Chebyshev(Mean, Sd) UCL	83.4	95% Chebyshev(Mean, Sd) UCL	99.91
97.5% Chebyshev(Mean, Sd) UCL	122.8	99% Chebyshev(Mean, Sd) UCL	167.9

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	99.91

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-4a
UCL Evaluation - ProUCL Input
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	UOM
ES-13	NON-REF	ES-13_17SN001_091417_RAS_01_WB	9/14/2017	30.7	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_02_WB	9/14/2017	87.8	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_03_WB	9/14/2017	42.2	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_04_WB	9/14/2017	35.5	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_05_WB	9/14/2017	29.9	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_06_WB	9/14/2017	76.7	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_07_WB	9/14/2017	78.8	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_08_WB	9/14/2017	32.7	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_09_WB	9/14/2017	26.4	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_10_WB	9/14/2017	37.4	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_11_WB	9/14/2017	37.5	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_12_WB	9/14/2017	29.8	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_13_WB	9/14/2017	63.1	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_14_WB	9/14/2017	43.5	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_15_WB	9/14/2017	39.1	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_16_WB	9/14/2017	34.8	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_17_WB	9/14/2017	56.6	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_18_WB	9/14/2017	40.2	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_19_WB	9/14/2017	38.1	NG/G
ES-13	NON-REF	ES-13_17SN001_091417_RAS_20_WB	9/14/2017	30.1	NG/G
ES-13	NON-REF	ES-13_092116_RAS_01_WB	9/21/2016	38.4	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_01_WB	9/14/2017	78.6	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_02_WB	9/14/2017	92.6	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_03_WB	9/14/2017	68.2	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_04_WB	9/14/2017	174	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_05_WB	9/14/2017	92.2	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_06_WB	9/14/2017	83.2	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_07_WB	9/14/2017	207	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_08_WB	9/14/2017	128	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_09_WB	9/14/2017	185	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_10_WB	9/14/2017	156	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_11_WB	9/14/2017	75.7	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_12_WB	9/14/2017	43	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_13_WB	9/14/2017	36.6	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_14_WB	9/14/2017	39	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_15_WB	9/14/2017	34.2	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_16_WB	9/14/2017	52	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_17_WB	9/14/2017	34.1	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_18_WB	9/14/2017	42.5	NG/G
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_19_WB	9/14/2017	31.7	NG/G

Appendix A-4a
UCL Evaluation - ProUCL Input
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	UOM
ES-FP	NON-REF	ES-FP_17SN001_091417_RAS_20_WB	9/14/2017	43.6	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_01_WB	9/27/2016	93.6	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_02_WB	9/27/2016	113	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_03_WB	9/27/2016	49.3	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_04_WB	9/27/2016	84.6	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_05_WB	9/27/2016	60.5	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_06_WB	9/27/2016	48.7	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_07_WB	9/27/2016	36.2	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_08_WB	9/27/2016	108	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_09_WB	9/27/2016	78.4	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_10_WB	9/27/2016	35.4	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_11_WB	9/27/2016	74.1	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_12_WB	9/27/2016	54.7	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_13_WB	9/27/2016	56	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_14_WB	9/27/2016	31.4	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_15_WB	9/27/2016	64	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_16_WB	9/27/2016	60.7	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_17_WB	9/27/2016	44.4	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_18_WB	9/27/2016	27.1	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_19_WB	9/27/2016	33.4	NG/G
ES-FP	NON-REF	ES-FP_092716_RAS_20_WB	9/27/2016	39.8	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_01_WB	9/12/2017	18.1	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_02_WB	9/12/2017	14.6	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_03_WB	9/12/2017	6.88	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_04_WB	9/12/2017	22.2	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_05_WB	9/12/2017	10.8	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_06_WB	9/12/2017	14.5	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_07_WB	9/12/2017	26.2	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_08_WB	9/12/2017	24.6	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_09_WB	9/12/2017	8.2	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_10_WB	9/12/2017	10.6	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_11_WB	9/12/2017	10.9	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_12_WB	9/12/2017	6.57	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_13_WB	9/12/2017	9.38	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_14_WB	9/12/2017	19	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_15_WB	9/12/2017	7.29	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_16_WB	9/12/2017	15.7	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_17_WB	9/12/2017	12.2	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_18_WB	9/12/2017	7.36	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_19_WB	9/12/2017	7.98	NG/G

Appendix A-4a
UCL Evaluation - ProUCL Input
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	UOM
FRB-REF	REFERENCE	FRB-01_17SN001_091217_RAS_20_WB	9/12/2017	11.8	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_01_WB	9/28/2016	5.46	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_02_WB	9/28/2016	5.96	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_03_WB	9/28/2016	7.27	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_04_WB	9/28/2016	6.37	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_05_WB	9/28/2016	6.5	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_06_WB	9/28/2016	7.62	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_07_WB	9/28/2016	5.07	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_08_WB	9/28/2016	8	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_09_WB	9/28/2016	7.03	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_10_WB	9/28/2016	6.89	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_11_WB	9/28/2016	6.46	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_12_WB	9/28/2016	6.6	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_13_WB	9/28/2016	6.79	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_14_WB	9/28/2016	6.67	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_15_WB	9/28/2016	8.37	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_16_WB	9/28/2016	6.19	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_17_WB	9/28/2016	5.72	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_18_WB	9/28/2016	8.26	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_19_WB	9/28/2016	7.35	NG/G
FRB-REF	REFERENCE	FRB-01_092816_RAS_20_WB	9/28/2016	6.52	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_01_WB	9/16/2017	45.3	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_02_WB	9/16/2017	36	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_03_WB	9/16/2017	72	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_04_WB	9/16/2017	77.4	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_05_WB	9/16/2017	46.5	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_06_WB	9/16/2017	39.7	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_07_WB	9/16/2017	52.1	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_08_WB	9/16/2017	42.7	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_09_WB	9/16/2017	38.2	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_10_WB	9/16/2017	47.5	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_11_WB	9/16/2017	61.7	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_12_WB	9/16/2017	42.5	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_13_WB	9/16/2017	49.8	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_14_WB	9/16/2017	49.6	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_15_WB	9/16/2017	45.3	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_16_WB	9/16/2017	49.2	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_17_WB	9/16/2017	46.9	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_18_WB	9/16/2017	44.8	NG/G
OB-01	NON-REF	OB-01_17SN001_091617_RAS_19_WB	9/16/2017	47.8	NG/G

Appendix A-4a
UCL Evaluation - ProUCL Input
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	UOM
OB-01	NON-REF	OB-01_17SN001_091617_RAS_20_WB	9/16/2017	45.3	NG/G
OB-01	NON-REF	OB-01_092116_RAS_06_WB	9/21/2016	146	NG/G
OB-01	NON-REF	OB-01_092116_RAS_07_WB	9/21/2016	140	NG/G
OB-01	NON-REF	OB-01_092116_RAS_08_WB	9/21/2016	75.3	NG/G
OB-01	NON-REF	OB-01_092116_RAS_09_WB	9/21/2016	90.8	NG/G
OB-01	NON-REF	OB-01_092116_RAS_10_WB	9/21/2016	94.6	NG/G
OB-01	NON-REF	OB-01_092116_RAS_11_WB	9/21/2016	95.4	NG/G
OB-01	NON-REF	OB-01_092116_RAS_12_WB	9/21/2016	116	NG/G
OB-01	NON-REF	OB-01_092116_RAS_13_WB	9/21/2016	79.5	NG/G
OB-01	NON-REF	OB-01_092116_RAS_14_WB	9/21/2016	31.8	NG/G
OB-01	NON-REF	OB-01_092116_RAS_15_WB	9/21/2016	33.6	NG/G
OB-01	NON-REF	OB-01_092116_RAS_16_WB	9/21/2016	102	NG/G
OB-01	NON-REF	OB-01_092116_RAS_17_WB	9/21/2016	103	NG/G
OB-01	NON-REF	OB-01_092116_RAS_18_WB	9/21/2016	44.2	NG/G
OB-01	NON-REF	OB-01_092116_RAS_19_WB	9/21/2016	58.2	NG/G
OB-01	NON-REF	OB-01_092116_RAS_20_WB	9/21/2016	82.8	NG/G
OB-04	NON-REF	OB-01_092116_RAS_01_WB	9/21/2016	44.5	NG/G
OB-04	NON-REF	OB-01_092116_RAS_02_WB	9/21/2016	54.9	NG/G
OB-04	NON-REF	OB-01_092116_RAS_03_WB	9/21/2016	55.6	NG/G
OB-04	NON-REF	OB-01_092116_RAS_04_WB	9/21/2016	47.5	NG/G
OB-04	NON-REF	OB-01_092116_RAS_05_WB	9/21/2016	81.9	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_RAS_01_WB	9/15/2017	72.1	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_RAS_02_WB	9/15/2017	64.4	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_RAS_03_WB	9/15/2017	83.5	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_RAS_04_WB	9/15/2017	96.5	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_RAS_05_WB	9/15/2017	83.9	NG/G
OB-05	NON-REF	OB-05_092116_RAS_01_WB	9/21/2016	201	NG/G

Appendix A-4b
UCL Evaluation - All Areas
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.111/15/2017 10:43:02 AM
From File	2017-11-14 PEN_BI21 BERA_smelt.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_hg(ng/g) (non-ref)

General Statistics

Total Number of Observations	107	Number of Distinct Observations	103
		Number of Missing Observations	0
Minimum	26.4	Mean	65.23
Maximum	207	Median	49.8
SD	37.21	Std. Error of Mean	3.598
Coefficient of Variation	0.571	Skewness	1.838

Normal GOF Test

Shapiro Wilk Test Statistic	0.802	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.165	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0859	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	71.2	95% Adjusted-CLT UCL (Chen-1995)	71.83
		95% Modified-t UCL (Johnson-1978)	71.3

Gamma GOF Test

A-D Test Statistic	2.593	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.145	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0879	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.155	k star (bias corrected MLE)	4.045
Theta hat (MLE)	15.7	Theta star (bias corrected MLE)	16.12
nu hat (MLE)	889.3	nu star (bias corrected)	865.7
MLE Mean (bias corrected)	65.23	MLE Sd (bias corrected)	32.43
		Approximate Chi Square Value (0.05)	798.4
Adjusted Level of Significance	0.0478	Adjusted Chi Square Value	797.5

Appendix A-4b
UCL Evaluation - All Areas
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	70.72	95% Adjusted Gamma UCL (use when n<50)	70.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	3.3166E-5	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.123	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0859	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.273	Mean of logged Data	4.053
Maximum of Logged Data	5.333	SD of logged Data	0.48

Assuming Lognormal Distribution

95% H-UCL	70.3	90% Chebyshev (MVUE) UCL	73.94
95% Chebyshev (MVUE) UCL	78.21	97.5% Chebyshev (MVUE) UCL	84.14
99% Chebyshev (MVUE) UCL	95.8		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	71.14	95% Jackknife UCL	71.2
95% Standard Bootstrap UCL	71.01	95% Bootstrap-t UCL	72.07
95% Hall's Bootstrap UCL	71.63	95% Percentile Bootstrap UCL	71.15
95% BCA Bootstrap UCL	72.13		
90% Chebyshev(Mean, Sd) UCL	76.02	95% Chebyshev(Mean, Sd) UCL	80.91
97.5% Chebyshev(Mean, Sd) UCL	87.69	99% Chebyshev(Mean, Sd) UCL	101

Suggested UCL to Use

95% Student's-t UCL	71.2	or 95% Modified-t UCL	71.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_hg(ng/g) (reference)

Appendix A-4b
UCL Evaluation - All Areas
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	5.07	Mean	9.999
Maximum	26.2	Median	7.49
SD	5.368	Std. Error of Mean	0.849
Coefficient of Variation	0.537	Skewness	1.725

Normal GOF Test

Shapiro Wilk Test Statistic	0.755	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.269	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	11.43	95% Adjusted-CLT UCL (Chen-1995)	11.64
		95% Modified-t UCL (Johnson-1978)	11.47

Gamma GOF Test

A-D Test Statistic	2.601	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.24	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.891	k star (bias corrected MLE)	4.541
Theta hat (MLE)	2.044	Theta star (bias corrected MLE)	2.202
nu hat (MLE)	391.3	nu star (bias corrected)	363.3
MLE Mean (bias corrected)	9.999	MLE Sd (bias corrected)	4.692
		Approximate Chi Square Value (0.05)	320.1
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	318.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	11.35	95% Adjusted Gamma UCL (use when n<50)	11.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.865	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.216	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Appendix A-4b
UCL Evaluation - All Areas
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	1.623	Mean of logged Data	2.197
Maximum of Logged Data	3.266	SD of logged Data	0.436

Assuming Lognormal Distribution

95% H-UCL	11.27	90% Chebyshev (MVUE) UCL	11.98
95% Chebyshev (MVUE) UCL	12.94	97.5% Chebyshev (MVUE) UCL	14.27
99% Chebyshev (MVUE) UCL	16.88		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	11.4	95% Jackknife UCL	11.43
95% Standard Bootstrap UCL	11.38	95% Bootstrap-t UCL	11.8
95% Hall's Bootstrap UCL	11.56	95% Percentile Bootstrap UCL	11.49
95% BCA Bootstrap UCL	11.7		
90% Chebyshev(Mean, Sd) UCL	12.55	95% Chebyshev(Mean, Sd) UCL	13.7
97.5% Chebyshev(Mean, Sd) UCL	15.3	99% Chebyshev(Mean, Sd) UCL	18.44

Suggested UCL to Use

95% Student's-t UCL	11.43	or 95% Modified-t UCL	11.47

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.111/14/2017 4:33:04 PM
From File	2017-11-14 PEN_BI21 BERA_smelt.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_hg(ng/g) (es-13)

General Statistics

Total Number of Observations	21	Number of Distinct Observations	21
		Number of Missing Observations	0
Minimum	26.4	Mean	44.25
Maximum	87.8	Median	38.1
SD	17.72	Std. Error of Mean	3.867
Coefficient of Variation	0.4	Skewness	1.443

Normal GOF Test

Shapiro Wilk Test Statistic	0.791	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.279	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.188	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	50.92	95% Adjusted-CLT UCL (Chen-1995)	51.91
		95% Modified-t UCL (Johnson-1978)	51.12

Gamma GOF Test

A-D Test Statistic	1.356	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.744	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.235	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.19	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.148	k star (bias corrected MLE)	7.016
Theta hat (MLE)	5.431	Theta star (bias corrected MLE)	6.308
nu hat (MLE)	342.2	nu star (bias corrected)	294.7
MLE Mean (bias corrected)	44.25	MLE Sd (bias corrected)	16.71
		Approximate Chi Square Value (0.05)	255.9
Adjusted Level of Significance	0.0383	Adjusted Chi Square Value	253.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	50.96	95% Adjusted Gamma UCL (use when n<50)	51.51

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.188	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.273	Mean of logged Data	3.727
Maximum of Logged Data	4.475	SD of logged Data	0.346

Assuming Lognormal Distribution

95% H-UCL	50.97	90% Chebyshev (MVUE) UCL	54.14
95% Chebyshev (MVUE) UCL	58.74	97.5% Chebyshev (MVUE) UCL	65.11
99% Chebyshev (MVUE) UCL	77.64		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	50.61	95% Jackknife UCL	50.92
95% Standard Bootstrap UCL	50.47	95% Bootstrap-t UCL	52.99
95% Hall's Bootstrap UCL	51.03	95% Percentile Bootstrap UCL	50.59
95% BCA Bootstrap UCL	51.47		
90% Chebyshev(Mean, Sd) UCL	55.85	95% Chebyshev(Mean, Sd) UCL	61.11
97.5% Chebyshev(Mean, Sd) UCL	68.4	99% Chebyshev(Mean, Sd) UCL	82.73

Suggested UCL to Use

95% Student's-t UCL	50.92	or 95% Modified-t UCL	51.12

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_hg(ng/g) (es-fp)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	27.1	Mean	72.26
Maximum	207	Median	58.25
SD	44.59	Std. Error of Mean	7.05
Coefficient of Variation	0.617	Skewness	1.548

Normal GOF Test

Shapiro Wilk Test Statistic	0.821	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.156	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	84.14	95% Adjusted-CLT UCL (Chen-1995)	85.7
		95% Modified-t UCL (Johnson-1978)	84.43

Gamma GOF Test

A-D Test Statistic	0.971	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.117	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.451	k star (bias corrected MLE)	3.209
Theta hat (MLE)	20.94	Theta star (bias corrected MLE)	22.52
nu hat (MLE)	276.1	nu star (bias corrected)	256.7
MLE Mean (bias corrected)	72.26	MLE Sd (bias corrected)	40.34
		Approximate Chi Square Value (0.05)	220.6
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	219.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	84.09	95% Adjusted Gamma UCL (use when n<50)	84.57

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.108	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.3	Mean of logged Data	4.128
Maximum of Logged Data	5.333	SD of logged Data	0.538

Assuming Lognormal Distribution

95% H-UCL	84.88	90% Chebyshev (MVUE) UCL	90.7
95% Chebyshev (MVUE) UCL	99.41	97.5% Chebyshev (MVUE) UCL	111.5
99% Chebyshev (MVUE) UCL	135.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	83.86	95% Jackknife UCL	84.14
95% Standard Bootstrap UCL	83.83	95% Bootstrap-t UCL	86.27
95% Hall's Bootstrap UCL	85.48	95% Percentile Bootstrap UCL	84.31
95% BCA Bootstrap UCL	85.87		
90% Chebyshev(Mean, Sd) UCL	93.41	95% Chebyshev(Mean, Sd) UCL	103
97.5% Chebyshev(Mean, Sd) UCL	116.3	99% Chebyshev(Mean, Sd) UCL	142.4

Suggested UCL to Use

95% Adjusted Gamma UCL	84.57

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_hg(ng/g) (frb-ref)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	5.07	Mean	9.999
Maximum	26.2	Median	7.49
SD	5.368	Std. Error of Mean	0.849
Coefficient of Variation	0.537	Skewness	1.725

Normal GOF Test

Shapiro Wilk Test Statistic	0.755	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.269	Lilliefors GOF Test
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Appendix A-4c
UCL Evaluation - Sample Areas
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	11.43	95% Adjusted-CLT UCL (Chen-1995)	11.64
		95% Modified-t UCL (Johnson-1978)	11.47

Gamma GOF Test

A-D Test Statistic	2.601	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.24	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.891	k star (bias corrected MLE)	4.541
Theta hat (MLE)	2.044	Theta star (bias corrected MLE)	2.202
nu hat (MLE)	391.3	nu star (bias corrected)	363.3
MLE Mean (bias corrected)	9.999	MLE Sd (bias corrected)	4.692
		Approximate Chi Square Value (0.05)	320.1
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	318.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	11.35	95% Adjusted Gamma UCL (use when n<50)	11.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.865	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.216	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.139	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.623	Mean of logged Data	2.197
Maximum of Logged Data	3.266	SD of logged Data	0.436

Assuming Lognormal Distribution

95% H-UCL	11.27	90% Chebyshev (MVUE) UCL	11.98
95% Chebyshev (MVUE) UCL	12.94	97.5% Chebyshev (MVUE) UCL	14.27
99% Chebyshev (MVUE) UCL	16.88		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	11.4	95% Jackknife UCL	11.43
95% Standard Bootstrap UCL	11.39	95% Bootstrap-t UCL	11.8
95% Hall's Bootstrap UCL	11.51	95% Percentile Bootstrap UCL	11.4
95% BCA Bootstrap UCL	11.7		
90% Chebyshev(Mean, Sd) UCL	12.55	95% Chebyshev(Mean, Sd) UCL	13.7
97.5% Chebyshev(Mean, Sd) UCL	15.3	99% Chebyshev(Mean, Sd) UCL	18.44

Suggested UCL to Use

95% Student's-t UCL	11.43	or 95% Modified-t UCL	11.47

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_hg(ng/g) (ob-01)

General Statistics

Total Number of Observations	35	Number of Distinct Observations	33
		Number of Missing Observations	0
Minimum	31.8	Mean	64.96
Maximum	146	Median	49.6
SD	29.91	Std. Error of Mean	5.055
Coefficient of Variation	0.46	Skewness	1.227

Normal GOF Test

Shapiro Wilk Test Statistic	0.844	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.934	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.238	Lilliefors GOF Test
5% Lilliefors Critical Value	0.148	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	73.51	95% Adjusted-CLT UCL (Chen-1995)	74.39
		95% Modified-t UCL (Johnson-1978)	73.68

Gamma GOF Test

A-D Test Statistic	1.442	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.224	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.149	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	5.793	k star (bias corrected MLE)	5.316
Theta hat (MLE)	11.21	Theta star (bias corrected MLE)	12.22
nu hat (MLE)	405.5	nu star (bias corrected)	372.1
MLE Mean (bias corrected)	64.96	MLE Sd (bias corrected)	28.17
		Approximate Chi Square Value (0.05)	328.4
Adjusted Level of Significance	0.0425	Adjusted Chi Square Value	326.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	73.6	95% Adjusted Gamma UCL (use when n<50)	74.04

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.917	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.934	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.208	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.148	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.459	Mean of logged Data	4.085
Maximum of Logged Data	4.984	SD of logged Data	0.414

Assuming Lognormal Distribution

95% H-UCL	74	90% Chebyshev (MVUE) UCL	78.59
95% Chebyshev (MVUE) UCL	84.93	97.5% Chebyshev (MVUE) UCL	93.73
99% Chebyshev (MVUE) UCL	111		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	73.27	95% Jackknife UCL	73.51
95% Standard Bootstrap UCL	73.23	95% Bootstrap-t UCL	74.89
95% Hall's Bootstrap UCL	74.4	95% Percentile Bootstrap UCL	73.23
95% BCA Bootstrap UCL	74.79		
90% Chebyshev(Mean, Sd) UCL	80.12	95% Chebyshev(Mean, Sd) UCL	86.99
97.5% Chebyshev(Mean, Sd) UCL	96.53	99% Chebyshev(Mean, Sd) UCL	115.3

Suggested UCL to Use

95% Student's-t UCL	73.51	or 95% Modified-t UCL	73.68

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-4c
UCL Evaluation - Sample Areas
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

resuse_hg(ng/g) (ob-04)

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	44.5	Mean	56.88
Maximum	81.9	Median	54.9
SD	14.77	Std. Error of Mean	6.606
Coefficient of Variation	0.26	Skewness	1.671

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.824	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.335	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	70.96	95% Adjusted-CLT UCL (Chen-1995)	73.02
		95% Modified-t UCL (Johnson-1978)	71.79

Gamma GOF Test

A-D Test Statistic	0.469	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.313	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	21.12	k star (bias corrected MLE)	8.581
Theta hat (MLE)	2.693	Theta star (bias corrected MLE)	6.628
nu hat (MLE)	211.2	nu star (bias corrected)	85.81
MLE Mean (bias corrected)	56.88	MLE Sd (bias corrected)	19.42
		Approximate Chi Square Value (0.05)	65.46
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	57.74

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	74.57	95% Adjusted Gamma UCL (use when n<50)	84.54

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.298	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.343	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.795	Mean of logged Data	4.017
Maximum of Logged Data	4.405	SD of logged Data	0.237

Assuming Lognormal Distribution

95% H-UCL	74.73	90% Chebyshev (MVUE) UCL	74.82
95% Chebyshev (MVUE) UCL	82.98	97.5% Chebyshev (MVUE) UCL	94.31
99% Chebyshev (MVUE) UCL	116.6		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	67.75	95% Jackknife UCL	70.96
95% Standard Bootstrap UCL	66.46	95% Bootstrap-t UCL	86.25
95% Hall's Bootstrap UCL	114.4	95% Percentile Bootstrap UCL	66.12
95% BCA Bootstrap UCL	69.62		
90% Chebyshev(Mean, Sd) UCL	76.7	95% Chebyshev(Mean, Sd) UCL	85.68
97.5% Chebyshev(Mean, Sd) UCL	98.14	99% Chebyshev(Mean, Sd) UCL	122.6

Suggested UCL to Use

95% Student's-t UCL	70.96

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_hg(ng/g) (ob-05)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	64.4	Mean	100.2
Maximum	201	Median	83.7
SD	50.58	Std. Error of Mean	20.65
Coefficient of Variation	0.505	Skewness	2.193

Appendix A-4c
UCL Evaluation - Sample Areas
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.702	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.363	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	141.8	95% Adjusted-CLT UCL (Chen-1995)	153.9
		95% Modified-t UCL (Johnson-1978)	144.9

Gamma GOF Test

A-D Test Statistic	0.74	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.319	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.484	k star (bias corrected MLE)	3.353
Theta hat (MLE)	15.46	Theta star (bias corrected MLE)	29.89
nu hat (MLE)	77.81	nu star (bias corrected)	40.24
MLE Mean (bias corrected)	100.2	MLE Sd (bias corrected)	54.74
		Approximate Chi Square Value (0.05)	26.7
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	22.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	151	95% Adjusted Gamma UCL (use when n<50)	176.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.811	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.293	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.165	Mean of logged Data	4.528
Maximum of Logged Data	5.303	SD of logged Data	0.404

Appendix A-4c
UCL Evaluation - Sample Areas
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Lognormal Distribution

95% H-UCL	155.8	90% Chebyshev (MVUE) UCL	148.1
95% Chebyshev (MVUE) UCL	170.3	97.5% Chebyshev (MVUE) UCL	201.1
99% Chebyshev (MVUE) UCL	261.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	134.2	95% Jackknife UCL	141.8
95% Standard Bootstrap UCL	130.7	95% Bootstrap-t UCL	244.1
95% Hall's Bootstrap UCL	299.5	95% Percentile Bootstrap UCL	137.2
95% BCA Bootstrap UCL	143.4		
90% Chebyshev(Mean, Sd) UCL	162.2	95% Chebyshev(Mean, Sd) UCL	190.2
97.5% Chebyshev(Mean, Sd) UCL	229.2	99% Chebyshev(Mean, Sd) UCL	305.7

Suggested UCL to Use

95% Adjusted Gamma UCL	176.9

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-5a
UCL Evaluation - ProUCL Input
Atlantic Tomcod

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	UOM
BO-04	NON-REF	BO-04_17ET008_091717_TOM_01_WB	9/17/2017	104	NG/G
BO-04	NON-REF	BO-04_17ET010_091717_TOM_02_WB	9/17/2017	148	NG/G
BO-04	NON-REF	BO-04_17ET014_091717_TOM_03_WB	9/17/2017	123	NG/G
BO-04	NON-REF	BO-04_17ET025_092017_TOM_04_WB	9/20/2017	152	NG/G
BO-04	NON-REF	BO-04_17ET026_092017_TOM_05_WB	9/20/2017	199	NG/G
BO-04	NON-REF	BO-04_17ET030_092017_TOM_06_WB	9/20/2017	224	NG/G
BO-04	NON-REF	BO-04_17ET035_092017_TOM_07_WB	9/20/2017	173	NG/G
BO-04	NON-REF	BO-04_17ET041_092017_TOM_08_WB	9/20/2017	162	NG/G
BO-04	NON-REF	BO-04_092516_TOM_01_WB	9/25/2016	304	NG/G
BO-04	NON-REF	BO-04_092516_TOM_02_WB	9/25/2016	315	NG/G
BO-04	NON-REF	BO-04_092516_TOM_03_WB	9/25/2016	195	NG/G
BO-04	NON-REF	BO-04_092516_TOM_04_WB	9/25/2016	312	NG/G
ES-13	NON-REF	ES-13_17ET717_091817_TOM_11_WB	9/18/2017	172	NG/G
ES-13	NON-REF	ES-13_17ET718_091817_TOM_02_WB	9/18/2017	114	NG/G
ES-13	NON-REF	ES-13_17ET719_091817_TOM_03_WB	9/18/2017	52.8	NG/G
ES-13	NON-REF	ES-13_17ET719_091817_TOM_04_WB	9/18/2017	36	NG/G
ES-13	NON-REF	ES-13_17ET719_091817_TOM_05_WB	9/18/2017	45.5	NG/G
ES-13	NON-REF	ES-13_17ET719_091817_TOM_06_WB	9/18/2017	32.7	NG/G
ES-13	NON-REF	ES-13_17ET722_091817_TOM_07_WB	9/18/2017	52.2	NG/G
ES-13	NON-REF	ES-13_17ET722_091817_TOM_08_WB	9/18/2017	60.2	NG/G
ES-13	NON-REF	ES-13_17ET723_091817_TOM_09_WB	9/18/2017	239	NG/G
ES-13	NON-REF	ES-13_17ET723_091817_TOM_10_WB	9/18/2017	209	NG/G
ES-13	NON-REF	ES-13_17LT012_091317_TOM_01_WB	9/13/2017	226	NG/G
ES-13	NON-REF	ES-13_092916_TOM_08_WB	9/29/2016	211	NG/G
ES-13	NON-REF	ES-13_093016_TOM_09_WB	9/30/2016	103	NG/G
ES-13	NON-REF	ES-13_092716_TOM_03_WB	9/27/2016	65	NG/G
ES-13	NON-REF	ES-13_092916_TOM_06_WB	9/29/2016	142	NG/G
ES-13	NON-REF	ES-13_092716_TOM_04_WB	9/27/2016	164	NG/G
ES-13	NON-REF	ES-13_093016_TOM_10_WB	9/30/2016	113	NG/G
ES-13	NON-REF	ES-13_093016_TOM_11_WB	9/30/2016	56.5	NG/G
ES-13	NON-REF	ES-13_092916_TOM_07_WB	9/29/2016	129	NG/G
ES-13	NON-REF	ES-13_092716_TOM_01_WB	9/27/2016	59.2	NG/G
ES-13	NON-REF	ES-13_092716_TOM_05_WB	9/27/2016	80.4	NG/G
ES-13	NON-REF	ES-13_092716_TOM_02_WB	9/27/2016	76.1	NG/G
ES-FP	NON-REF	ES-FP_17ET658_091517_TOM_01_WB	9/15/2017	37.2	NG/G
ES-FP	NON-REF	ES-FP_100116_TOM_02_WB	10/1/2016	74.3	NG/G
ES-FP	NON-REF	ES-FP_092716_TOM_01_WB	9/27/2016	55.5	NG/G
FRB-REF	REFERENCE	FRB-01_092916_TOM_01_WB	9/29/2016	36.5	NG/G
OB-01	NON-REF	OB-01_17ET001_091617_TOM_01_WB	9/16/2017	274	NG/G
OB-01	NON-REF	OB-01_17ET001_091617_TOM_02_WB	9/16/2017	382	NG/G
OB-01	NON-REF	OB-01_17ET001_091617_TOM_03_WB	9/16/2017	389	NG/G
OB-01	NON-REF	OB-01_17ET001_091617_TOM_04_WB	9/16/2017	233	NG/G
OB-01	NON-REF	OB-01_17ET001_091617_TOM_05_WB	9/16/2017	190	NG/G

Appendix A-5a
UCL Evaluation - ProUCL Input
Atlantic Tomcod

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	UOM
OB-01	NON-REF	OB-01_17ET001_091617_TOM_06_WB	9/16/2017	66	NG/G
OB-01	NON-REF	OB-01_17ET001_091617_TOM_07_WB	9/16/2017	308	NG/G
OB-01	NON-REF	OB-01_17ET001_091617_TOM_08_WB	9/16/2017	413	NG/G
OB-01	NON-REF	OB-01_17ET001_091617_TOM_09_WB	9/16/2017	78.7	NG/G
OB-01	NON-REF	OB-01_17ET002_091617_TOM_10_WB	9/16/2017	205	NG/G
OB-01	NON-REF	OB-01_17ET002_091617_TOM_11_WB	9/16/2017	70	NG/G
OB-01	NON-REF	OB-01_17ET002_091617_TOM_12_WB	9/16/2017	49.7	NG/G
OB-01	NON-REF	OB-01_17ET003_091617_TOM_13_WB	9/16/2017	231	NG/G
OB-01	NON-REF	OB-01_17ET004_091617_TOM_14_WB	9/16/2017	50.1	NG/G
OB-01	NON-REF	OB-01_17ET004_091617_TOM_15_WB	9/16/2017	81.1	NG/G
OB-01	NON-REF	OB-01_17ET004_091617_TOM_16_WB	9/16/2017	77.3	NG/G
OB-01	NON-REF	OB-01_17ET005_091617_TOM_17_WB	9/16/2017	65.7	NG/G
OB-01	NON-REF	OB-01_17ET006_091617_TOM_18_WB	9/16/2017	136	NG/G
OB-01	NON-REF	OB-01_17ET007_091617_TOM_19_WB	9/16/2017	160	NG/G
OB-01	NON-REF	OB-01_17ET008_091617_TOM_20_WB	9/16/2017	182	NG/G
OB-01	NON-REF	OB-01_092416_TOM_01_WB	9/24/2016	115	NG/G
OB-01	NON-REF	OB-01_092416_TOM_02_WB	9/24/2016	215	NG/G
OB-01	NON-REF	OB-01_092416_TOM_03_WB	9/24/2016	232	NG/G
OB-01	NON-REF	OB-01_092416_TOM_04_WB	9/24/2016	170	NG/G
OB-01	NON-REF	OB-01_092416_TOM_05_WB	9/24/2016	69	NG/G
OB-01	NON-REF	OB-01_092416_TOM_06_WB	9/24/2016	159	NG/G
OB-01	NON-REF	OB-01_092416_TOM_07_WB	9/24/2016	76	NG/G
OB-01	NON-REF	OB-01_092416_TOM_08_WB	9/24/2016	174	NG/G
OB-01	NON-REF	OB-01_092416_TOM_09_WB	9/24/2016	196	NG/G
OB-01	NON-REF	OB-01_092416_TOM_10_WB	9/24/2016	82.1	NG/G
OB-01	NON-REF	OB-01_092416_TOM_11_WB	9/24/2016	89.5	NG/G
OB-01	NON-REF	OB-01_092416_TOM_12_WB	9/24/2016	89.5	NG/G
OB-01	NON-REF	OB-01_092416_TOM_13_WB	9/24/2016	179	NG/G
OB-01	NON-REF	OB-01_092416_TOM_14_WB	9/24/2016	280	NG/G
OB-01	NON-REF	OB-01_092416_TOM_15_WB	9/24/2016	276	NG/G
OB-01	NON-REF	OB-01_092416_TOM_16_WB	9/24/2016	188	NG/G
OB-01	NON-REF	OB-01_092416_TOM_17_WB	9/24/2016	155	NG/G
OB-01	NON-REF	OB-01_092416_TOM_18_WB	9/24/2016	212	NG/G
OB-01	NON-REF	OB-01_092416_TOM_19_WB	9/24/2016	245	NG/G
OB-05	NON-REF	OB-05_17ET002_091717_TOM_01_WB	9/17/2017	268	NG/G
OB-05	NON-REF	OB-05_17ET002_091717_TOM_02_WB	9/17/2017	139	NG/G
OB-05	NON-REF	OB-05_17ET002_091817_TOM_16_WB	9/18/2017	71.9	NG/G
OB-05	NON-REF	OB-05_17ET003_091717_TOM_03_WB	9/17/2017	70.7	NG/G
OB-05	NON-REF	OB-05_17ET003_091717_TOM_04_WB	9/17/2017	122	NG/G
OB-05	NON-REF	OB-05_17ET003_091817_TOM_17_WB	9/18/2017	173	NG/G
OB-05	NON-REF	OB-05_17ET003_091817_TOM_18_WB	9/18/2017	152	NG/G
OB-05	NON-REF	OB-05_17ET005_091817_TOM_19_WB	9/18/2017	78.4	NG/G
OB-05	NON-REF	OB-05_17ET008_091817_TOM_20_WB	9/18/2017	72.7	NG/G

Appendix A-5a
UCL Evaluation - ProUCL Input
Atlantic Tomcod

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	UOM
OB-05	NON-REF	OB-05_17ET009_091717_TOM_05_WB	9/17/2017	379	NG/G
OB-05	NON-REF	OB-05_17ET010_091717_TOM_06_WB	9/17/2017	99.8	NG/G
OB-05	NON-REF	OB-05_17ET011_091717_TOM_07_WB	9/17/2017	90.7	NG/G
OB-05	NON-REF	OB-05_17ET012_091717_TOM_08_WB	9/17/2017	230	NG/G
OB-05	NON-REF	OB-05_17ET012_091717_TOM_09_WB	9/17/2017	118	NG/G
OB-05	NON-REF	OB-05_17ET013_091717_TOM_10_WB	9/17/2017	227	NG/G
OB-05	NON-REF	OB-05_17ET013_091717_TOM_11_WB	9/17/2017	124	NG/G
OB-05	NON-REF	OB-05_17ET014_091717_TOM_13_WB	9/17/2017	159	NG/G
OB-05	NON-REF	OB-05_17ET014_091717_TOM_12_WB	9/17/2017	103	NG/G
OB-05	NON-REF	OB-05_17ET014_091717_TOM_14_WB	9/17/2017	126	NG/G
OB-05	NON-REF	OB-05_17ET014_091717_TOM_15_WB	9/17/2017	315	NG/G
OB-05	NON-REF	OB-05_092516_TOM_16_WB	9/25/2016	149	NG/G
OB-05	NON-REF	OB-05_092516_TOM_17_WB	9/25/2016	275	NG/G
OB-05	NON-REF	OB-05_092516_TOM_06_WB	9/25/2016	154	NG/G
OB-05	NON-REF	OB-05_092516_TOM_13_WB	9/25/2016	105	NG/G
OB-05	NON-REF	OB-05_092516_TOM_01_WB	9/25/2016	158	NG/G
OB-05	NON-REF	OB-05_092516_TOM_02_WB	9/25/2016	105	NG/G
OB-05	NON-REF	OB-05_092516_TOM_03_WB	9/25/2016	80.6	NG/G
OB-05	NON-REF	OB-05_092516_TOM_04_WB	9/25/2016	142	NG/G
OB-05	NON-REF	OB-05_092516_TOM_05_WB	9/25/2016	109	NG/G
OB-05	NON-REF	OB-05_092516_TOM_12_WB	9/25/2016	253	NG/G
OB-05	NON-REF	OB-05_092516_TOM_14_WB	9/25/2016	201	NG/G
OB-05	NON-REF	OB-05_092516_TOM_15_WB	9/25/2016	213	NG/G
OB-05	NON-REF	OB-05_092516_TOM_08_WB	9/25/2016	146	NG/G
OB-05	NON-REF	OB-05_092516_TOM_09_WB	9/25/2016	246	NG/G
OB-05	NON-REF	OB-05_092516_TOM_18_WB	9/25/2016	161	NG/G
OB-05	NON-REF	OB-05_092516_TOM_10_WB	9/25/2016	135	NG/G
OB-05	NON-REF	OB-05_092516_TOM_11_WB	9/25/2016	117	NG/G
OB-05	NON-REF	OB-05_092516_TOM_07_WB	9/25/2016	194	NG/G

Appendix A-5b
UCL Evaluation - All Areas
Atlantic Tomcod

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.111/15/2017 10:50:09 AM
From File	2017-11-14 PEN_BI21 BERA_tomcod.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_Hg(ng/g) (non-ref)

General Statistics

Total Number of Observations	114	Number of Distinct Observations	106
		Number of Missing Observations	0
Minimum	32.7	Mean	157.2
Maximum	413	Median	148.5
SD	85.12	Std. Error of Mean	7.972
Coefficient of Variation	0.541	Skewness	0.818

Normal GOF Test

Shapiro Wilk Test Statistic	0.928	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	1.7731E-6	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.0744	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0833	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	170.4	95% Adjusted-CLT UCL (Chen-1995)	171
		95% Modified-t UCL (Johnson-1978)	170.5

Gamma GOF Test

A-D Test Statistic	0.413	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0768	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0863	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.401	k star (bias corrected MLE)	3.318
Theta hat (MLE)	46.22	Theta star (bias corrected MLE)	47.39
nu hat (MLE)	775.5	nu star (bias corrected)	756.4
MLE Mean (bias corrected)	157.2	MLE Sd (bias corrected)	86.32
		Approximate Chi Square Value (0.05)	693.6
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	692.9

Appendix A-5b
UCL Evaluation - All Areas
Atlantic Tomcod

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	171.5	95% Adjusted Gamma UCL (use when n<50)	171.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.964	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0323	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0737	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0833	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.487	Mean of logged Data	4.904
Maximum of Logged Data	6.023	SD of logged Data	0.578

Assuming Lognormal Distribution

95% H-UCL	176.5	90% Chebyshev (MVUE) UCL	186.8
95% Chebyshev (MVUE) UCL	199.3	97.5% Chebyshev (MVUE) UCL	216.8
99% Chebyshev (MVUE) UCL	251.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	170.3	95% Jackknife UCL	170.4
95% Standard Bootstrap UCL	170.4	95% Bootstrap-t UCL	171.6
95% Hall's Bootstrap UCL	171.6	95% Percentile Bootstrap UCL	170.7
95% BCA Bootstrap UCL	170.6		
90% Chebyshev(Mean, Sd) UCL	181.1	95% Chebyshev(Mean, Sd) UCL	192
97.5% Chebyshev(Mean, Sd) UCL	207	99% Chebyshev(Mean, Sd) UCL	236.5

Suggested UCL to Use

95% Student's-t UCL	170.4

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (reference)

Appendix A-5b

UCL Evaluation - All Areas

Atlantic Tomcod

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	36.5	Mean	36.5
Maximum	36.5	Median	36.5

Warning: This data set only has 1 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable resuse_Hg(ng/g) (reference) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Appendix A-5c
UCL Evaluation - Sample Areas
Atlantic Tomcod

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.111/14/2017 5:17:09 PM
From File	2017-11-14 PEN_BI21 BERA_tomcod.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_Hg(ng/g) (bo-04)

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	104	Mean	200.9
Maximum	315	Median	184
SD	73.55	Std. Error of Mean	21.23
Coefficient of Variation	0.366	Skewness	0.612

Normal GOF Test

Shapiro Wilk Test Statistic	0.893	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.859	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.177	Lilliefors GOF Test
5% Lilliefors Critical Value	0.243	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	239	95% Adjusted-CLT UCL (Chen-1995)	239.9
		95% Modified-t UCL (Johnson-1978)	239.7

Gamma GOF Test

A-D Test Statistic	0.379	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.731	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.17	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.246	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.433	k star (bias corrected MLE)	6.38
Theta hat (MLE)	23.83	Theta star (bias corrected MLE)	31.49
nu hat (MLE)	202.4	nu star (bias corrected)	153.1
MLE Mean (bias corrected)	200.9	MLE Sd (bias corrected)	79.54
		Approximate Chi Square Value (0.05)	125.5
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	121.7

Appendix A-5c
UCL Evaluation - Sample Areas
Atlantic Tomcod

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	245.1	95% Adjusted Gamma UCL (use when n<50)	252.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.942	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.154	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.644	Mean of logged Data	5.242
Maximum of Logged Data	5.753	SD of logged Data	0.363

Assuming Lognormal Distribution

95% H-UCL	251.1	90% Chebyshev (MVUE) UCL	264.9
95% Chebyshev (MVUE) UCL	293.9	97.5% Chebyshev (MVUE) UCL	334.1
99% Chebyshev (MVUE) UCL	413.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	235.8	95% Jackknife UCL	239
95% Standard Bootstrap UCL	234.9	95% Bootstrap-t UCL	244
95% Hall's Bootstrap UCL	235	95% Percentile Bootstrap UCL	235.9
95% BCA Bootstrap UCL	238.8		
90% Chebyshev(Mean, Sd) UCL	264.6	95% Chebyshev(Mean, Sd) UCL	293.5
97.5% Chebyshev(Mean, Sd) UCL	333.5	99% Chebyshev(Mean, Sd) UCL	412.2

Suggested UCL to Use

95% Student's-t UCL	239

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (es-13)

Appendix A-5c

UCL Evaluation - Sample Areas

Atlantic Tomcod

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	22	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	32.7	Mean	110.8
Maximum	239	Median	91.7
SD	66.37	Std. Error of Mean	14.15
Coefficient of Variation	0.599	Skewness	0.686

Normal GOF Test

Shapiro Wilk Test Statistic	0.893	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.177	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.184	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	135.2	95% Adjusted-CLT UCL (Chen-1995)	136.3
		95% Modified-t UCL (Johnson-1978)	135.5

Gamma GOF Test

A-D Test Statistic	0.512	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.149	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.187	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.969	k star (bias corrected MLE)	2.595
Theta hat (MLE)	37.33	Theta star (bias corrected MLE)	42.72
nu hat (MLE)	130.7	nu star (bias corrected)	114.2
MLE Mean (bias corrected)	110.8	MLE Sd (bias corrected)	68.81
		Approximate Chi Square Value (0.05)	90.51
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	88.93

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	139.8	95% Adjusted Gamma UCL (use when n<50)	142.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.947	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.911	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.126	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.184	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.487	Mean of logged Data	4.53
Maximum of Logged Data	5.476	SD of logged Data	0.62

Assuming Lognormal Distribution

95% H-UCL	149.7	90% Chebyshev (MVUE) UCL	158
95% Chebyshev (MVUE) UCL	179.1	97.5% Chebyshev (MVUE) UCL	208.5
99% Chebyshev (MVUE) UCL	266.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	134.1	95% Jackknife UCL	135.2
95% Standard Bootstrap UCL	133.5	95% Bootstrap-t UCL	138.7
95% Hall's Bootstrap UCL	134.8	95% Percentile Bootstrap UCL	133.1
95% BCA Bootstrap UCL	133.7		
90% Chebyshev(Mean, Sd) UCL	153.3	95% Chebyshev(Mean, Sd) UCL	172.5
97.5% Chebyshev(Mean, Sd) UCL	199.2	99% Chebyshev(Mean, Sd) UCL	251.6

Suggested UCL to Use

95% Student's-t UCL	135.2

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (es-fp)

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	37.2	Mean	55.67
Maximum	74.3	Median	55.5
SD	18.55	Std. Error of Mean	10.71
Coefficient of Variation	0.333	Skewness	0.0404

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Appendix A-5c
UCL Evaluation - Sample Areas
Atlantic Tomcod

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	1	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.176	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	86.94	95% Adjusted-CLT UCL (Chen-1995)	73.55
		95% Modified-t UCL (Johnson-1978)	86.98

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	12.95	k star (bias corrected MLE)	N/A
Theta hat (MLE)	4.299	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	77.69	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.992	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.208	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.616	Mean of logged Data	3.98
Maximum of Logged Data	4.308	SD of logged Data	0.347

Assuming Lognormal Distribution

95% H-UCL	175.9	90% Chebyshev (MVUE) UCL	88.72
95% Chebyshev (MVUE) UCL	103.7	97.5% Chebyshev (MVUE) UCL	124.4
99% Chebyshev (MVUE) UCL	165.2		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	73.28	95% Jackknife UCL	86.94

95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	87.8	95% Chebyshev(Mean, Sd) UCL	102.4
97.5% Chebyshev(Mean, Sd) UCL	122.6	99% Chebyshev(Mean, Sd) UCL	162.2

Suggested UCL to Use

95% Student's-t UCL 86.94

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (frb-ref)

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	36.5	Mean	36.5
Maximum	36.5	Median	36.5

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable resuse_Hg(ng/g) (frb-ref) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

resuse_Hg(ng/g) (ob-01)

General Statistics

Total Number of Observations	39	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	49.7	Mean	175.5
Maximum	413	Median	174
SD	97	Std. Error of Mean	15.53
Coefficient of Variation	0.553	Skewness	0.71

Normal GOF Test

Shapiro Wilk Test Statistic	0.918	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.939	Data Not Normal at 5% Significance Level

Lilliefors Test Statistic	0.146	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.14	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	201.7	95% Adjusted-CLT UCL (Chen-1995)	202.9
		95% Modified-t UCL (Johnson-1978)	202

Gamma GOF Test

A-D Test Statistic	0.705	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.148	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.142	Data Not Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.25	k star (bias corrected MLE)	3.017
Theta hat (MLE)	53.99	Theta star (bias corrected MLE)	58.16
nu hat (MLE)	253.5	nu star (bias corrected)	235.4
MLE Mean (bias corrected)	175.5	MLE Sd (bias corrected)	101
		Approximate Chi Square Value (0.05)	200.8
Adjusted Level of Significance	0.0437	Adjusted Chi Square Value	199.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	205.6	95% Adjusted Gamma UCL (use when n<50)	206.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.939	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.14	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.14	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.906	Mean of logged Data	5.006
Maximum of Logged Data	6.023	SD of logged Data	0.597

Assuming Lognormal Distribution

95% H-UCL	216.4	90% Chebyshev (MVUE) UCL	231.7
95% Chebyshev (MVUE) UCL	256.3	97.5% Chebyshev (MVUE) UCL	290.4
99% Chebyshev (MVUE) UCL	357.4		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	201	95% Jackknife UCL	201.7
95% Standard Bootstrap UCL	200.5	95% Bootstrap-t UCL	203.4
95% Hall's Bootstrap UCL	204.1	95% Percentile Bootstrap UCL	200.9
95% BCA Bootstrap UCL	201.8		
90% Chebyshev(Mean, Sd) UCL	222.1	95% Chebyshev(Mean, Sd) UCL	243.2
97.5% Chebyshev(Mean, Sd) UCL	272.5	99% Chebyshev(Mean, Sd) UCL	330

Suggested UCL to Use

95% Adjusted Gamma UCL 206.9

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (ob-05)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	70.7	Mean	159.5
Maximum	379	Median	144
SD	72.43	Std. Error of Mean	11.75
Coefficient of Variation	0.454	Skewness	1.125

Normal GOF Test

Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.938	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.176	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.142	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	179.4	95% Adjusted-CLT UCL (Chen-1995)	181.2
		95% Modified-t UCL (Johnson-1978)	179.7

Gamma GOF Test

A-D Test Statistic	0.399	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.12	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.143	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.594	k star (bias corrected MLE)	5.17
Theta hat (MLE)	28.52	Theta star (bias corrected MLE)	30.86
nu hat (MLE)	425.2	nu star (bias corrected)	392.9
MLE Mean (bias corrected)	159.5	MLE Sd (bias corrected)	70.17
		Approximate Chi Square Value (0.05)	348
Adjusted Level of Significance	0.0434	Adjusted Chi Square Value	346.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	180.2	95% Adjusted Gamma UCL (use when n<50)	181.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.938	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0914	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.142	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.258	Mean of logged Data	4.98
Maximum of Logged Data	5.938	SD of logged Data	0.431

Assuming Lognormal Distribution

95% H-UCL	182.2	90% Chebyshev (MVUE) UCL	193.8
95% Chebyshev (MVUE) UCL	209.5	97.5% Chebyshev (MVUE) UCL	231.2
99% Chebyshev (MVUE) UCL	273.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	178.9	95% Jackknife UCL	179.4
95% Standard Bootstrap UCL	178.6	95% Bootstrap-t UCL	182.6
95% Hall's Bootstrap UCL	182.6	95% Percentile Bootstrap UCL	180
95% BCA Bootstrap UCL	180.9		
90% Chebyshev(Mean, Sd) UCL	194.8	95% Chebyshev(Mean, Sd) UCL	210.8
97.5% Chebyshev(Mean, Sd) UCL	232.9	99% Chebyshev(Mean, Sd) UCL	276.4

Suggested UCL to Use

95% Adjusted Gamma UCL	181.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-6a
UCL Evaluation - ProUCL Input
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	RESULT_UOM
BO-04	OTHER	BO-04_080516_EEL_01_WB	8/5/2016	1370	NG/G
BO-04	OTHER	Bo-04_17et002_060517_EEL_01_WB	6/5/2017	389	NG/G
BO-04	OTHER	Bo-04_17et002_060517_EEL_02_WB	6/5/2017	1320	NG/G
BO-04	OTHER	Bo-04_17et002_060517_EEL_03_WB	6/5/2017	732	NG/G
BO-04	OTHER	Bo-04_17et003_060517_EEL_04_WB	6/5/2017	430	NG/G
BO-04	OTHER	Bo-04_17et004_060517_EEL_05_WB	6/5/2017	391	NG/G
BO-04	OTHER	Bo-04_17et005_060517_EEL_06_WB	6/5/2017	422	NG/G
BO-04	OTHER	Bo-04_17et009_060517_EEL_07_WB	6/5/2017	643	NG/G
BO-04	OTHER	Bo-04_17et012_060517_EEL_08_WB	6/5/2017	488	NG/G
BO-04	OTHER	Bo-04_17et015_060517_EEL_09_WB	6/5/2017	485	NG/G
BO-04	OTHER	Bo-04_17et015_060517_EEL_10_WB	6/5/2017	540	NG/G
BO-04	OTHER	Bo-04_17et015_060517_EEL_11_WB	6/5/2017	483	NG/G
BO-04	OTHER	Bo-04_17et015_060517_EEL_12_WB	6/5/2017	589	NG/G
BO-04	OTHER	Bo-04_17et015_060517_EEL_13_WB	6/5/2017	519	NG/G
BO-04	OTHER	Bo-04_17et015_060517_EEL_14_WB	6/5/2017	648	NG/G
BO-04	OTHER	Bo-04_17et015_060517_EEL_15_WB	6/5/2017	489	NG/G
BO-04	OTHER	Bo-04_17et016_060517_EEL_16_WB	6/5/2017	604	NG/G
BO-04	OTHER	Bo-04_17et016_060517_EEL_17_WB	6/5/2017	493	NG/G
BO-04	OTHER	Bo-04_17et017_060517_EEL_18_WB	6/5/2017	679	NG/G
BO-04	OTHER	Bo-04_17et018_060517_EEL_19_WB	6/5/2017	294	NG/G
BO-04	OTHER	Bo-04_17et020_060517_EEL_20_WB	6/5/2017	386	NG/G
OB-01	OTHER	OB-01_080216_EEL_01_WB	8/2/2016	394	NG/G
OB-05	OTHER	OB-05_080316_EEL_01_WB	8/3/2016	391	NG/G
OB-05	OTHER	OB-05_080316_EEL_02_WB	8/3/2016	579	NG/G
OB-05	OTHER	OB-05_080316_EEL_03_WB	8/3/2016	485	NG/G
OB-05	OTHER	OB-05_080316_EEL_04_WB	8/3/2016	461	NG/G
OB-05	OTHER	OB-05_080516_EEL_05_WB	8/5/2016	428	NG/G
OB-05	OTHER	OB-05_17ET100_060517_EEL_01_WB	6/5/2017	468	NG/G
OB-05	OTHER	OB-05_17ET100_060517_EEL_02_WB	6/5/2017	322	NG/G
OB-05	OTHER	OB-05_17ET100_060517_EEL_03_WB	6/5/2017	293	NG/G
OB-05	OTHER	OB-05_17ET111_060517_EEL_04_WB	6/5/2017	706	NG/G
OB-05	OTHER	OB-05_17ET111_060517_EEL_05_WB	6/5/2017	381	NG/G
OB-05	OTHER	OB-05_17ET110_060517_EEL_06_WB	6/5/2017	224	NG/G
OB-05	OTHER	OB-05_17ET110_060517_EEL_07_WB	6/5/2017	92.1	NG/G
OB-05	OTHER	OB-05_17ET104_060517_EEL_08_WB	6/5/2017	249	NG/G
OB-05	OTHER	OB-05_17ET104_060517_EEL_09_WB	6/5/2017	417	NG/G
OB-05	OTHER	OB-05_17ET101_060517_EEL_10_WB	6/5/2017	528	NG/G
OB-05	OTHER	OB-05_17ET101_060517_EEL_11_WB	6/5/2017	316	NG/G
OB-05	OTHER	OB-05_17ET141_060617_EEL_12_WB	6/6/2017	234	NG/G
OB-05	OTHER	OB-05_17ET141_060617_EEL_13_WB	6/6/2017	201	NG/G
OB-05	OTHER	OB-05_17ET141_060617_EEL_14_WB	6/6/2017	277	NG/G
OB-05	OTHER	OB-05_17ET141_060617_EEL_15_WB	6/6/2017	124	NG/G
OB-05	OTHER	OB-05_17ET141_060617_EEL_16_WB	6/6/2017	110	NG/G
OB-05	OTHER	OB-05_17ET141_060617_EEL_17_WB	6/6/2017	80	NG/G
OB-05	OTHER	OB-05_17ET141_060617_EEL_18_WB	6/6/2017	116	NG/G
OB-05	OTHER	OB-05_17ET141_060617_EEL_19_WB	6/6/2017	303	NG/G
OB-05	OTHER	OB-05_17ET141_060617_EEL_20_WB	6/6/2017	221	NG/G

Appendix A-6a
UCL Evaluation - ProUCL Input
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	RESULT_UOM
OV-04	REFERENCE	OV-04_17ET015_060917_EEL_01_WB	6/9/2017	306	NG/G
OV-04	REFERENCE	OV-04_17ET628_072817_EEL_02_WB	7/28/2017	320	NG/G
OV-04	REFERENCE	OV-04_17ET628_072817_EEL_03_WB	7/28/2017	176	NG/G
OV-04	REFERENCE	OV-04_17ET628_072817_EEL_04_WB	7/28/2017	161	NG/G
OV-04	REFERENCE	OV-04_17ET628_072817_EEL_05_WB	7/28/2017	153	NG/G
OV-04	REFERENCE	OV-04_17ET628_072817_EEL_06_WB	7/28/2017	142	NG/G

Appendix A-6b
UCL Evaluation - All Areas
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/2/2017 10:32:01 AM
From File	_100217 HH_eel_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hg (ng/g) (other)

General Statistics

Total Number of Observations	47	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	80	Mean	442.4
Maximum	1370	Median	422
SD	254.2	Std. Error of Mean	37.08
Coefficient of Variation	0.575	Skewness	1.788

Normal GOF Test

Shapiro Wilk Test Statistic	0.849	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.946	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.145	Lilliefors GOF Test
5% Lilliefors Critical Value	0.128	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	504.7	95% Adjusted-CLT UCL (Chen-1995)	513.8
		95% Modified-t UCL (Johnson-1978)	506.3

Gamma GOF Test

A-D Test Statistic	0.778	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.128	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.13	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.303	k star (bias corrected MLE)	3.107
Theta hat (MLE)	133.9	Theta star (bias corrected MLE)	142.4
nu hat (MLE)	310.5	nu star (bias corrected)	292
MLE Mean (bias corrected)	442.4	MLE Sd (bias corrected)	251
		Approximate Chi Square Value (0.05)	253.4
Adjusted Level of Significance	0.0449	Adjusted Chi Square Value	252.3

Appendix A-6b
UCL Evaluation - All Areas
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	509.8	95% Adjusted Gamma UCL (use when n<50)	512.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.946	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.166	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.128	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.382	Mean of logged Data	5.933
Maximum of Logged Data	7.223	SD of logged Data	0.602

Assuming Lognormal Distribution

95% H-UCL	538.6	90% Chebyshev (MVUE) UCL	577.6
95% Chebyshev (MVUE) UCL	635.2	97.5% Chebyshev (MVUE) UCL	715.2
99% Chebyshev (MVUE) UCL	872.2		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	503.4	95% Jackknife UCL	504.7
95% Standard Bootstrap UCL	504.3	95% Bootstrap-t UCL	524.2
95% Hall's Bootstrap UCL	535.6	95% Percentile Bootstrap UCL	505.4
95% BCA Bootstrap UCL	515.1		
90% Chebyshev(Mean, Sd) UCL	553.7	95% Chebyshev(Mean, Sd) UCL	604.1
97.5% Chebyshev(Mean, Sd) UCL	674	99% Chebyshev(Mean, Sd) UCL	811.4

Suggested UCL to Use

95% Adjusted Gamma UCL	512.1

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-6b
UCL Evaluation - All Areas
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Hg (ng/g) (reference)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	142	Mean	209.7
Maximum	320	Median	168.5
SD	80.93	Std. Error of Mean	33.04
Coefficient of Variation	0.386	Skewness	0.901

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.769	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.328	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	276.2	95% Adjusted-CLT UCL (Chen-1995)	277
		95% Modified-t UCL (Johnson-1978)	278.3

Gamma GOF Test

A-D Test Statistic	0.727	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.32	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.908	k star (bias corrected MLE)	4.565
Theta hat (MLE)	23.54	Theta star (bias corrected MLE)	45.93
nu hat (MLE)	106.9	nu star (bias corrected)	54.78
MLE Mean (bias corrected)	209.7	MLE Sd (bias corrected)	98.13
		Approximate Chi Square Value (0.05)	38.78
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	33.98

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	296.2	95% Adjusted Gamma UCL (use when n<50)	338.1

Appendix A-6b
UCL Evaluation - All Areas
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.804	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.294	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.956	Mean of logged Data	5.288
Maximum of Logged Data	5.768	SD of logged Data	0.362

Assuming Lognormal Distribution

95% H-UCL	308.5	90% Chebyshev (MVUE) UCL	301.5
95% Chebyshev (MVUE) UCL	343.4	97.5% Chebyshev (MVUE) UCL	401.6
99% Chebyshev (MVUE) UCL	515.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	264	95% Jackknife UCL	276.2
95% Standard Bootstrap UCL	257.8	95% Bootstrap-t UCL	543.5
95% Hall's Bootstrap UCL	784.9	95% Percentile Bootstrap UCL	263.3
95% BCA Bootstrap UCL	264.7		
90% Chebyshev(Mean, Sd) UCL	308.8	95% Chebyshev(Mean, Sd) UCL	353.7
97.5% Chebyshev(Mean, Sd) UCL	416	99% Chebyshev(Mean, Sd) UCL	538.4

Suggested UCL to Use

95% Adjusted Gamma UCL 338.1

Recommended UCL exceeds the maximum observation

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-6c
UCL Evaluation - Sample Areas
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.19/18/2017 5:04:57 PM
From File	PEN_BI16_EEL.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

FINAL_RESU (bo-04)

General Statistics

Total Number of Observations	21	Number of Distinct Observations	21
		Number of Missing Observations	0
Minimum	294	Mean	590.2
Maximum	1370	Median	493
SD	273.8	Std. Error of Mean	59.74
Coefficient of Variation	0.464	Skewness	2.159

Normal GOF Test

Shapiro Wilk Test Statistic	0.723	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.23	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.188	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	693.2	95% Adjusted-CLT UCL (Chen-1995)	718.5
		95% Modified-t UCL (Johnson-1978)	697.9

Gamma GOF Test

A-D Test Statistic	1.199	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.744	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.165	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.19	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.843	k star (bias corrected MLE)	5.897
Theta hat (MLE)	86.24	Theta star (bias corrected MLE)	100.1
nu hat (MLE)	287.4	nu star (bias corrected)	247.7
MLE Mean (bias corrected)	590.2	MLE Sd (bias corrected)	243
		Approximate Chi Square Value (0.05)	212.3
Adjusted Level of Significance	0.0383	Adjusted Chi Square Value	209.7

Appendix A-6c
UCL Evaluation - Sample Areas
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	688.7	95% Adjusted Gamma UCL (use when n<50)	697

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.889	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.908	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.138	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.188	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.684	Mean of logged Data	6.306
Maximum of Logged Data	7.223	SD of logged Data	0.371

Assuming Lognormal Distribution

95% H-UCL	685.8	90% Chebyshev (MVUE) UCL	729.6
95% Chebyshev (MVUE) UCL	795.2	97.5% Chebyshev (MVUE) UCL	886.4
99% Chebyshev (MVUE) UCL	1065		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	688.5	95% Jackknife UCL	693.2
95% Standard Bootstrap UCL	689.7	95% Bootstrap-t UCL	800.7
95% Hall's Bootstrap UCL	1292	95% Percentile Bootstrap UCL	692.4
95% BCA Bootstrap UCL	724.9		
90% Chebyshev(Mean, Sd) UCL	769.4	95% Chebyshev(Mean, Sd) UCL	850.6
97.5% Chebyshev(Mean, Sd) UCL	963.3	99% Chebyshev(Mean, Sd) UCL	1185

Suggested UCL to Use

95% Adjusted Gamma UCL	697

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU (ob-01)

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	394	Mean	394
Maximum	394	Median	394

Appendix A-6c
UCL Evaluation - Sample Areas
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Warning: This data set only has 1 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable FINAL_RESU (ob-01) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

FINAL_RESU (ob-05)

General Statistics

Total Number of Observations	25	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	80	Mean	320.2
Maximum	706	Median	303
SD	163.3	Std. Error of Mean	32.67
Coefficient of Variation	0.51	Skewness	0.427

Normal GOF Test

Shapiro Wilk Test Statistic	0.965	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.918	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0957	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.173	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	376.1	95% Adjusted-CLT UCL (Chen-1995)	377
		95% Modified-t UCL (Johnson-1978)	376.6

Gamma GOF Test

A-D Test Statistic	0.332	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.11	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.176	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.488	k star (bias corrected MLE)	3.096
Theta hat (MLE)	91.82	Theta star (bias corrected MLE)	103.4
nu hat (MLE)	174.4	nu star (bias corrected)	154.8
MLE Mean (bias corrected)	320.2	MLE Sd (bias corrected)	182
		Approximate Chi Square Value (0.05)	127
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	125.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	390.2	95% Adjusted Gamma UCL (use when n<50)	395.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.939	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.116	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.382	Mean of logged Data	5.619
Maximum of Logged Data	6.56	SD of logged Data	0.597

Assuming Lognormal Distribution

95% H-UCL	422.7	90% Chebyshev (MVUE) UCL	450.4
95% Chebyshev (MVUE) UCL	506.5	97.5% Chebyshev (MVUE) UCL	584.3
99% Chebyshev (MVUE) UCL	737.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	374	95% Jackknife UCL	376.1
95% Standard Bootstrap UCL	374	95% Bootstrap-t UCL	377.5
95% Hall's Bootstrap UCL	377.3	95% Percentile Bootstrap UCL	374.3
95% BCA Bootstrap UCL	373.6		
90% Chebyshev(Mean, Sd) UCL	418.3	95% Chebyshev(Mean, Sd) UCL	462.6
97.5% Chebyshev(Mean, Sd) UCL	524.3	99% Chebyshev(Mean, Sd) UCL	645.3

Suggested UCL to Use

95% Student's-t UCL	376.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU (ov-04)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	142	Mean	209.7
Maximum	320	Median	168.5
SD	80.93	Std. Error of Mean	33.04
Coefficient of Variation	0.386	Skewness	0.901

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Appendix A-6c
UCL Evaluation - Sample Areas
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.769	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.328	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	276.2	95% Adjusted-CLT UCL (Chen-1995)	277
		95% Modified-t UCL (Johnson-1978)	278.3

Gamma GOF Test

A-D Test Statistic	0.727	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.698	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.32	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.908	k star (bias corrected MLE)	4.565
Theta hat (MLE)	23.54	Theta star (bias corrected MLE)	45.93
nu hat (MLE)	106.9	nu star (bias corrected)	54.78
MLE Mean (bias corrected)	209.7	MLE Sd (bias corrected)	98.13
		Approximate Chi Square Value (0.05)	38.78
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	33.98

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	296.2	95% Adjusted Gamma UCL (use when n<50)	338.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.804	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.294	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.956	Mean of logged Data	5.288
Maximum of Logged Data	5.768	SD of logged Data	0.362

Assuming Lognormal Distribution

95% H-UCL	308.5	90% Chebyshev (MVUE) UCL	301.5
95% Chebyshev (MVUE) UCL	343.4	97.5% Chebyshev (MVUE) UCL	401.6
99% Chebyshev (MVUE) UCL	515.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	264	95% Jackknife UCL	276.2
95% Standard Bootstrap UCL	259.6	95% Bootstrap-t UCL	543.4
95% Hall's Bootstrap UCL	781.7	95% Percentile Bootstrap UCL	262
95% BCA Bootstrap UCL	264		
90% Chebyshev(Mean, Sd) UCL	308.8	95% Chebyshev(Mean, Sd) UCL	353.7
97.5% Chebyshev(Mean, Sd) UCL	416	99% Chebyshev(Mean, Sd) UCL	538.4

Suggested UCL to Use

95% Adjusted Gamma UCL	338.1

Recommended UCL exceeds the maximum observation

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-7a
UCL Evaluation - ProUCL Input
American black duck

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_AA	EA_SA	ID	DATE	MEDIA	Mercury	UOM
NON-REF	ES-13	ES-13_012417_ABD_01_MU	1/24/2017	TIS	717	NG/G
NON-REF	ES-13	ES-13_012417_ABD_02_MU	1/24/2017	TIS	243	NG/G
NON-REF	ES-13	ES-13_012817_ABD_03_MU	1/28/2017	TIS	371	NG/G
NON-REF	ES-13	ES-13_012817_ABD_04_MU	1/28/2017	TIS	507	NG/G
NON-REF	ES-13	ES-13_020517_ABD_05_MU	2/5/2017	TIS	441	NG/G
NON-REF	ES-13	ES-13_18WT001_012918_ABD_01_BL	1/29/2018	[BL]TIS	184.172	NG/G
NON-REF	ES-13	ES-13_18WT001_012918_ABD_02_BL	1/29/2018	[BL]TIS	260.549	NG/G
NON-REF	ES-13	ES-13_18WT001_012918_ABD_03_BL	1/29/2018	[BL]TIS	102.304	NG/G
NON-REF	ES-13	ES-13_18WT001_012918_ABD_04_BL	1/29/2018	[BL]TIS	216.791	NG/G
NON-REF	ES-13	ES-13_18WT001_012918_ABD_05_BL	1/29/2018	[BL]TIS	65.3089	NG/G
NON-REF	ES-13	ES-13_18WT001_012918_ABD_06_BL	1/29/2018	[BL]TIS	207.244	NG/G
NON-REF	ES-13	ES-13_18WT001_012918_ABD_07_BL	1/29/2018	[BL]TIS	88.9382	NG/G
NON-REF	ES-13	ES-13_18WT001_013018_ABD_08_BL	1/30/2018	[BL]TIS	151.552	NG/G
NON-REF	ES-13	ES-13_18WT001_013018_ABD_09_BL	1/30/2018	[BL]TIS	156.326	NG/G
NON-REF	ES-13	ES-13_18WT001_013018_ABD_10_BL	1/30/2018	[BL]TIS	119.728	NG/G
NON-REF	ES-13	ES-13_18WT001_013018_ABD_11_BL	1/30/2018	[BL]TIS	111.772	NG/G
NON-REF	ES-13	ES-13_18WT001_013018_ABD_12_BL	1/30/2018	[BL]TIS	162.69	NG/G
NON-REF	ES-13	ES-13_18WT001_013118_ABD_13_BL	1/31/2018	[BL]TIS	114.954	NG/G
NON-REF	ES-13	ES-13_18WT001_013118_ABD_14_BL	1/31/2018	[BL]TIS	188.945	NG/G
NON-REF	ES-13	ES-13_18WT001_013118_ABD_15_BL	1/31/2018	[BL]TIS	390.232	NG/G
REF	FRB	FRB-01_012417_ABD_06_MU	1/25/2017	TIS	10.1	NG/G
REF	FRB	FRB-01_012417_ABD_07_MU	1/25/2017	TIS	46.5	NG/G
REF	FRB	FRB-01_012417_ABD_08_MU	1/25/2017	TIS	44.8	NG/G
REF	FRB	FRB-01_012417_ABD_09_MU	1/26/2017	TIS	47.6	NG/G
REF	FRB	FRB-01_012417_ABD_10_MU	1/26/2017	TIS	41.7	NG/G
REF	FRB	ABDU-012714_ABD_MU	1/27/2014	TIS	85.3	NG/G
REF	FRB	FRB-01_18WT001_013018_ABD_01_BL	1/30/2018	[BL]TIS	70.0029	NG/G
REF	FRB	FRB-01_18WT001_013018_ABD_02_BL	1/30/2018	[BL]TIS	69.446	NG/G
REF	FRB	FRB-01_18WT001_013018_ABD_03_BL	1/30/2018	[BL]TIS	75.8903	NG/G
REF	FRB	FRB-01_18WT001_013018_ABD_04_BL	1/30/2018	[BL]TIS	43.2707	NG/G
REF	FRB	FRB-01_18WT001_013018_ABD_05_BL	1/30/2018	[BL]TIS	41.9978	NG/G
REF	FRB	FRB-OCN_18WT001_013018_ABD_06_BL	1/30/2018	[BL]TIS	66.4227	NG/G
REF	FRB	FRB-OCN_18WT001_013018_ABD_07_BL	1/30/2018	[BL]TIS	93.5527	NG/G
REF	FRB	FRB-OCN_18WT001_013018_ABD_08_BL	1/30/2018	[BL]TIS	80.9822	NG/G
REF	FRB	FRB-OCN_18WT001_013018_ABD_09_BL	1/30/2018	[BL]TIS	89.0177	NG/G
REF	FRB	FRB-OCN_18WT001_013018_ABD_10_BL	1/30/2018	[BL]TIS	66.9796	NG/G
REF	FRB	FRB-OCN_18WT001_013018_ABD_11_BL	1/30/2018	[BL]TIS	74.3787	NG/G
REF	FRB	FRB-OCN_18WT001_013018_ABD_12_BL	1/30/2018	[BL]TIS	64.0359	NG/G
REF	FRB	FRB-01_18WT001_013118_ABD_13_BL	1/31/2018	[BL]TIS	52.0223	NG/G
REF	FRB	FRB-01_18WT001_013118_ABD_14_BL	1/31/2018	[BL]TIS	74.9356	NG/G
REF	FRB	FRB-01_18WT001_013118_ABD_15_BL	1/31/2018	[BL]TIS	68.4913	NG/G

Appendix A-7a
UCL Evaluation - ProUCL Input
American black duck

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_AA	EA_SA	ID	DATE	MEDIA	Mercury	UOM
NON-REF	Mendall Marsh	MMBKD-01_012217_ABD_01_MU	1/23/2017	TIS	177	NG/G
NON-REF	Mendall Marsh	MMBKD-01_012217_ABD_02_MU	1/23/2017	TIS	121	NG/G
NON-REF	Mendall Marsh	MMBKD-01_012417_ABD_03_MU	1/24/2017	TIS	854	NG/G
NON-REF	Mendall Marsh	MMBKD-01_012417_ABD_04_MU	1/24/2017	TIS	325	NG/G
NON-REF	Mendall Marsh	MMBKD-01_012417_ABD_05_MU	1/24/2017	TIS	170	NG/G
NON-REF	Mendall Marsh	ABDU-122013_ABD_MU	12/20/2013	TIS	429.53	NG/G
NON-REF	Mendall Marsh	ABDU-122113_ABD_MU	12/21/2013	TIS	388.96	NG/G
NON-REF	Mendall Marsh	ABDU-122313_ABD_MU	12/23/2013	TIS	476.44	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_012918_ABD_01_BL	1/29/2018	[BL]TIS	390.232	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_02_BL	1/30/2018	[BL]TIS	214.404	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_03_BL	1/30/2018	[BL]TIS	364.773	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_04_BL	1/30/2018	[BL]TIS	214.404	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_05_BL	1/30/2018	[BL]TIS	332.153	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_06_BL	1/30/2018	[BL]TIS	310.672	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_07_BL	1/30/2018	[BL]TIS	259.754	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_08_BL	1/30/2018	[BL]TIS	173.829	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_09_BL	1/30/2018	[BL]TIS	282.826	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_10_BL	1/30/2018	[BL]TIS	270.892	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_11_BL	1/30/2018	[BL]TIS	205.653	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_12_BL	1/30/2018	[BL]TIS	219.974	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_13_BL	1/30/2018	[BL]TIS	191.332	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_14_BL	1/30/2018	[BL]TIS	188.945	NG/G
NON-REF	Mendall Marsh	MMBKD-01_18WT001_013018_ABD_15_BL	1/30/2018	[BL]TIS	243.842	NG/G

Appendix A-7b
UCL Evaluation - All Areas
American black duck

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/13/2018 3:20:16 PM
From File	07_ABD (tissue) 041318 INPUT.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (non-ref)

General Statistics

Total Number of Observations	43	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	65.31	Mean	269.9
Maximum	854	Median	216.8
SD	160.1	Std. Error of Mean	24.41
Coefficient of Variation	0.593	Skewness	1.725

Normal GOF Test

Shapiro Wilk Test Statistic	0.859	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.943	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.157	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.134	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	311	95% Adjusted-CLT UCL (Chen-1995)	316.9
		95% Modified-t UCL (Johnson-1978)	312

Gamma GOF Test

A-D Test Statistic	0.386	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.111	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.136	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.542	k star (bias corrected MLE)	3.31
Theta hat (MLE)	76.21	Theta star (bias corrected MLE)	81.54
nu hat (MLE)	304.6	nu star (bias corrected)	284.7
MLE Mean (bias corrected)	269.9	MLE Sd (bias corrected)	148.4
		Approximate Chi Square Value (0.05)	246.6
Adjusted Level of Significance	0.0444	Adjusted Chi Square Value	245.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	311.6	95% Adjusted Gamma UCL (use when n<50)	313.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.991	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.943	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0762	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.134	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.179	Mean of logged Data	5.45
Maximum of Logged Data	6.75	SD of logged Data	0.547

Assuming Lognormal Distribution

95% H-UCL	318.4	90% Chebyshev (MVUE) UCL	340.6
95% Chebyshev (MVUE) UCL	372.9	97.5% Chebyshev (MVUE) UCL	417.8
99% Chebyshev (MVUE) UCL	505.8		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	310.1	95% Jackknife UCL	311
95% Standard Bootstrap UCL	309.4	95% Bootstrap-t UCL	319.1
95% Hall's Bootstrap UCL	322.6	95% Percentile Bootstrap UCL	311.4
95% BCA Bootstrap UCL	320.2		
90% Chebyshev(Mean, Sd) UCL	343.1	95% Chebyshev(Mean, Sd) UCL	376.3
97.5% Chebyshev(Mean, Sd) UCL	422.4	99% Chebyshev(Mean, Sd) UCL	512.8

Suggested UCL to Use

95% Adjusted Gamma UCL	313.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (ref)

General Statistics

Total Number of Observations	21	Number of Distinct Observations	21
		Number of Missing Observations	0
Minimum	10.1	Mean	62.26
Maximum	93.55	Median	66.98
SD	20.06	Std. Error of Mean	4.378
Coefficient of Variation	0.322	Skewness	-0.705

Normal GOF Test

Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk GOF Test**	

Appendix A-7b
UCL Evaluation - All Areas
American black duck

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

5% Shapiro Wilk Critical Value	0.908	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.154	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.188	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	69.81	95% Adjusted-CLT UCL (Chen-1995)	68.74
		95% Modified-t UCL (Johnson-1978)	69.7

Gamma GOF Test

A-D Test Statistic	0.985	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.199	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.19	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.509	k star (bias corrected MLE)	5.611
Theta hat (MLE)	9.565	Theta star (bias corrected MLE)	11.1
nu hat (MLE)	273.4	nu star (bias corrected)	235.7
MLE Mean (bias corrected)	62.26	MLE Sd (bias corrected)	26.28
		Approximate Chi Square Value (0.05)	201.1
Adjusted Level of Significance	0.0383	Adjusted Chi Square Value	198.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	72.95	95% Adjusted Gamma UCL (use when n<50)	73.85

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.736	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.208	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.188	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.313	Mean of logged Data	4.053
Maximum of Logged Data	4.539	SD of logged Data	0.476

Assuming Lognormal Distribution

95% H-UCL	79.48	90% Chebyshev (MVUE) UCL	84.73
95% Chebyshev (MVUE) UCL	94.09	97.5% Chebyshev (MVUE) UCL	107.1
99% Chebyshev (MVUE) UCL	132.6		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	69.46	95% Jackknife UCL	69.81

Appendix A-7b
UCL Evaluation - All Areas
American black duck

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

95% Standard Bootstrap UCL	69.26	95% Bootstrap-t UCL	69.19
95% Hall's Bootstrap UCL	69.12	95% Percentile Bootstrap UCL	68.92
95% BCA Bootstrap UCL	68.93		
90% Chebyshev(Mean, Sd) UCL	75.39	95% Chebyshev(Mean, Sd) UCL	81.34
97.5% Chebyshev(Mean, Sd) UCL	89.6	99% Chebyshev(Mean, Sd) UCL	105.8

Suggested UCL to Use

95% Student's-t UCL	69.81

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Appendix A-7c
UCL Evaluation - Sample Areas
American black duck

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/13/2018 3:20:34 PM
From File	07_ABD (tissue) 041318 INPUT.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (es-13)

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	65.31	Mean	240
Maximum	717	Median	186.6
SD	166.4	Std. Error of Mean	37.22
Coefficient of Variation	0.693	Skewness	1.547

Normal GOF Test

Shapiro Wilk Test Statistic	0.841	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.206	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	304.4	95% Adjusted-CLT UCL (Chen-1995)	315
		95% Modified-t UCL (Johnson-1978)	306.5

Gamma GOF Test

A-D Test Statistic	0.434	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.134	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.714	k star (bias corrected MLE)	2.341
Theta hat (MLE)	88.43	Theta star (bias corrected MLE)	102.5
nu hat (MLE)	108.6	nu star (bias corrected)	93.62
MLE Mean (bias corrected)	240	MLE Sd (bias corrected)	156.9
		Approximate Chi Square Value (0.05)	72.31
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	70.83

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	310.8	95% Adjusted Gamma UCL (use when n<50)	317.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.092	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.179	Mean of logged Data	5.285
Maximum of Logged Data	6.575	SD of logged Data	0.629

Assuming Lognormal Distribution

95% H-UCL	328.4	90% Chebyshev (MVUE) UCL	343.8
95% Chebyshev (MVUE) UCL	391.8	97.5% Chebyshev (MVUE) UCL	458.4
99% Chebyshev (MVUE) UCL	589.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	301.2	95% Jackknife UCL	304.4
95% Standard Bootstrap UCL	298.4	95% Bootstrap-t UCL	329.7
95% Hall's Bootstrap UCL	333	95% Percentile Bootstrap UCL	302.3
95% BCA Bootstrap UCL	317.3		
90% Chebyshev(Mean, Sd) UCL	351.7	95% Chebyshev(Mean, Sd) UCL	402.3
97.5% Chebyshev(Mean, Sd) UCL	472.4	99% Chebyshev(Mean, Sd) UCL	610.3

Suggested UCL to Use

95% Adjusted Gamma UCL	317.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (frb)

General Statistics

Total Number of Observations	21	Number of Distinct Observations	21
		Number of Missing Observations	0
Minimum	10.1	Mean	62.26
Maximum	93.55	Median	66.98
SD	20.06	Std. Error of Mean	4.378
Coefficient of Variation	0.322	Skewness	-0.705

Normal GOF Test

Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk GOF Test**

Appendix A-7c
UCL Evaluation - Sample Areas
American black duck

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

5% Shapiro Wilk Critical Value	0.908	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.154	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.188	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	69.81	95% Adjusted-CLT UCL (Chen-1995)	68.74
		95% Modified-t UCL (Johnson-1978)	69.7

Gamma GOF Test

A-D Test Statistic	0.985	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.199	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.19	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.509	k star (bias corrected MLE)	5.611
Theta hat (MLE)	9.565	Theta star (bias corrected MLE)	11.1
nu hat (MLE)	273.4	nu star (bias corrected)	235.7
MLE Mean (bias corrected)	62.26	MLE Sd (bias corrected)	26.28
		Approximate Chi Square Value (0.05)	201.1
Adjusted Level of Significance	0.0383	Adjusted Chi Square Value	198.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	72.95	95% Adjusted Gamma UCL (use when n<50)	73.85

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.736	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.208	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.188	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.313	Mean of logged Data	4.053
Maximum of Logged Data	4.539	SD of logged Data	0.476

Assuming Lognormal Distribution

95% H-UCL	79.48	90% Chebyshev (MVUE) UCL	84.73
95% Chebyshev (MVUE) UCL	94.09	97.5% Chebyshev (MVUE) UCL	107.1
99% Chebyshev (MVUE) UCL	132.6		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	69.46	95% Jackknife UCL	69.81

Appendix A-7c
UCL Evaluation - Sample Areas
American black duck

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

95% Standard Bootstrap UCL	69.34	95% Bootstrap-t UCL	68.99
95% Hall's Bootstrap UCL	68.85	95% Percentile Bootstrap UCL	69.11
95% BCA Bootstrap UCL	68.6		
90% Chebyshev(Mean, Sd) UCL	75.39	95% Chebyshev(Mean, Sd) UCL	81.34
97.5% Chebyshev(Mean, Sd) UCL	89.6	99% Chebyshev(Mean, Sd) UCL	105.8

Suggested UCL to Use

95% Student's-t UCL 69.81

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Mercury (mendall marsh)

General Statistics

Total Number of Observations	23	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	121	Mean	295.9
Maximum	854	Median	259.8
SD	153.2	Std. Error of Mean	31.95
Coefficient of Variation	0.518	Skewness	2.332

Normal GOF Test

Shapiro Wilk Test Statistic	0.786	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.18	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	350.8	95% Adjusted-CLT UCL (Chen-1995)	365
		95% Modified-t UCL (Johnson-1978)	353.3

Gamma GOF Test

A-D Test Statistic	0.489	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.128	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.182	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.355	k star (bias corrected MLE)	4.686

Appendix A-7c
UCL Evaluation - Sample Areas
American black duck

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Theta hat (MLE)	55.25	Theta star (bias corrected MLE)	63.15
nu hat (MLE)	246.3	nu star (bias corrected)	215.5
MLE Mean (bias corrected)	295.9	MLE Sd (bias corrected)	136.7
		Approximate Chi Square Value (0.05)	182.6
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	180.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	349.3	95% Adjusted Gamma UCL (use when n<50)	353.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.964	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.115	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.18	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.796	Mean of logged Data	5.594
Maximum of Logged Data	6.75	SD of logged Data	0.428

Assuming Lognormal Distribution

95% H-UCL	350.8	90% Chebyshev (MVUE) UCL	374.1
95% Chebyshev (MVUE) UCL	410.8	97.5% Chebyshev (MVUE) UCL	461.6
99% Chebyshev (MVUE) UCL	561.5		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	348.4	95% Jackknife UCL	350.8
95% Standard Bootstrap UCL	346.6	95% Bootstrap-t UCL	381.6
95% Hall's Bootstrap UCL	591.9	95% Percentile Bootstrap UCL	355.2
95% BCA Bootstrap UCL	369.2		
90% Chebyshev(Mean, Sd) UCL	391.7	95% Chebyshev(Mean, Sd) UCL	435.2
97.5% Chebyshev(Mean, Sd) UCL	495.4	99% Chebyshev(Mean, Sd) UCL	613.8

Suggested UCL to Use

95% Student's-t UCL	350.8

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-8a
UCL Evaluation - ProUCL Input
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	UOM
BO-04	NON-REF	BO-04_17SN001_091717_MUM_01_WB	9/17/2017	63.4	NG/G
BO-04	NON-REF	BO-04_100316_MUM_01_WB	10/3/2016	234	NG/G
BO-04	NON-REF	BO-04_100316_MUM_02_WB	10/3/2016	57.7	NG/G
BO-04	NON-REF	BO-04_100316_MUM_03_WB	10/3/2016	146	NG/G
BO-04	NON-REF	BO-04_100316_MUM_04_WB	10/3/2016	67.3	NG/G
BO-04	NON-REF	BO-04_100316_MUM_05_WB	10/3/2016	214	NG/G
BO-04	NON-REF	BO-04_100316_MUM_06_WB	10/3/2016	76	NG/G
BO-04	NON-REF	BO-04_100316_MUM_07_WB	10/3/2016	76	NG/G
BO-04	NON-REF	BO-04_100316_MUM_08_WB	10/3/2016	75	NG/G
BO-04	NON-REF	BO-04_100316_MUM_09_WB	10/3/2016	60.6	NG/G
BO-04	NON-REF	BO-04_100316_MUM_10_WB	10/3/2016	52.4	NG/G
BO-04	NON-REF	BO-04_100316_MUM_11_WB	10/3/2016	94.3	NG/G
BO-04	NON-REF	BO-04_100316_MUM_12_WB	10/3/2016	200	NG/G
BO-04	NON-REF	BO-04_100316_MUM_13_WB	10/3/2016	55	NG/G
BO-04	NON-REF	BO-04_100316_MUM_14_WB	10/3/2016	66.7	NG/G
BO-04	NON-REF	BO-04_100316_MUM_15_WB	10/3/2016	58.1	NG/G
BO-04	NON-REF	BO-04_100316_MUM_16_WB	10/3/2016	61.7	NG/G
BO-04	NON-REF	BO-04_100316_MUM_17_WB	10/3/2016	108	NG/G
BO-04	NON-REF	BO-04_100316_MUM_18_WB	10/3/2016	85.9	NG/G
BO-04	NON-REF	BO-04_100316_MUM_19_WB	10/3/2016	59.3	NG/G
BO-04	NON-REF	BO-04_100316_MUM_20_WB	10/3/2016	63.9	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_01_WB	9/12/2017	5.17	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_02_WB	9/12/2017	8.36	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_03_WB	9/12/2017	5.05	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_04_WB	9/12/2017	7.11	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_05_WB	9/12/2017	7.57	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_06_WB	9/12/2017	6.46	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_07_WB	9/12/2017	7.7	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_08_WB	9/12/2017	7.6	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_09_WB	9/12/2017	6.16	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_10_WB	9/12/2017	6.74	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_11_WB	9/12/2017	6.7	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_12_WB	9/12/2017	4.81	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_13_WB	9/12/2017	5.65	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_14_WB	9/12/2017	6.1	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_15_WB	9/12/2017	5.08	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_16_WB	9/12/2017	6.6	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_17_WB	9/12/2017	5.85	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_18_WB	9/12/2017	7.84	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_19_WB	9/12/2017	6.53	NG/G
FRB-REF	REFERENCE	FRB-01_17SN001_091217_MUM_20_WB	9/12/2017	4.44	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_01_WB	9/28/2016	6.49	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_02_WB	9/28/2016	9.83	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_03_WB	9/28/2016	6.77	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_04_WB	9/28/2016	5.16	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_05_WB	9/28/2016	6.9	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_06_WB	9/28/2016	7.83	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_07_WB	9/28/2016	9.29	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_08_WB	9/28/2016	5.76	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_09_WB	9/28/2016	7.05	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_10_WB	9/28/2016	8.37	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_11_WB	9/28/2016	13.5	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_12_WB	9/28/2016	7.67	NG/G

Appendix A-8a
UCL Evaluation - ProUCL Input
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	UOM
FRB-REF	REFERENCE	FRB-01_092816_MUM_13_WB	9/28/2016	9.38	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_14_WB	9/28/2016	7.9	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_15_WB	9/28/2016	8.19	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_16_WB	9/28/2016	8.01	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_17_WB	9/28/2016	8.58	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_18_WB	9/28/2016	11.1	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_19_WB	9/28/2016	4.94	NG/G
FRB-REF	REFERENCE	FRB-01_092816_MUM_20_WB	9/28/2016	8.43	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT001_091817_MUM_01_WB	9/18/2017	51.4	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT001_092017_MUM_02_WB	9/20/2017	137	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_06_WB	9/20/2017	109	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_07_WB	9/20/2017	122	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_08_WB	9/20/2017	107	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_09_WB	9/20/2017	88.2	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_10_WB	9/20/2017	207	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_11_WB	9/20/2017	94.4	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_12_WB	9/20/2017	73.2	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_13_WB	9/20/2017	104	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_14_WB	9/20/2017	150	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_15_WB	9/20/2017	145	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_16_WB	9/20/2017	72.4	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_17_WB	9/20/2017	136	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_18_WB	9/20/2017	112	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_19_WB	9/20/2017	100	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT003_092017_MUM_20_WB	9/20/2017	256	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT004_092017_MUM_03_WB	9/20/2017	173	NG/G
MENDAL MARSH	NON-REF	MMMC-01_17MT004_092017_MUM_04_WB	9/20/2017	109	NG/G
MENDAL MARSH	NON-REF	MMMC-01_092316_MUM_01_WB	9/23/2016	177	NG/G
MENDAL MARSH	NON-REF	MMMC-01_092316_MUM_02_WB	9/23/2016	249	NG/G
MENDAL MARSH	NON-REF	MMMC-01_092316_MUM_03_WB	9/23/2016	140	NG/G
MENDAL MARSH	NON-REF	MMMC-01_092316_MUM_04_WB	9/23/2016	121	NG/G
OB-01	NON-REF	OB-01_17MT001_091817_MUM_01_WB	9/18/2017	86.9	NG/G
OB-01	NON-REF	OB-01_17MT001_091917_MUM_09_WB	9/19/2017	79.6	NG/G
OB-01	NON-REF	OB-01_17MT001_091917_MUM_10_WB	9/19/2017	242	NG/G
OB-01	NON-REF	OB-01_17MT001_091917_MUM_11_WB	9/19/2017	83.4	NG/G
OB-01	NON-REF	OB-01_17MT001_091917_MUM_12_WB	9/19/2017	130	NG/G
OB-01	NON-REF	OB-01_17MT001_091917_MUM_13_WB	9/19/2017	127	NG/G
OB-01	NON-REF	OB-01_17MT002_091817_MUM_02_WB	9/18/2017	86.1	NG/G
OB-01	NON-REF	OB-01_17MT002_091817_MUM_03_WB	9/18/2017	103	NG/G
OB-01	NON-REF	OB-01_17MT002_091817_MUM_04_WB	9/18/2017	154	NG/G
OB-01	NON-REF	OB-01_17MT002_091817_MUM_05_WB	9/18/2017	110	NG/G
OB-01	NON-REF	OB-01_17MT002_091817_MUM_06_WB	9/18/2017	109	NG/G
OB-01	NON-REF	OB-01_17MT002_091817_MUM_07_WB	9/18/2017	37.4	NG/G
OB-01	NON-REF	OB-01_17MT002_091817_MUM_08_WB	9/18/2017	87.2	NG/G
OB-01	NON-REF	OB-01_17MT002_091917_MUM_14_WB	9/19/2017	237	NG/G
OB-01	NON-REF	OB-01_17MT002_091917_MUM_15_WB	9/19/2017	118	NG/G
OB-01	NON-REF	OB-01_092516_MUM_01_WB	9/25/2016	134	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_01_WB	9/15/2017	150	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_02_WB	9/15/2017	114	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_03_WB	9/15/2017	121	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_04_WB	9/15/2017	117	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_05_WB	9/15/2017	65.2	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_06_WB	9/15/2017	76.5	NG/G

Appendix A-8a
UCL Evaluation - ProUCL Input
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	EA_AA	ID	DATE	Mercury	UOM
OB-05	NON-REF	OB-05_17SN001_091517_MUM_07_WB	9/15/2017	71.5	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_08_WB	9/15/2017	77.6	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_09_WB	9/15/2017	74.1	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_10_WB	9/15/2017	74.6	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_11_WB	9/15/2017	77.1	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_12_WB	9/15/2017	80.8	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_13_WB	9/15/2017	76.9	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_14_WB	9/15/2017	81.3	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_15_WB	9/15/2017	77.6	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_16_WB	9/15/2017	65	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_17_WB	9/15/2017	66.5	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_18_WB	9/15/2017	69.9	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_19_WB	9/15/2017	76.5	NG/G
OB-05	NON-REF	OB-05_17SN001_091517_MUM_20_WB	9/15/2017	62.6	NG/G
OB-05	NON-REF	OB-05_092516_MUM_01_WB	9/25/2016	111	NG/G
OB-05	NON-REF	OB-05_092516_MUM_02_WB	9/25/2016	125	NG/G
OB-05	NON-REF	OB-05_092516_MUM_03_WB	9/25/2016	113	NG/G
OB-05	NON-REF	OB-05_092516_MUM_04_WB	9/25/2016	82.1	NG/G
OB-05	NON-REF	OB-05_092516_MUM_05_WB	9/25/2016	96.1	NG/G
OB-05	NON-REF	OB-05_092516_MUM_06_WB	9/25/2016	114	NG/G
OB-05	NON-REF	OB-05_100316_MUM_07_WB	10/3/2016	106	NG/G
OB-05	NON-REF	OB-05_100316_MUM_08_WB	10/3/2016	83.2	NG/G
OB-05	NON-REF	OB-05_100316_MUM_09_WB	10/3/2016	83.4	NG/G
OB-05	NON-REF	OB-05_100316_MUM_10_WB	10/3/2016	92.6	NG/G
OB-05	NON-REF	OB-05_100316_MUM_11_WB	10/3/2016	88.2	NG/G
OB-05	NON-REF	OB-05_100316_MUM_12_WB	10/3/2016	69.4	NG/G
OB-05	NON-REF	OB-05_100316_MUM_13_WB	10/3/2016	98.5	NG/G
OB-05	NON-REF	OB-05_100316_MUM_14_WB	10/3/2016	71.3	NG/G
OB-05	NON-REF	OB-05_100316_MUM_15_WB	10/3/2016	48.9	NG/G
OB-05	NON-REF	OB-05_100316_MUM_16_WB	10/3/2016	89.9	NG/G
OB-05	NON-REF	OB-05_100316_MUM_17_WB	10/3/2016	71.6	NG/G
OB-05	NON-REF	OB-05_100316_MUM_18_WB	10/3/2016	66.2	NG/G
OB-05	NON-REF	OB-05_100316_MUM_19_WB	10/3/2016	95.8	NG/G
OB-05	NON-REF	OB-05_100316_MUM_20_WB	10/3/2016	87.6	NG/G

Appendix A-8b
UCL Evaluation - All Areas
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.111/15/2017 10:40:46 AM
From File	2017-11-14 PEN_BI21 BERA_mummichog.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_Hg(ng/g) (non-ref)

General Statistics

Total Number of Observations	100	Number of Distinct Observations	90
		Number of Missing Observations	0
Minimum	37.4	Mean	104
Maximum	256	Median	88.2
SD	46.99	Std. Error of Mean	4.699
Coefficient of Variation	0.452	Skewness	1.587

Normal GOF Test

Shapiro Wilk Test Statistic	0.833	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.146	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0889	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	111.8	95% Adjusted-CLT UCL (Chen-1995)	112.6
		95% Modified-t UCL (Johnson-1978)	112

Gamma GOF Test

A-D Test Statistic	2.021	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.114	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0895	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.204	k star (bias corrected MLE)	6.024
Theta hat (MLE)	16.77	Theta star (bias corrected MLE)	17.27
nu hat (MLE)	1241	nu star (bias corrected)	1205
MLE Mean (bias corrected)	104	MLE Sd (bias corrected)	42.38
		Approximate Chi Square Value (0.05)	1125
Adjusted Level of Significance	0.0476	Adjusted Chi Square Value	1124

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	111.4	95% Adjusted Gamma UCL (use when n<50)	111.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.0112	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0926	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0889	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.622	Mean of logged Data	4.562
Maximum of Logged Data	5.545	SD of logged Data	0.394

Assuming Lognormal Distribution

95% H-UCL	111.1	90% Chebyshev (MVUE) UCL	116.1
95% Chebyshev (MVUE) UCL	121.8	97.5% Chebyshev (MVUE) UCL	129.8
99% Chebyshev (MVUE) UCL	145.4		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	111.8	95% Jackknife UCL	111.8
95% Standard Bootstrap UCL	111.8	95% Bootstrap-t UCL	112.9
95% Hall's Bootstrap UCL	113	95% Percentile Bootstrap UCL	111.9
95% BCA Bootstrap UCL	112.2		
90% Chebyshev(Mean, Sd) UCL	118.1	95% Chebyshev(Mean, Sd) UCL	124.5
97.5% Chebyshev(Mean, Sd) UCL	133.4	99% Chebyshev(Mean, Sd) UCL	150.8

Suggested UCL to Use

95% Student's-t UCL	111.8	or 95% Modified-t UCL	112

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (reference)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	4.44	Mean	7.217
Maximum	13.5	Median	6.975
SD	1.81	Std. Error of Mean	0.286
Coefficient of Variation	0.251	Skewness	1.161

Normal GOF Test

Shapiro Wilk Test Statistic	0.93	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.101	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.139	Data appear Normal at 5% Significance Level	

Data appear Approximate Normal at 5% Significance Level

Appendix A-8b
UCL Evaluation - All Areas
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	7.699	95% Adjusted-CLT UCL (Chen-1995)	7.744
		95% Modified-t UCL (Johnson-1978)	7.708

Gamma GOF Test

A-D Test Statistic	0.294	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0784	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	17.79	k star (bias corrected MLE)	16.47
Theta hat (MLE)	0.406	Theta star (bias corrected MLE)	0.438
nu hat (MLE)	1423	nu star (bias corrected)	1318
MLE Mean (bias corrected)	7.217	MLE Sd (bias corrected)	1.778
		Approximate Chi Square Value (0.05)	1234
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	1231

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7.704	95% Adjusted Gamma UCL (use when n<50)	7.723

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0753	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.491	Mean of logged Data	1.948
Maximum of Logged Data	2.603	SD of logged Data	0.238

Assuming Lognormal Distribution

95% H-UCL	7.718	90% Chebyshev (MVUE) UCL	8.037
95% Chebyshev (MVUE) UCL	8.411	97.5% Chebyshev (MVUE) UCL	8.929
99% Chebyshev (MVUE) UCL	9.948		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	7.688	95% Jackknife UCL	7.699
95% Standard Bootstrap UCL	7.679	95% Bootstrap-t UCL	7.769
95% Hall's Bootstrap UCL	7.817	95% Percentile Bootstrap UCL	7.694
95% BCA Bootstrap UCL	7.734		
90% Chebyshev(Mean, Sd) UCL	8.075	95% Chebyshev(Mean, Sd) UCL	8.464
97.5% Chebyshev(Mean, Sd) UCL	9.004	99% Chebyshev(Mean, Sd) UCL	10.06

Suggested UCL to Use

95% Student's-t UCL	7.699

Appendix A-8b
UCL Evaluation - All Areas
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-8c
UCL Evaluation - Sample Areas
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.111/14/2017 4:20:15 PM
From File	2017-11-14 PEN_BI21 BERA_mummichog.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_Hg(ng/g) (bo-04)

General Statistics

Total Number of Observations	21	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	52.4	Mean	94.06
Maximum	234	Median	67.3
SD	55.56	Std. Error of Mean	12.12
Coefficient of Variation	0.591	Skewness	1.722

Normal GOF Test

Shapiro Wilk Test Statistic	0.701	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.908	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.294	Lilliefors GOF Test
5% Lilliefors Critical Value	0.188	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	115	95% Adjusted-CLT UCL (Chen-1995)	118.9
		95% Modified-t UCL (Johnson-1978)	115.7

Gamma GOF Test

A-D Test Statistic	2.03	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.27	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.19	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.277	k star (bias corrected MLE)	3.698
Theta hat (MLE)	21.99	Theta star (bias corrected MLE)	25.44
nu hat (MLE)	179.6	nu star (bias corrected)	155.3
MLE Mean (bias corrected)	94.06	MLE Sd (bias corrected)	48.91
		Approximate Chi Square Value (0.05)	127.5
Adjusted Level of Significance	0.0383	Adjusted Chi Square Value	125.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	114.6	95% Adjusted Gamma UCL (use when n<50)	116.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.806	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.908	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.245	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.188	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.959	Mean of logged Data	4.423
Maximum of Logged Data	5.455	SD of logged Data	0.466

Assuming Lognormal Distribution

95% H-UCL	113.9	90% Chebyshev (MVUE) UCL	121.5
95% Chebyshev (MVUE) UCL	134.7	97.5% Chebyshev (MVUE) UCL	153
99% Chebyshev (MVUE) UCL	188.9		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	114	95% Jackknife UCL	115
95% Standard Bootstrap UCL	114	95% Bootstrap-t UCL	125.9
95% Hall's Bootstrap UCL	113.2	95% Percentile Bootstrap UCL	115.2
95% BCA Bootstrap UCL	119.3		
90% Chebyshev(Mean, Sd) UCL	130.4	95% Chebyshev(Mean, Sd) UCL	146.9
97.5% Chebyshev(Mean, Sd) UCL	169.8	99% Chebyshev(Mean, Sd) UCL	214.7

Suggested UCL to Use

95% Student's-t UCL	115	or 95% Modified-t UCL	115.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (frb-ref)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	4.44	Mean	7.217
Maximum	13.5	Median	6.975
SD	1.81	Std. Error of Mean	0.286
Coefficient of Variation	0.251	Skewness	1.161

Normal GOF Test

Shapiro Wilk Test Statistic	0.93	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.101	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.139	Data appear Normal at 5% Significance Level	

Data appear Approximate Normal at 5% Significance Level

Appendix A-8c
UCL Evaluation - Sample Areas
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.699	95% Adjusted-CLT UCL (Chen-1995)	7.744
		95% Modified-t UCL (Johnson-1978)	7.708

Gamma GOF Test

A-D Test Statistic	0.294	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0784	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	17.79	k star (bias corrected MLE)	16.47
Theta hat (MLE)	0.406	Theta star (bias corrected MLE)	0.438
nu hat (MLE)	1423	nu star (bias corrected)	1318
MLE Mean (bias corrected)	7.217	MLE Sd (bias corrected)	1.778
		Approximate Chi Square Value (0.05)	1234
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	1231

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7.704	95% Adjusted Gamma UCL (use when n<50)	7.723

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0753	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.491	Mean of logged Data	1.948
Maximum of Logged Data	2.603	SD of logged Data	0.238

Assuming Lognormal Distribution

95% H-UCL	7.718	90% Chebyshev (MVUE) UCL	8.037
95% Chebyshev (MVUE) UCL	8.411	97.5% Chebyshev (MVUE) UCL	8.929
99% Chebyshev (MVUE) UCL	9.948		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	7.688	95% Jackknife UCL	7.699
95% Standard Bootstrap UCL	7.687	95% Bootstrap-t UCL	7.771
95% Hall's Bootstrap UCL	7.803	95% Percentile Bootstrap UCL	7.706
95% BCA Bootstrap UCL	7.745		
90% Chebyshev(Mean, Sd) UCL	8.075	95% Chebyshev(Mean, Sd) UCL	8.464
97.5% Chebyshev(Mean, Sd) UCL	9.004	99% Chebyshev(Mean, Sd) UCL	10.06

Suggested UCL to Use

95% Student's-t UCL	7.699

Appendix A-8c
UCL Evaluation - Sample Areas
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (mendal marsh)

General Statistics

Total Number of Observations	23	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	51.4	Mean	131.9
Maximum	256	Median	121
SD	52.2	Std. Error of Mean	10.88
Coefficient of Variation	0.396	Skewness	1.028

Normal GOF Test

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.147	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.18	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	150.6	95% Adjusted-CLT UCL (Chen-1995)	152.3
		95% Modified-t UCL (Johnson-1978)	151

Gamma GOF Test

A-D Test Statistic	0.3	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0997	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.182	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.2	k star (bias corrected MLE)	6.289
Theta hat (MLE)	18.32	Theta star (bias corrected MLE)	20.97
nu hat (MLE)	331.2	nu star (bias corrected)	289.3
MLE Mean (bias corrected)	131.9	MLE Sd (bias corrected)	52.59
		Approximate Chi Square Value (0.05)	250.9
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	248.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	152.1	95% Adjusted Gamma UCL (use when n<50)	153.7

Appendix A-8c
UCL Evaluation - Sample Areas
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.914	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0851	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.18	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.94	Mean of logged Data	4.811
Maximum of Logged Data	5.545	SD of logged Data	0.386

Assuming Lognormal Distribution

95% H-UCL	154.5	90% Chebyshev (MVUE) UCL	164.5
95% Chebyshev (MVUE) UCL	179.3	97.5% Chebyshev (MVUE) UCL	199.8
99% Chebyshev (MVUE) UCL	240.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	149.8	95% Jackknife UCL	150.6
95% Standard Bootstrap UCL	148.8	95% Bootstrap-t UCL	153.7
95% Hall's Bootstrap UCL	154.2	95% Percentile Bootstrap UCL	149.6
95% BCA Bootstrap UCL	150.3		
90% Chebyshev(Mean, Sd) UCL	164.5	95% Chebyshev(Mean, Sd) UCL	179.3
97.5% Chebyshev(Mean, Sd) UCL	199.9	99% Chebyshev(Mean, Sd) UCL	240.2

Suggested UCL to Use

95% Student's-t UCL 150.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (ob-01)

General Statistics

Total Number of Observations	16	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	37.4	Mean	120.3
Maximum	242	Median	109.5
SD	53.98	Std. Error of Mean	13.49
Coefficient of Variation	0.449	Skewness	1.273

Normal GOF Test

Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.212	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.213	Data appear Normal at 5% Significance Level	

Data appear Approximate Normal at 5% Significance Level

Appendix A-8c
UCL Evaluation - Sample Areas
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	143.9	95% Adjusted-CLT UCL (Chen-1995)	147.1
		95% Modified-t UCL (Johnson-1978)	144.7

Gamma GOF Test

A-D Test Statistic	0.559	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.156	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.216	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.769	k star (bias corrected MLE)	4.729
Theta hat (MLE)	20.85	Theta star (bias corrected MLE)	25.44
nu hat (MLE)	184.6	nu star (bias corrected)	151.3
MLE Mean (bias corrected)	120.3	MLE Sd (bias corrected)	55.31
		Approximate Chi Square Value (0.05)	123.9
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	121.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	146.9	95% Adjusted Gamma UCL (use when n<50)	150.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.925	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.17	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.622	Mean of logged Data	4.701
Maximum of Logged Data	5.489	SD of logged Data	0.442

Assuming Lognormal Distribution

95% H-UCL	152.4	90% Chebyshev (MVUE) UCL	161.5
95% Chebyshev (MVUE) UCL	180.1	97.5% Chebyshev (MVUE) UCL	205.9
99% Chebyshev (MVUE) UCL	256.5		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	142.5	95% Jackknife UCL	143.9
95% Standard Bootstrap UCL	141.8	95% Bootstrap-t UCL	153.5
95% Hall's Bootstrap UCL	195.8	95% Percentile Bootstrap UCL	142.5
95% BCA Bootstrap UCL	147		
90% Chebyshev(Mean, Sd) UCL	160.8	95% Chebyshev(Mean, Sd) UCL	179.1
97.5% Chebyshev(Mean, Sd) UCL	204.6	99% Chebyshev(Mean, Sd) UCL	254.6

Suggested UCL to Use

95% Student's-t UCL	143.9

Appendix A-8c
UCL Evaluation - Sample Areas
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (ob-05)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	48.9	Mean	86.74
Maximum	150	Median	81.05
SD	20.94	Std. Error of Mean	3.31
Coefficient of Variation	0.241	Skewness	0.955

Normal GOF Test

Shapiro Wilk Test Statistic	0.928	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.163	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	92.32	95% Adjusted-CLT UCL (Chen-1995)	92.72
		95% Modified-t UCL (Johnson-1978)	92.4

Gamma GOF Test

A-D Test Statistic	0.757	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.137	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	19.03	k star (bias corrected MLE)	17.62
Theta hat (MLE)	4.557	Theta star (bias corrected MLE)	4.922
nu hat (MLE)	1523	nu star (bias corrected)	1410
MLE Mean (bias corrected)	86.74	MLE Sd (bias corrected)	20.66
		Approximate Chi Square Value (0.05)	1324
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	1321

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	92.39	95% Adjusted Gamma UCL (use when n<50)	92.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.97	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.122	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Appendix A-8c
UCL Evaluation - Sample Areas
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.89	Mean of logged Data	4.436
Maximum of Logged Data	5.011	SD of logged Data	0.23

Assuming Lognormal Distribution

95% H-UCL	92.54	90% Chebyshev (MVUE) UCL	96.25
95% Chebyshev (MVUE) UCL	100.6	97.5% Chebyshev (MVUE) UCL	106.6
99% Chebyshev (MVUE) UCL	118.4		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	92.18	95% Jackknife UCL	92.32
95% Standard Bootstrap UCL	92.11	95% Bootstrap-t UCL	93.03
95% Hall's Bootstrap UCL	93.22	95% Percentile Bootstrap UCL	92.08
95% BCA Bootstrap UCL	92.72		
90% Chebyshev(Mean, Sd) UCL	96.67	95% Chebyshev(Mean, Sd) UCL	101.2
97.5% Chebyshev(Mean, Sd) UCL	107.4	99% Chebyshev(Mean, Sd) UCL	119.7

Suggested UCL to Use

95% Adjusted Gamma UCL	92.6

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-9a
UCL Evaluation - ProUCL Input
Nelson's sharp-tailed sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_GRP	ID	DATE	Mercury	D_Mercury	UOM
ADD-01	ADD-01_072116_NSS_01_BL	7/21/2016	740	1	NG/G
ADD-01	ADD-01_072116_NSS_02_BL	7/21/2016	566	1	NG/G
ADD-01	ADD-01_072216_NSS_03_BL	7/22/2016	317	1	NG/G
ADD-01	ADD-01_072216_NSS_04_BL	7/22/2016	558	1	NG/G
ADD-01	ADD-01_072216_NSS_05_BL	7/22/2016	382	1	NG/G
ADD-01	ADD-01_072516_NSS_06_BL	7/25/2016	290	1	NG/G
ADD-01	ADD-01_072516_NSS_07_BL	7/25/2016	637	1	NG/G
ADD-01	ADD-01_072616_NSS_08_BL	7/25/2016	434	1	NG/G
ADD-01	ADD-01_072616_NSS_09_BL	7/25/2016	296	1	NG/G
ADD-01	ADD-01_072616_NSS_10_BL	7/25/2016	467	1	NG/G
ADD-01	ADD-01_072616_NSS_11_BL	7/25/2016	469	1	NG/G
ADD-01	ADD-01_17MN001_062117_NSS_01_BL	6/21/2017	508	1	NG/G
ADD-01	ADD-01_17MN001_062117_NSS_02_BL	6/21/2017	520	1	NG/G
ADD-01	ADD-01_17MN001_062117_NSS_03_BL	6/21/2017	342	1	NG/G
ADD-01	ADD-01_17MN001_062217_NSS_09_BL	6/22/2017	343	1	NG/G
ADD-01	ADD-01_17MN002_062217_NSS_11_BL	6/22/2017	378	1	NG/G
ADD-01	ADD-01_17MN002_062217_NSS_12_BL	6/22/2017	373	1	NG/G
ADD-01	ADD-01_17MN003_062117_NSS_08_BL	6/21/2017	343	1	NG/G
ADD-01	ADD-01_17MN004_062117_NSS_06_BL	6/21/2017	375	1	NG/G
ADD-01	ADD-01_17MN006_062117_NSS_05_BL	6/21/2017	465	1	NG/G
ADD-01	ADD-01_17MN006_062117_NSS_07_BL	6/21/2017	339	1	NG/G
ADD-01	ADD-01_17MN007_062217_NSS_10_BL	6/22/2017	219	1	NG/G
ADD-01	ADD-01_17MN009_062117_NSS_04_BL	6/21/2017	280	1	NG/G
ADD-01	ADD-01_17MN011_062217_NSS_13_BL	6/22/2017	264	1	NG/G
ADD-01	ADD-01_17MN050_062717_NSS_14_BL	6/27/2017	460	1	NG/G
ADD-01	ADD-01_17MN051_062717_NSS_15_BL	6/27/2017	618	1	NG/G
MMSE	MMSE-1_072116_NSS_01_BL	7/21/2016	7450	1	NG/G
MMSE	MMSE-1_072116_NSS_02_BL	7/21/2016	5730	1	NG/G
MMSE	MMSE-1_072116_NSS_03_BL	7/21/2016	9240	1	NG/G
MMSE	MMSE-1_072116_NSS_04_BL	7/21/2016	4130	1	NG/G
MMSE	MMSE-1_072116_NSS_05_BL	7/21/2016	8450	1	NG/G
MMSE	MMSE-1_072116_NSS_06_BL	7/21/2016	4590	1	NG/G
MMSE	MMSE-1_072116_NSS_07_BL	7/21/2016	4330	1	NG/G
MMSE	MMSE-1_072116_NSS_08_BL	7/21/2016	5730	1	NG/G
MMSE	MMSE-1_072316_NSS_11_BL	7/23/2016	6220	1	NG/G
MMSE	MMSE-1_072316_NSS_12_BL	7/23/2016	4880	1	NG/G
MMSE	MMSE-1_072316_NSS_13_BL	7/23/2016	6130	1	NG/G
MMSE	MMSE-1_072316_NSS_15_BL	7/23/2016	6380	1	NG/G
MMSE	MMSE-1_072316_NSS_16_BL	7/23/2016	7520	1	NG/G
MMSE	MMSE-1_072516_NSS_17_BL	7/25/2016	8070	1	NG/G
MMSE	MMSE-1_072516_NSS_18_BL	7/25/2016	4020	1	NG/G
MMSE	MMSE-1_17MN001_062117_NSS_06_BL	6/21/2017	1620	1	NG/G
MMSE	MMSE-1_17MN002_062117_NSS_07_BL	6/21/2017	2070	1	NG/G
MMSE	MMSE-1_17MN002_062117_NSS_08_BL	6/21/2017	1570	1	NG/G
MMSE	MMSE-1_17MN003_062117_NSS_01_BL	6/21/2017	2350	1	NG/G
MMSE	MMSE-1_17MN007_062117_NSS_03_BL	6/21/2017	3110	1	NG/G

LOC_GRP	ID	DATE	Mercury	D_Mercury	UOM
MMSE	MMSE-1_17MN008_062217_NSS_15_BL	6/22/2017	2340	1	NG/G
MMSE	MMSE-1_17MN009_062117_NSS_02_BL	6/21/2017	2810	1	NG/G
MMSE	MMSE-1_17MN010_062117_NSS_04_BL	6/21/2017	2200	1	NG/G
MMSE	MMSE-1_17MN010_062117_NSS_05_BL	6/21/2017	2860	1	NG/G
MMSE	MMSE-1_17MN010_062117_NSS_09_BL	6/21/2017	1820	1	NG/G
MMSE	MMSE-1_17MN010_062117_NSS_10_BL	6/21/2017	1290	1	NG/G
MMSE	MMSE-1_17MN011_062217_NSS_12_BL	6/22/2017	1810	1	NG/G
MMSE	MMSE-1_17MN011_062217_NSS_14_BL	6/22/2017	3020	1	NG/G
MMSE	MMSE-1_17MN018_062217_NSS_13_BL	6/22/2017	2670	1	NG/G
MMSE	MMSE-1_17MN019_062217_NSS_11_BL	6/22/2017	1940	1	NG/G
MMSW	MMSW-C_071916_NSS_01_BL	7/19/2016	7790	1	NG/G
MMSW	MMSW-C_071916_NSS_02_BL	7/19/2016	4230	1	NG/G
MMSW	MMSW-C_071916_NSS_03_BL	7/19/2016	5910	1	NG/G
MMSW	MMSW-C_072016_NSS_04_BL	7/20/2016	6770	1	NG/G
MMSW	MMSW-C_072016_NSS_05_BL	7/20/2016	5240	1	NG/G
MMSW	MMSW-C_072016_NSS_06_BL	7/20/2016	6620	1	NG/G
MMSW	MMSW-C_072016_NSS_07_BL	7/20/2016	7630	1	NG/G
MMSW	MMSW-C_072316_NSS_08_BL	7/23/2016	5670	1	NG/G
MMSW	MMSW-C_072316_NSS_10_BL	7/23/2016	5840	1	NG/G
MMSW	MMSW-C_072416_NSS_09_BL	7/24/2016	3280	1	NG/G
MMSW	MMSW-C_072416_NSS_11_BL	7/24/2016	5310	1	NG/G
MMSW	MMSW-C_17MN006_061917_NSS_01_BL	6/19/2017	3460	1	NG/G
MMSW	MMSW-C_17MN006_061917_NSS_03_BL	6/19/2017	4200	1	NG/G
MMSW	MMSW-C_17MN008_061917_NSS_02_BL	6/19/2017	2990	1	NG/G
MMSW	MMSW-C_17MN009_061917_NSS_04_BL	6/19/2017	4190	1	NG/G
MMSW	MMSW-C_17MN009_061917_NSS_05_BL	6/19/2017	1410	1	NG/G
MMSW	MMSW-C_17MN010_062017_NSS_09_BL	6/20/2017	2400	1	NG/G
MMSW	MMSW-C_17MN015_062017_NSS_06_BL	6/20/2017	2150	1	NG/G
MMSW	MMSW-C_17MN015_062017_NSS_08_BL	6/20/2017	2300	1	NG/G
MMSW	MMSW-C_17MN016_062017_NSS_07_BL	6/20/2017	2190	1	NG/G
MMSW	MMSW-C_17MN021_062317_NSS_10_BL	6/23/2017	2140	1	NG/G
MMSW	MMSW-C_17MN026_062317_NSS_12_BL	6/23/2017	5010	1	NG/G
MMSW	MMSW-C_17MN027_062317_NSS_11_BL	6/23/2017	1890	1	NG/G
MMSW	MMSW-C_17MN027_062317_NSS_13_BL	6/23/2017	3280	1	NG/G
MMSW	MMSW-C_17MN027_062517_NSS_14_BL	6/25/2017	4410	1	NG/G
MMSW	MMSW-C_17MN027_062517_NSS_15_BL	6/25/2017	3740	1	NG/G
W-17-N	W17-N_071916_NSS_01_BL	7/19/2016	7570	1	NG/G
W-17-N	W17-N_071916_NSS_02_BL	7/19/2016	6020	1	NG/G
W-17-N	W17-N_071916_NSS_03_BL	7/19/2016	9590	1	NG/G
W-17-N	W17-N_071916_NSS_04_BL	7/19/2016	734	1	NG/G
W-17-N	W17-N_071916_NSS_05_BL	7/19/2016	10300	1	NG/G
W-17-N	W17-N_071916_NSS_08_BL	7/19/2016	3990	1	NG/G
W-17-N	W17-N_071916_NSS_11_BL	7/19/2016	6680	1	NG/G
W-17-N	W17-N_072016_NSS_06_BL	7/20/2016	2140	1	NG/G
W-17-N	W17-N_072016_NSS_07_BL	7/20/2016	1630	1	NG/G
W-17-N	W17-N_072016_NSS_09_BL	7/20/2016	1560	1	NG/G

Appendix A-9a
UCL Evaluation - ProUCL Input
Nelson's sharp-tailed sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_GRP	ID	DATE	Mercury	D_Mercury	UOM
W-17-N	W17-N_072016_NSS_14_BL	7/20/2016	1960	1	NG/G
W-17-N	W17-N_072416_NSS_12_BL	7/24/2016	5350	1	NG/G
W-17-N	W17-N_072516_NSS_10_BL	7/25/2016	5240	1	NG/G
W-17-N	W17-N_072516_NSS_15_BL	7/25/2016	5000	1	NG/G
W-17-N	W17-N_072516_NSS_16_BL	7/25/2016	2920	1	NG/G
W-17-N	W17-N_17MN001_061917_NSS_01_BL	6/19/2017	1820	1	NG/G
W-17-N	W17-N_17MN001_062017_NSS_04_BL	6/20/2017	3630	1	NG/G
W-17-N	W17-N_17MN002_062017_NSS_05_BL	6/20/2017	1410	1	NG/G
W-17-N	W17-N_17MN007_062017_NSS_03_BL	6/20/2017	2630	1	NG/G
W-17-N	W17-N_17MN007_062017_NSS_06_BL	6/20/2017	2020	1	NG/G
W-17-N	W17-N_17MN008_061917_NSS_02_BL	6/19/2017	1690	1	NG/G
W-17-N	W17-N_17MN010_062017_NSS_07_BL	6/20/2017	2360	1	NG/G
W-17-N	W17-N_17MN037_062517_NSS_08_BL	6/25/2017	3300	1	NG/G
W-17-N	W17-N_17MN037_062517_NSS_09_BL	6/25/2017	2350	1	NG/G
W-17-N	W17-N_17MN041_062517_NSS_10_BL	6/25/2017	3060	1	NG/G
W-17-N	W17-N_17MN058_062617_NSS_11_BL	6/26/2017	2570	1	NG/G
W-17-N	W17-N_17MN063_062917_NSS_12_BL	6/29/2017	6010	1	NG/G

Appendix A-9b
UCL Evaluation - Sample Area
Nelson's sharp-tailed sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.19/18/2017 4:05:56 PM
From File	AFW_NSP_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (ng/g) (add-01)

General Statistics

Total Number of Observations	26	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	219	Mean	422.4
Maximum	740	Median	380
SD	128.7	Std. Error of Mean	25.24
Coefficient of Variation	0.305	Skewness	0.679

Normal GOF Test

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.92	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.17	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	465.5	95% Adjusted-CLT UCL (Chen-1995)	467.5
		95% Modified-t UCL (Johnson-1978)	466.1

Gamma GOF Test

A-D Test Statistic	0.259	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.133	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.171	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.65	k star (bias corrected MLE)	10.33
Theta hat (MLE)	36.26	Theta star (bias corrected MLE)	40.88
nu hat (MLE)	605.9	nu star (bias corrected)	537.3
MLE Mean (bias corrected)	422.4	MLE Sd (bias corrected)	131.4
		Approximate Chi Square Value (0.05)	484.5
Adjusted Level of Significance	0.0398	Adjusted Chi Square Value	481.2

Appendix A-9b
UCL Evaluation - Sample Area
Nelson's sharp-tailed sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	468.4	95% Adjusted Gamma UCL (use when n<50)	471.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.985	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.17	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.389	Mean of logged Data	6.002
Maximum of Logged Data	6.607	SD of logged Data	0.301

Assuming Lognormal Distribution

95% H-UCL	472	90% Chebyshev (MVUE) UCL	498.3
95% Chebyshev (MVUE) UCL	532.7	97.5% Chebyshev (MVUE) UCL	580.4
99% Chebyshev (MVUE) UCL	674.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	463.9	95% Jackknife UCL	465.5
95% Standard Bootstrap UCL	462.9	95% Bootstrap-t UCL	469.6
95% Hall's Bootstrap UCL	467.4	95% Percentile Bootstrap UCL	464
95% BCA Bootstrap UCL	467.2		
90% Chebyshev(Mean, Sd) UCL	498.2	95% Chebyshev(Mean, Sd) UCL	532.5
97.5% Chebyshev(Mean, Sd) UCL	580.1	99% Chebyshev(Mean, Sd) UCL	673.6

Suggested UCL to Use

95% Student's-t UCL	465.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (ng/g) (mmse)

Appendix A-9b
UCL Evaluation - Sample Area
Nelson's sharp-tailed sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	30	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	1290	Mean	4212
Maximum	9240	Median	3565
SD	2353	Std. Error of Mean	429.5
Coefficient of Variation	0.559	Skewness	0.626

Normal GOF Test

Shapiro Wilk Test Statistic	0.906	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.927	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.18	Lilliefors GOF Test
5% Lilliefors Critical Value	0.159	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4942	95% Adjusted-CLT UCL (Chen-1995)	4971
		95% Modified-t UCL (Johnson-1978)	4950

Gamma GOF Test

A-D Test Statistic	0.597	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.133	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.161	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.332	k star (bias corrected MLE)	3.021
Theta hat (MLE)	1264	Theta star (bias corrected MLE)	1394
nu hat (MLE)	199.9	nu star (bias corrected)	181.3
MLE Mean (bias corrected)	4212	MLE Sd (bias corrected)	2423
		Approximate Chi Square Value (0.05)	151.1
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	149.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	5052	95% Adjusted Gamma UCL (use when n<50)	5105

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.946	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.927	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.122	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.159	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Appendix A-9b
UCL Evaluation - Sample Area
Nelson's sharp-tailed sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	7.162	Mean of logged Data	8.188
Maximum of Logged Data	9.131	SD of logged Data	0.58

Assuming Lognormal Distribution

95% H-UCL	5294	90% Chebyshev (MVUE) UCL	5654
95% Chebyshev (MVUE) UCL	6298	97.5% Chebyshev (MVUE) UCL	7193
99% Chebyshev (MVUE) UCL	8951		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4918	95% Jackknife UCL	4942
95% Standard Bootstrap UCL	4886	95% Bootstrap-t UCL	4984
95% Hall's Bootstrap UCL	4954	95% Percentile Bootstrap UCL	4912
95% BCA Bootstrap UCL	4976		
90% Chebyshev(Mean, Sd) UCL	5500	95% Chebyshev(Mean, Sd) UCL	6084
97.5% Chebyshev(Mean, Sd) UCL	6894	99% Chebyshev(Mean, Sd) UCL	8486

Suggested UCL to Use

95% Adjusted Gamma UCL	5105

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (ng/g) (mmsw)

General Statistics

Total Number of Observations	26	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	1410	Mean	4233
Maximum	7790	Median	4195
SD	1836	Std. Error of Mean	360
Coefficient of Variation	0.434	Skewness	0.344

Normal GOF Test

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.92	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.11	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.17	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Appendix A-9b
UCL Evaluation - Sample Area
Nelson's sharp-tailed sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4848	95% Adjusted-CLT UCL (Chen-1995)	4851
		95% Modified-t UCL (Johnson-1978)	4852

Gamma GOF Test

A-D Test Statistic	0.321	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.117	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.172	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.183	k star (bias corrected MLE)	4.611
Theta hat (MLE)	816.6	Theta star (bias corrected MLE)	918
nu hat (MLE)	269.5	nu star (bias corrected)	239.8
MLE Mean (bias corrected)	4233	MLE Sd (bias corrected)	1971
		Approximate Chi Square Value (0.05)	204.9
Adjusted Level of Significance	0.0398	Adjusted Chi Square Value	202.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4952	95% Adjusted Gamma UCL (use when n<50)	5004

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.17	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.251	Mean of logged Data	8.251
Maximum of Logged Data	8.961	SD of logged Data	0.47

Assuming Lognormal Distribution

95% H-UCL	5136	90% Chebyshev (MVUE) UCL	5482
95% Chebyshev (MVUE) UCL	6035	97.5% Chebyshev (MVUE) UCL	6804
99% Chebyshev (MVUE) UCL	8313		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-9b
UCL Evaluation - Sample Area
Nelson's sharp-tailed sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	4825	95% Jackknife UCL	4848
95% Standard Bootstrap UCL	4819	95% Bootstrap-t UCL	4888
95% Hall's Bootstrap UCL	4861	95% Percentile Bootstrap UCL	4786
95% BCA Bootstrap UCL	4802		
90% Chebyshev(Mean, Sd) UCL	5313	95% Chebyshev(Mean, Sd) UCL	5802
97.5% Chebyshev(Mean, Sd) UCL	6481	99% Chebyshev(Mean, Sd) UCL	7815

Suggested UCL to Use

95% Student's-t UCL 4848

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (ng/g) (w-17-n)

General Statistics

Total Number of Observations	27	Number of Distinct Observations	27
		Number of Missing Observations	0
Minimum	734	Mean	3835
Maximum	10300	Median	2920
SD	2521	Std. Error of Mean	485.1
Coefficient of Variation	0.657	Skewness	1.17

Normal GOF Test

Shapiro Wilk Test Statistic	0.874	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.177	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.167	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4662	95% Adjusted-CLT UCL (Chen-1995)	4749
		95% Modified-t UCL (Johnson-1978)	4680

Gamma GOF Test

A-D Test Statistic	0.476	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.126	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.17	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-9b
UCL Evaluation - Sample Area
Nelson's sharp-tailed sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	2.686	k star (bias corrected MLE)	2.413
Theta hat (MLE)	1427	Theta star (bias corrected MLE)	1589
nu hat (MLE)	145.1	nu star (bias corrected)	130.3
MLE Mean (bias corrected)	3835	MLE Sd (bias corrected)	2469
		Approximate Chi Square Value (0.05)	104.9
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	103.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	4762	95% Adjusted Gamma UCL (use when n<50)	4829

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0965	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.167	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.599	Mean of logged Data	8.054
Maximum of Logged Data	9.24	SD of logged Data	0.646

Assuming Lognormal Distribution

95% H-UCL	5064	90% Chebyshev (MVUE) UCL	5373
95% Chebyshev (MVUE) UCL	6066	97.5% Chebyshev (MVUE) UCL	7028
99% Chebyshev (MVUE) UCL	8918		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4633	95% Jackknife UCL	4662
95% Standard Bootstrap UCL	4623	95% Bootstrap-t UCL	4793
95% Hall's Bootstrap UCL	4722	95% Percentile Bootstrap UCL	4639
95% BCA Bootstrap UCL	4703		
90% Chebyshev(Mean, Sd) UCL	5290	95% Chebyshev(Mean, Sd) UCL	5949
97.5% Chebyshev(Mean, Sd) UCL	6864	99% Chebyshev(Mean, Sd) UCL	8661

Suggested UCL to Use

95% Adjusted Gamma UCL	4829

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-10a
UCL Evaluation - ProUCL Input
Red-winged blackbird

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	ID	DATE	MEDIA	Mercury	UOM
MMSE	MMSE-1_17MN004_062117_RWB_01_BL	6/21/2017	BL	1090	NG/G
MMSE	MMSE-1_17MN044_062717_RWB_02_BL	6/27/2017	BL	6260	NG/G
MMSE	MMSE-1_17MN045_062717_RWB_03_BL	6/27/2017	BL	6170	NG/G
MMSE	MMSE-1_17MN047_062717_RWB_05_BL	6/27/2017	BL	1150	NG/G
MMSE	MMSE-1_17MN064_062817_RWB_06_BL	6/28/2017	BL	7210	NG/G
MMSE	MMSE-1_17MN075_062717_RWB_04_BL	6/27/2017	BL	2680	NG/G
MMSW	MMSW-C_17MN009_061917_RWB_01_BL	6/19/2017	BL	5740	NG/G
MMSW	MMSW-C_17MN020_062317_RWB_03_BL	6/23/2017	BL	8460	NG/G
MMSW	MMSW-C_17MN020_062317_RWB_04_BL	6/23/2017	BL	1030	NG/G
MMSW	MMSW-C_17MN022_062317_RWB_02_BL	6/23/2017	BL	6020	NG/G
MMSW	MMSW-C_17MN036_062517_RWB_05_BL	6/25/2017	BL	5020	NG/G
MMSW	MMSW-C_17MN036_062617_RWB_06_BL	6/26/2017	BL	6720	NG/G
W-17-N	W17-N_071916_RWB_01_BL	7/19/2016	BL	5850	NG/G
W-17-N	W17-N_072016_RWB_02_BL	7/20/2016	BL	99.4	NG/G
W-17-N	W17-N_072016_RWB_03_BL	7/20/2016	BL	2500	NG/G
W-17-N	W17-N_17MN002_061917_RWB_01_BL	6/19/2017	BL	165	NG/G
W-17-N	W17-N_17MN005_061917_RWB_02_BL	6/19/2017	BL	2450	NG/G
W-17-N	W17-N_17MN006_061917_RWB_03_BL	6/19/2017	BL	1800	NG/G
W-17-N	W17-N_17MN006_061917_RWB_04_BL	6/19/2017	BL	4940	NG/G
W-17-N	W17-N_17MN039_062517_RWB_05_BL	6/25/2017	BL	4440	NG/G

Appendix A-10b
UCL Evaluation - Sample Area
Red-winged blackbird

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.19/18/2017 1:32:32 PM
From File	AFW_RWB.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (ng/g) (mmse)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	1090	Mean	4093
Maximum	7210	Median	4425
SD	2771	Std. Error of Mean	1131
Coefficient of Variation	0.677	Skewness	-0.0847

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.839	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.273	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6373	95% Adjusted-CLT UCL (Chen-1995)	5912
		95% Modified-t UCL (Johnson-1978)	6367

Gamma GOF Test

A-D Test Statistic	0.579	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.704	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.303	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.336	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-10b
UCL Evaluation - Sample Area
Red-winged blackbird

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	2.008	k star (bias corrected MLE)	1.115
Theta hat (MLE)	2038	Theta star (bias corrected MLE)	3670
nu hat (MLE)	24.1	nu star (bias corrected)	13.38
MLE Mean (bias corrected)	4093	MLE Sd (bias corrected)	3876
		Approximate Chi Square Value (0.05)	6.151
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	4.501

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	8906	95% Adjusted Gamma UCL (use when n<50)	12171

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.823	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.283	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.994	Mean of logged Data	8.048
Maximum of Logged Data	8.883	SD of logged Data	0.869

Assuming Lognormal Distribution

95% H-UCL	19072	90% Chebyshev (MVUE) UCL	8684
95% Chebyshev (MVUE) UCL	10702	97.5% Chebyshev (MVUE) UCL	13503
99% Chebyshev (MVUE) UCL	19004		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5954	95% Jackknife UCL	6373
95% Standard Bootstrap UCL	5784	95% Bootstrap-t UCL	6372
95% Hall's Bootstrap UCL	5289	95% Percentile Bootstrap UCL	5777
95% BCA Bootstrap UCL	5715		
90% Chebyshev(Mean, Sd) UCL	7488	95% Chebyshev(Mean, Sd) UCL	9025
97.5% Chebyshev(Mean, Sd) UCL	11159	99% Chebyshev(Mean, Sd) UCL	15351

Suggested UCL to Use

95% Student's-t UCL	6373

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-10b
UCL Evaluation - Sample Area
Red-winged blackbird

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Mercury (ng/g) (mmsw)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	1030	Mean	5498
Maximum	8460	Median	5880
SD	2482	Std. Error of Mean	1013
Coefficient of Variation	0.451	Skewness	-1.205

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.905	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.257	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7540	95% Adjusted-CLT UCL (Chen-1995)	6632
		95% Modified-t UCL (Johnson-1978)	7457

Gamma GOF Test

A-D Test Statistic	0.751	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.701	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.346	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.334	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.155	k star (bias corrected MLE)	1.688
Theta hat (MLE)	1743	Theta star (bias corrected MLE)	3256
nu hat (MLE)	37.86	nu star (bias corrected)	20.26
MLE Mean (bias corrected)	5498	MLE Sd (bias corrected)	4231
		Approximate Chi Square Value (0.05)	11.04
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	8.695

Appendix A-10b
UCL Evaluation - Sample Area
Red-winged blackbird

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	10087	95% Adjusted Gamma UCL (use when n<50)	12812

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.72	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.373	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.937	Mean of logged Data	8.445
Maximum of Logged Data	9.043	SD of logged Data	0.759

Assuming Lognormal Distribution

95% H-UCL	19364	90% Chebyshev (MVUE) UCL	11298
95% Chebyshev (MVUE) UCL	13755	97.5% Chebyshev (MVUE) UCL	17166
99% Chebyshev (MVUE) UCL	23867		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	7165	95% Jackknife UCL	7540
95% Standard Bootstrap UCL	7055	95% Bootstrap-t UCL	6949
95% Hall's Bootstrap UCL	6798	95% Percentile Bootstrap UCL	6900
95% BCA Bootstrap UCL	6730		
90% Chebyshev(Mean, Sd) UCL	8538	95% Chebyshev(Mean, Sd) UCL	9914
97.5% Chebyshev(Mean, Sd) UCL	11825	99% Chebyshev(Mean, Sd) UCL	15578

Suggested UCL to Use

95% Student's-t UCL 7540

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Mercury (ng/g) (w-17-n)

Appendix A-10b
UCL Evaluation - Sample Area
Red-winged blackbird

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	99.4	Mean	2781
Maximum	5850	Median	2475
SD	2139	Std. Error of Mean	756.1
Coefficient of Variation	0.769	Skewness	0.105

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.177	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4213	95% Adjusted-CLT UCL (Chen-1995)	4054
		95% Modified-t UCL (Johnson-1978)	4218

Gamma GOF Test

A-D Test Statistic	0.595	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.738	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.238	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.302	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.925	k star (bias corrected MLE)	0.662
Theta hat (MLE)	3005	Theta star (bias corrected MLE)	4202
nu hat (MLE)	14.81	nu star (bias corrected)	10.59
MLE Mean (bias corrected)	2781	MLE Sd (bias corrected)	3418
		Approximate Chi Square Value (0.05)	4.312
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	3.358

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6827	95% Adjusted Gamma UCL (use when n<50)	8766

Appendix A-10b
UCL Evaluation - Sample Area
Red-winged blackbird

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.795	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.299	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.283	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.599	Mean of logged Data	7.301
Maximum of Logged Data	8.674	SD of logged Data	1.569

Assuming Lognormal Distribution

95% H-UCL	94178	90% Chebyshev (MVUE) UCL	10455
95% Chebyshev (MVUE) UCL	13415	97.5% Chebyshev (MVUE) UCL	17523
99% Chebyshev (MVUE) UCL	25592		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4024	95% Jackknife UCL	4213
95% Standard Bootstrap UCL	3957	95% Bootstrap-t UCL	4324
95% Hall's Bootstrap UCL	3943	95% Percentile Bootstrap UCL	3930
95% BCA Bootstrap UCL	3918		
90% Chebyshev(Mean, Sd) UCL	5049	95% Chebyshev(Mean, Sd) UCL	6076
97.5% Chebyshev(Mean, Sd) UCL	7503	99% Chebyshev(Mean, Sd) UCL	10304

Suggested UCL to Use

95% Student's-t UCL 4213

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-11a
UCL Evaluation - ProUCL Input
American black duck (blood)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	ID	DATE	MEDIA	Mercury	UOM
ES-13	1827-850-18_012914_ABD_BL	1/29/2014	BL	81.37	NG/G
ES-13	1827-859-67_012914_ABD_BL	1/29/2014	BL	78.21	NG/G
ES-13	1837-563-07_012914_ABD_BL	1/29/2014	BL	70.73	NG/G
ES-13	1917-293-23_021214_ABD_BL	2/12/2014	BL	86.7	NG/G
ES-13	2047-309-20_012814_ABD_BL	1/28/2014	BL	97.31	NG/G
ES-13	2047-309-21_012814_ABD_BL	1/28/2014	BL	97.37	NG/G
ES-13	2047-309-22_012814_ABD_BL	1/28/2014	BL	134.51	NG/G
ES-13	2047-309-23_012814_ABD_BL	1/28/2014	BL	152.82	NG/G
ES-13	2047-309-24_012814_ABD_BL	1/28/2014	BL	70.81	NG/G
ES-13	2047-309-25_012814_ABD_BL	1/28/2014	BL	117.47	NG/G
ES-13	2047-309-26_012814_ABD_BL	1/28/2014	BL	88.7	NG/G
ES-13	2047-309-27_012914_ABD_BL	1/29/2014	BL	96.17	NG/G
ES-13	2047-309-28_012914_ABD_BL	1/29/2014	BL	125.3	NG/G
ES-13	2047-309-29_012914_ABD_BL	1/29/2014	BL	61.14	NG/G
ES-13	2047-309-30_012914_ABD_BL	1/29/2014	BL	112.2	NG/G
ES-13	2047-309-31_012914_ABD_BL	1/29/2014	BL	154.64	NG/G
ES-13	2047-309-32_012914_ABD_BL	1/29/2014	BL	149.55	NG/G
ES-13	2047-309-33_013014_ABD_BL	1/30/2014	BL	60.72	NG/G
ES-13	2047-309-34_013014_ABD_BL	1/30/2014	BL	117.66	NG/G
ES-13	2047-309-35_021214_ABD_BL	2/12/2014	BL	85.33	NG/G
ES-13	2047-309-36_021214_ABD_BL	2/12/2014	BL	126.01	NG/G
ES-13	ES-13_020517_ABD_05_BL	2/5/2017	BL	403	NG/G
ES-13	ES-13_012417_ABD_01_BL	1/24/2017	BL	331	NG/G
ES-13	ES-13_012417_ABD_02_BL	1/24/2017	BL	310	NG/G
ES-13	ES-13_012817_ABD_03_BL	1/28/2017	BL	487	NG/G
ES-13	ES-13_012817_ABD_04_BL	1/28/2017	BL	700	NG/G
ES-13	ES-13_020517_ABD_06_BL	2/5/2017	BL	396	NG/G
ES-13	ES-13_020517_ABD_07_BL	2/5/2017	BL	126	NG/G
ES-13	ES-13_020517_ABD_08_BL	2/5/2017	BL	319	NG/G
ES-13	ES-13_020517_ABD_09_BL	2/5/2017	BL	209	NG/G
ES-13	ES-13_020517_ABD_10_BL	2/5/2017	BL	362	NG/G
ES-13	ES-13_020517_ABD_11_BL	2/5/2017	BL	377	NG/G
ES-13	ES-13_020517_ABD_12_BL	2/5/2017	BL	596	NG/G
ES-13	ES-13_020517_ABD_13_BL	2/5/2017	BL	472	NG/G
ES-13	ES-13_020517_ABD_14_BL	2/5/2017	BL	198	NG/G
ES-13	ES-13_020517_ABD_15_BL	2/5/2017	BL	408	NG/G
ES-13	ES-13_18WT001_013118_ABD_13_BL	1/31/2018	BL	113	NG/G
ES-13	ES-13_18WT001_013118_ABD_14_BL	1/31/2018	BL	206	NG/G
ES-13	ES-13_18WT001_013118_ABD_15_BL	1/31/2018	BL	459	NG/G
ES-13	ES-13_18WT001_013018_ABD_08_BL	1/30/2018	BL	159	NG/G
ES-13	ES-13_18WT001_013018_ABD_09_BL	1/30/2018	BL	165	NG/G
ES-13	ES-13_18WT001_013018_ABD_10_BL	1/30/2018	BL	119	NG/G
ES-13	ES-13_18WT001_013018_ABD_11_BL	1/30/2018	BL	109	NG/G
ES-13	ES-13_18WT001_013018_ABD_12_BL	1/30/2018	BL	173	NG/G
ES-13	ES-13_18WT001_012918_ABD_01_BL	1/29/2018	BL	200	NG/G
ES-13	ES-13_18WT001_012918_ABD_02_BL	1/29/2018	BL	296	NG/G

Appendix A-11a
UCL Evaluation - ProUCL Input
American black duck (blood)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	ID	DATE	MEDIA	Mercury	UOM
ES-13	ES-13_18WT001_012918_ABD_03_BL	1/29/2018	BL	97.1	NG/G
ES-13	ES-13_18WT001_012918_ABD_04_BL	1/29/2018	BL	241	NG/G
ES-13	ES-13_18WT001_012918_ABD_05_BL	1/29/2018	BL	50.6	NG/G
ES-13	ES-13_18WT001_012918_ABD_06_BL	1/29/2018	BL	229	NG/G
ES-13	ES-13_18WT001_012918_ABD_07_BL	1/29/2018	BL	80.3	NG/G
Mendall Marsh	MMBKD-01_012217_ABD_01_BL	1/22/2017	BL	264	NG/G
Mendall Marsh	MMBKD-01_012217_ABD_02_BL	1/22/2017	BL	157	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_03_BL	1/24/2017	BL	1400	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_04_BL	1/24/2017	BL	379	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_05_BL	1/24/2017	BL	284	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_06_BL	1/24/2017	BL	961	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_07_BL	1/24/2017	BL	558	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_08_BL	1/24/2017	BL	504	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_09_BL	1/24/2017	BL	242	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_10_BL	1/24/2017	BL	409	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_11_BL	1/24/2017	BL	533	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_12_BL	1/24/2017	BL	701	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_13_BL	1/24/2017	BL	330	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_14_BL	1/24/2017	BL	589	NG/G
Mendall Marsh	MMBKD-01_012417_ABD_15_BL	1/24/2017	BL	628	NG/G
Mendall Marsh	1827-847-95_021314_ABD_BL	2/13/2014	BL	236.29	NG/G
Mendall Marsh	2047-309-52_021214_ABD_BL	2/12/2014	BL	105.83	NG/G
Mendall Marsh	2047-309-53_021314_ABD_BL	2/13/2014	BL	240.7	NG/G
Mendall Marsh	2047-309-54_021314_ABD_BL	2/13/2014	BL	498.45	NG/G
Mendall Marsh	2047-309-55_021314_ABD_BL	2/13/2014	BL	243.51	NG/G
Mendall Marsh	2047-309-56_021314_ABD_BL	2/13/2014	BL	746.12	NG/G
Mendall Marsh	2047-309-57_021314_ABD_BL	2/13/2014	BL	334.21	NG/G
Mendall Marsh	2047-309-58_021314_ABD_BL	2/13/2014	BL	104.51	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_02_BL	1/30/2018	BL	238	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_03_BL	1/30/2018	BL	427	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_04_BL	1/30/2018	BL	238	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_05_BL	1/30/2018	BL	386	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_06_BL	1/30/2018	BL	359	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_07_BL	1/30/2018	BL	295	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_08_BL	1/30/2018	BL	187	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_09_BL	1/30/2018	BL	324	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_10_BL	1/30/2018	BL	309	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_11_BL	1/30/2018	BL	227	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_12_BL	1/30/2018	BL	245	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_13_BL	1/30/2018	BL	209	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_14_BL	1/30/2018	BL	206	NG/G
Mendall Marsh	MMBKD-01_18WT001_013018_ABD_15_BL	1/30/2018	BL	275	NG/G
Mendall Marsh	MMBKD-01_18WT001_012918_ABD_01_BL	1/29/2018	BL	459	NG/G
FRB	FRB-01_012417_ABD_01_BL	1/24/2017	BL	43.5	NG/G
FRB	FRB-01_012417_ABD_02_BL	1/24/2017	BL	35.5	NG/G
FRB	FRB-01_012417_ABD_03_BL	1/24/2017	BL	31.2	NG/G

Appendix A-11a
UCL Evaluation - ProUCL Input
American black duck (blood)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	ID	DATE	MEDIA	Mercury	UOM
FRB	FRB-01_012417_ABD_04_BL	1/24/2017	BL	109	NG/G
FRB	FRB-01_012417_ABD_05_BL	1/24/2017	BL	70.6	NG/G
FRB	FRB-01_012417_ABD_06_BL	1/24/2017	BL	11.3	NG/G
FRB	FRB-01_012417_ABD_07_BL	1/24/2017	BL	53.8	NG/G
FRB	FRB-01_012417_ABD_08_BL	1/24/2017	BL	53.1	NG/G
FRB	FRB-01_012417_ABD_09_BL	1/24/2017	BL	43.3	NG/G
FRB	FRB-01_012417_ABD_10_BL	1/24/2017	BL	69	NG/G
FRB	FRB-01_020217_ABD_11_BL	2/2/2017	BL	83.9	NG/G
FRB	FRB-01_020217_ABD_12_BL	2/2/2017	BL	41.5	NG/G
FRB	FRB-01_020217_ABD_13_BL	2/2/2017	BL	31.5	NG/G
FRB	FRB-01_020217_ABD_14_BL	2/2/2017	BL	89.3	NG/G
FRB	FRB-01_020217_ABD_15_BL	2/2/2017	BL	32.6	NG/G
FRB	1917-294-05_021214_ABD_BL	2/12/2014	BL	54.76	NG/G
FRB	1917-294-12_021214_ABD_BL	2/12/2014	BL	31.17	NG/G
FRB	1917-294-14_021214_ABD_BL	2/12/2014	BL	32.04	NG/G
FRB	2047-308-73_012714_ABD_BL	1/27/2014	BL	123.73	NG/G
FRB	2047-308-74_012714_ABD_BL	1/27/2014	BL	202.9	NG/G
FRB	2047-308-75_012714_ABD_BL	1/27/2014	BL	15.91	NG/G
FRB	2047-308-78_012714_ABD_BL	1/27/2014	BL	370.26	NG/G
FRB	2047-308-81_012714_ABD_BL	1/27/2014	BL	51.09	NG/G
FRB	2047-308-83_012714_ABD_BL	1/27/2014	BL	51.8	NG/G
FRB	2047-308-87_012714_ABD_BL	1/27/2014	BL	75.57	NG/G
FRB	2047-309-09_012814_ABD_BL	1/28/2014	BL	90.56	NG/G
FRB	2047-309-10_012814_ABD_BL	1/28/2014	BL	67.21	NG/G
FRB	2047-309-11_012814_ABD_BL	1/28/2014	BL	40.79	NG/G
FRB	2047-309-12_012814_ABD_BL	1/28/2014	BL	84.17	NG/G
FRB	2047-309-13_012814_ABD_BL	1/28/2014	BL	40.47	NG/G
FRB	2047-309-14_012814_ABD_BL	1/28/2014	BL	57.62	NG/G
FRB	2047-309-15_012814_ABD_BL	1/28/2014	BL	44.76	NG/G
FRB	2047-309-16_012814_ABD_BL	1/28/2014	BL	88.71	NG/G
FRB	2047-309-17_012814_ABD_BL	1/28/2014	BL	100.57	NG/G
FRB	2047-309-18_012814_ABD_BL	1/28/2014	BL	96.78	NG/G
FRB	2047-309-19_012814_ABD_BL	1/28/2014	BL	62.65	NG/G
FRB	ABDU-012714_ABD_BL	1/27/2014	BL	69.4	NG/G
FRB	FRB-01_18WT001_013118_ABD_13_BL	1/31/2018	BL	33.9	NG/G
FRB	FRB-01_18WT001_013118_ABD_14_BL	1/31/2018	BL	62.7	NG/G
FRB	FRB-01_18WT001_013118_ABD_15_BL	1/31/2018	BL	54.6	NG/G
FRB	FRB-01_18WT001_013018_ABD_01_BL	1/30/2018	BL	56.5	NG/G
FRB	FRB-01_18WT001_013018_ABD_02_BL	1/30/2018	BL	55.8	NG/G
FRB	FRB-01_18WT001_013018_ABD_03_BL	1/30/2018	BL	63.9	NG/G
FRB	FRB-01_18WT001_013018_ABD_04_BL	1/30/2018	BL	22.9	NG/G
FRB	FRB-01_18WT001_013018_ABD_05_BL	1/30/2018	BL	21.3	NG/G
FRB	FRB-OCN_18WT001_013018_ABD_06_BL	1/30/2018	BL	52	NG/G
FRB	FRB-OCN_18WT001_013018_ABD_07_BL	1/30/2018	BL	86.1	NG/G
FRB	FRB-OCN_18WT001_013018_ABD_08_BL	1/30/2018	BL	70.3	NG/G
FRB	FRB-OCN_18WT001_013018_ABD_09_BL	1/30/2018	BL	80.4	NG/G

Appendix A-11a
UCL Evaluation - ProUCL Input
American black duck (blood)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	ID	DATE	MEDIA	Mercury	UOM
FRB	FRB-OCN_18WT001_013018_ABD_10_BL	1/30/2018	BL	52.7	NG/G
FRB	FRB-OCN_18WT001_013018_ABD_11_BL	1/30/2018	BL	62	NG/G
FRB	FRB-OCN_18WT001_013018_ABD_12_BL	1/30/2018	BL	49	NG/G

Appendix A-11b
UCL Evaluation - Sample Area
American black duck (blood)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/9/2018 3:27:10 PM
From File	11_ABD (blood) ProUCL input_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (es-13)

General Statistics

Total Number of Observations	51	Number of Distinct Observations	51
		Number of Missing Observations	0
Minimum	50.6	Mean	207
Maximum	700	Median	149.6
SD	152.1	Std. Error of Mean	21.3
Coefficient of Variation	0.735	Skewness	1.374

Normal GOF Test

Shapiro Wilk Test Statistic	0.831	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	1.4874E-7	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.197	Lilliefors GOF Test
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	242.7	95% Adjusted-CLT UCL (Chen-1995)	246.4
		95% Modified-t UCL (Johnson-1978)	243.4

Gamma GOF Test

A-D Test Statistic	1.373	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.761	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.151	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.126	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.314	k star (bias corrected MLE)	2.191
Theta hat (MLE)	89.44	Theta star (bias corrected MLE)	94.47
nu hat (MLE)	236	nu star (bias corrected)	223.5
MLE Mean (bias corrected)	207	MLE Sd (bias corrected)	139.8
		Approximate Chi Square Value (0.05)	189.9
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	189

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	243.6	95% Adjusted Gamma UCL (use when n<50)	244.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.0429	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.124	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.123	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.924	Mean of logged Data	5.101
Maximum of Logged Data	6.551	SD of logged Data	0.673

Assuming Lognormal Distribution

95% H-UCL	249.3	90% Chebyshev (MVUE) UCL	268
95% Chebyshev (MVUE) UCL	296.5	97.5% Chebyshev (MVUE) UCL	336.2
99% Chebyshev (MVUE) UCL	414.1		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	242	95% Jackknife UCL	242.7
95% Standard Bootstrap UCL	242	95% Bootstrap-t UCL	249.7
95% Hall's Bootstrap UCL	246.2	95% Percentile Bootstrap UCL	243.5
95% BCA Bootstrap UCL	245.4		
90% Chebyshev(Mean, Sd) UCL	270.9	95% Chebyshev(Mean, Sd) UCL	299.8
97.5% Chebyshev(Mean, Sd) UCL	340	99% Chebyshev(Mean, Sd) UCL	418.9

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	299.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (frb)

General Statistics

Total Number of Observations	52	Number of Distinct Observations	52
		Number of Missing Observations	0
Minimum	11.3	Mean	66.85
Maximum	370.3	Median	55.28
SD	53.17	Std. Error of Mean	7.374
Coefficient of Variation	0.795	Skewness	4.061

Normal GOF Test

Shapiro Wilk Test Statistic	0.633	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	1.332E-15	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.212	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.122	Data Not Normal at 5% Significance Level	

Appendix A-11b
UCL Evaluation - Sample Area
American black duck (blood)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	79.2	95% Adjusted-CLT UCL (Chen-1995)	83.41
		95% Modified-t UCL (Johnson-1978)	79.89

Gamma GOF Test

A-D Test Statistic	1.129	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.117	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.937	k star (bias corrected MLE)	2.78
Theta hat (MLE)	22.76	Theta star (bias corrected MLE)	24.04
nu hat (MLE)	305.4	nu star (bias corrected)	289.2
MLE Mean (bias corrected)	66.85	MLE Sd (bias corrected)	40.09
		Approximate Chi Square Value (0.05)	250.8
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	249.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	77.08	95% Adjusted Gamma UCL (use when n<50)	77.39

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.968	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.309	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0927	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.122	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.425	Mean of logged Data	4.023
Maximum of Logged Data	5.914	SD of logged Data	0.579

Assuming Lognormal Distribution

95% H-UCL	77.24	90% Chebyshev (MVUE) UCL	82.71
95% Chebyshev (MVUE) UCL	90.37	97.5% Chebyshev (MVUE) UCL	101
99% Chebyshev (MVUE) UCL	121.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	78.98	95% Jackknife UCL	79.2
95% Standard Bootstrap UCL	78.74	95% Bootstrap-t UCL	88.65
95% Hall's Bootstrap UCL	139.2	95% Percentile Bootstrap UCL	78.95
95% BCA Bootstrap UCL	85.21		
90% Chebyshev(Mean, Sd) UCL	88.97	95% Chebyshev(Mean, Sd) UCL	98.99
97.5% Chebyshev(Mean, Sd) UCL	112.9	99% Chebyshev(Mean, Sd) UCL	140.2

Appendix A-11b
UCL Evaluation - Sample Area
American black duck (blood)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Approximate Gamma UCL 77.08

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (mendall marsh)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	104.5	Mean	390.3
Maximum	1400	Median	316.5
SD	250.5	Std. Error of Mean	40.63
Coefficient of Variation	0.642	Skewness	2.192

Normal GOF Test

Shapiro Wilk Test Statistic	0.805	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.938	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.142	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	458.9	95% Adjusted-CLT UCL (Chen-1995)	472.6
		95% Modified-t UCL (Johnson-1978)	461.3

Gamma GOF Test

A-D Test Statistic	0.669	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.116	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.144	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.374	k star (bias corrected MLE)	3.126
Theta hat (MLE)	115.7	Theta star (bias corrected MLE)	124.9
nu hat (MLE)	256.5	nu star (bias corrected)	237.5
MLE Mean (bias corrected)	390.3	MLE Sd (bias corrected)	220.8
		Approximate Chi Square Value (0.05)	202.9
Adjusted Level of Significance	0.0434	Adjusted Chi Square Value	201.5

Appendix A-11b
UCL Evaluation - Sample Area
American black duck (blood)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	457.1	95% Adjusted Gamma UCL (use when n<50)	460.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.938	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0846	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.142	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.649	Mean of logged Data	5.812
Maximum of Logged Data	7.244	SD of logged Data	0.551

Assuming Lognormal Distribution

95% H-UCL	464.1	90% Chebyshev (MVUE) UCL	496.7
95% Chebyshev (MVUE) UCL	546.4	97.5% Chebyshev (MVUE) UCL	615.3
99% Chebyshev (MVUE) UCL	750.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	457.2	95% Jackknife UCL	458.9
95% Standard Bootstrap UCL	455.7	95% Bootstrap-t UCL	489.2
95% Hall's Bootstrap UCL	509.3	95% Percentile Bootstrap UCL	457.9
95% BCA Bootstrap UCL	475.8		
90% Chebyshev(Mean, Sd) UCL	512.2	95% Chebyshev(Mean, Sd) UCL	567.4
97.5% Chebyshev(Mean, Sd) UCL	644.1	99% Chebyshev(Mean, Sd) UCL	794.6

Suggested UCL to Use

95% Adjusted Gamma UCL	460.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-12a
UCL Evaluation - ProUCL Input
Surface Water Mercury

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	ID	DATE	Mercury	D_Mercury	UOM
ES-15	ES-15_052616_SW_10	5/26/2016	6.13	1	NG/L
ES-15	ES-15_062916_SW_10	6/29/2016	1.87	0	NG/L
ES-15	ES-15_071816_SW_10	7/18/2016	1.72	1	NG/L
ES-15	ES-15_082916_SW_10	8/29/2016	21	1	NG/L
ES-15	ES-15_092616_SW_10	9/26/2016	7.59	1	NG/L
ES-15	ES-15_102616_SW_10	10/26/2016	2.35	1	NG/L
WQ-FPT	WQ_FPT_083016_SW_10	8/30/2016	1.87	1	NG/L
WQ-FPT	WQ-FPT_052616_SW_10	5/26/2016	1.67	1	NG/L
WQ-FPT	WQ-FPT_062916_SW_10	6/29/2016	1.67	0	NG/L
WQ-FPT	WQ-FPT_071816_SW_10	7/18/2016	1.44	1	NG/L
WQ-FPT	WQ-FPT_092616_SW_10	9/26/2016	1.63	1	NG/L
WQ-FPT	WQ-FPT_102616_SW_10	10/26/2016	1.64	1	NG/L

Appendix A-12b
UCL Evaluation - Sample Area
Surface Water Mercury

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.19/13/2017 9:58:19 AM
From File	2016Surface_Water_Samples_For_Nicole_4_5_17 Dataset_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (ng/l) (es-15)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	1
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	1.72	Minimum Non-Detect	1.87
Maximum Detect	21	Maximum Non-Detect	1.87
Variance Detects	60.93	Percent Non-Detects	16.67%
Mean Detects	7.758	SD Detects	7.806
Median Detects	6.13	CV Detects	1.006
Skewness Detects	1.699	Kurtosis Detects	3.09
Mean of Logged Detects	1.656	SD of Logged Detects	0.997

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.813	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.309	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	6.752	KM Standard Error of Mean	3.085
KM SD	6.759	95% KM (BCA) UCL	12.15
95% KM (t) UCL	12.97	95% KM (Percentile Bootstrap) UCL	12.1
95% KM (z) UCL	11.83	95% KM Bootstrap t UCL	18.75
90% KM Chebyshev UCL	16.01	95% KM Chebyshev UCL	20.2
97.5% KM Chebyshev UCL	26.02	99% KM Chebyshev UCL	37.45

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.301	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.687	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.212	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.362	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.418	k star (bias corrected MLE)	0.7
Theta hat (MLE)	5.473	Theta star (bias corrected MLE)	11.08
nu hat (MLE)	14.18	nu star (bias corrected)	7.004
Mean (detects)	7.758		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	6.467
Maximum	21	Median	4.24
SD	7.665	CV	1.185
k hat (MLE)	0.506	k star (bias corrected MLE)	0.364
Theta hat (MLE)	12.79	Theta star (bias corrected MLE)	17.77
nu hat (MLE)	6.068	nu star (bias corrected)	4.367
Adjusted Level of Significance (β)	0.0122		
Approximate Chi Square Value (4.37, α)	0.872	Adjusted Chi Square Value (4.37, β)	0.442
95% Gamma Approximate UCL (use when n>=50)	32.39	95% Gamma Adjusted UCL (use when n<50)	63.96

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.752	SD (KM)	6.759
Variance (KM)	45.69	SE of Mean (KM)	3.085
k hat (KM)	0.998	k star (KM)	0.61
nu hat (KM)	11.97	nu star (KM)	7.32
theta hat (KM)	6.767	theta star (KM)	11.07
80% gamma percentile (KM)	11.13	90% gamma percentile (KM)	17.49
95% gamma percentile (KM)	24.15	99% gamma percentile (KM)	40.23

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.32, α)	2.348	Adjusted Chi Square Value (7.32, β)	1.463
95% Gamma Approximate KM-UCL (use when n>=50)	21.05	95% Gamma Adjusted KM-UCL (use when n<50)	33.79

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.189	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Appendix A-12b
UCL Evaluation - Sample Area
Surface Water Mercury

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.682	Mean in Log Scale	1.424
SD in Original Scale	7.463	SD in Log Scale	1.057
95% t UCL (assumes normality of ROS data)	12.82	95% Percentile Bootstrap UCL	11.5
95% BCA Bootstrap UCL	13.18	95% Bootstrap t UCL	23.69
95% H-UCL (Log ROS)	56.2		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.471	KM Geo Mean	4.352
KM SD (logged)	0.914	95% Critical H Value (KM-Log)	3.814
KM Standard Error of Mean (logged)	0.417	95% H-UCL (KM -Log)	31.37
KM SD (logged)	0.914	95% Critical H Value (KM-Log)	3.814
KM Standard Error of Mean (logged)	0.417		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	6.621	Mean in Log Scale	1.369
SD in Original Scale	7.517	SD in Log Scale	1.136
95% t UCL (Assumes normality)	12.8	95% H-Stat UCL	77.52

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 12.97

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (ng/l) (wq-fpt)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
Number of Detects	5	Number of Non-Detects	1
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	1.44	Minimum Non-Detect	1.67
Maximum Detect	1.87	Maximum Non-Detect	1.67
Variance Detects	0.0234	Percent Non-Detects	16.67%
Mean Detects	1.65	SD Detects	0.153
Median Detects	1.64	CV Detects	0.0926
Skewness Detects	0.162	Kurtosis Detects	1.83
Mean of Logged Detects	0.497	SD of Logged Detects	0.0928

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Appendix A-12b
UCL Evaluation - Sample Area
Surface Water Mercury

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.934	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.248	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.637	KM Standard Error of Mean	0.0641
KM SD	0.134	95% KM (BCA) UCL	1.725
95% KM (t) UCL	1.766	95% KM (Percentile Bootstrap) UCL	1.725
95% KM (z) UCL	1.742	95% KM Bootstrap t UCL	1.749
90% KM Chebyshev UCL	1.829	95% KM Chebyshev UCL	1.916
97.5% KM Chebyshev UCL	2.037	99% KM Chebyshev UCL	2.275

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.356	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.678	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.253	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	145.6	k star (bias corrected MLE)	58.36
Theta hat (MLE)	0.0113	Theta star (bias corrected MLE)	0.0283
nu hat (MLE)	1456	nu star (bias corrected)	583.6
Mean (detects)	1.65		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1.44	Mean	1.635
Maximum	1.87	Median	1.635
SD	0.141	CV	0.0864
k hat (MLE)	162.9	k star (bias corrected MLE)	81.56
Theta hat (MLE)	0.01	Theta star (bias corrected MLE)	0.02
nu hat (MLE)	1955	nu star (bias corrected)	978.8
Adjusted Level of Significance (β)	0.0122		
Approximate Chi Square Value (978.76, α)	907.1	Adjusted Chi Square Value (978.76, β)	881.9
95% Gamma Approximate UCL (use when n>=50)	1.764	95% Gamma Adjusted UCL (use when n<50)	1.815

Appendix A-12b
UCL Evaluation - Sample Area
Surface Water Mercury

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.637	SD (KM)	0.134
Variance (KM)	0.0179	SE of Mean (KM)	0.0641
k hat (KM)	149.9	k star (KM)	75.07
nu hat (KM)	1799	nu star (KM)	900.9
theta hat (KM)	0.0109	theta star (KM)	0.0218
80% gamma percentile (KM)	1.793	90% gamma percentile (KM)	1.883
95% gamma percentile (KM)	1.959	99% gamma percentile (KM)	2.108

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (900.89, α)	832.2	Adjusted Chi Square Value (900.89, β)	808.1
95% Gamma Approximate KM-UCL (use when n>=50)	1.772	95% Gamma Adjusted KM-UCL (use when n<50)	1.825

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.262	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.635	Mean in Log Scale	0.489
SD in Original Scale	0.142	SD in Log Scale	0.0858
95% t UCL (assumes normality of ROS data)	1.751	95% Percentile Bootstrap UCL	1.722
95% BCA Bootstrap UCL	1.727	95% Bootstrap t UCL	1.762
95% H-UCL (Log ROS)	N/A		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.489	KM Geo Mean	1.631
KM SD (logged)	0.0816	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0394	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0816	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0394		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.514	Mean in Log Scale	0.384
SD in Original Scale	0.36	SD in Log Scale	0.289
95% t UCL (Assumes normality)	1.81	95% H-Stat UCL	2.036

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 1.766

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-13a
UCL Evaluation - ProUCL Input
Surface Water Methyl Mercury

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	ID	DATE	Methyl mercury	D_Methyl mercury	UOM
ES-15	ES-15_052616_SW_10	5/26/2016	0.05	0	NG/L
ES-15	ES-15_062916_SW_10	6/29/2016	0.05	0	NG/L
ES-15	ES-15_071816_SW_10	7/18/2016	0.043	1	NG/L
ES-15	ES-15_082916_SW_10	8/29/2016	0.345	1	NG/L
ES-15	ES-15_092616_SW_10	9/26/2016	0.209	1	NG/L
ES-15	ES-15_102616_SW_10	10/26/2016	0.05	0	NG/L
WQ-FPT	WQ_FPT_083016_SW_10	8/30/2016	0.04	1	NG/L
WQ-FPT	WQ-FPT_052616_SW_10	5/26/2016	0.05	0	NG/L
WQ-FPT	WQ-FPT_062916_SW_10	6/29/2016	0.05	0	NG/L
WQ-FPT	WQ-FPT_071816_SW_10	7/18/2016	0.035	1	NG/L
WQ-FPT	WQ-FPT_092616_SW_10	9/26/2016	0.05	0	NG/L
WQ-FPT	WQ-FPT_102616_SW_10	10/26/2016	0.05	0	NG/L

Appendix A-13b
UCL Evaluation - Sample Area
Surface Water Methyl Mercury

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.19/19/2017 2:26:43 PM
From File	2016Surface_Water_Samples_For_Nicole_4_5_17 Dataset_e.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Methyl mercury (es-15)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	3
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.043	Minimum Non-Detect	0.05
Maximum Detect	0.345	Maximum Non-Detect	0.05
Variance Detects	0.0229	Percent Non-Detects	50%
Mean Detects	0.199	SD Detects	0.151
Median Detects	0.209	CV Detects	0.76
Skewness Detects	-0.296	Kurtosis Detects	N/A
Mean of Logged Detects	-1.925	SD of Logged Detects	1.087

Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.997	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.193	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.121	KM Standard Error of Mean	0.0585
KM SD	0.117	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.239	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.217	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.297	95% KM Chebyshev UCL	0.376
97.5% KM Chebyshev UCL	0.487	99% KM Chebyshev UCL	0.703

Appendix A-13b
UCL Evaluation - Sample Area
Surface Water Methyl Mercury

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.756	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.113	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	10.54	nu star (bias corrected)	N/A
Mean (detects)	0.199		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.123
Maximum	0.345	Median	0.0673
SD	0.13	CV	1.06
k hat (MLE)	0.994	k star (bias corrected MLE)	0.608
Theta hat (MLE)	0.123	Theta star (bias corrected MLE)	0.201
nu hat (MLE)	11.93	nu star (bias corrected)	7.3
Adjusted Level of Significance (β)	0.0122		
Approximate Chi Square Value (7.30, α)	2.336	Adjusted Chi Square Value (7.30, β)	1.454
95% Gamma Approximate UCL (use when n>=50)	0.383	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.121	SD (KM)	0.117
Variance (KM)	0.0137	SE of Mean (KM)	0.0585
k hat (KM)	1.068	k star (KM)	0.645
nu hat (KM)	12.82	nu star (KM)	7.741
theta hat (KM)	0.113	theta star (KM)	0.188
80% gamma percentile (KM)	0.199	90% gamma percentile (KM)	0.31
95% gamma percentile (KM)	0.424	99% gamma percentile (KM)	0.7

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.74, α)	2.586	Adjusted Chi Square Value (7.74, β)	1.641
95% Gamma Approximate KM-UCL (use when n>=50)	0.362	95% Gamma Adjusted KM-UCL (use when n<50)	0.571

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.296	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Appendix A-13b
UCL Evaluation - Sample Area
Surface Water Methyl Mercury

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.123	Mean in Log Scale	-2.552
SD in Original Scale	0.128	SD in Log Scale	1.047
95% t UCL (assumes normality of ROS data)	0.228	95% Percentile Bootstrap UCL	0.204
95% BCA Bootstrap UCL	0.237	95% Bootstrap t UCL	0.655
95% H-UCL (Log ROS)	1.006		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.536	KM Geo Mean	0.0792
KM SD (logged)	0.876	95% Critical H Value (KM-Log)	3.699
KM Standard Error of Mean (logged)	0.438	95% H-UCL (KM -Log)	0.494
KM SD (logged)	0.876	95% Critical H Value (KM-Log)	3.699
KM Standard Error of Mean (logged)	0.438		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.112	Mean in Log Scale	-2.807
SD in Original Scale	0.135	SD in Log Scale	1.186
95% t UCL (Assumes normality)	0.223	95% H-Stat UCL	1.53

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.239

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Methyl mercury (wq-fpt)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	4
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.035	Minimum Non-Detect	0.05
Maximum Detect	0.04	Maximum Non-Detect	0.05
Variance Detects	1.2500E-5	Percent Non-Detects	66.67%
Mean Detects	0.0375	SD Detects	0.00354
Median Detects	0.0375	CV Detects	0.0943
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-3.286	SD of Logged Detects	0.0944

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Appendix A-13b
UCL Evaluation - Sample Area
Surface Water Methyl Mercury

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0375	KM Standard Error of Mean	0.0025
KM SD	0.0025	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0425	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0416	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.045	95% KM Chebyshev UCL	0.0484
97.5% KM Chebyshev UCL	0.0531	99% KM Chebyshev UCL	0.0624

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	224.7	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.6691E-4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	898.7	nu star (bias corrected)	N/A
Mean (detects)	0.0375		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0375	SD (KM)	0.0025
Variance (KM)	6.2500E-6	SE of Mean (KM)	0.0025
k hat (KM)	225	k star (KM)	112.6
nu hat (KM)	2700	nu star (KM)	1351
theta hat (KM)	1.6667E-4	theta star (KM)	3.3300E-4
80% gamma percentile (KM)	0.0404	90% gamma percentile (KM)	0.0421
95% gamma percentile (KM)	0.0435	99% gamma percentile (KM)	0.0462

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.0122
Approximate Chi Square Value (N/A, α)	1267	Adjusted Chi Square Value (N/A, β)	1237
95% Gamma Approximate KM-UCL (use when n>=50)	0.04	95% Gamma Adjusted KM-UCL (use when n<50)	0.041

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0376	Mean in Log Scale	-3.286
SD in Original Scale	0.0036	SD in Log Scale	0.096
95% t UCL (assumes normality of ROS data)	0.0405	95% Percentile Bootstrap UCL	0.0396
95% BCA Bootstrap UCL	0.0398	95% Bootstrap t UCL	0.0407
95% H-UCL (Log ROS)	N/A		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

Appendix A-13b
UCL Evaluation - Sample Area
Surface Water Methyl Mercury

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

KM Mean (logged)	-3.286	KM Geo Mean	0.0374
KM SD (logged)	0.0668	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0668	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0668	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0668		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0292	Mean in Log Scale	-3.554
SD in Original Scale	0.00665	SD in Log Scale	0.212
95% t UCL (Assumes normality)	0.0346	95% H-Stat UCL	0.0357

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0425	KM H-UCL	N/A
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!

Warning: Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-14a
UCL Evaluation - ProUCL Input for Nelson's sparrow
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_NSP&RWB	ID	Year	Mercury	UOM
add01	ADD-01.2017	2017	23.9	NG/G
add01	ADD-01_072116_SED_03	2016	29.6	NG/G
add01	ADD-02.2017	2017	35.7	NG/G
add01	ADD-02_072216_SED_03	2016	32.6	NG/G
mmse	MM-MR-INT.2017	2017	932.2	NG/G
mmse	MMSE-1_N1.2017	2017	1851.4	NG/G
mmse	MMSE-1_N2.2017	2017	398.2	NG/G
mmse	MMSE-1_S1.2017	2017	282.4	NG/G
mmse	MMSE-1_S2.2017	2017	320.2	NG/G
mmse	W-65-High.2017	2017	201.0	NG/G
mmse	W-65-HIGH_072516_SED_03	2016	84.3	NG/G
mmse	W-65-Intertidal.2017	2017	196.6	NG/G
mmse	W-65-Low.2017	2017	1048.6	NG/G
mmse	W-65-LOW_072516_SED_03	2016	32.6	NG/G
mmse	W-65-Mid.2017	2017	161.2	NG/G
mmse	W-65-MID_072516_SED_03	2016	225.7	NG/G
mmse	W-MM-03.2017	2017	112.8	NG/G
mmse	W-MM-04.2017	2017	518.6	NG/G
mmse	W-MM-05.2017	2017	691.2	NG/G
mmse	W-MM-06.2017	2017	620.0	NG/G
mmse	W-MM-11.2017	2017	1067.2	NG/G
mmse	W-MM-12.2017	2017	417.6	NG/G
mmse	W-MM-13.2017	2017	306.6	NG/G
mmsw	MM-64THRU67.2017	2017	425.0	NG/G
mmsw	MM-MR-INT.2017	2017	932.2	NG/G
mmsw	MMSE-1_S1.2017	2017	282.4	NG/G
mmsw	MMSE-1_S2.2017	2017	320.2	NG/G
mmsw	MMSW-C_N.2017	2017	899.4	NG/G
mmsw	MMSW-C_S.2017	2017	965.4	NG/G
mmsw	MMSW-C_SW.2017	2017	207.4	NG/G
mmsw	W-21-High.2017	2017	801.6	NG/G
mmsw	W-21-HIGH_072516_SED_03	2016	929.0	NG/G
mmsw	W-21-Intertidal.2017	2017	780.2	NG/G
mmsw	W-21-Low.2017	2017	873.2	NG/G
mmsw	W-21-LOW_072516_SED_03	2016	704.7	NG/G
mmsw	W-21-Mid.2017	2017	927.0	NG/G
mmsw	W-21-MID_072516_SED_03	2016	869.0	NG/G
mmsw	W-21-UM-Central-C.2017	2017	265.0	NG/G
mmsw	W-21UM-CENTRAL-C_072716_SED_03	2016	617.3	NG/G
mmsw	W-21-UM-East-C.2017	2017	1008.2	NG/G
mmsw	W-21UM-EAST-C_072516_SED_03	2016	751.7	NG/G
mmsw	W-21-UM-West-A.2017	2017	165.5	NG/G
mmsw	W-21UM-WEST-A_07/27/16_SED_03	2016	434.3	NG/G
mmsw	W-65-High.2017	2017	201.0	NG/G
mmsw	W-65-HIGH_072516_SED_03	2016	84.3	NG/G
mmsw	W-65-Intertidal.2017	2017	196.6	NG/G
mmsw	W-65-Low.2017	2017	1048.6	NG/G
mmsw	W-65-LOW_072516_SED_03	2016	32.6	NG/G

Appendix A-14a
UCL Evaluation - ProUCL Input for Nelson's sparrow
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_NSP&RWB	ID	Year	Mercury	UOM
mmsw	W-65-Mid.2017	2017	161.2	NG/G
mmsw	W-65-MID_072516_SED_03	2016	225.7	NG/G
mmsw	W-MM-06.2017	2017	620.0	NG/G
mmsw	W-MM-07.2017	2017	560.2	NG/G
mmsw	W-MM-08.2017	2017	792.6	NG/G
mmsw	W-MM-09.2017	2017	575.0	NG/G
mmsw	W-MM-10.2017	2017	225.8	NG/G
mmsw	W-MM-14.2017	2017	635.2	NG/G
mmsw	W-MM-15.2017	2017	257.6	NG/G
w17	W-17-HIGH_072116_SED_03	2016	1266.7	NG/G
w17	W-17-Intertidal.2017	2017	590.0	NG/G
w17	W-17-Low.2017	2017	998.0	NG/G
w17	W-17-LOW_072616_SED_03	2016	471.0	NG/G
w17	W-17-Mid.2017	2017	1268.8	NG/G
w17	W-17-MID_072116_SED_03	2016	1179.3	NG/G
w17	W-17-NE.2017	2017	705.0	NG/G
w17	W-17-NW.2017	2017	403.0	NG/G
w17	W17-N_072116_SED_03	2016	476.0	NG/G
mmsw	MM-C3-A.2017	2017	1412.862185	NG/G
mmse	MM-T2-C1-B.2017	2017	371.757647	NG/G
mmse	MM-T2-C2-A.2017	2017	1245.862185	NG/G
mmse	MM-T2-C3-A.2017	2017	1503.072269	NG/G
mmse	MM-T2-C4-B.2017	2017	51.74958	NG/G
mmse	MM-T2-C6-A.2017	2017	734.431933	NG/G
mmse	MM-T2-C7-A.2017	2017	76.62958	NG/G
mmse	MM-T2-C8-B.2017	2017	643.2	NG/G
mmsw	MM-T3-C1.2017	2017	71.097882	NG/G
mmsw	MM-T3-C2-C.2017	2017	569.522689	NG/G
mmsw	MM-T3-C2-F.2017	2017	845	NG/G
mmsw	MM-T3-C3-B2.2017	2017	327.867227	NG/G
mmsw	MM-T3-C3-C.2017	2017	330	NG/G
mmsw	MM-T3-C4-C.2017	2017	867.2	NG/G
mmsw	MM-T3-C4-D.2017	2017	790.882353	NG/G
mmsw	MM-T3-C5-C.2017	2017	904.559664	NG/G
mmsw	MM-T3-C6.2017	2017	437.969748	NG/G
mmsw	MM-T3-C7.2017	2017	255.630756	NG/G
mmse	MM-T5-C1.2017	2017	1007.6	NG/G
mmse	MM-T5-C2.2017	2017	82.07479	NG/G
mmse	MM-T5-C3.2017	2017	947.921008	NG/G

Appendix A-14b
UCL Evaluation - Sample Area for Nelson's sparrow
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/31/2018 2:36:28 PM
From File	2018-01-31 SED_NSP_1617.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (add01)

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	23.92	Mean	30.47
Maximum	35.7	Median	31.13
SD	5.021	Std. Error of Mean	2.511
Coefficient of Variation	0.165	Skewness	-0.678

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.977	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.184	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	36.38	95% Adjusted-CLT UCL (Chen-1995)	33.69
		95% Modified-t UCL (Johnson-1978)	36.24

Gamma GOF Test

A-D Test Statistic	0.252	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.199	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	46.58	k star (bias corrected MLE)	11.81

Appendix A-14b
UCL Evaluation - Sample Area for Nelson's sparrow
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Theta hat (MLE)	0.654	Theta star (bias corrected MLE)	2.58
nu hat (MLE)	372.6	nu star (bias corrected)	94.5
MLE Mean (bias corrected)	30.47	MLE Sd (bias corrected)	8.866
		Approximate Chi Square Value (0.05)	73.08
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	39.4	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.175	Mean of logged Data	3.406
Maximum of Logged Data	3.575	SD of logged Data	0.172

Assuming Lognormal Distribution

95% H-UCL	38.78	90% Chebyshev (MVUE) UCL	38.32
95% Chebyshev (MVUE) UCL	41.88	97.5% Chebyshev (MVUE) UCL	46.81
99% Chebyshev (MVUE) UCL	56.5		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	34.6	95% Jackknife UCL	36.38
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	38	95% Chebyshev(Mean, Sd) UCL	41.41
97.5% Chebyshev(Mean, Sd) UCL	46.15	99% Chebyshev(Mean, Sd) UCL	55.45

Suggested UCL to Use

95% Student's-t UCL	36.38

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-14b
UCL Evaluation - Sample Area for Nelson's sparrow
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Mercury (mmse)

General Statistics

Total Number of Observations	29	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	32.57	Mean	556.3
Maximum	1851	Median	398.2
SD	474.7	Std. Error of Mean	88.15
Coefficient of Variation	0.853	Skewness	1.034

Normal GOF Test

Shapiro Wilk Test Statistic	0.893	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.926	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.167	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.161	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	706.3	95% Adjusted-CLT UCL (Chen-1995)	719.4
		95% Modified-t UCL (Johnson-1978)	709.1

Gamma GOF Test

A-D Test Statistic	0.237	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.768	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0973	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.166	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.253	k star (bias corrected MLE)	1.147
Theta hat (MLE)	443.9	Theta star (bias corrected MLE)	485.2
nu hat (MLE)	72.68	nu star (bias corrected)	66.5
MLE Mean (bias corrected)	556.3	MLE Sd (bias corrected)	519.5
		Approximate Chi Square Value (0.05)	48.73
Adjusted Level of Significance	0.0407	Adjusted Chi Square Value	47.82

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	759.1	95% Adjusted Gamma UCL (use when n<50)	773.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk Lognormal GOF Test**

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UCL Evaluation - Sample Area for Nelson's sparrow
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

5% Shapiro Wilk Critical Value	0.926	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.112	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.161	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.483	Mean of logged Data	5.872
Maximum of Logged Data	7.524	SD of logged Data	1.077

Assuming Lognormal Distribution

95% H-UCL	1067	90% Chebyshev (MVUE) UCL	1044
95% Chebyshev (MVUE) UCL	1239	97.5% Chebyshev (MVUE) UCL	1509
99% Chebyshev (MVUE) UCL	2039		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	701.3	95% Jackknife UCL	706.3
95% Standard Bootstrap UCL	701.7	95% Bootstrap-t UCL	734.8
95% Hall's Bootstrap UCL	716.1	95% Percentile Bootstrap UCL	699.7
95% BCA Bootstrap UCL	721.7		
90% Chebyshev(Mean, Sd) UCL	820.7	95% Chebyshev(Mean, Sd) UCL	940.5
97.5% Chebyshev(Mean, Sd) UCL	1107	99% Chebyshev(Mean, Sd) UCL	1433

Suggested UCL to Use

95% Adjusted Gamma UCL	773.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (mmsw)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	32.57	Mean	568.6
Maximum	1413	Median	575
SD	332.1	Std. Error of Mean	49.51
Coefficient of Variation	0.584	Skewness	0.205

Normal GOF Test

Shapiro Wilk Test Statistic	0.938	**Shapiro Wilk GOF Test**

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UCL Evaluation - Sample Area for Nelson's sparrow
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.142	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	651.8	95% Adjusted-CLT UCL (Chen-1995)	651.7
		95% Modified-t UCL (Johnson-1978)	652.1

Gamma GOF Test

A-D Test Statistic	1.138	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.144	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.133	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.186	k star (bias corrected MLE)	2.055
Theta hat (MLE)	260.1	Theta star (bias corrected MLE)	276.6
nu hat (MLE)	196.8	nu star (bias corrected)	185
MLE Mean (bias corrected)	568.6	MLE Sd (bias corrected)	396.6
		Approximate Chi Square Value (0.05)	154.5
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	153.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	680.7	95% Adjusted Gamma UCL (use when n<50)	684.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.892	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.167	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.483	Mean of logged Data	6.097
Maximum of Logged Data	7.253	SD of logged Data	0.815

Assuming Lognormal Distribution

95% H-UCL	809.7	90% Chebyshev (MVUE) UCL	864.6
95% Chebyshev (MVUE) UCL	978.1	97.5% Chebyshev (MVUE) UCL	1136
99% Chebyshev (MVUE) UCL	1445		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Appendix A-14b
UCL Evaluation - Sample Area for Nelson's sparrow
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	650.1	95% Jackknife UCL	651.8
95% Standard Bootstrap UCL	648.9	95% Bootstrap-t UCL	652.5
95% Hall's Bootstrap UCL	646.8	95% Percentile Bootstrap UCL	644.3
95% BCA Bootstrap UCL	649		
90% Chebyshev(Mean, Sd) UCL	717.1	95% Chebyshev(Mean, Sd) UCL	784.4
97.5% Chebyshev(Mean, Sd) UCL	877.8	99% Chebyshev(Mean, Sd) UCL	1061

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 784.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (w17)

General Statistics

Total Number of Observations	9	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	403	Mean	817.5
Maximum	1269	Median	705
SD	360.9	Std. Error of Mean	120.3
Coefficient of Variation	0.441	Skewness	0.239

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.858	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.18	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1041	95% Adjusted-CLT UCL (Chen-1995)	1026
		95% Modified-t UCL (Johnson-1978)	1043

Gamma GOF Test

Appendix A-14b
UCL Evaluation - Sample Area for Nelson's sparrow
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

A-D Test Statistic	0.539	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.723	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.188	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.28	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.579	k star (bias corrected MLE)	3.793
Theta hat (MLE)	146.5	Theta star (bias corrected MLE)	215.5
nu hat (MLE)	100.4	nu star (bias corrected)	68.28
MLE Mean (bias corrected)	817.5	MLE Sd (bias corrected)	419.8
		Approximate Chi Square Value (0.05)	50.26
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	47.01

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1111	95% Adjusted Gamma UCL (use when n<50)	1187

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.879	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.181	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.999	Mean of logged Data	6.614
Maximum of Logged Data	7.146	SD of logged Data	0.462

Assuming Lognormal Distribution

95% H-UCL	1187	90% Chebyshev (MVUE) UCL	1202
95% Chebyshev (MVUE) UCL	1375	97.5% Chebyshev (MVUE) UCL	1616
99% Chebyshev (MVUE) UCL	2089		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1015	95% Jackknife UCL	1041
95% Standard Bootstrap UCL	1006	95% Bootstrap-t UCL	1048
95% Hall's Bootstrap UCL	971.7	95% Percentile Bootstrap UCL	1014
95% BCA Bootstrap UCL	1002		
90% Chebyshev(Mean, Sd) UCL	1178	95% Chebyshev(Mean, Sd) UCL	1342
97.5% Chebyshev(Mean, Sd) UCL	1569	99% Chebyshev(Mean, Sd) UCL	2014

Suggested UCL to Use

95% Student's-t UCL	1041

Appendix A-14b
UCL Evaluation - Sample Area for Nelson's sparrow
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-15a
UCL Evaluation - ProUCL Input for Nelson's sparrow
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_NSP&RWB	ID__1	Year	Methyl Mercury	UOM
add01	ADD-01.2017	2017	4.42	NG/G
add01	ADD-01_072116_SED_03	2016	1.19	NG/G
add01	ADD-02.2017	2017	2.10	NG/G
add01	ADD-02_072216_SED_03	2016	4.11	NG/G
mmse	MM-MR-INT.2017	2017	3.47	NG/G
mmse	MMSE-1_N1.2017	2017	13.10	NG/G
mmse	MMSE-1_N2.2017	2017	5.27	NG/G
mmse	MMSE-1_S1.2017	2017	13.97	NG/G
mmse	MMSE-1_S2.2017	2017	4.63	NG/G
mmse	W-65-High.2017	2017	17.87	NG/G
mmse	W-65-Intertidal.2017	2017	2.77	NG/G
mmse	W-65-Low.2017	2017	5.67	NG/G
mmse	W-65-Mid.2017	2017	14.27	NG/G
mmse	W-65-MID_072516_SED_03	2016	9.02	NG/G
mmse	W-MM-03.2017	2017	3.73	NG/G
mmse	W-MM-04.2017	2017	6.77	NG/G
mmse	W-MM-05.2017	2017	14.93	NG/G
mmse	W-MM-06.2017	2017	12.83	NG/G
mmse	W-MM-11.2017	2017	15.87	NG/G
mmse	W-MM-12.2017	2017	7.73	NG/G
mmse	W-MM-13.2017	2017	10.90	NG/G
mmsw	MM-64THRU67.2017	2017	3.48	NG/G
mmsw	MM-MR-INT.2017	2017	3.47	NG/G
mmsw	MMSE-1_S1.2017	2017	13.97	NG/G
mmsw	MMSE-1_S2.2017	2017	4.63	NG/G
mmsw	MMSW-C_N.2017	2017	17.13	NG/G
mmsw	MMSW-C_S.2017	2017	3.90	NG/G
mmsw	MMSW-C_SW.2017	2017	2.87	NG/G
mmsw	W-21-High.2017	2017	3.27	NG/G
mmsw	W-21-HIGH_072516_SED_03	2016	27.04	NG/G
mmsw	W-21-Intertidal.2017	2017	3.20	NG/G
mmsw	W-21-Low.2017	2017	4.33	NG/G
mmsw	W-21-LOW_072516_SED_03	2016	4.59	NG/G
mmsw	W-21-Mid.2017	2017	3.90	NG/G
mmsw	W-21-MID_072516_SED_03	2016	4.74	NG/G
mmsw	W-21-UM-Central-C.2017	2017	14.17	NG/G
mmsw	W-21UM-CENTRAL-C_072716_SED_03	2016	12.01	NG/G
mmsw	W-21-UM-East-C.2017	2017	18.93	NG/G
mmsw	W-21UM-EAST-C_072516_SED_03	2016	2.19	NG/G
mmsw	W-21-UM-West-A.2017	2017	3.10	NG/G
mmsw	W-21UM-WEST-A_07/27/16_SED_03	2016	1.22	NG/G
mmsw	W-65-High.2017	2017	17.87	NG/G
mmsw	W-65-Intertidal.2017	2017	2.77	NG/G
mmsw	W-65-Low.2017	2017	5.67	NG/G
mmsw	W-65-Mid.2017	2017	14.27	NG/G

Appendix A-15a
UCL Evaluation - ProUCL Input for Nelson's sparrow
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_NSP&RWB	ID__1	Year	Methyl Mercury	UOM
mmsw	W-65-MID_072516_SED_03	2016	9.02	NG/G
mmsw	W-MM-06.2017	2017	12.83	NG/G
mmsw	W-MM-07.2017	2017	11.73	NG/G
mmsw	W-MM-08.2017	2017	17.40	NG/G
mmsw	W-MM-09.2017	2017	2.43	NG/G
mmsw	W-MM-10.2017	2017	2.27	NG/G
mmsw	W-MM-14.2017	2017	18.97	NG/G
mmsw	W-MM-15.2017	2017	3.40	NG/G
w17	W-17-HIGH_072116_SED_03	2016	37.99	NG/G
w17	W-17-Intertidal.2017	2017	5.17	NG/G
w17	W-17-Low.2017	2017	9.10	NG/G
w17	W-17-LOW_072616_SED_03	2016	4.88	NG/G
w17	W-17-Mid.2017	2017	11.77	NG/G
w17	W-17-MID_072116_SED_03	2016	5.15	NG/G
w17	W-17-NE.2017	2017	37.27	NG/G
w17	W-17-NW.2017	2017	6.67	NG/G
w17	W17-N_072116_SED_03	2016	86.77	NG/G

Appendix A-15b
UCL Evaluation - Sample Area Nelson's sparrow
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.112/19/2017 10:11:41 AM
From File	2017-12-19 SED_NSP_1617_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Methyl Mercury (add01)

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1.186	Mean	2.953
Maximum	4.417	Median	3.104
SD	1.563	Std. Error of Mean	0.781
Coefficient of Variation	0.529	Skewness	-0.254

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.892	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.27	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.791	95% Adjusted-CLT UCL (Chen-1995)	4.132
		95% Modified-t UCL (Johnson-1978)	4.775

Gamma GOF Test

A-D Test Statistic	0.374	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.306	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-15b
UCL Evaluation - Sample Area Nelson's sparrow
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	4.006	k star (bias corrected MLE)	1.168
Theta hat (MLE)	0.737	Theta star (bias corrected MLE)	2.528
nu hat (MLE)	32.05	nu star (bias corrected)	9.345
MLE Mean (bias corrected)	2.953	MLE Sd (bias corrected)	2.732
		Approximate Chi Square Value (0.05)	3.537
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7.802	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.896	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.271	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.171	Mean of logged Data	0.953
Maximum of Logged Data	1.485	SD of logged Data	0.62

Assuming Lognormal Distribution

95% H-UCL	14.74	90% Chebyshev (MVUE) UCL	5.675
95% Chebyshev (MVUE) UCL	6.895	97.5% Chebyshev (MVUE) UCL	8.588
99% Chebyshev (MVUE) UCL	11.91		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4.238	95% Jackknife UCL	4.791
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.296	95% Chebyshev(Mean, Sd) UCL	6.358
97.5% Chebyshev(Mean, Sd) UCL	7.832	99% Chebyshev(Mean, Sd) UCL	10.73

Suggested UCL to Use

95% Student's-t UCL	4.791

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-15b
UCL Evaluation - Sample Area Nelson's sparrow
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Methyl Mercury (mmse)

General Statistics

Total Number of Observations	17	Number of Distinct Observations	17
		Number of Missing Observations	0
Minimum	2.767	Mean	9.576
Maximum	17.87	Median	9.019
SD	4.942	Std. Error of Mean	1.199
Coefficient of Variation	0.516	Skewness	0.123

Normal GOF Test

Shapiro Wilk Test Statistic	0.926	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.157	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.207	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	11.67	95% Adjusted-CLT UCL (Chen-1995)	11.59
		95% Modified-t UCL (Johnson-1978)	11.67

Gamma GOF Test

A-D Test Statistic	0.506	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.184	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.21	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.448	k star (bias corrected MLE)	2.878
Theta hat (MLE)	2.777	Theta star (bias corrected MLE)	3.327
nu hat (MLE)	117.2	nu star (bias corrected)	97.87
MLE Mean (bias corrected)	9.576	MLE Sd (bias corrected)	5.644
		Approximate Chi Square Value (0.05)	76.05
Adjusted Level of Significance	0.0346	Adjusted Chi Square Value	74.03

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	12.32	95% Adjusted Gamma UCL (use when n<50)	12.66

Appendix A-15b
UCL Evaluation - Sample Area Nelson's sparrow
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.892	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.183	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.207	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.018	Mean of logged Data	2.107
Maximum of Logged Data	2.883	SD of logged Data	0.599

Assuming Lognormal Distribution

95% H-UCL	13.56	90% Chebyshev (MVUE) UCL	14.16
95% Chebyshev (MVUE) UCL	16.16	97.5% Chebyshev (MVUE) UCL	18.95
99% Chebyshev (MVUE) UCL	24.42		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	11.55	95% Jackknife UCL	11.67
95% Standard Bootstrap UCL	11.46	95% Bootstrap-t UCL	11.76
95% Hall's Bootstrap UCL	11.5	95% Percentile Bootstrap UCL	11.56
95% BCA Bootstrap UCL	11.48		
90% Chebyshev(Mean, Sd) UCL	13.17	95% Chebyshev(Mean, Sd) UCL	14.8
97.5% Chebyshev(Mean, Sd) UCL	17.06	99% Chebyshev(Mean, Sd) UCL	21.5

Suggested UCL to Use

95% Student's-t UCL	11.67

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Methyl Mercury (mmsw)

General Statistics

Total Number of Observations	32	Number of Distinct Observations	31
		Number of Missing Observations	0
Minimum	1.22	Mean	8.461
Maximum	27.04	Median	4.61
SD	6.832	Std. Error of Mean	1.208
Coefficient of Variation	0.807	Skewness	0.963

Appendix A-15b
UCL Evaluation - Sample Area Nelson's sparrow
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.834	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.93	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.269	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.154	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	10.51	95% Adjusted-CLT UCL (Chen-1995)	10.67
		95% Modified-t UCL (Johnson-1978)	10.54

Gamma GOF Test

A-D Test Statistic	1.537	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.762	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.223	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.158	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.68	k star (bias corrected MLE)	1.543
Theta hat (MLE)	5.036	Theta star (bias corrected MLE)	5.482
nu hat (MLE)	107.5	nu star (bias corrected)	98.77
MLE Mean (bias corrected)	8.461	MLE Sd (bias corrected)	6.811
		Approximate Chi Square Value (0.05)	76.85
Adjusted Level of Significance	0.0416	Adjusted Chi Square Value	75.81

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	10.88	95% Adjusted Gamma UCL (use when n<50)	11.02

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.93	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.182	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.154	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.199	Mean of logged Data	1.809
Maximum of Logged Data	3.297	SD of logged Data	0.832

Assuming Lognormal Distribution

95% H-UCL	12.07	90% Chebyshev (MVUE) UCL	12.69
95% Chebyshev (MVUE) UCL	14.58	97.5% Chebyshev (MVUE) UCL	17.21
99% Chebyshev (MVUE) UCL	22.37		

Appendix A-15b
UCL Evaluation - Sample Area Nelson's sparrow
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	10.45	95% Jackknife UCL	10.51
95% Standard Bootstrap UCL	10.44	95% Bootstrap-t UCL	10.8
95% Hall's Bootstrap UCL	10.46	95% Percentile Bootstrap UCL	10.48
95% BCA Bootstrap UCL	10.69		
90% Chebyshev(Mean, Sd) UCL	12.08	95% Chebyshev(Mean, Sd) UCL	13.73
97.5% Chebyshev(Mean, Sd) UCL	16	99% Chebyshev(Mean, Sd) UCL	20.48

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	13.73

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Methyl Mercury (w17)

General Statistics

Total Number of Observations	9	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	4.878	Mean	22.75
Maximum	86.77	Median	9.1
SD	27.49	Std. Error of Mean	9.163
Coefficient of Variation	1.208	Skewness	1.89

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.714	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.322	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	39.79	95% Adjusted-CLT UCL (Chen-1995)	43.99
		95% Modified-t UCL (Johnson-1978)	40.75

Appendix A-15b
UCL Evaluation - Sample Area Nelson's sparrow
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.783	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.743	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.27	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.287	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.041	k star (bias corrected MLE)	0.768
Theta hat (MLE)	21.85	Theta star (bias corrected MLE)	29.62
nu hat (MLE)	18.74	nu star (bias corrected)	13.83
MLE Mean (bias corrected)	22.75	MLE Sd (bias corrected)	25.96
		Approximate Chi Square Value (0.05)	6.454
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	5.428

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	48.75	95% Adjusted Gamma UCL (use when n<50)	57.96

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.852	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.207	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.585	Mean of logged Data	2.573
Maximum of Logged Data	4.463	SD of logged Data	1.067

Assuming Lognormal Distribution

95% H-UCL	83.27	90% Chebyshev (MVUE) UCL	44.77
95% Chebyshev (MVUE) UCL	55.42	97.5% Chebyshev (MVUE) UCL	70.21
99% Chebyshev (MVUE) UCL	99.27		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	37.82	95% Jackknife UCL	39.79
95% Standard Bootstrap UCL	37.03	95% Bootstrap-t UCL	55.31
95% Hall's Bootstrap UCL	46.14	95% Percentile Bootstrap UCL	37.89
95% BCA Bootstrap UCL	43.94		
90% Chebyshev(Mean, Sd) UCL	50.24	95% Chebyshev(Mean, Sd) UCL	62.69
97.5% Chebyshev(Mean, Sd) UCL	79.98	99% Chebyshev(Mean, Sd) UCL	113.9

Appendix A-15b
UCL Evaluation - Sample Area Nelson's sparrow
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Adjusted Gamma UCL	57.96

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-16a
UCL Evaluation - ProUCL Input for American black duck
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_ABD	ID_1	YEAR	RESULT.TYPE	Int	Mercury	UOM
frb	FRB-01_092816_SED_03	2016	NON-IPWC	1	7.53	NG/G
frb	FBJR.2017	2017	IPWC		27.4	NG/G

Appendix A-16b

UCL Evaluation - Sample Area for American black duck

Sediment (Mercury)

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/9/2018 5:16:04 PM
From File	16_SED_abd (Hg) ProUCL input.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (es13)

General Statistics

Total Number of Observations	31	Number of Distinct Observations	31
		Number of Missing Observations	0
Minimum	92.16	Mean	613.2
Maximum	1483	Median	675
SD	331.8	Std. Error of Mean	59.58
Coefficient of Variation	0.541	Skewness	0.246

Normal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.929	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.118	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.156	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	714.3	95% Adjusted-CLT UCL (Chen-1995)	714
		95% Modified-t UCL (Johnson-1978)	714.8

Gamma GOF Test

A-D Test Statistic	1.195	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.192	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.159	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Appendix A-16b

UCL Evaluation - Sample Area for American black duck

Sediment (Mercury)

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	2.57	k star (bias corrected MLE)	2.342
Theta hat (MLE)	238.6	Theta star (bias corrected MLE)	261.8
nu hat (MLE)	159.3	nu star (bias corrected)	145.2
MLE Mean (bias corrected)	613.2	MLE Sd (bias corrected)	400.6
		Approximate Chi Square Value (0.05)	118.4
Adjusted Level of Significance	0.0413	Adjusted Chi Square Value	117

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	752.3	95% Adjusted Gamma UCL (use when n<50)	760.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.87	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.929	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.224	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.156	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.524	Mean of logged Data	6.212
Maximum of Logged Data	7.302	SD of logged Data	0.741

Assuming Lognormal Distribution

95% H-UCL	876	90% Chebyshev (MVUE) UCL	931
95% Chebyshev (MVUE) UCL	1059	97.5% Chebyshev (MVUE) UCL	1237
99% Chebyshev (MVUE) UCL	1585		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	711.2	95% Jackknife UCL	714.3
95% Standard Bootstrap UCL	708.8	95% Bootstrap-t UCL	717.1
95% Hall's Bootstrap UCL	714.6	95% Percentile Bootstrap UCL	715.6
95% BCA Bootstrap UCL	711.6		
90% Chebyshev(Mean, Sd) UCL	791.9	95% Chebyshev(Mean, Sd) UCL	872.9
97.5% Chebyshev(Mean, Sd) UCL	985.3	99% Chebyshev(Mean, Sd) UCL	1206

Suggested UCL to Use

95% Student's-t UCL	714.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-16b
UCL Evaluation - Sample Area for American black duck
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Mercury (frb)

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	7.53	Mean	17.47
Maximum	27.4	Median	17.47

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable Mercury (frb) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Mercury (mmbkd)

General Statistics

Total Number of Observations	117	Number of Distinct Observations	115
		Number of Missing Observations	0
Minimum	32.57	Mean	659.8
Maximum	2238	Median	637.4
SD	399	Std. Error of Mean	36.88
Coefficient of Variation	0.605	Skewness	0.844

Normal GOF Test

Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	1.7731E-4	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.0599	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0822	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	721	95% Adjusted-CLT UCL (Chen-1995)	723.6
		95% Modified-t UCL (Johnson-1978)	721.5

Gamma GOF Test

A-D Test Statistic	2.07	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.765	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.113	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0861	Data Not Gamma Distributed at 5% Significance Level

Appendix A-16b
UCL Evaluation - Sample Area for American black duck
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.104	k star (bias corrected MLE)	2.056
Theta hat (MLE)	313.6	Theta star (bias corrected MLE)	321
nu hat (MLE)	492.3	nu star (bias corrected)	481.1
MLE Mean (bias corrected)	659.8	MLE Sd (bias corrected)	460.2
		Approximate Chi Square Value (0.05)	431.2
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	430.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	736.1	95% Adjusted Gamma UCL (use when n<50)	737.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.887	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	7.782E-13	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.16	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0822	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.483	Mean of logged Data	6.236
Maximum of Logged Data	7.713	SD of logged Data	0.838

Assuming Lognormal Distribution

95% H-UCL	852.5	90% Chebyshev (MVUE) UCL	915
95% Chebyshev (MVUE) UCL	1002	97.5% Chebyshev (MVUE) UCL	1123
99% Chebyshev (MVUE) UCL	1361		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	720.5	95% Jackknife UCL	721
95% Standard Bootstrap UCL	720.7	95% Bootstrap-t UCL	726.3
95% Hall's Bootstrap UCL	720.7	95% Percentile Bootstrap UCL	721.3
95% BCA Bootstrap UCL	721.5		
90% Chebyshev(Mean, Sd) UCL	770.5	95% Chebyshev(Mean, Sd) UCL	820.6
97.5% Chebyshev(Mean, Sd) UCL	890.2	99% Chebyshev(Mean, Sd) UCL	1027

Suggested UCL to Use

95% Student's-t UCL	721

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-17a
UCL Evaluation - ProUCL Input for American black duck
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_ABD	ID_1	YEAR	Methyl Mercury	D_Methyl Mercury	UOM
es13	ES-02_072716_SED_03	2016	38.0	1	NG/G
es13	ES-13_072716_SED_03	2016	28.8	1	NG/G
es13	ES-15_072716_SED_03	2016	4.7	1	NG/G
es13	OL-01_072716_SED_03	2016	11.7	1	NG/G
es13	SVE-01_072716_SED_03	2016	31.3	1	NG/G
es13	W-61-HIGH_110816_SED_03	2016	8.3	1	NG/G
es13	W-61-INT_110816_SED_03	2016	9.6	1	NG/G
es13	W-61-LOW_110816_SED_03	2016	32.2	1	NG/G
es13	W-61-MID_110816_SED_03	2016	11.4	1	NG/G
mmbkd	MMPOLY_072916_SED_03	2016	13.4	1	NG/G
mmbkd	W-17-INTERTIDAL_072616_SED_03	2016	3.8	1	NG/G
mmbkd	W-17-LOW_072616_SED_03	2016	4.9	1	NG/G
mmbkd	W-21-HIGH_072516_SED_03	2016	27.0	1	NG/G
mmbkd	W-21-INTERTIDAL_072516_SED_03	2016	4.0	1	NG/G
mmbkd	W-21-LOW_072516_SED_03	2016	4.6	1	NG/G
mmbkd	W-21-MID_072516_SED_03	2016	4.7	1	NG/G
mmbkd	W-21UM-CENTRAL-C_072716_SED_03	2016	12.0	1	NG/G
mmbkd	W-21UM-EAST-C_072516_SED_03	2016	2.2	1	NG/G
mmbkd	W-21UM-SOUTH_072716_SED_03	2016	5.9	1	NG/G
mmbkd	W-21UM-WEST-A_07/27/16_SED_03	2016	1.2	1	NG/G
mmbkd	W-65-INTERTIDAL_072516_SED_03	2016	0.4	1	NG/G
mmbkd	W-65-MID_072516_SED_03	2016	9.0	1	NG/G
frb01	FRB-01_092816_SED_03	2016	0.071	0	NG/G
es13	ES-13.2017	2017	7.4	1	NG/G
es13	SVE-02INT.2017	2017	3.9	1	NG/G
es13	VE-58THRU60.2017	2017	5.4	1	NG/G
es13	VI-W.2017	2017	2.3	1	NG/G
es13	W-108-A.2017	2017	3.1	1	NG/G
es13	W-109-A.2017	2017	0.7	1	NG/G
es13	W-110-A.2017	2017	3.2	1	NG/G
es13	W-61-High.2017	2017	6.5	1	NG/G
es13	W-61-Intertidal.2017	2017	6.8	1	NG/G
es13	W-61-Low.2017	2017	17.1	1	NG/G
es13	W-61-Mid.2017	2017	20.5	1	NG/G
es13	VE-09-01-E.2017	2017	13.2	1	NG/G
es13	VE-10-01-E.2017	2017	24.6	1	NG/G
es13	VN-03-01-D.2017	2017	14.6	1	NG/G
frb01	FBJR.2017	2017	1.6	1	NG/G
mmbkd	BU-50THRU52.2017	2017	5.1	1	NG/G
mmbkd	FF-51THRU52.2017	2017	6.3	1	NG/G

Appendix A-17a
UCL Evaluation - ProUCL Input for American black duck
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_ABD	ID_1	YEAR	Methyl Mercury	D_Methyl Mercury	UOM
mmbkd	MM-50THRU56.2017	2017	1.7	1	NG/G
mmbkd	MM-64THRU67.2017	2017	3.5	1	NG/G
mmbkd	MM-MR-INT.2017	2017	3.5	1	NG/G
mmbkd	MMSE-1_N1.2017	2017	13.1	1	NG/G
mmbkd	MMSE-1_N2.2017	2017	5.3	1	NG/G
mmbkd	MMSE-1_S1.2017	2017	14.0	1	NG/G
mmbkd	MMSE-1_S2.2017	2017	4.6	1	NG/G
mmbkd	MMSW-C_N.2017	2017	17.1	1	NG/G
mmbkd	MMSW-C_S.2017	2017	3.9	1	NG/G
mmbkd	MMSW-C_SW.2017	2017	2.9	1	NG/G
mmbkd	W-102-A.2017	2017	17.8	1	NG/G
mmbkd	W-102-B.2017	2017	5.5	1	NG/G
mmbkd	W-102-C.2017	2017	11.4	1	NG/G
mmbkd	W-102-INTA.2017	2017	12.8	1	NG/G
mmbkd	W-17-High.2017	2017	16.3	1	NG/G
mmbkd	W-17-Intertidal.2017	2017	5.2	1	NG/G
mmbkd	W-17-Low.2017	2017	9.1	1	NG/G
mmbkd	W-17-Mid.2017	2017	11.8	1	NG/G
mmbkd	W-17-NE.2017	2017	37.3	1	NG/G
mmbkd	W-17-NW.2017	2017	6.7	1	NG/G
mmbkd	W-21-High.2017	2017	3.3	1	NG/G
mmbkd	W-21-Intertidal.2017	2017	3.2	1	NG/G
mmbkd	W-21-Low.2017	2017	4.3	1	NG/G
mmbkd	W-21-Mid.2017	2017	3.9	1	NG/G
mmbkd	W-21-UM-Central-C.2017	2017	14.2	1	NG/G
mmbkd	W-21-UM-East-C.2017	2017	18.9	1	NG/G
mmbkd	W-21-UM-West-A.2017	2017	3.1	1	NG/G
mmbkd	W-65-High.2017	2017	17.9	1	NG/G
mmbkd	W-65-Intertidal.2017	2017	2.8	1	NG/G
mmbkd	W-65-Low.2017	2017	5.7	1	NG/G
mmbkd	W-65-Mid.2017	2017	14.3	1	NG/G
mmbkd	W-MM-01.2017	2017	30.1	1	NG/G
mmbkd	W-MM-02.2017	2017	19.2	1	NG/G
mmbkd	W-MM-03.2017	2017	3.7	1	NG/G
mmbkd	W-MM-04.2017	2017	6.8	1	NG/G
mmbkd	W-MM-05.2017	2017	14.9	1	NG/G
mmbkd	W-MM-06.2017	2017	12.8	1	NG/G
mmbkd	W-MM-07.2017	2017	11.7	1	NG/G
mmbkd	W-MM-08.2017	2017	17.4	1	NG/G

Appendix A-17a
UCL Evaluation - ProUCL Input for American black duck
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_ABD	ID_1	YEAR	Methyl Mercury	D_Methyl Mercury	UOM
mmbkd	W-MM-09.2017	2017	2.4	1	NG/G
mmbkd	W-MM-10.2017	2017	2.3	1	NG/G
mmbkd	W-MM-11.2017	2017	15.9	1	NG/G
mmbkd	W-MM-12.2017	2017	7.7	1	NG/G
mmbkd	W-MM-13.2017	2017	10.9	1	NG/G
mmbkd	W-MM-14.2017	2017	19.0	1	NG/G
mmbkd	W-MM-15.2017	2017	3.4	1	NG/G
mmbkd	W-MM-16.2017	2017	0.9	1	NG/G
mmbkd	W-MM-17.2017	2017	8.5	1	NG/G
mmbkd	W-MM-18.2017	2017	26.3	1	NG/G
mmbkd	W-MM-TP.2017	2017	1.9	1	NG/G
mmbkd	BU-08-01-E.2017	2017	14.3	1	NG/G
mmbkd	FF-08-02-G.2017	2017	13.4	1	NG/G
mmbkd	MM-04-01-F.2017	2017	10.53333333	1	NG/G

Appendix A-17b
UCL Evaluation - Sample Area American black duck Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.14/9/2018 5:17:15 PM
From File	17_SED_abd (MeHg) ProUCL input.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Methyl Mercury (es13)

General Statistics

Total Number of Observations	23	Number of Distinct Observations	23
		Number of Missing Observations	0
Minimum	0.717	Mean	13.27
Maximum	37.99	Median	9.567
SD	10.88	Std. Error of Mean	2.269
Coefficient of Variation	0.82	Skewness	0.969

Normal GOF Test

Shapiro Wilk Test Statistic	0.881	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.18	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	17.16	95% Adjusted-CLT UCL (Chen-1995)	17.49
		95% Modified-t UCL (Johnson-1978)	17.24

Gamma GOF Test

A-D Test Statistic	0.197	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.761	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0821	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.185	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-17b
UCL Evaluation - Sample Area American black duck
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	1.45	k star (bias corrected MLE)	1.29
Theta hat (MLE)	9.149	Theta star (bias corrected MLE)	10.29
nu hat (MLE)	66.71	nu star (bias corrected)	59.34
MLE Mean (bias corrected)	13.27	MLE Sd (bias corrected)	11.68
		Approximate Chi Square Value (0.05)	42.63
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	41.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	18.47	95% Adjusted Gamma UCL (use when n<50)	18.93

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0727	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.18	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.333	Mean of logged Data	2.203
Maximum of Logged Data	3.637	SD of logged Data	0.985

Assuming Lognormal Distribution

95% H-UCL	24.89	90% Chebyshev (MVUE) UCL	24.19
95% Chebyshev (MVUE) UCL	28.68	97.5% Chebyshev (MVUE) UCL	34.91
99% Chebyshev (MVUE) UCL	47.16		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	17	95% Jackknife UCL	17.16
95% Standard Bootstrap UCL	16.88	95% Bootstrap-t UCL	18
95% Hall's Bootstrap UCL	17.29	95% Percentile Bootstrap UCL	17.1
95% BCA Bootstrap UCL	17.23		
90% Chebyshev(Mean, Sd) UCL	20.07	95% Chebyshev(Mean, Sd) UCL	23.16
97.5% Chebyshev(Mean, Sd) UCL	27.44	99% Chebyshev(Mean, Sd) UCL	35.84

Suggested UCL to Use

95% Student's-t UCL	17.16

Appendix A-17b
UCL Evaluation - Sample Area American black duck
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Methyl Mercury (frb01)

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	1
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable Methyl Mercury (frb01) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Methyl Mercury (mmbkd)

General Statistics

Total Number of Observations	68	Number of Distinct Observations	66
		Number of Missing Observations	0
Minimum	0.354	Mean	9.609
Maximum	37.27	Median	6.717
SD	7.566	Std. Error of Mean	0.917
Coefficient of Variation	0.787	Skewness	1.321

Normal GOF Test

Shapiro Wilk Test Statistic	0.875	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	1.6703E-7	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.161	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.107	Data Not Normal at 5% Significance Level

Appendix A-17b
UCL Evaluation - Sample Area American black duck
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	11.14	95% Adjusted-CLT UCL (Chen-1995)	11.27
		95% Modified-t UCL (Johnson-1978)	11.16

Gamma GOF Test

A-D Test Statistic	0.653	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.767	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0918	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.11	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.633	k star (bias corrected MLE)	1.571
Theta hat (MLE)	5.883	Theta star (bias corrected MLE)	6.116
nu hat (MLE)	222.1	nu star (bias corrected)	213.7
MLE Mean (bias corrected)	9.609	MLE Sd (bias corrected)	7.666
		Approximate Chi Square Value (0.05)	180.9
Adjusted Level of Significance	0.0465	Adjusted Chi Square Value	180.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	11.35	95% Adjusted Gamma UCL (use when n<50)	11.39

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.102	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.11	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.107	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.038	Mean of logged Data	1.926
Maximum of Logged Data	3.618	SD of logged Data	0.899

Assuming Lognormal Distribution

95% H-UCL	13.08	90% Chebyshev (MVUE) UCL	14.06
95% Chebyshev (MVUE) UCL	15.8	97.5% Chebyshev (MVUE) UCL	18.23
99% Chebyshev (MVUE) UCL	22.99		

Appendix A-17b
UCL Evaluation - Sample Area American black duck Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	11.12	95% Jackknife UCL	11.14
95% Standard Bootstrap UCL	11.16	95% Bootstrap-t UCL	11.35
95% Hall's Bootstrap UCL	11.33	95% Percentile Bootstrap UCL	11.1
95% BCA Bootstrap UCL	11.42		
90% Chebyshev(Mean, Sd) UCL	12.36	95% Chebyshev(Mean, Sd) UCL	13.61
97.5% Chebyshev(Mean, Sd) UCL	15.34	99% Chebyshev(Mean, Sd) UCL	18.74

Suggested UCL to Use

95% Approximate Gamma UCL	11.35

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-18a
UCL Evaluation - ProUCL Input
Shrimp (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

ID	DATE	MERCURY	UOM
OB-01-E-TR-4_081309_CRA_WB_01	8/13/2009	61.30	NG/G
OB-01-E-TR-4_081309_CRA_WB_02	8/13/2009	74.70	NG/G
OB-01-E-TR-4_081309_CRA_WB_03	8/13/2009	62.40	NG/G
OB-01-E-TR-4_081309_CRA_WB_04	8/13/2009	49.80	NG/G
OB-01-E-TR-4_081309_CRA_WB_05	8/13/2009	86.10	NG/G
OB-01-E-TR-4_100609_CRA_WB_01	10/6/2009	56.40	NG/G
OB-01-E-TR-4_100609_CRA_WB_02	10/6/2009	58.10	NG/G
OB-01-E-TR-4_100609_CRA_WB_03	10/6/2009	63.60	NG/G
OB-01-E-TR-4_100609_CRA_WB_04	10/6/2009	59.10	NG/G
OB-01-E-TR-4_100609_CRA_WB_05	10/6/2009	54.40	NG/G
OB-01-E-TR-4_100609_SHR_WB_06	10/6/2009	17.40	NG/G
OB-03_090909_CRA_WB_01	9/9/2009	79.90	NG/G
OB-03_090909_CRA_WB_02	9/9/2009	69.40	NG/G
OB-03_090909_CRA_WB_03	9/9/2009	96.10	NG/G
OB-03_090909_CRA_WB_04	9/9/2009	78.10	NG/G
OB-03_090909_CRA_WB_05	9/9/2009	87.70	NG/G
OB-04_081309_CRA_WB_01	8/13/2009	84.70	NG/G
OB-04_081309_CRA_WB_02	8/13/2009	60.60	NG/G
OB-04_081309_CRA_WB_03	8/13/2009	67.00	NG/G
OB-04_081309_CRA_WB_04	8/13/2009	90.00	NG/G
OB-04_081309_CRA_WB_05	8/13/2009	83.90	NG/G
OB-04_090909_CRA_WB_01	9/9/2009	77.10	NG/G
OB-04_090909_CRA_WB_02	9/9/2009	67.60	NG/G
OB-04_090909_CRA_WB_03	9/9/2009	92.30	NG/G
OB-04_090909_CRA_WB_04	9/9/2009	58.20	NG/G
OB-04_090909_CRA_WB_05	9/9/2009	75.10	NG/G
OB-04_100809_CRA_WB_01	10/8/2009	73.70	NG/G
OB-04_100809_CRA_WB_02	10/8/2009	90.00	NG/G
OB-04_100809_CRA_WB_03	10/8/2009	84.10	NG/G
OB-05_090909_CRA_WB_01	9/9/2009	86.20	NG/G
OB-05_090909_CRA_WB_02	9/9/2009	69.70	NG/G
OB-05_090909_CRA_WB_03	9/9/2009	67.70	NG/G
OB-05_090909_CRA_WB_04	9/9/2009	56.30	NG/G
OB-05_090909_CRA_WB_05	9/9/2009	89.70	NG/G
OB-05_100609_CRA_WB_01	10/6/2009	82.40	NG/G

Appendix A-18b
UCL Evaluation - Sample Area
Shrimp (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.19/6/2017 4:19:40 PM
From File	2017_09_06 Shrimp Data 2009 UCL Import - Penobscot.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

MERCURY

General Statistics

Total Number of Observations	35	Number of Distinct Observations	34
		Number of Missing Observations	0
Minimum	17.4	Mean	71.74
Maximum	96.1	Median	73.7
SD	15.91	Std. Error of Mean	2.689
Coefficient of Variation	0.222	Skewness	-1.048

Normal GOF Test

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.934	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.092	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.148	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	76.28	95% Adjusted-CLT UCL (Chen-1995)	75.65
		95% Modified-t UCL (Johnson-1978)	76.21

Gamma GOF Test

A-D Test Statistic	1.14	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.125	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.149	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	14.73	k star (bias corrected MLE)	13.49
Theta hat (MLE)	4.869	Theta star (bias corrected MLE)	5.318
nu hat (MLE)	1031	nu star (bias corrected)	944.3
MLE Mean (bias corrected)	71.74	MLE Sd (bias corrected)	19.53
		Approximate Chi Square Value (0.05)	874
Adjusted Level of Significance	0.0425	Adjusted Chi Square Value	870.8

Appendix A-18b
UCL Evaluation - Sample Area
Shrimp (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	77.51	95% Adjusted Gamma UCL (use when n<50)	77.79

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.739	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.934	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.158	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.148	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.856	Mean of logged Data	4.239
Maximum of Logged Data	4.565	SD of logged Data	0.3

Assuming Lognormal Distribution

95% H-UCL	79.53	90% Chebyshev (MVUE) UCL	83.59
95% Chebyshev (MVUE) UCL	88.66	97.5% Chebyshev (MVUE) UCL	95.7
99% Chebyshev (MVUE) UCL	109.5		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	76.16	95% Jackknife UCL	76.28
95% Standard Bootstrap UCL	76	95% Bootstrap-t UCL	76.03
95% Hall's Bootstrap UCL	75.69	95% Percentile Bootstrap UCL	75.89
95% BCA Bootstrap UCL	75.63		
90% Chebyshev(Mean, Sd) UCL	79.81	95% Chebyshev(Mean, Sd) UCL	83.46
97.5% Chebyshev(Mean, Sd) UCL	88.53	99% Chebyshev(Mean, Sd) UCL	98.5

Suggested UCL to Use

95% Student's-t UCL	76.28

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Appendix A-19a
UCL Evaluation - ProUCL Input
Shrimp (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

ID	SAMPLE DATE	METHYL MERCURY	UOM
OB-01-E-TR-4_081309_SHR_WB_01	8/13/2009	51.90	NG/G
OB-01-E-TR-4_081309_SHR_WB_02	8/13/2009	53.40	NG/G
OB-01-E-TR-4_081309_SHR_WB_03	8/13/2009	45.60	NG/G
OB-01-E-TR-4_081309_SHR_WB_04	8/13/2009	34.80	NG/G
OB-01-E-TR-4_081309_SHR_WB_05	8/13/2009	84.60	NG/G
OB-01-E-TR-4_100609_SHR_WB_01	10/6/2009	51.20	NG/G
OB-01-E-TR-4_100609_SHR_WB_02	10/6/2009	50.50	NG/G
OB-01-E-TR-4_100609_SHR_WB_03	10/6/2009	58.50	NG/G
OB-01-E-TR-4_100609_SHR_WB_04	10/6/2009	47.20	NG/G
OB-01-E-TR-4_100609_SHR_WB_05	10/6/2009	53.70	NG/G
OB-03_090909_GRS_WB_01	9/9/2009	36.20	NG/G
OB-03_090909_GRS_WB_02	9/9/2009	29.50	NG/G
OB-03_090909_GRS_WB_03	9/9/2009	59.40	NG/G
OB-03_090909_GRS_WB_04	9/9/2009	38.30	NG/G
OB-03_090909_GRS_WB_05	9/9/2009	56.70	NG/G
OB-04_081309_SHR_WB_01	8/13/2009	69.60	NG/G
OB-04_081309_SHR_WB_02	8/13/2009	41.70	NG/G
OB-04_081309_SHR_WB_03	8/13/2009	46.80	NG/G
OB-04_081309_SHR_WB_04	8/13/2009	63.90	NG/G
OB-04_081309_SHR_WB_05	8/13/2009	48.10	NG/G
OB-04_090909_GRS_WB_01	9/9/2009	44.20	NG/G
OB-04_090909_GRS_WB_02	9/9/2009	44.10	NG/G
OB-04_090909_GRS_WB_03	9/9/2009	38.80	NG/G
OB-04_090909_GRS_WB_04	9/9/2009	34.50	NG/G
OB-04_090909_GRS_WB_05	9/9/2009	25.40	NG/G
OB-04_100809_SHR_WB_01	10/8/2009	47.10	NG/G
OB-04_100809_SHR_WB_02	10/8/2009	72.40	NG/G
OB-04_100809_SHR_WB_03	10/8/2009	53.70	NG/G
OB-05_090909_GRS_WB_01	9/9/2009	62.20	NG/G
OB-05_090909_GRS_WB_02	9/9/2009	54.30	NG/G
OB-05_090909_GRS_WB_03	9/9/2009	47.30	NG/G
OB-05_090909_GRS_WB_04	9/9/2009	39.00	NG/G
OB-05_090909_GRS_WB_05	9/9/2009	70.80	NG/G
OB-05_100609_CRA_WB_01	10/6/2009	68.20	NG/G

Appendix A-19b
UCL Evaluation - Sample Area
Shrimp (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.19/6/2017 4:18:29 PM
From File	2017_09_06 Shrimp Data 2009 UCL Import - Penobscot_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

METHYL MERCURY

General Statistics

Total Number of Observations	34	Number of Distinct Observations	33
		Number of Missing Observations	0
Minimum	25.4	Mean	50.69
Maximum	84.6	Median	49.3
SD	13.15	Std. Error of Mean	2.255
Coefficient of Variation	0.259	Skewness	0.438

Normal GOF Test

Shapiro Wilk Test Statistic	0.982	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0978	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.15	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	54.51	95% Adjusted-CLT UCL (Chen-1995)	54.58
		95% Modified-t UCL (Johnson-1978)	54.54

Gamma GOF Test

A-D Test Statistic	0.135	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0668	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.151	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	15.17	k star (bias corrected MLE)	13.85
Theta hat (MLE)	3.343	Theta star (bias corrected MLE)	3.661
nu hat (MLE)	1031	nu star (bias corrected)	941.6
MLE Mean (bias corrected)	50.69	MLE Sd (bias corrected)	13.62
		Approximate Chi Square Value (0.05)	871.4
Adjusted Level of Significance	0.0422	Adjusted Chi Square Value	868.1

Appendix A-19b
UCL Evaluation - Sample Area
Shrimp (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	54.78	95% Adjusted Gamma UCL (use when n<50)	54.99

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.988	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.933	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0801	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.15	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.235	Mean of logged Data	3.892
Maximum of Logged Data	4.438	SD of logged Data	0.265

Assuming Lognormal Distribution

95% H-UCL	55.14	90% Chebyshev (MVUE) UCL	57.76
95% Chebyshev (MVUE) UCL	60.94	97.5% Chebyshev (MVUE) UCL	65.35
99% Chebyshev (MVUE) UCL	74.02		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	54.4	95% Jackknife UCL	54.51
95% Standard Bootstrap UCL	54.22	95% Bootstrap-t UCL	55.01
95% Hall's Bootstrap UCL	54.71	95% Percentile Bootstrap UCL	54.51
95% BCA Bootstrap UCL	54.53		
90% Chebyshev(Mean, Sd) UCL	57.46	95% Chebyshev(Mean, Sd) UCL	60.52
97.5% Chebyshev(Mean, Sd) UCL	64.78	99% Chebyshev(Mean, Sd) UCL	73.13

Suggested UCL to Use

95% Student's-t UCL	54.51

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-20a
UCL Evaluation - ProUCL Input
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_NSR&RWB	EA_Mummichog	EA_Eel	ID	DATE	Mercury	RESULT_UOM
MMSE	MM	STUDY AREA	MMSE-1_17BN001_062117_TIN_01_WB	6/21/2017	71.7	NG/G
MMSE	MM	STUDY AREA	MMSE-1_17BN001_062117_TIN_02_WB	6/21/2017	7.6	NG/G
MMSE	MM	STUDY AREA	MMSE-1_17BN001_062117_TIN_04_WB	6/21/2017	3.0	NG/G
MMSE	MM	STUDY AREA	MMSE-1_17BN003_062117_TIN_05_WB	6/21/2017	22.7	NG/G
MMSE	MM	STUDY AREA	MMSE-1_17BN004_062117_TIN_03_WB	6/21/2017	24.6	NG/G
MMSE	MM	STUDY AREA	MMSE-1_072016_TIN_01_WB	7/20/2016	16.5	NG/G
MMSE	MM	STUDY AREA	MMSE-1_072016_TIN_02_WB	7/20/2016	327.0	NG/G
MMSE	MM	STUDY AREA	MMSE-1_072016_TIN_03_WB	7/20/2016	354.0	NG/G
MMSE	MM	STUDY AREA	MMSE-1_072016_TIN_04_WB	7/20/2016	222.0	NG/G
MMSE	MM	STUDY AREA	MMSE-1_072016_TIN_05_WB	7/20/2016	56.3	NG/G
MMSW	MM	STUDY AREA	MMSW-C_17BN001_062317_TIN_04_WB	6/23/2017	11.6	NG/G
MMSW	MM	STUDY AREA	MMSW-C_17BN002_062317_TIN_02_WB	6/23/2017	35.6	NG/G
MMSW	MM	STUDY AREA	MMSW-C_17BN002_062317_TIN_03_WB	6/23/2017	34.3	NG/G
MMSW	MM	STUDY AREA	MMSW-C_17BN003_062317_TIN_01_WB	6/23/2017	3.8	NG/G
MMSW	MM	STUDY AREA	MMSW-C_17BN004_062317_TIN_05_WB	6/23/2017	93.7	NG/G
MMSW	MM	STUDY AREA	MMSW-C_072016_TIN_02_WB	7/20/2016	33.8	NG/G
MMSW	MM	STUDY AREA	MMSW-C_072016_TIN_03_WB	7/20/2016	47.5	NG/G
MMSW	MM	STUDY AREA	MMSW-C_072016_TIN_04_WB	7/20/2016	43.8	NG/G
MMSW	MM	STUDY AREA	MMSW-C_072016_TIN_05_WB	7/20/2016	52.9	NG/G
MMSW	MM	STUDY AREA	MMSW-C_072016_TIN_06_WB	7/20/2016	59.4	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_17BN001_062517_TIN_03_WB	6/25/2017	5.2	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_17BN001_062517_TIN_04_WB	6/25/2017	5.7	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_17BN004_062417_TIN_02_WB	6/24/2017	36.5	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_17BN005_062417_TIN_01_WB	6/24/2017	6.6	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_17MN001_062517_TIN_05_WB	6/25/2017	49.7	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_071916_TIN_01_WB	7/19/2016	254.0	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_071916_TIN_02_WB	7/19/2016	25.5	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_071916_TIN_03_WB	7/19/2016	50.0	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_071916_TIN_04_WB	7/19/2016	30.4	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_071916_TIN_05_WB	7/19/2016	29.2	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_17BN001_062317_TIN_01_WB	6/23/2017	1.5	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_17BN002_062317_TIN_02_WB	6/23/2017	11.5	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_17BN003_062317_TIN_03_WB	6/23/2017	41.8	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_17BN004_062317_TIN_04_WB	6/23/2017	25.0	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_17HC002_062317_TIN_05_WB	6/23/2017	2.6	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_072116_TIN_01_WB	7/21/2016	63.2	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_072116_TIN_02_WB	7/21/2016	49.2	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_072116_TIN_03_WB	7/21/2016	16.8	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_072116_TIN_04_WB	7/21/2016	7.4	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_072116_TIN_05_WB	7/21/2016	8.9	NG/G

Appendix A-20b
UCL Evaluation - Sample Area for Mummichog
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.19/27/2017 4:13:07 PM
From File	_092717 Terrestrial Insects.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

FINAL_RESU (mm)

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	2.95	Mean	76.09
Maximum	354	Median	39.7
SD	102.2	Std. Error of Mean	22.86
Coefficient of Variation	1.343	Skewness	2.092

Normal GOF Test

Shapiro Wilk Test Statistic	0.658	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.317	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	115.6	95% Adjusted-CLT UCL (Chen-1995)	125.1
		95% Modified-t UCL (Johnson-1978)	117.4

Gamma GOF Test

A-D Test Statistic	0.672	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.776	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.185	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.201	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.822	k star (bias corrected MLE)	0.732
Theta hat (MLE)	92.61	Theta star (bias corrected MLE)	104
nu hat (MLE)	32.86	nu star (bias corrected)	29.27
MLE Mean (bias corrected)	76.09	MLE Sd (bias corrected)	88.95
		Approximate Chi Square Value (0.05)	17.92
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	17.22

Appendix A-20b
UCL Evaluation - Sample Area for Mummichog
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	124.3	95% Adjusted Gamma UCL (use when n<50)	129.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.122	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.082	Mean of logged Data	3.612
Maximum of Logged Data	5.869	SD of logged Data	1.288

Assuming Lognormal Distribution

95% H-UCL	210.7	90% Chebyshev (MVUE) UCL	159.2
95% Chebyshev (MVUE) UCL	195.4	97.5% Chebyshev (MVUE) UCL	245.7
99% Chebyshev (MVUE) UCL	344.4		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	113.7	95% Jackknife UCL	115.6
95% Standard Bootstrap UCL	113	95% Bootstrap-t UCL	146
95% Hall's Bootstrap UCL	125.5	95% Percentile Bootstrap UCL	116.1
95% BCA Bootstrap UCL	128.2		
90% Chebyshev(Mean, Sd) UCL	144.7	95% Chebyshev(Mean, Sd) UCL	175.7
97.5% Chebyshev(Mean, Sd) UCL	218.8	99% Chebyshev(Mean, Sd) UCL	303.5

Suggested UCL to Use

95% Adjusted Gamma UCL	129.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU (penobscot river)

Appendix A-20b
UCL Evaluation - Sample Area for Mummichog
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	5.19	Mean	49.28
Maximum	254	Median	29.8
SD	73.84	Std. Error of Mean	23.35
Coefficient of Variation	1.498	Skewness	2.865

Normal GOF Test

Shapiro Wilk Test Statistic	0.575	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.396	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	92.08	95% Adjusted-CLT UCL (Chen-1995)	110.3
		95% Modified-t UCL (Johnson-1978)	95.6

Gamma GOF Test

A-D Test Statistic	0.662	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.254	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.275	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.873	k star (bias corrected MLE)	0.678
Theta hat (MLE)	56.45	Theta star (bias corrected MLE)	72.71
nu hat (MLE)	17.46	nu star (bias corrected)	13.56
MLE Mean (bias corrected)	49.28	MLE Sd (bias corrected)	59.86
		Approximate Chi Square Value (0.05)	6.268
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	5.431

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	106.6	95% Adjusted Gamma UCL (use when n<50)	123

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.905	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.204	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Appendix A-20b
UCL Evaluation - Sample Area for Mummichog
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	1.647	Mean of logged Data	3.225
Maximum of Logged Data	5.537	SD of logged Data	1.2

Assuming Lognormal Distribution

95% H-UCL	212.2	90% Chebyshev (MVUE) UCL	102.4
95% Chebyshev (MVUE) UCL	127.8	97.5% Chebyshev (MVUE) UCL	162.9
99% Chebyshev (MVUE) UCL	232		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	87.68	95% Jackknife UCL	92.08
95% Standard Bootstrap UCL	85.2	95% Bootstrap-t UCL	184.5
95% Hall's Bootstrap UCL	250.8	95% Percentile Bootstrap UCL	91.45
95% BCA Bootstrap UCL	116.4		
90% Chebyshev(Mean, Sd) UCL	119.3	95% Chebyshev(Mean, Sd) UCL	151.1
97.5% Chebyshev(Mean, Sd) UCL	195.1	99% Chebyshev(Mean, Sd) UCL	281.6

Suggested UCL to Use

95% Adjusted Gamma UCL	123

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU (reference)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	1.54	Mean	22.79
Maximum	63.2	Median	14.15
SD	21.47	Std. Error of Mean	6.791
Coefficient of Variation	0.942	Skewness	0.918

Normal GOF Test

Shapiro Wilk Test Statistic	0.875	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Appendix A-20b
UCL Evaluation - Sample Area for Mummichog
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	35.24	95% Adjusted-CLT UCL (Chen-1995)	36.07
		95% Modified-t UCL (Johnson-1978)	35.57

Gamma GOF Test

A-D Test Statistic	0.206	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.143	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.273	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.056	k star (bias corrected MLE)	0.806
Theta hat (MLE)	21.58	Theta star (bias corrected MLE)	28.28
nu hat (MLE)	21.12	nu star (bias corrected)	16.12
MLE Mean (bias corrected)	22.79	MLE Sd (bias corrected)	25.39
		Approximate Chi Square Value (0.05)	8.045
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	7.076

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	45.65	95% Adjusted Gamma UCL (use when n<50)	51.91

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.124	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.432	Mean of logged Data	2.583
Maximum of Logged Data	4.146	SD of logged Data	1.235

Assuming Lognormal Distribution

95% H-UCL	125.2	90% Chebyshev (MVUE) UCL	56.67
95% Chebyshev (MVUE) UCL	70.86	97.5% Chebyshev (MVUE) UCL	90.57
99% Chebyshev (MVUE) UCL	129.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-20b
UCL Evaluation - Sample Area for Mummichog
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	33.96	95% Jackknife UCL	35.24
95% Standard Bootstrap UCL	33.52	95% Bootstrap-t UCL	40.11
95% Hall's Bootstrap UCL	34.55	95% Percentile Bootstrap UCL	34.35
95% BCA Bootstrap UCL	35.01		
90% Chebyshev(Mean, Sd) UCL	43.16	95% Chebyshev(Mean, Sd) UCL	52.39
97.5% Chebyshev(Mean, Sd) UCL	65.2	99% Chebyshev(Mean, Sd) UCL	90.36

Suggested UCL to Use

95% Student's-t UCL	35.24

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-20c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.19/27/2017 4:09:49 PM
From File	_092717 Terrestrial Insects.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

FINAL_RESU (mmse)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	2.95	Mean	110.5
Maximum	354	Median	40.45
SD	137.1	Std. Error of Mean	43.35
Coefficient of Variation	1.24	Skewness	1.146

Normal GOF Test

Shapiro Wilk Test Statistic	0.757	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.312	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	190	95% Adjusted-CLT UCL (Chen-1995)	198.6
		95% Modified-t UCL (Johnson-1978)	192.6

Gamma GOF Test

A-D Test Statistic	0.413	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.765	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.2	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.278	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.647	k star (bias corrected MLE)	0.519
Theta hat (MLE)	170.9	Theta star (bias corrected MLE)	212.8
nu hat (MLE)	12.94	nu star (bias corrected)	10.39
MLE Mean (bias corrected)	110.5	MLE Sd (bias corrected)	153.4
		Approximate Chi Square Value (0.05)	4.187
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	3.529

Appendix A-20c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	274.3	95% Adjusted Gamma UCL (use when n<50)	325.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.146	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.082	Mean of logged Data	3.761
Maximum of Logged Data	5.869	SD of logged Data	1.612

Assuming Lognormal Distribution

95% H-UCL	1742	90% Chebyshev (MVUE) UCL	326.6
95% Chebyshev (MVUE) UCL	417.8	97.5% Chebyshev (MVUE) UCL	544.5
99% Chebyshev (MVUE) UCL	793.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	181.8	95% Jackknife UCL	190
95% Standard Bootstrap UCL	178.6	95% Bootstrap-t UCL	239.3
95% Hall's Bootstrap UCL	172.7	95% Percentile Bootstrap UCL	182.3
95% BCA Bootstrap UCL	199.5		
90% Chebyshev(Mean, Sd) UCL	240.6	95% Chebyshev(Mean, Sd) UCL	299.5
97.5% Chebyshev(Mean, Sd) UCL	381.2	99% Chebyshev(Mean, Sd) UCL	541.8

Suggested UCL to Use

95% Adjusted Gamma UCL	325.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU (mmsw)

Appendix A-20c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	3.75	Mean	41.64
Maximum	93.7	Median	39.7
SD	25.12	Std. Error of Mean	7.945
Coefficient of Variation	0.603	Skewness	0.576

Normal GOF Test

Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.178	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	56.2	95% Adjusted-CLT UCL (Chen-1995)	56.25
		95% Modified-t UCL (Johnson-1978)	56.44

Gamma GOF Test

A-D Test Statistic	0.531	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.281	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.27	Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.034	k star (bias corrected MLE)	1.49
Theta hat (MLE)	20.47	Theta star (bias corrected MLE)	27.94
nu hat (MLE)	40.68	nu star (bias corrected)	29.81
MLE Mean (bias corrected)	41.64	MLE Sd (bias corrected)	34.11
		Approximate Chi Square Value (0.05)	18.34
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	16.79

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	67.66	95% Adjusted Gamma UCL (use when n<50)	73.89

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.831	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.325	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Appendix A-20c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	1.322	Mean of logged Data	3.463
Maximum of Logged Data	4.54	SD of logged Data	0.924

Assuming Lognormal Distribution

95% H-UCL	121.5	90% Chebyshev (MVUE) UCL	88.74
95% Chebyshev (MVUE) UCL	108	97.5% Chebyshev (MVUE) UCL	134.6
99% Chebyshev (MVUE) UCL	187		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	54.7	95% Jackknife UCL	56.2
95% Standard Bootstrap UCL	53.89	95% Bootstrap-t UCL	56.5
95% Hall's Bootstrap UCL	62.54	95% Percentile Bootstrap UCL	54.51
95% BCA Bootstrap UCL	55.03		
90% Chebyshev(Mean, Sd) UCL	65.47	95% Chebyshev(Mean, Sd) UCL	76.27
97.5% Chebyshev(Mean, Sd) UCL	91.25	99% Chebyshev(Mean, Sd) UCL	120.7

Suggested UCL to Use

95% Student's-t UCL	56.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU (reference)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	1.54	Mean	22.79
Maximum	63.2	Median	14.15
SD	21.47	Std. Error of Mean	6.791
Coefficient of Variation	0.942	Skewness	0.918

Normal GOF Test

Shapiro Wilk Test Statistic	0.875	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Appendix A-20c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	35.24	95% Adjusted-CLT UCL (Chen-1995)	36.07
		95% Modified-t UCL (Johnson-1978)	35.57

Gamma GOF Test

A-D Test Statistic	0.206	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.143	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.273	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.056	k star (bias corrected MLE)	0.806
Theta hat (MLE)	21.58	Theta star (bias corrected MLE)	28.28
nu hat (MLE)	21.12	nu star (bias corrected)	16.12
MLE Mean (bias corrected)	22.79	MLE Sd (bias corrected)	25.39
		Approximate Chi Square Value (0.05)	8.045
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	7.076

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	45.65	95% Adjusted Gamma UCL (use when n<50)	51.91

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.124	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.432	Mean of logged Data	2.583
Maximum of Logged Data	4.146	SD of logged Data	1.235

Assuming Lognormal Distribution

95% H-UCL	125.2	90% Chebyshev (MVUE) UCL	56.67
95% Chebyshev (MVUE) UCL	70.86	97.5% Chebyshev (MVUE) UCL	90.57
99% Chebyshev (MVUE) UCL	129.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	33.96	95% Jackknife UCL	35.24
95% Standard Bootstrap UCL	33.5	95% Bootstrap-t UCL	40.04
95% Hall's Bootstrap UCL	35.26	95% Percentile Bootstrap UCL	34.58
95% BCA Bootstrap UCL	35.98		
90% Chebyshev(Mean, Sd) UCL	43.16	95% Chebyshev(Mean, Sd) UCL	52.39
97.5% Chebyshev(Mean, Sd) UCL	65.2	99% Chebyshev(Mean, Sd) UCL	90.36

Suggested UCL to Use

95% Student's-t UCL	35.24

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU (w-17-n)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	5.19	Mean	49.28
Maximum	254	Median	29.8
SD	73.84	Std. Error of Mean	23.35
Coefficient of Variation	1.498	Skewness	2.865

Normal GOF Test

Shapiro Wilk Test Statistic	0.575	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.396	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	92.08	95% Adjusted-CLT UCL (Chen-1995)	110.3
		95% Modified-t UCL (Johnson-1978)	95.6

Gamma GOF Test

A-D Test Statistic	0.662	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.254	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.275	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-20c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	0.873	k star (bias corrected MLE)	0.678
Theta hat (MLE)	56.45	Theta star (bias corrected MLE)	72.71
nu hat (MLE)	17.46	nu star (bias corrected)	13.56
MLE Mean (bias corrected)	49.28	MLE Sd (bias corrected)	59.86
		Approximate Chi Square Value (0.05)	6.268
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	5.431

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	106.6	95% Adjusted Gamma UCL (use when n<50)	123

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.905	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.204	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.647	Mean of logged Data	3.225
Maximum of Logged Data	5.537	SD of logged Data	1.2

Assuming Lognormal Distribution

95% H-UCL	212.2	90% Chebyshev (MVUE) UCL	102.4
95% Chebyshev (MVUE) UCL	127.8	97.5% Chebyshev (MVUE) UCL	162.9
99% Chebyshev (MVUE) UCL	232		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	87.68	95% Jackknife UCL	92.08
95% Standard Bootstrap UCL	85.22	95% Bootstrap-t UCL	188.7
95% Hall's Bootstrap UCL	251.1	95% Percentile Bootstrap UCL	93.25
95% BCA Bootstrap UCL	116.2		
90% Chebyshev(Mean, Sd) UCL	119.3	95% Chebyshev(Mean, Sd) UCL	151.1
97.5% Chebyshev(Mean, Sd) UCL	195.1	99% Chebyshev(Mean, Sd) UCL	281.6

Suggested UCL to Use

95% Adjusted Gamma UCL	123

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-20d
UCL Evaluation - Sample Area for American eel
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.19/27/2017 4:15:36 PM
From File	_092717 Terrestrial Insects.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

FINAL_RESU

General Statistics

Total Number of Observations	30	Number of Distinct Observations	30
		Number of Missing Observations	0
Minimum	2.95	Mean	67.15
Maximum	354	Median	34.95
SD	93.29	Std. Error of Mean	17.03
Coefficient of Variation	1.389	Skewness	2.237

Normal GOF Test

Shapiro Wilk Test Statistic	0.633	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.927	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.333	Lilliefors GOF Test
5% Lilliefors Critical Value	0.159	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	96.09	95% Adjusted-CLT UCL (Chen-1995)	102.6
		95% Modified-t UCL (Johnson-1978)	97.25

Gamma GOF Test

A-D Test Statistic	1.119	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.784	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.195	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.166	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.818	k star (bias corrected MLE)	0.758
Theta hat (MLE)	82.13	Theta star (bias corrected MLE)	88.58
nu hat (MLE)	49.06	nu star (bias corrected)	45.48
MLE Mean (bias corrected)	67.15	MLE Sd (bias corrected)	77.13
		Approximate Chi Square Value (0.05)	31.01
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	30.32

Appendix A-20d
UCL Evaluation - Sample Area for American eel
Terrestrial Insects (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	98.49	95% Adjusted Gamma UCL (use when n<50)	100.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.12	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.159	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.082	Mean of logged Data	3.483
Maximum of Logged Data	5.869	SD of logged Data	1.253

Assuming Lognormal Distribution

95% H-UCL	137.2	90% Chebyshev (MVUE) UCL	124.9
95% Chebyshev (MVUE) UCL	150.5	97.5% Chebyshev (MVUE) UCL	186.1
99% Chebyshev (MVUE) UCL	256		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	95.17	95% Jackknife UCL	96.09
95% Standard Bootstrap UCL	94.45	95% Bootstrap-t UCL	113.5
95% Hall's Bootstrap UCL	98.78	95% Percentile Bootstrap UCL	96.39
95% BCA Bootstrap UCL	105.5		
90% Chebyshev(Mean, Sd) UCL	118.2	95% Chebyshev(Mean, Sd) UCL	141.4
97.5% Chebyshev(Mean, Sd) UCL	173.5	99% Chebyshev(Mean, Sd) UCL	236.6

Suggested UCL to Use

95% H-UCL	137.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Appendix A-21a
UCL Evaluation - ProUCL Input
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_NSP&RWB	EA_Mummichog	EA_Tomcod&Eel	ID	DATE	Methyl Mercury	UOM
REFERENCE	REFERENCE	REFERENCE	ADD-01_072116_TIN_01_WB	7/21/2016	24.9	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_072116_TIN_02_WB	7/21/2016	2.5	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_072116_TIN_03_WB	7/21/2016	31.2	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_072116_TIN_04_WB	7/21/2016	12.7	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_072116_TIN_05_WB	7/21/2016	18.6	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_17BN001_062317_TIN_01_WB	6/23/2017	1.3	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_17BN002_062317_TIN_02_WB	6/23/2017	8.2	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_17BN003_062317_TIN_03_WB	6/23/2017	29.8	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_17BN004_062317_TIN_04_WB	6/23/2017	26.1	NG/G
REFERENCE	REFERENCE	REFERENCE	ADD-01_17HC002_062317_TIN_05_WB	6/23/2017	2.2	NG/G
MMSE	MM	STUDY AREA	MMSE-1_072016_TIN_01_WB	7/20/2016	91.2	NG/G
MMSE	MM	STUDY AREA	MMSE-1_072016_TIN_02_WB	7/20/2016	68.3	NG/G
MMSE	MM	STUDY AREA	MMSE-1_072016_TIN_03_WB	7/20/2016	241.0	NG/G
MMSE	MM	STUDY AREA	MMSE-1_072016_TIN_04_WB	7/20/2016	100.0	NG/G
MMSE	MM	STUDY AREA	MMSE-1_072016_TIN_05_WB	7/20/2016	6.9	NG/G
MMSE	MM	STUDY AREA	MMSE-1_17BN001_062117_TIN_01_WB	6/21/2017	60.2	NG/G
MMSE	MM	STUDY AREA	MMSE-1_17BN001_062117_TIN_02_WB	6/21/2017	6.9	NG/G
MMSE	MM	STUDY AREA	MMSE-1_17BN001_062117_TIN_04_WB	6/21/2017	2.1	NG/G
MMSE	MM	STUDY AREA	MMSE-1_17BN003_062117_TIN_05_WB	6/21/2017	21.2	NG/G
MMSE	MM	STUDY AREA	MMSE-1_17BN004_062117_TIN_03_WB	6/21/2017	21.5	NG/G
MMSW	MM	STUDY AREA	MMSW-C_072016_TIN_02_WB	7/20/2016	28.3	NG/G
MMSW	MM	STUDY AREA	MMSW-C_072016_TIN_03_WB	7/20/2016	33.5	NG/G
MMSW	MM	STUDY AREA	MMSW-C_072016_TIN_04_WB	7/20/2016	16.8	NG/G
MMSW	MM	STUDY AREA	MMSW-C_072016_TIN_05_WB	7/20/2016	26.8	NG/G
MMSW	MM	STUDY AREA	MMSW-C_072016_TIN_06_WB	7/20/2016	7.9	NG/G
MMSW	MM	STUDY AREA	MMSW-C_17BN001_062317_TIN_04_WB	6/23/2017	14.7	NG/G
MMSW	MM	STUDY AREA	MMSW-C_17BN002_062317_TIN_02_WB	6/23/2017	27.1	NG/G
MMSW	MM	STUDY AREA	MMSW-C_17BN002_062317_TIN_03_WB	6/23/2017	28.4	NG/G
MMSW	MM	STUDY AREA	MMSW-C_17BN003_062317_TIN_01_WB	6/23/2017	2.9	NG/G
MMSW	MM	STUDY AREA	MMSW-C_17BN004_062317_TIN_05_WB	6/23/2017	49.5	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_071916_TIN_01_WB	7/19/2016	64.2	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_071916_TIN_02_WB	7/19/2016	118.0	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_071916_TIN_03_WB	7/19/2016	56.7	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_071916_TIN_04_WB	7/19/2016	21.7	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_071916_TIN_05_WB	7/19/2016	28.0	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_17BN001_062517_TIN_03_WB	6/25/2017	3.2	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_17BN001_062517_TIN_04_WB	6/25/2017	4.9	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_17BN004_062417_TIN_02_WB	6/24/2017	39.2	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_17BN005_062417_TIN_01_WB	6/24/2017	2.4	NG/G
W-17-N	Penobscot River	STUDY AREA	W17-N_17MN001_062517_TIN_05_WB	6/25/2017	41.6	NG/G

Appendix A-21b
UCL Evaluation - Sample Area for Mummichog
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/9/2017 3:53:18 PM
From File	A-23xB TIN-meHg_FF.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

FINAL_RESU_meHg (mm)

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	2.1	Mean	42.76
Maximum	241	Median	26.95
SD	54.45	Std. Error of Mean	12.18
Coefficient of Variation	1.273	Skewness	2.816

Normal GOF Test

Shapiro Wilk Test Statistic	0.673	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.268	Lilliefors GOF Test
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	63.81	95% Adjusted-CLT UCL (Chen-1995)	70.98
		95% Modified-t UCL (Johnson-1978)	65.09

Gamma GOF Test

A-D Test Statistic	0.344	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.77	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.158	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.2	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.957	k star (bias corrected MLE)	0.847
Theta hat (MLE)	44.69	Theta star (bias corrected MLE)	50.51
nu hat (MLE)	38.27	nu star (bias corrected)	33.86
MLE Mean (bias corrected)	42.76	MLE Sd (bias corrected)	46.47
		Approximate Chi Square Value (0.05)	21.56
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	20.78

Appendix A-21b
UCL Evaluation - Sample Area for Mummichog
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	67.18	95% Adjusted Gamma UCL (use when n<50)	69.68

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.118	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.742	Mean of logged Data	3.149
Maximum of Logged Data	5.485	SD of logged Data	1.19

Assuming Lognormal Distribution

95% H-UCL	105.1	90% Chebyshev (MVUE) UCL	85.97
95% Chebyshev (MVUE) UCL	104.6	97.5% Chebyshev (MVUE) UCL	130.5
99% Chebyshev (MVUE) UCL	181.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	62.79	95% Jackknife UCL	63.81
95% Standard Bootstrap UCL	62.67	95% Bootstrap-t UCL	85.51
95% Hall's Bootstrap UCL	143.3	95% Percentile Bootstrap UCL	64.36
95% BCA Bootstrap UCL	70.75		
90% Chebyshev(Mean, Sd) UCL	79.29	95% Chebyshev(Mean, Sd) UCL	95.83
97.5% Chebyshev(Mean, Sd) UCL	118.8	99% Chebyshev(Mean, Sd) UCL	163.9

Suggested UCL to Use

95% Adjusted Gamma UCL	69.68

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU_meHg (penobscot river)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	2.4	Mean	37.99

Appendix A-21b
UCL Evaluation - Sample Area for Mummichog
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Maximum	118	Median	33.6
SD	35.58	Std. Error of Mean	11.25
Coefficient of Variation	0.936	Skewness	1.259

Normal GOF Test

Shapiro Wilk Test Statistic	0.885	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.16	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	58.61	95% Adjusted-CLT UCL (Chen-1995)	61.28
		95% Modified-t UCL (Johnson-1978)	59.36

Gamma GOF Test

A-D Test Statistic	0.345	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.274	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.971	k star (bias corrected MLE)	0.746
Theta hat (MLE)	39.14	Theta star (bias corrected MLE)	50.92
nu hat (MLE)	19.41	nu star (bias corrected)	14.92
MLE Mean (bias corrected)	37.99	MLE Sd (bias corrected)	43.98
		Approximate Chi Square Value (0.05)	7.206
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	6.297

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	78.66	95% Adjusted Gamma UCL (use when n<50)	90.01

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.893	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.211	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.875	Mean of logged Data	3.04
Maximum of Logged Data	4.771	SD of logged Data	1.355

Assuming Lognormal Distribution

95% H-UCL	301	90% Chebyshev (MVUE) UCL	106.8
95% Chebyshev (MVUE) UCL	134.7	97.5% Chebyshev (MVUE) UCL	173.4
99% Chebyshev (MVUE) UCL	249.4		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	56.49	95% Jackknife UCL	58.61
95% Standard Bootstrap UCL	55.14	95% Bootstrap-t UCL	67.6
95% Hall's Bootstrap UCL	79.68	95% Percentile Bootstrap UCL	55.7
95% BCA Bootstrap UCL	59.84		
90% Chebyshev(Mean, Sd) UCL	71.74	95% Chebyshev(Mean, Sd) UCL	87.03
97.5% Chebyshev(Mean, Sd) UCL	108.2	99% Chebyshev(Mean, Sd) UCL	149.9

Suggested UCL to Use

95% Student's-t UCL 58.61

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU_meHg (reference-add)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	1.3	Mean	15.75
Maximum	31.2	Median	15.65
SD	11.88	Std. Error of Mean	3.756
Coefficient of Variation	0.754	Skewness	0.00576

Normal GOF Test

Shapiro Wilk Test Statistic	0.888	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.179	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	22.63	95% Adjusted-CLT UCL (Chen-1995)	21.93
		95% Modified-t UCL (Johnson-1978)	22.64

Appendix A-21b
UCL Evaluation - Sample Area for Mummichog
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.583	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.199	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.273	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.198	k star (bias corrected MLE)	0.906
Theta hat (MLE)	13.14	Theta star (bias corrected MLE)	17.39
nu hat (MLE)	23.97	nu star (bias corrected)	18.11
MLE Mean (bias corrected)	15.75	MLE Sd (bias corrected)	16.55
		Approximate Chi Square Value (0.05)	9.471
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	8.406

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	30.12	95% Adjusted Gamma UCL (use when n<50)	33.93

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.849	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.202	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.262	Mean of logged Data	2.285
Maximum of Logged Data	3.44	SD of logged Data	1.206

Assuming Lognormal Distribution

95% H-UCL	84.46	90% Chebyshev (MVUE) UCL	40.33
95% Chebyshev (MVUE) UCL	50.33	97.5% Chebyshev (MVUE) UCL	64.2
99% Chebyshev (MVUE) UCL	91.46		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	21.93	95% Jackknife UCL	22.63
95% Standard Bootstrap UCL	21.71	95% Bootstrap-t UCL	22.96
95% Hall's Bootstrap UCL	21.04	95% Percentile Bootstrap UCL	21.8
95% BCA Bootstrap UCL	21.32		
90% Chebyshev(Mean, Sd) UCL	27.02	95% Chebyshev(Mean, Sd) UCL	32.12
97.5% Chebyshev(Mean, Sd) UCL	39.2	99% Chebyshev(Mean, Sd) UCL	53.12

Suggested UCL to Use

Appendix A-21b
UCL Evaluation - Sample Area for Mummichog
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

95% Student's-t UCL	22.63

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-21c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/9/2017 3:11:41 PM
From File	A-23B TIN-meHg_NSRWB.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

FINAL_RESU_meHg (mmse)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	2.1	Mean	61.93
Maximum	241	Median	40.85
SD	72.53	Std. Error of Mean	22.94
Coefficient of Variation	1.171	Skewness	1.872

Normal GOF Test

Shapiro Wilk Test Statistic	0.788	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.211	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	104	95% Adjusted-CLT UCL (Chen-1995)	114.2
		95% Modified-t UCL (Johnson-1978)	106.2

Gamma GOF Test

A-D Test Statistic	0.258	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.153	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.276	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.782	k star (bias corrected MLE)	0.614
Theta hat (MLE)	79.16	Theta star (bias corrected MLE)	100.8
nu hat (MLE)	15.65	nu star (bias corrected)	12.29
MLE Mean (bias corrected)	61.93	MLE Sd (bias corrected)	79.01
		Approximate Chi Square Value (0.05)	5.416
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	4.648

Appendix A-21c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	140.5	95% Adjusted Gamma UCL (use when n<50)	163.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.951	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.189	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.742	Mean of logged Data	3.365
Maximum of Logged Data	5.485	SD of logged Data	1.483

Assuming Lognormal Distribution

95% H-UCL	682.5	90% Chebyshev (MVUE) UCL	179.7
95% Chebyshev (MVUE) UCL	228.4	97.5% Chebyshev (MVUE) UCL	295.9
99% Chebyshev (MVUE) UCL	428.6		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	99.66	95% Jackknife UCL	104
95% Standard Bootstrap UCL	98.03	95% Bootstrap-t UCL	134.8
95% Hall's Bootstrap UCL	246.2	95% Percentile Bootstrap UCL	100.5
95% BCA Bootstrap UCL	112.2		
90% Chebyshev(Mean, Sd) UCL	130.7	95% Chebyshev(Mean, Sd) UCL	161.9
97.5% Chebyshev(Mean, Sd) UCL	205.2	99% Chebyshev(Mean, Sd) UCL	290.1

Suggested UCL to Use

95% Student's-t UCL	104

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU_meHg (mmsw)

Appendix A-21c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	2.9	Mean	23.59
Maximum	49.5	Median	26.95
SD	13.49	Std. Error of Mean	4.265
Coefficient of Variation	0.572	Skewness	0.279

Normal GOF Test

Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.194	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	31.41	95% Adjusted-CLT UCL (Chen-1995)	31.01
		95% Modified-t UCL (Johnson-1978)	31.47

Gamma GOF Test

A-D Test Statistic	0.476	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.262	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.269	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.349	k star (bias corrected MLE)	1.711
Theta hat (MLE)	10.04	Theta star (bias corrected MLE)	13.79
nu hat (MLE)	46.99	nu star (bias corrected)	34.22
MLE Mean (bias corrected)	23.59	MLE Sd (bias corrected)	18.03
		Approximate Chi Square Value (0.05)	21.84
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	20.14

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	36.96	95% Adjusted Gamma UCL (use when n<50)	40.09

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.862	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.266	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.065	Mean of logged Data	2.933
Maximum of Logged Data	3.902	SD of logged Data	0.829

Assuming Lognormal Distribution

95% H-UCL	56.87	90% Chebyshev (MVUE) UCL	46.14
95% Chebyshev (MVUE) UCL	55.54	97.5% Chebyshev (MVUE) UCL	68.59
99% Chebyshev (MVUE) UCL	94.21		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	30.6	95% Jackknife UCL	31.41
95% Standard Bootstrap UCL	30.26	95% Bootstrap-t UCL	31.62
95% Hall's Bootstrap UCL	32.41	95% Percentile Bootstrap UCL	30.27
95% BCA Bootstrap UCL	30.02		
90% Chebyshev(Mean, Sd) UCL	36.38	95% Chebyshev(Mean, Sd) UCL	42.18
97.5% Chebyshev(Mean, Sd) UCL	50.22	99% Chebyshev(Mean, Sd) UCL	66.02

Suggested UCL to Use

95% Student's-t UCL	31.41

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU_meHg (reference-add)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	1.3	Mean	15.75
Maximum	31.2	Median	15.65
SD	11.88	Std. Error of Mean	3.756
Coefficient of Variation	0.754	Skewness	0.00576

Normal GOF Test

Shapiro Wilk Test Statistic	0.888	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.179	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Appendix A-21c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	22.63	95% Adjusted-CLT UCL (Chen-1995)	21.93
		95% Modified-t UCL (Johnson-1978)	22.64

Gamma GOF Test

A-D Test Statistic	0.583	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.199	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.273	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.198	k star (bias corrected MLE)	0.906
Theta hat (MLE)	13.14	Theta star (bias corrected MLE)	17.39
nu hat (MLE)	23.97	nu star (bias corrected)	18.11
MLE Mean (bias corrected)	15.75	MLE Sd (bias corrected)	16.55
		Approximate Chi Square Value (0.05)	9.471
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	8.406

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	30.12	95% Adjusted Gamma UCL (use when n<50)	33.93

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.849	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.202	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.262	Mean of logged Data	2.285
Maximum of Logged Data	3.44	SD of logged Data	1.206

Assuming Lognormal Distribution

95% H-UCL	84.46	90% Chebyshev (MVUE) UCL	40.33
95% Chebyshev (MVUE) UCL	50.33	97.5% Chebyshev (MVUE) UCL	64.2
99% Chebyshev (MVUE) UCL	91.46		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-21c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	21.93	95% Jackknife UCL	22.63
95% Standard Bootstrap UCL	21.49	95% Bootstrap-t UCL	22.29
95% Hall's Bootstrap UCL	20.99	95% Percentile Bootstrap UCL	21.91
95% BCA Bootstrap UCL	21.56		
90% Chebyshev(Mean, Sd) UCL	27.02	95% Chebyshev(Mean, Sd) UCL	32.12
97.5% Chebyshev(Mean, Sd) UCL	39.2	99% Chebyshev(Mean, Sd) UCL	53.12

Suggested UCL to Use

95% Student's-t UCL 22.63

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU_meHg (w-17-n)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	2.4	Mean	37.99
Maximum	118	Median	33.6
SD	35.58	Std. Error of Mean	11.25
Coefficient of Variation	0.936	Skewness	1.259

Normal GOF Test

Shapiro Wilk Test Statistic	0.885	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.16	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	58.61	95% Adjusted-CLT UCL (Chen-1995)	61.28
		95% Modified-t UCL (Johnson-1978)	59.36

Gamma GOF Test

A-D Test Statistic	0.345	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.274	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-21c
UCL Evaluation - Sample Area for Nelson's sparrow and Red-winged blackbird
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	0.971	k star (bias corrected MLE)	0.746
Theta hat (MLE)	39.14	Theta star (bias corrected MLE)	50.92
nu hat (MLE)	19.41	nu star (bias corrected)	14.92
MLE Mean (bias corrected)	37.99	MLE Sd (bias corrected)	43.98
		Approximate Chi Square Value (0.05)	7.206
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	6.297

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	78.66	95% Adjusted Gamma UCL (use when n<50)	90.01

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.893	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.211	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.875	Mean of logged Data	3.04
Maximum of Logged Data	4.771	SD of logged Data	1.355

Assuming Lognormal Distribution

95% H-UCL	301	90% Chebyshev (MVUE) UCL	106.8
95% Chebyshev (MVUE) UCL	134.7	97.5% Chebyshev (MVUE) UCL	173.4
99% Chebyshev (MVUE) UCL	249.4		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	56.49	95% Jackknife UCL	58.61
95% Standard Bootstrap UCL	55.78	95% Bootstrap-t UCL	66.98
95% Hall's Bootstrap UCL	76.04	95% Percentile Bootstrap UCL	56.31
95% BCA Bootstrap UCL	59.42		
90% Chebyshev(Mean, Sd) UCL	71.74	95% Chebyshev(Mean, Sd) UCL	87.03
97.5% Chebyshev(Mean, Sd) UCL	108.2	99% Chebyshev(Mean, Sd) UCL	149.9

Suggested UCL to Use

95% Student's-t UCL	58.61

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-21d
UCL Evaluation - Sample Area for American eel
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/9/2017 4:03:47 PM
From File	A-23xB TIN-meHg_PF.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

FINAL_RESU_meHg (marsh-penobscot river)

General Statistics

Total Number of Observations	30	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	2.1	Mean	41.17
Maximum	241	Median	27.55
SD	48.38	Std. Error of Mean	8.833
Coefficient of Variation	1.175	Skewness	2.722

Normal GOF Test

Shapiro Wilk Test Statistic	0.722	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.927	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.21	Lilliefors GOF Test
5% Lilliefors Critical Value	0.159	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	56.18	95% Adjusted-CLT UCL (Chen-1995)	60.39
		95% Modified-t UCL (Johnson-1978)	56.91

Gamma GOF Test

A-D Test Statistic	0.288	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.777	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0959	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.165	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.959	k star (bias corrected MLE)	0.885
Theta hat (MLE)	42.92	Theta star (bias corrected MLE)	46.5
nu hat (MLE)	57.55	nu star (bias corrected)	53.13
MLE Mean (bias corrected)	41.17	MLE Sd (bias corrected)	43.75
		Approximate Chi Square Value (0.05)	37.38
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	36.62

Appendix A-21d
UCL Evaluation - Sample Area for American eel
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	58.51	95% Adjusted Gamma UCL (use when n<50)	59.73

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.147	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.159	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.742	Mean of logged Data	3.113
Maximum of Logged Data	5.485	SD of logged Data	1.225

Assuming Lognormal Distribution

95% H-UCL	89.47	90% Chebyshev (MVUE) UCL	82.55
95% Chebyshev (MVUE) UCL	99.24	97.5% Chebyshev (MVUE) UCL	122.4
99% Chebyshev (MVUE) UCL	167.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	55.7	95% Jackknife UCL	56.18
95% Standard Bootstrap UCL	55.58	95% Bootstrap-t UCL	66.17
95% Hall's Bootstrap UCL	114.8	95% Percentile Bootstrap UCL	57.11
95% BCA Bootstrap UCL	61.22		
90% Chebyshev(Mean, Sd) UCL	67.67	95% Chebyshev(Mean, Sd) UCL	79.67
97.5% Chebyshev(Mean, Sd) UCL	96.33	99% Chebyshev(Mean, Sd) UCL	129.1

Suggested UCL to Use

95% Adjusted Gamma UCL	59.73

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU_meHg (reference-add)

Appendix A-21d
UCL Evaluation - Sample Area for American eel
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	1.3	Mean	15.75
Maximum	31.2	Median	15.65
SD	11.88	Std. Error of Mean	3.756
Coefficient of Variation	0.754	Skewness	0.00576

Normal GOF Test

Shapiro Wilk Test Statistic	0.888	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.179	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	22.63	95% Adjusted-CLT UCL (Chen-1995)	21.93
		95% Modified-t UCL (Johnson-1978)	22.64

Gamma GOF Test

A-D Test Statistic	0.583	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.199	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.273	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.198	k star (bias corrected MLE)	0.906
Theta hat (MLE)	13.14	Theta star (bias corrected MLE)	17.39
nu hat (MLE)	23.97	nu star (bias corrected)	18.11
MLE Mean (bias corrected)	15.75	MLE Sd (bias corrected)	16.55
		Approximate Chi Square Value (0.05)	9.471
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	8.406

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	30.12	95% Adjusted Gamma UCL (use when n<50)	33.93

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.849	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.202	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Appendix A-21d
UCL Evaluation - Sample Area for American eel
Terrestrial Insects (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	0.262	Mean of logged Data	2.285
Maximum of Logged Data	3.44	SD of logged Data	1.206

Assuming Lognormal Distribution

95% H-UCL	84.46	90% Chebyshev (MVUE) UCL	40.33
95% Chebyshev (MVUE) UCL	50.33	97.5% Chebyshev (MVUE) UCL	64.2
99% Chebyshev (MVUE) UCL	91.46		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	21.93	95% Jackknife UCL	22.63
95% Standard Bootstrap UCL	21.65	95% Bootstrap-t UCL	22.85
95% Hall's Bootstrap UCL	20.92	95% Percentile Bootstrap UCL	21.78
95% BCA Bootstrap UCL	21.44		
90% Chebyshev(Mean, Sd) UCL	27.02	95% Chebyshev(Mean, Sd) UCL	32.12
97.5% Chebyshev(Mean, Sd) UCL	39.2	99% Chebyshev(Mean, Sd) UCL	53.12

Suggested UCL to Use

95% Student's-t UCL	22.63

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-22a
UCL Evaluation - ProUCL Input
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_ABD	EA_Tomcod&Eel	ID	DATE	Mercury	D_Mercury	UOM
PENOBSCOT RIVER	STUDY AREA	BFK_17HC001_073117_POL_01_WB	7/31/2017	17.6	1	NG/G
PENOBSCOT RIVER	STUDY AREA	BFK_17HC001_073117_POL_02_WB	7/31/2017	21.2	1	NG/G
PENOBSCOT RIVER	STUDY AREA	BFK_17HC001_073117_POL_03_WB	7/31/2017	14.7	1	NG/G
PENOBSCOT RIVER	STUDY AREA	BFK_17HC001_073117_POL_04_WB	7/31/2017	12.4	1	NG/G
PENOBSCOT RIVER	STUDY AREA	BFK_17HC001_073117_POL_05_WB	7/31/2017	18.3	1	NG/G
PENOBSCOT RIVER	STUDY AREA	BO-04_072616_POL_01_WB	7/26/2016	142	1	NG/G
PENOBSCOT RIVER	STUDY AREA	BO-04_072616_POL_02_WB	7/26/2016	176	1	NG/G
PENOBSCOT RIVER	STUDY AREA	BO-04_072616_POL_03_WB	7/26/2016	185	1	NG/G
PENOBSCOT RIVER	STUDY AREA	BO-04_072616_POL_04_WB	7/26/2016	311	1	NG/G
PENOBSCOT RIVER	STUDY AREA	BO-04_072616_POL_05_WB	7/26/2016	256	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-02E_17HC001_073117_POL_01_WB	7/31/2017	10.3	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-02E_17HC001_073117_POL_02_WB	7/31/2017	24.6	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-02E_17HC001_073117_POL_03_WB	7/31/2017	29.8	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-02E_17HC001_073117_POL_04_WB	7/31/2017	31.5	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-02E_17HC001_073117_POL_05_WB	7/31/2017	38.8	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-03_17HC001_072717_POL_01_WB	7/27/2017	35.9	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-03_17HC001_072717_POL_02_WB	7/27/2017	29.7	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-03_17HC001_072717_POL_03_WB	7/27/2017	48	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-03_17HC001_072717_POL_04_WB	7/27/2017	27.8	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-03_17HC001_072717_POL_05_WB	7/27/2017	22.4	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-13_17HC001_072517_POL_01_WB	7/25/2017	46.1	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-13_17HC001_072517_POL_02_WB	7/25/2017	28	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-13_17HC001_072517_POL_03_WB	7/25/2017	19.5	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-13_17HC001_072517_POL_04_WB	7/25/2017	13	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-13_17HC001_072517_POL_05_WB	7/25/2017	13.6	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-13_072716_POL_01_WB	7/27/2016	20.8	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-13_072716_POL_02_WB	7/27/2016	45.2	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-13_072716_POL_03_WB	7/27/2016	12.8	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-13_072716_POL_04_WB	7/27/2016	24.7	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-13_072716_POL_05_WB	7/27/2016	71.3	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-15_17HC001_081617_POL_01_WB	8/16/2017	42	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-15_17HC001_081617_POL_02_WB	8/16/2017	21.2	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-15_17HC001_081617_POL_03_WB	8/16/2017	30.5	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-15_17HC001_081617_POL_04_WB	8/16/2017	32	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-15_17HC001_081617_POL_05_WB	8/16/2017	21.7	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ESFP_17HC001_072817_POL_01_WB	7/28/2017	12.9	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ESFP_17HC001_072817_POL_02_WB	7/28/2017	12	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ESFP_17HC001_072817_POL_03_WB	7/28/2017	9.71	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ESFP_17HC001_072817_POL_04_WB	7/28/2017	12.9	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ESFP_17HC001_072817_POL_05_WB	7/28/2017	8.94	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-FP_072816_POL_01_WB	7/28/2016	34.6	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-FP_072816_POL_02_WB	7/28/2016	24	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-FP_072816_POL_03_WB	7/28/2016	24.5	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-FP_072816_POL_04_WB	7/28/2016	19.4	1	NG/G
PENOBSCOT RIVER	STUDY AREA	ES-FP_072816_POL_05_WB	7/28/2016	46.1	1	NG/G
FRENCHMAN BAY - REF	FRENCHMAN BAY - REF	FRB-01_17HD001_091217_POL_01_WB	9/12/2017	8.82	1	NG/G
FRENCHMAN BAY - REF	FRENCHMAN BAY - REF	FRB-01_17HD001_091217_POL_02_WB	9/12/2017	7.66	1	NG/G
FRENCHMAN BAY - REF	FRENCHMAN BAY - REF	FRB-01_17HD001_091217_POL_03_WB	9/12/2017	7.4	1	NG/G
FRENCHMAN BAY - REF	FRENCHMAN BAY - REF	FRB-01_17HD001_091217_POL_04_WB	9/12/2017	8.1	1	NG/G
FRENCHMAN BAY - REF	FRENCHMAN BAY - REF	FRB-01_17HD001_091217_POL_05_WB	9/12/2017	7.17	1	NG/G
FRENCHMAN BAY - REF	FRENCHMAN BAY - REF	FRB-01_092816_POL_01_WB	9/28/2016	1.9	0	NG/G
FRENCHMAN BAY - REF	FRENCHMAN BAY - REF	FRB-01_092816_POL_02_WB	9/28/2016	2.46	0	NG/G
FRENCHMAN BAY - REF	FRENCHMAN BAY - REF	FRB-01_092816_POL_03_WB	9/28/2016	1.15	0	NG/G
FRENCHMAN BAY - REF	FRENCHMAN BAY - REF	FRB-01_092816_POL_04_WB	9/28/2016	3.18	1	NG/G
FRENCHMAN BAY - REF	FRENCHMAN BAY - REF	FRB-01_092816_POL_05_WB	9/28/2016	1.82	0	NG/G
MENDALL MARSH	STUDY AREA	MM-MR_INT_17HC001_080117_POL_01_WB	8/1/2017	53.8	1	NG/G
MENDALL MARSH	STUDY AREA	MM-MR_INT_17HC001_080117_POL_02_WB	8/1/2017	39.9	1	NG/G
MENDALL MARSH	STUDY AREA	MM-MR_INT_17HC001_080117_POL_03_WB	8/1/2017	37.4	1	NG/G
MENDALL MARSH	STUDY AREA	MM-MR_INT_17HC001_080117_POL_04_WB	8/1/2017	59.2	1	NG/G
MENDALL MARSH	STUDY AREA	MM-MR_INT_17HC001_080117_POL_05_WB	8/1/2017	54.5	1	NG/G
MENDALL MARSH	STUDY AREA	MMPOLY-01_072916_POL_01_WB	7/29/2016	69.9	1	NG/G

Appendix A-22a
UCL Evaluation - ProUCL Input
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_ABD	EA_Tomcod&Eel	ID	DATE	Mercury	D_Mercury	UOM
MENDALL MARSH	STUDY AREA	MMPOLY-01_072916_POL_02_WB	7/29/2016	321	1	NG/G
MENDALL MARSH	STUDY AREA	MMPOLY-01_072916_POL_03_WB	7/29/2016	190	1	NG/G
MENDALL MARSH	STUDY AREA	MMPOLY-01_072916_POL_04_WB	7/29/2016	142	1	NG/G
MENDALL MARSH	STUDY AREA	MMPOLY-01_072916_POL_05_WB	7/29/2016	239	1	NG/G
PENOBSCOT RIVER	STUDY AREA	OB-01_17HC001_072517_POL_01_WB	7/25/2017	30.5	1	NG/G
PENOBSCOT RIVER	STUDY AREA	OB-01_17HC001_072517_POL_02_WB	7/25/2017	30.6	1	NG/G
PENOBSCOT RIVER	STUDY AREA	OB-01_17HC001_072517_POL_03_WB	7/25/2017	32	1	NG/G
PENOBSCOT RIVER	STUDY AREA	OB-01_17HC001_072517_POL_04_WB	7/25/2017	35.8	1	NG/G
PENOBSCOT RIVER	STUDY AREA	OB-01_17HC001_072517_POL_05_WB	7/25/2017	29.5	1	NG/G
PENOBSCOT RIVER	STUDY AREA	OB-05_072616_POL_01_WB	7/26/2016	215	1	NG/G
PENOBSCOT RIVER	STUDY AREA	OB-05_072616_POL_02_WB	7/26/2016	224	1	NG/G
PENOBSCOT RIVER	STUDY AREA	OB-05_072616_POL_03_WB	7/26/2016	205	1	NG/G
PENOBSCOT RIVER	STUDY AREA	OB-05_072616_POL_04_WB	7/26/2016	189	1	NG/G
PENOBSCOT RIVER	STUDY AREA	OB-05_072616_POL_05_WB	7/26/2016	230	1	NG/G
PENOBSCOT RIVER	STUDY AREA	PI-01_17HC001_080217_POL_01_WB	8/2/2017	37.1	1	NG/G
PENOBSCOT RIVER	STUDY AREA	PI-01_17HC001_080217_POL_02_WB	8/2/2017	45.5	1	NG/G
PENOBSCOT RIVER	STUDY AREA	PI-01_17HC001_080217_POL_03_WB	8/2/2017	33.2	1	NG/G
PENOBSCOT RIVER	STUDY AREA	PI-01_17HC001_080217_POL_04_WB	8/2/2017	21.8	1	NG/G
PENOBSCOT RIVER	STUDY AREA	PI-01_17HC001_080217_POL_05_WB	8/2/2017	42	1	NG/G
PENOBSCOT RIVER	STUDY AREA	SVE-02INT_17HC001_080217_POL_01_WB	8/2/2017	28.9	1	NG/G
PENOBSCOT RIVER	STUDY AREA	SVE-02INT_17HC001_080217_POL_02_WB	8/2/2017	23.9	1	NG/G
PENOBSCOT RIVER	STUDY AREA	SVE-02INT_17HC001_080217_POL_03_WB	8/2/2017	24.7	1	NG/G
PENOBSCOT RIVER	STUDY AREA	SVE-02INT_17HC001_080217_POL_04_WB	8/2/2017	22.1	1	NG/G
PENOBSCOT RIVER	STUDY AREA	SVE-02INT_17HC001_080217_POL_05_WB	8/2/2017	25	1	NG/G
PENOBSCOT RIVER	STUDY AREA	VI-W_17HC001_081617_POL_01_WB	8/16/2017	23.8	1	NG/G
PENOBSCOT RIVER	STUDY AREA	VI-W_17HC001_081617_POL_02_WB	8/16/2017	19.6	1	NG/G
PENOBSCOT RIVER	STUDY AREA	VI-W_17HC001_081617_POL_03_WB	8/16/2017	16.9	1	NG/G
PENOBSCOT RIVER	STUDY AREA	VI-W_17HC001_081617_POL_04_WB	8/16/2017	23.7	1	NG/G
PENOBSCOT RIVER	STUDY AREA	VI-W_17HC001_081617_POL_05_WB	8/16/2017	20.1	1	NG/G

Appendix A-22b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/14/2017 12:04:51 PM
From File	2017-11-14 PEN_BI21 BERA_polychaetes_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

PPM_RESULT_Hg (frenchman bay - ref)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Number of Detects	6	Number of Non-Detects	4
Number of Distinct Detects	6	Number of Distinct Non-Detects	4
Minimum Detect	3.18	Minimum Non-Detect	1.15
Maximum Detect	8.82	Maximum Non-Detect	2.46
Variance Detects	3.944	Percent Non-Detects	40%
Mean Detects	7.055	SD Detects	1.986
Median Detects	7.53	CV Detects	0.282
Skewness Detects	-1.964	Kurtosis Detects	4.392
Mean of Logged Detects	1.906	SD of Logged Detects	0.374

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.776	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.356	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	4.693	KM Standard Error of Mean	1.114
KM SD	3.216	95% KM (BCA) UCL	6.574
95% KM (t) UCL	6.735	95% KM (Percentile Bootstrap) UCL	6.459
95% KM (z) UCL	6.525	95% KM Bootstrap t UCL	6.112
90% KM Chebyshev UCL	8.035	95% KM Chebyshev UCL	9.549
97.5% KM Chebyshev UCL	11.65	99% KM Chebyshev UCL	15.78

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.932	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.698	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.395	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.332	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Appendix A-22b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics on Detected Data Only

k hat (MLE)	10.54	k star (bias corrected MLE)	5.379
Theta hat (MLE)	0.67	Theta star (bias corrected MLE)	1.312
nu hat (MLE)	126.4	nu star (bias corrected)	64.55
Mean (detects)	7.055		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	3.18	Mean	5.564
Maximum	8.82	Median	5.249
SD	2.428	CV	0.436
k hat (MLE)	5.589	k star (bias corrected MLE)	3.979
Theta hat (MLE)	0.996	Theta star (bias corrected MLE)	1.398
nu hat (MLE)	111.8	nu star (bias corrected)	79.57
Adjusted Level of Significance (β)	0.0267		
Approximate Chi Square Value (79.57, α)	60.02	Adjusted Chi Square Value (79.57, β)	57.08
95% Gamma Approximate UCL (use when n>=50)	7.376	95% Gamma Adjusted UCL (use when n<50)	7.757

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.693	SD (KM)	3.216
Variance (KM)	10.34	SE of Mean (KM)	1.114
k hat (KM)	2.13	k star (KM)	1.558
nu hat (KM)	42.6	nu star (KM)	31.15
theta hat (KM)	2.203	theta star (KM)	3.013
80% gamma percentile (KM)	7.231	90% gamma percentile (KM)	9.69
95% gamma percentile (KM)	12.07	99% gamma percentile (KM)	17.44

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (31.15, α)	19.4	Adjusted Chi Square Value (31.15, β)	17.8
95% Gamma Approximate KM-UCL (use when n>=50)	7.536	95% Gamma Adjusted KM-UCL (use when n<50)	8.211

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.687	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.402	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Appendix A-22b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.488	Mean in Log Scale	1.601
SD in Original Scale	2.507	SD in Log Scale	0.482
95% t UCL (assumes normality of ROS data)	6.941	95% Percentile Bootstrap UCL	6.755
95% BCA Bootstrap UCL	6.745	95% Bootstrap t UCL	7.019
95% H-UCL (Log ROS)	7.924		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.199	KM Geo Mean	3.318
KM SD (logged)	0.905	95% Critical H Value (KM-Log)	2.911
KM Standard Error of Mean (logged)	0.313	95% H-UCL (KM -Log)	12.01
KM SD (logged)	0.905	95% Critical H Value (KM-Log)	2.911
KM Standard Error of Mean (logged)	0.313		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.6	Mean in Log Scale	1.094
SD in Original Scale	3.502	SD in Log Scale	1.099
95% t UCL (Assumes normality)	6.63	95% H-Stat UCL	18.38

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	6.735	KM H-UCL	12.01
95% KM (BCA) UCL	6.574		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

PPM_RESULT_Hg (mendall marsh)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	37.4	Mean	120.7
Maximum	321	Median	64.55
SD	98.92	Std. Error of Mean	31.28
Coefficient of Variation	0.82	Skewness	1.146

Appendix A-22b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.819	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.296	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	178	95% Adjusted-CLT UCL (Chen-1995)	184.2
		95% Modified-t UCL (Johnson-1978)	179.9

Gamma GOF Test

A-D Test Statistic	0.645	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.736	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.269	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.27	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.898	k star (bias corrected MLE)	1.395
Theta hat (MLE)	63.59	Theta star (bias corrected MLE)	86.5
nu hat (MLE)	37.96	nu star (bias corrected)	27.9
MLE Mean (bias corrected)	120.7	MLE Sd (bias corrected)	102.2
		Approximate Chi Square Value (0.05)	16.85
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	15.38

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	199.8	95% Adjusted Gamma UCL (use when n<50)	219

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.889	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.23	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.622	Mean of logged Data	4.507
Maximum of Logged Data	5.771	SD of logged Data	0.784

Assuming Lognormal Distribution

95% H-UCL	248.1	90% Chebyshev (MVUE) UCL	210.2
95% Chebyshev (MVUE) UCL	251.6	97.5% Chebyshev (MVUE) UCL	309.1
99% Chebyshev (MVUE) UCL	422		

Appendix A-22b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	172.1	95% Jackknife UCL	178
95% Standard Bootstrap UCL	169.1	95% Bootstrap-t UCL	210.8
95% Hall's Bootstrap UCL	179.7	95% Percentile Bootstrap UCL	170.5
95% BCA Bootstrap UCL	179.3		
90% Chebyshev(Mean, Sd) UCL	214.5	95% Chebyshev(Mean, Sd) UCL	257
97.5% Chebyshev(Mean, Sd) UCL	316	99% Chebyshev(Mean, Sd) UCL	431.9

Suggested UCL to Use

95% Adjusted Gamma UCL	219

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

PPM_RESULT_Hg (penobscot river)

General Statistics

Total Number of Observations	70	Number of Distinct Observations	63
		Number of Missing Observations	0
Minimum	8.94	Mean	53.29
Maximum	311	Median	27.9
SD	68.79	Std. Error of Mean	8.222
Coefficient of Variation	1.291	Skewness	2.26

Normal GOF Test

Shapiro Wilk Test Statistic	0.585	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.373	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.106	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	67	95% Adjusted-CLT UCL (Chen-1995)	69.18
		95% Modified-t UCL (Johnson-1978)	67.37

Appendix A-22b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	7.045	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.776	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.265	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.109	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.18	k star (bias corrected MLE)	1.139
Theta hat (MLE)	45.15	Theta star (bias corrected MLE)	46.78
nu hat (MLE)	165.2	nu star (bias corrected)	159.5
MLE Mean (bias corrected)	53.29	MLE Sd (bias corrected)	49.93
		Approximate Chi Square Value (0.05)	131.3
Adjusted Level of Significance	0.0466	Adjusted Chi Square Value	130.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	64.73	95% Adjusted Gamma UCL (use when n<50)	65

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.851	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	1.8190E-9	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.178	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.106	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.191	Mean of logged Data	3.496
Maximum of Logged Data	5.74	SD of logged Data	0.866

Assuming Lognormal Distribution

95% H-UCL	60.15	90% Chebyshev (MVUE) UCL	64.63
95% Chebyshev (MVUE) UCL	72.32	97.5% Chebyshev (MVUE) UCL	83
99% Chebyshev (MVUE) UCL	104		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	66.81	95% Jackknife UCL	67
95% Standard Bootstrap UCL	66.89	95% Bootstrap-t UCL	71.31
95% Hall's Bootstrap UCL	68.47	95% Percentile Bootstrap UCL	67.57
95% BCA Bootstrap UCL	69.61		
90% Chebyshev(Mean, Sd) UCL	77.95	95% Chebyshev(Mean, Sd) UCL	89.13
97.5% Chebyshev(Mean, Sd) UCL	104.6	99% Chebyshev(Mean, Sd) UCL	135.1

Appendix A-22b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	89.13

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-22c
UCL Evaluation - Sample Area for Atlantic tomcod
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/14/2017 12:05:53 PM
From File	2017-11-14 PEN_BI21 BERA_polychaetes_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

PPM_RESULT_Hg (frenchman bay - ref)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Number of Detects	6	Number of Non-Detects	4
Number of Distinct Detects	6	Number of Distinct Non-Detects	4
Minimum Detect	3.18	Minimum Non-Detect	1.15
Maximum Detect	8.82	Maximum Non-Detect	2.46
Variance Detects	3.944	Percent Non-Detects	40%
Mean Detects	7.055	SD Detects	1.986
Median Detects	7.53	CV Detects	0.282
Skewness Detects	-1.964	Kurtosis Detects	4.392
Mean of Logged Detects	1.906	SD of Logged Detects	0.374

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.776	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.356	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	4.693	KM Standard Error of Mean	1.114
KM SD	3.216	95% KM (BCA) UCL	6.521
95% KM (t) UCL	6.735	95% KM (Percentile Bootstrap) UCL	6.397
95% KM (z) UCL	6.525	95% KM Bootstrap t UCL	6.062
90% KM Chebyshev UCL	8.035	95% KM Chebyshev UCL	9.549
97.5% KM Chebyshev UCL	11.65	99% KM Chebyshev UCL	15.78

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.932	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.698	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.395	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.332	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Appendix A-22c
UCL Evaluation - Sample Area for Atlantic tomcod
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics on Detected Data Only

k hat (MLE)	10.54	k star (bias corrected MLE)	5.379
Theta hat (MLE)	0.67	Theta star (bias corrected MLE)	1.312
nu hat (MLE)	126.4	nu star (bias corrected)	64.55
Mean (detects)	7.055		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	3.18	Mean	5.564
Maximum	8.82	Median	5.249
SD	2.428	CV	0.436
k hat (MLE)	5.589	k star (bias corrected MLE)	3.979
Theta hat (MLE)	0.996	Theta star (bias corrected MLE)	1.398
nu hat (MLE)	111.8	nu star (bias corrected)	79.57
Adjusted Level of Significance (β)	0.0267		
Approximate Chi Square Value (79.57, α)	60.02	Adjusted Chi Square Value (79.57, β)	57.08
95% Gamma Approximate UCL (use when n>=50)	7.376	95% Gamma Adjusted UCL (use when n<50)	7.757

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.693	SD (KM)	3.216
Variance (KM)	10.34	SE of Mean (KM)	1.114
k hat (KM)	2.13	k star (KM)	1.558
nu hat (KM)	42.6	nu star (KM)	31.15
theta hat (KM)	2.203	theta star (KM)	3.013
80% gamma percentile (KM)	7.231	90% gamma percentile (KM)	9.69
95% gamma percentile (KM)	12.07	99% gamma percentile (KM)	17.44

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (31.15, α)	19.4	Adjusted Chi Square Value (31.15, β)	17.8
95% Gamma Approximate KM-UCL (use when n>=50)	7.536	95% Gamma Adjusted KM-UCL (use when n<50)	8.211

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.687	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.402	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Appendix A-22c
UCL Evaluation - Sample Area for Atlantic tomcod
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.488	Mean in Log Scale	1.601
SD in Original Scale	2.507	SD in Log Scale	0.482
95% t UCL (assumes normality of ROS data)	6.941	95% Percentile Bootstrap UCL	6.674
95% BCA Bootstrap UCL	6.717	95% Bootstrap t UCL	6.917
95% H-UCL (Log ROS)	7.924		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.199	KM Geo Mean	3.318
KM SD (logged)	0.905	95% Critical H Value (KM-Log)	2.911
KM Standard Error of Mean (logged)	0.313	95% H-UCL (KM -Log)	12.01
KM SD (logged)	0.905	95% Critical H Value (KM-Log)	2.911
KM Standard Error of Mean (logged)	0.313		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.6	Mean in Log Scale	1.094
SD in Original Scale	3.502	SD in Log Scale	1.099
95% t UCL (Assumes normality)	6.63	95% H-Stat UCL	18.38

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	6.735	KM H-UCL	12.01
95% KM (BCA) UCL	6.521		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

PPM_RESULT_Hg (marsh-penobscot river)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	72
		Number of Missing Observations	0
Minimum	8.94	Mean	61.71
Maximum	321	Median	30.15
SD	75.83	Std. Error of Mean	8.478
Coefficient of Variation	1.229	Skewness	1.983

Appendix A-22c
UCL Evaluation - Sample Area for Atlantic tomcod
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.636	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.334	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	75.82	95% Adjusted-CLT UCL (Chen-1995)	77.67
		95% Modified-t UCL (Johnson-1978)	76.14

Gamma GOF Test

A-D Test Statistic	6.556	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.779	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.24	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.102	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.137	k star (bias corrected MLE)	1.103
Theta hat (MLE)	54.28	Theta star (bias corrected MLE)	55.97
nu hat (MLE)	181.9	nu star (bias corrected)	176.4
MLE Mean (bias corrected)	61.71	MLE Sd (bias corrected)	58.77
		Approximate Chi Square Value (0.05)	146.7
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	146.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	74.21	95% Adjusted Gamma UCL (use when n<50)	74.46

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.877	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	7.5208E-9	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.16	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.191	Mean of logged Data	3.622
Maximum of Logged Data	5.771	SD of logged Data	0.916

Assuming Lognormal Distribution

95% H-UCL	71.3	90% Chebyshev (MVUE) UCL	76.74
95% Chebyshev (MVUE) UCL	85.9	97.5% Chebyshev (MVUE) UCL	98.63
99% Chebyshev (MVUE) UCL	123.6		

Appendix A-22c
UCL Evaluation - Sample Area for Atlantic tomcod
Polychaete worm (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	75.66	95% Jackknife UCL	75.82
95% Standard Bootstrap UCL	75.74	95% Bootstrap-t UCL	78.81
95% Hall's Bootstrap UCL	77.51	95% Percentile Bootstrap UCL	76.25
95% BCA Bootstrap UCL	78.34		
90% Chebyshev(Mean, Sd) UCL	87.15	95% Chebyshev(Mean, Sd) UCL	98.67
97.5% Chebyshev(Mean, Sd) UCL	114.7	99% Chebyshev(Mean, Sd) UCL	146.1

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	98.67

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-23a
UCL Evaluation - ProUCL Input
Polychaete worm (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_ABD	EA_Tomcod_Eel	ID	DATE	Methyl mercury	D_Methyl mercury	UOM
Penobscot River	Study Area	ES-13_072716_POL_01_WB	7/27/2016	3.3	1	NG/G
Penobscot River	Study Area	ES-13_072716_POL_02_WB	7/27/2016	1.5	1	NG/G
Penobscot River	Study Area	ES-13_072716_POL_03_WB	7/27/2016	1.7	0	NG/G
Penobscot River	Study Area	ES-13_072716_POL_04_WB	7/27/2016	1.1	1	NG/G
Penobscot River	Study Area	ES-13_072716_POL_05_WB	7/27/2016	4.1	1	NG/G
Frenchman Bay	Frenchman Bay	FRB-01_092816_POL_01_WB	9/28/2016	1.7	0	NG/G
Frenchman Bay	Frenchman Bay	FRB-01_092816_POL_02_WB	9/28/2016	1.7	0	NG/G
Frenchman Bay	Frenchman Bay	FRB-01_092816_POL_03_WB	9/28/2016	1.9	0	NG/G
Frenchman Bay	Frenchman Bay	FRB-01_092816_POL_04_WB	9/28/2016	2	0	NG/G
Frenchman Bay	Frenchman Bay	FRB-01_092816_POL_05_WB	9/28/2016	1.8	0	NG/G
Penobscot River	Study Area	BFK_17HC001_073117_POL_01_WB	7/31/2017	9.5	1	NG/G
Penobscot River	Study Area	BFK_17HC001_073117_POL_02_WB	7/31/2017	8.7	1	NG/G
Penobscot River	Study Area	BFK_17HC001_073117_POL_03_WB	7/31/2017	8	1	NG/G
Penobscot River	Study Area	BFK_17HC001_073117_POL_04_WB	7/31/2017	3.4	1	NG/G
Penobscot River	Study Area	BFK_17HC001_073117_POL_05_WB	7/31/2017	9.5	1	NG/G
Penobscot River	Study Area	ES-02E_17HC001_073117_POL_01_WB	7/31/2017	6.2	1	NG/G
Penobscot River	Study Area	ES-02E_17HC001_073117_POL_02_WB	7/31/2017	11.8	1	NG/G
Penobscot River	Study Area	ES-02E_17HC001_073117_POL_03_WB	7/31/2017	11.4	1	NG/G
Penobscot River	Study Area	ES-02E_17HC001_073117_POL_04_WB	7/31/2017	17.7	1	NG/G
Penobscot River	Study Area	ES-02E_17HC001_073117_POL_05_WB	7/31/2017	10.8	1	NG/G
Marsh	Study Area	MM-MR_INT_17HC001_080117_POL_01_WB	8/1/2017	7.5	1	NG/G
Marsh	Study Area	MM-MR_INT_17HC001_080117_POL_02_WB	8/1/2017	4.1	1	NG/G
Marsh	Study Area	MM-MR_INT_17HC001_080117_POL_03_WB	8/1/2017	5.7	1	NG/G
Marsh	Study Area	MM-MR_INT_17HC001_080117_POL_04_WB	8/1/2017	7.7	1	NG/G
Marsh	Study Area	MM-MR_INT_17HC001_080117_POL_05_WB	8/1/2017	6.1	1	NG/G
Penobscot River	Study Area	PI-01_17HC001_080217_POL_01_WB	8/2/2017	16.9	1	NG/G
Penobscot River	Study Area	PI-01_17HC001_080217_POL_02_WB	8/2/2017	5.9	1	NG/G
Penobscot River	Study Area	PI-01_17HC001_080217_POL_03_WB	8/2/2017	11.6	1	NG/G
Penobscot River	Study Area	PI-01_17HC001_080217_POL_04_WB	8/2/2017	4.6	1	NG/G
Penobscot River	Study Area	PI-01_17HC001_080217_POL_05_WB	8/2/2017	16	1	NG/G
Penobscot River	Study Area	SVE-02INT_17HC001_080217_POL_01_WB	8/2/2017	12.6	1	NG/G
Penobscot River	Study Area	SVE-02INT_17HC001_080217_POL_02_WB	8/2/2017	9.7	1	NG/G
Penobscot River	Study Area	SVE-02INT_17HC001_080217_POL_03_WB	8/2/2017	8.7	1	NG/G
Penobscot River	Study Area	SVE-02INT_17HC001_080217_POL_04_WB	8/2/2017	9.3	1	NG/G
Penobscot River	Study Area	SVE-02INT_17HC001_080217_POL_05_WB	8/2/2017	11.1	1	NG/G
Penobscot River	Study Area	OB-01_17HC001_072517_POL_01_WB	7/25/2017	9.9	1	NG/G
Penobscot River	Study Area	OB-01_17HC001_072517_POL_02_WB	7/25/2017	7.5	1	NG/G
Penobscot River	Study Area	OB-01_17HC001_072517_POL_03_WB	7/25/2017	12.7	1	NG/G
Penobscot River	Study Area	OB-01_17HC001_072517_POL_04_WB	7/25/2017	10.4	1	NG/G
Penobscot River	Study Area	OB-01_17HC001_072517_POL_05_WB	7/25/2017	12.3	1	NG/G
Penobscot River	Study Area	BO-04_072616_POL_01_WB	7/26/2016	8.6	1	NG/G
Penobscot River	Study Area	BO-04_072616_POL_02_WB	7/26/2016	6.9	1	NG/G
Penobscot River	Study Area	BO-04_072616_POL_03_WB	7/26/2016	9.2	1	NG/G
Penobscot River	Study Area	BO-04_072616_POL_04_WB	7/26/2016	7.3	1	NG/G
Penobscot River	Study Area	BO-04_072616_POL_05_WB	7/26/2016	8.3	1	NG/G
Penobscot River	Study Area	ES-FP_072816_POL_01_WB	7/28/2016	6.2	1	NG/G
Penobscot River	Study Area	ES-FP_072816_POL_02_WB	7/28/2016	4.4	1	NG/G
Penobscot River	Study Area	ES-FP_072816_POL_03_WB	7/28/2016	1.6	0	NG/G
Penobscot River	Study Area	ES-FP_072816_POL_04_WB	7/28/2016	5.3	1	NG/G
Penobscot River	Study Area	ES-FP_072816_POL_05_WB	7/28/2016	15.7	1	NG/G
Marsh	Study Area	MMPOLY-01_072916_POL_01_WB	7/29/2016	1.4	1	NG/G
Marsh	Study Area	MMPOLY-01_072916_POL_02_WB	7/29/2016	11.3	1	NG/G
Marsh	Study Area	MMPOLY-01_072916_POL_03_WB	7/29/2016	11.1	1	NG/G
Marsh	Study Area	MMPOLY-01_072916_POL_04_WB	7/29/2016	8.2	1	NG/G
Marsh	Study Area	MMPOLY-01_072916_POL_05_WB	7/29/2016	9.9	1	NG/G
Penobscot River	Study Area	OB-05_072616_POL_01_WB	7/26/2016	11.7	1	NG/G

Appendix A-23a
UCL Evaluation - ProUCL Input
Polychaete worm (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_ABD	EA_Tomcod_Eel	ID	DATE	Methyl mercury	D_Methyl mercury	UOM
Penobscot River	Study Area	OB-05_072616_POL_02_WB	7/26/2016	12.8	1	NG/G
Penobscot River	Study Area	OB-05_072616_POL_03_WB	7/26/2016	11	1	NG/G
Penobscot River	Study Area	OB-05_072616_POL_04_WB	7/26/2016	12.8	1	NG/G
Penobscot River	Study Area	OB-05_072616_POL_05_WB	7/26/2016	12.7	1	NG/G

Appendix A-23b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.112/19/2017 2:51:00 PM
From File	2017-12-19 PEN_BI23 BERA_polychaetes_MeHg.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Methyl mercury (frenchman bay)

General Statistics

Total Number of Observations	5	Number of Distinct Observations	4
Number of Detects	0	Number of Non-Detects	5
Number of Distinct Detects	0	Number of Distinct Non-Detects	4

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Methyl mercury (frenchman bay) was not processed!

Methyl mercury (marsh)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	1.4	Mean	7.3
Maximum	11.3	Median	7.6
SD	3.114	Std. Error of Mean	0.985
Coefficient of Variation	0.427	Skewness	-0.491

Normal GOF Test

Shapiro Wilk Test Statistic	0.959	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.126	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	9.105	95% Adjusted-CLT UCL (Chen-1995)	8.756
		95% Modified-t UCL (Johnson-1978)	9.08

Appendix A-23b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.471	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.188	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.011	k star (bias corrected MLE)	2.875
Theta hat (MLE)	1.82	Theta star (bias corrected MLE)	2.54
nu hat (MLE)	80.22	nu star (bias corrected)	57.49
MLE Mean (bias corrected)	7.3	MLE Sd (bias corrected)	4.306
		Approximate Chi Square Value (0.05)	41.06
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	38.66

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	10.22	95% Adjusted Gamma UCL (use when n<50)	10.86

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.817	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.225	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.336	Mean of logged Data	1.858
Maximum of Logged Data	2.425	SD of logged Data	0.62

Assuming Lognormal Distribution

95% H-UCL	12.76	90% Chebyshev (MVUE) UCL	12.19
95% Chebyshev (MVUE) UCL	14.27	97.5% Chebyshev (MVUE) UCL	17.15
99% Chebyshev (MVUE) UCL	22.82		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	8.92	95% Jackknife UCL	9.105
95% Standard Bootstrap UCL	8.856	95% Bootstrap-t UCL	8.937
95% Hall's Bootstrap UCL	8.862	95% Percentile Bootstrap UCL	8.91
95% BCA Bootstrap UCL	8.66		
90% Chebyshev(Mean, Sd) UCL	10.25	95% Chebyshev(Mean, Sd) UCL	11.59
97.5% Chebyshev(Mean, Sd) UCL	13.45	99% Chebyshev(Mean, Sd) UCL	17.1

Appendix A-23b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	9.105

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Methyl mercury (penobscot river)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	40
Number of Detects	43	Number of Non-Detects	2
Number of Distinct Detects	38	Number of Distinct Non-Detects	2
Minimum Detect	1.1	Minimum Non-Detect	1.6
Maximum Detect	17.7	Maximum Non-Detect	1.7
Variance Detects	15.46	Percent Non-Detects	4.444%
Mean Detects	9.281	SD Detects	3.932
Median Detects	9.5	CV Detects	0.424
Skewness Detects	-0.0325	Kurtosis Detects	-0.23
Mean of Logged Detects	2.101	SD of Logged Detects	0.583

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.98	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.943	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0924	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.134	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	8.927	KM Standard Error of Mean	0.624
KM SD	4.14	95% KM (BCA) UCL	10.03
95% KM (t) UCL	9.976	95% KM (Percentile Bootstrap) UCL	9.951
95% KM (z) UCL	9.954	95% KM Bootstrap t UCL	9.931
90% KM Chebyshev UCL	10.8	95% KM Chebyshev UCL	11.65
97.5% KM Chebyshev UCL	12.83	99% KM Chebyshev UCL	15.14

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.952	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.753	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.134	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.135	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Appendix A-23b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics on Detected Data Only

k hat (MLE)	4.097	k star (bias corrected MLE)	3.827
Theta hat (MLE)	2.265	Theta star (bias corrected MLE)	2.425
nu hat (MLE)	352.4	nu star (bias corrected)	329.1
Mean (detects)	9.281		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1.1	Mean	9.02
Maximum	17.7	Median	9.3
SD	4.032	CV	0.447
k hat (MLE)	3.797	k star (bias corrected MLE)	3.559
Theta hat (MLE)	2.375	Theta star (bias corrected MLE)	2.534
nu hat (MLE)	341.8	nu star (bias corrected)	320.3
Adjusted Level of Significance (β)	0.0447		
Approximate Chi Square Value (320.31, α)	279.8	Adjusted Chi Square Value (320.31, β)	278.6
95% Gamma Approximate UCL (use when n>=50)	10.32	95% Gamma Adjusted UCL (use when n<50)	10.37

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	8.927	SD (KM)	4.14
Variance (KM)	17.14	SE of Mean (KM)	0.624
k hat (KM)	4.65	k star (KM)	4.355
nu hat (KM)	418.5	nu star (KM)	392
theta hat (KM)	1.92	theta star (KM)	2.05
80% gamma percentile (KM)	12.19	90% gamma percentile (KM)	14.66
95% gamma percentile (KM)	16.92	99% gamma percentile (KM)	21.74

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (391.95, α)	347.1	Adjusted Chi Square Value (391.95, β)	345.7
95% Gamma Approximate KM-UCL (use when n>=50)	10.08	95% Gamma Adjusted KM-UCL (use when n<50)	10.12

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.862	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.943	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.163	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.134	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Appendix A-23b
UCL Evaluation - Sample Area for American black duck
Polychaete worm (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	8.993	Mean in Log Scale	2.053
SD in Original Scale	4.072	SD in Log Scale	0.612
95% t UCL (assumes normality of ROS data)	10.01	95% Percentile Bootstrap UCL	9.993
95% BCA Bootstrap UCL	9.989	95% Bootstrap t UCL	10.01
95% H-UCL (Log ROS)	11.3		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.019	KM Geo Mean	7.529
KM SD (logged)	0.681	95% Critical H Value (KM-Log)	2.055
KM Standard Error of Mean (logged)	0.103	95% H-UCL (KM -Log)	11.73
KM SD (logged)	0.681	95% Critical H Value (KM-Log)	2.055
KM Standard Error of Mean (logged)	0.103		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	8.906	Mean in Log Scale	1.999
SD in Original Scale	4.226	SD in Log Scale	0.744
95% t UCL (Assumes normality)	9.964	95% H-Stat UCL	12.34

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	9.976

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-23c
UCL Evaluation - Sample Area for Atlantic tomcod
Polychaete worm (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.112/19/2017 2:51:40 PM
From File	2017-12-19 PEN_BI23 BERA_polychaetes_MeHg.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Methyl mercury (frenchman bay)

General Statistics

Total Number of Observations	5	Number of Distinct Observations	4
Number of Detects	0	Number of Non-Detects	5
Number of Distinct Detects	0	Number of Distinct Non-Detects	4

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Methyl mercury (frenchman bay) was not processed!

Methyl mercury (study area)

General Statistics

Total Number of Observations	55	Number of Distinct Observations	46
Number of Detects	53	Number of Non-Detects	2
Number of Distinct Detects	44	Number of Distinct Non-Detects	2
Minimum Detect	1.1	Minimum Non-Detect	1.6
Maximum Detect	17.7	Maximum Non-Detect	1.7
Variance Detects	14.78	Percent Non-Detects	3.636%
Mean Detects	8.908	SD Detects	3.844
Median Detects	9.2	CV Detects	0.432
Skewness Detects	0.0289	Kurtosis Detects	-0.172
Mean of Logged Detects	2.055	SD of Logged Detects	0.592

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.977	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0.579	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0802	Lilliefors GOF Test
5% Lilliefors Critical Value	0.121	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Appendix A-23c
UCL Evaluation - Sample Area for Atlantic tomcod
Polychaete worm (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	8.632	KM Standard Error of Mean	0.544
KM SD	3.998	95% KM (BCA) UCL	9.578
95% KM (t) UCL	9.543	95% KM (Percentile Bootstrap) UCL	9.522
95% KM (z) UCL	9.527	95% KM Bootstrap t UCL	9.541
90% KM Chebyshev UCL	10.26	95% KM Chebyshev UCL	11
97.5% KM Chebyshev UCL	12.03	99% KM Chebyshev UCL	14.05

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.117	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.115	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.123	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.955	k star (bias corrected MLE)	3.744
Theta hat (MLE)	2.252	Theta star (bias corrected MLE)	2.379
nu hat (MLE)	419.3	nu star (bias corrected)	396.9
Mean (detects)	8.908		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1.1	Mean	8.704
Maximum	17.7	Median	8.7
SD	3.917	CV	0.45
k hat (MLE)	3.737	k star (bias corrected MLE)	3.545
Theta hat (MLE)	2.329	Theta star (bias corrected MLE)	2.455
nu hat (MLE)	411	nu star (bias corrected)	389.9
Adjusted Level of Significance (β)	0.0456		
Approximate Chi Square Value (389.95, α)	345.2	Adjusted Chi Square Value (389.95, β)	344.1
95% Gamma Approximate UCL (use when n>=50)	9.833	95% Gamma Adjusted UCL (use when n<50)	9.866

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	8.632	SD (KM)	3.998
Variance (KM)	15.98	SE of Mean (KM)	0.544
k hat (KM)	4.662	k star (KM)	4.42
nu hat (KM)	512.9	nu star (KM)	486.2
theta hat (KM)	1.851	theta star (KM)	1.953
80% gamma percentile (KM)	11.77	90% gamma percentile (KM)	14.13
95% gamma percentile (KM)	16.3	99% gamma percentile (KM)	20.91

Appendix A-23c
UCL Evaluation - Sample Area for Atlantic tomcod
Polychaete worm (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (486.21, α)	436.1	Adjusted Chi Square Value (486.21, β)	434.8
95% Gamma Approximate KM-UCL (use when n>=50)	9.624	95% Gamma Adjusted KM-UCL (use when n<50)	9.653

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.859	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	1.5300E-6	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.153	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.121	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	8.682	Mean in Log Scale	2.017
SD in Original Scale	3.949	SD in Log Scale	0.614
95% t UCL (assumes normality of ROS data)	9.574	95% Percentile Bootstrap UCL	9.535
95% BCA Bootstrap UCL	9.536	95% Bootstrap t UCL	9.579
95% H-UCL (Log ROS)	10.69		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.991	KM Geo Mean	7.32
KM SD (logged)	0.665	95% Critical H Value (KM-Log)	2.004
KM Standard Error of Mean (logged)	0.0907	95% H-UCL (KM -Log)	10.95
KM SD (logged)	0.665	95% Critical H Value (KM-Log)	2.004
KM Standard Error of Mean (logged)	0.0907		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	8.614	Mean in Log Scale	1.973
SD in Original Scale	4.07	SD in Log Scale	0.72
95% t UCL (Assumes normality)	9.532	95% H-Stat UCL	11.4

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 9.543

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-24a
UCL Evaluation - ProUCL Input
Spider (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	ID	DATE	Mercury	UOM
REFERENCE_ADD	ADD-01_17HC001_062317_SPI_01_WB	6/23/2017	67.5	NG/G
REFERENCE_ADD	ADD-01_17HC001_062717_SPI_02_WB	6/27/2017	51.2	NG/G
REFERENCE_ADD	ADD-01_17HC001_062717_SPI_03_WB	6/27/2017	44.2	NG/G
REFERENCE_ADD	ADD-01_17HC001_062717_SPI_05_WB	6/27/2017	55	NG/G
REFERENCE_ADD	ADD-01_17HC002_062717_SPI_04_WB	6/27/2017	57.3	NG/G
REFERENCE_ADD	ADD-01_072116_SPI_01_WB	7/21/2016	25.9	NG/G
REFERENCE_ADD	ADD-01_072116_SPI_02_WB	7/21/2016	43.3	NG/G
REFERENCE_ADD	ADD-01_072116_SPI_03_WB	7/21/2016	31.4	NG/G
REFERENCE_ADD	ADD-01_072116_SPI_04_WB	7/21/2016	44.2	NG/G
REFERENCE_ADD	ADD-01_072116_SPI_05_WB	7/21/2016	30.5	NG/G
MMSE	MMSE-1_17HC005_071917_SPI_03_WB	7/19/2017	622	NG/G
MMSE	MMSE-1_17HC005_071917_SPI_04_WB	7/19/2017	581	NG/G
MMSE	MMSE-1_17HC005_071917_SPI_05_WB	7/19/2017	560	NG/G
MMSE	MMSE-1_17PT002_062117_SPI_02_WB	6/21/2017	526	NG/G
MMSE	MMSE-1_17PT003_062117_SPI_01_WB	6/21/2017	278	NG/G
MMSE	MMSE-1_072616_SPI_04_WB	7/25/2016	200	NG/G
MMSE	MMSE-01_072216_SPI_01_WB	7/22/2016	198	NG/G
MMSE	MMSE-01_072216_SPI_02_WB	7/22/2016	771	NG/G
MMSE	MMSE-01_072216_SPI_05_WB	7/22/2016	208	NG/G
MMSE	MMSE-01_072316_SPI_03_WB	7/23/2016	205	NG/G
MMSW	MMSW-C_17PT001_062317_SPI_04_WB	6/23/2017	315	NG/G
MMSW	MMSW-C_17PT002_062317_SPI_01_WB	6/23/2017	403	NG/G
MMSW	MMSW-C_17PT002_062317_SPI_02_WB	6/23/2017	305	NG/G
MMSW	MMSW-C_17PT003_062317_SPI_03_WB	6/23/2017	325	NG/G
MMSW	MMSW-C_17PT005_062317_SPI_05_WB	6/23/2017	279	NG/G
MMSW	MMSW-C_072016_SPI_01_WB	7/20/2016	166	NG/G
MMSW	MMSW-C_072016_SPI_02_WB	7/20/2016	200	NG/G
MMSW	MMSW-C_072016_SPI_04_WB	7/20/2016	270	NG/G
MMSW	MMSW-C_072016_SPI_05_WB	7/20/2016	219	NG/G
MMSW	MMSW-C_072616_SPI_03_WB	7/25/2016	257	NG/G
W-17-N	W17-N_17PT001_062517_SPI_05_WB	6/25/2017	402	NG/G
W-17-N	W17-N_17PT002_062517_SPI_03_WB	6/25/2017	349	NG/G
W-17-N	W17-N_17PT003_062417_SPI_01_WB	6/24/2017	302	NG/G
W-17-N	W17-N_17PT003_062417_SPI_02_WB	6/24/2017	315	NG/G
W-17-N	W17-N_17PT004_062517_SPI_04_WB	6/25/2017	293	NG/G
W-17-N	W17-N_072616_SPI_01_WB	7/25/2016	431	NG/G
W-17-N	W17-N_072616_SPI_03_WB	7/25/2016	420	NG/G
W-17-N	W17-N_072616_SPI_04_WB	7/25/2016	263	NG/G
W-17-N	W17-N_072416_SPI_02_WB	7/24/2016	197	NG/G
W-17-N	W17-N_072416_SPI_05_WB	7/24/2016	213	NG/G

Appendix A-24b
UCL Evaluation - Sample Area
Spider (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.19/28/2017 10:06:22 AM
From File	_092817 Spiders-Hg_NS&RWB.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

FINAL_RESU (mmse)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	198	Mean	414.9
Maximum	771	Median	402
SD	218.5	Std. Error of Mean	69.08
Coefficient of Variation	0.527	Skewness	0.296

Normal GOF Test

Shapiro Wilk Test Statistic	0.842	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.235	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	541.5	95% Adjusted-CLT UCL (Chen-1995)	535.4
		95% Modified-t UCL (Johnson-1978)	542.6

Gamma GOF Test

A-D Test Statistic	0.874	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.73	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.249	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.816	k star (bias corrected MLE)	2.738
Theta hat (MLE)	108.7	Theta star (bias corrected MLE)	151.5
nu hat (MLE)	76.33	nu star (bias corrected)	54.76
MLE Mean (bias corrected)	414.9	MLE Sd (bias corrected)	250.7
		Approximate Chi Square Value (0.05)	38.76
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	36.43

Appendix A-24b
UCL Evaluation - Sample Area
Spider (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	586.2	95% Adjusted Gamma UCL (use when n<50)	623.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.819	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.247	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.288	Mean of logged Data	5.891
Maximum of Logged Data	6.648	SD of logged Data	0.561

Assuming Lognormal Distribution

95% H-UCL	652.4	90% Chebyshev (MVUE) UCL	642.7
95% Chebyshev (MVUE) UCL	745.3	97.5% Chebyshev (MVUE) UCL	887.6
99% Chebyshev (MVUE) UCL	1167		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	528.5	95% Jackknife UCL	541.5
95% Standard Bootstrap UCL	523	95% Bootstrap-t UCL	550.6
95% Hall's Bootstrap UCL	516.4	95% Percentile Bootstrap UCL	519.4
95% BCA Bootstrap UCL	528		
90% Chebyshev(Mean, Sd) UCL	622.1	95% Chebyshev(Mean, Sd) UCL	716
97.5% Chebyshev(Mean, Sd) UCL	846.3	99% Chebyshev(Mean, Sd) UCL	1102

Suggested UCL to Use

95% Student's-t UCL	541.5

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU (mmsw)

Appendix A-24b
UCL Evaluation - Sample Area
Spider (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	166	Mean	273.9
Maximum	403	Median	274.5
SD	68.62	Std. Error of Mean	21.7
Coefficient of Variation	0.251	Skewness	0.238

Normal GOF Test

Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.128	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	313.7	95% Adjusted-CLT UCL (Chen-1995)	311.3
		95% Modified-t UCL (Johnson-1978)	314

Gamma GOF Test

A-D Test Statistic	0.18	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.128	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	17.18	k star (bias corrected MLE)	12.09
Theta hat (MLE)	15.95	Theta star (bias corrected MLE)	22.65
nu hat (MLE)	343.6	nu star (bias corrected)	241.8
MLE Mean (bias corrected)	273.9	MLE Sd (bias corrected)	78.77
		Approximate Chi Square Value (0.05)	206.8
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	201.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	320.3	95% Adjusted Gamma UCL (use when n<50)	329.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.147	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Appendix A-24b
UCL Evaluation - Sample Area
Spider (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	5.112	Mean of logged Data	5.583
Maximum of Logged Data	5.999	SD of logged Data	0.259

Assuming Lognormal Distribution

95% H-UCL	325.2	90% Chebyshev (MVUE) UCL	341.9
95% Chebyshev (MVUE) UCL	372.6	97.5% Chebyshev (MVUE) UCL	415.2
99% Chebyshev (MVUE) UCL	498.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	309.6	95% Jackknife UCL	313.7
95% Standard Bootstrap UCL	309	95% Bootstrap-t UCL	316.8
95% Hall's Bootstrap UCL	320.7	95% Percentile Bootstrap UCL	307.1
95% BCA Bootstrap UCL	310		
90% Chebyshev(Mean, Sd) UCL	339	95% Chebyshev(Mean, Sd) UCL	368.5
97.5% Chebyshev(Mean, Sd) UCL	409.4	99% Chebyshev(Mean, Sd) UCL	489.8

Suggested UCL to Use

95% Student's-t UCL	313.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU (reference)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	25.9	Mean	45.05
Maximum	67.5	Median	44.2
SD	13.17	Std. Error of Mean	4.164
Coefficient of Variation	0.292	Skewness	0.105

Normal GOF Test

Shapiro Wilk Test Statistic	0.961	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.15	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Appendix A-24b
UCL Evaluation - Sample Area
Spider (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	52.68	95% Adjusted-CLT UCL (Chen-1995)	52.05
		95% Modified-t UCL (Johnson-1978)	52.71

Gamma GOF Test

A-D Test Statistic	0.302	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.183	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	12.36	k star (bias corrected MLE)	8.721
Theta hat (MLE)	3.644	Theta star (bias corrected MLE)	5.165
nu hat (MLE)	247.3	nu star (bias corrected)	174.4
MLE Mean (bias corrected)	45.05	MLE Sd (bias corrected)	15.25
		Approximate Chi Square Value (0.05)	144.9
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	140.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	54.24	95% Adjusted Gamma UCL (use when n<50)	56.05

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.946	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.202	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.254	Mean of logged Data	3.767
Maximum of Logged Data	4.212	SD of logged Data	0.308

Assuming Lognormal Distribution

95% H-UCL	55.57	90% Chebyshev (MVUE) UCL	58.38
95% Chebyshev (MVUE) UCL	64.39	97.5% Chebyshev (MVUE) UCL	72.73
99% Chebyshev (MVUE) UCL	89.11		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-24b
UCL Evaluation - Sample Area
Spider (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	51.9	95% Jackknife UCL	52.68
95% Standard Bootstrap UCL	51.6	95% Bootstrap-t UCL	52.99
95% Hall's Bootstrap UCL	52.02	95% Percentile Bootstrap UCL	51.6
95% BCA Bootstrap UCL	51.4		
90% Chebyshev(Mean, Sd) UCL	57.54	95% Chebyshev(Mean, Sd) UCL	63.2
97.5% Chebyshev(Mean, Sd) UCL	71.05	99% Chebyshev(Mean, Sd) UCL	86.48

Suggested UCL to Use

95% Student's-t UCL 52.68

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

FINAL_RESU (w-17-n)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	197	Mean	318.5
Maximum	431	Median	308.5
SD	82.17	Std. Error of Mean	25.98
Coefficient of Variation	0.258	Skewness	-0.02

Normal GOF Test

Shapiro Wilk Test Statistic	0.944	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.145	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	366.1	95% Adjusted-CLT UCL (Chen-1995)	361.1
		95% Modified-t UCL (Johnson-1978)	366.1

Gamma GOF Test

A-D Test Statistic	0.263	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.152	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-24b
UCL Evaluation - Sample Area
Spider (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	15.86	k star (bias corrected MLE)	11.17
Theta hat (MLE)	20.08	Theta star (bias corrected MLE)	28.51
nu hat (MLE)	317.3	nu star (bias corrected)	223.4
MLE Mean (bias corrected)	318.5	MLE Sd (bias corrected)	95.3
		Approximate Chi Square Value (0.05)	189.8
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	184.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	374.9	95% Adjusted Gamma UCL (use when n<50)	385.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.938	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.136	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.283	Mean of logged Data	5.732
Maximum of Logged Data	6.066	SD of logged Data	0.271

Assuming Lognormal Distribution

95% H-UCL	381.5	90% Chebyshev (MVUE) UCL	401.2
95% Chebyshev (MVUE) UCL	438.5	97.5% Chebyshev (MVUE) UCL	490.3
99% Chebyshev (MVUE) UCL	592		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	361.2	95% Jackknife UCL	366.1
95% Standard Bootstrap UCL	358.4	95% Bootstrap-t UCL	365.5
95% Hall's Bootstrap UCL	357.6	95% Percentile Bootstrap UCL	358.8
95% BCA Bootstrap UCL	360		
90% Chebyshev(Mean, Sd) UCL	396.5	95% Chebyshev(Mean, Sd) UCL	431.8
97.5% Chebyshev(Mean, Sd) UCL	480.8	99% Chebyshev(Mean, Sd) UCL	577

Appendix A-24b
UCL Evaluation - Sample Area
Spider (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	366.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Appendix A-25a
UCL Evaluation - ProUCL Input
Spider (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_SA	ID	DATE	Methyl mercury	UOM
MMSW	MMSW-C_072016_SPI_01_WB	7/20/2016	274	NG/G
MMSW	MMSW-C_072016_SPI_02_WB	7/20/2016	201	NG/G
MMSW	MMSW-C_072016_SPI_04_WB	7/20/2016	151	NG/G
MMSW	MMSW-C_072016_SPI_05_WB	7/20/2016	217	NG/G
REFERENCE_ADD	ADD-01_17HC001_062317_SPI_01_WB	6/23/2017	73.2	NG/G
REFERENCE_ADD	ADD-01_17HC001_062717_SPI_02_WB	6/27/2017	59.5	NG/G
REFERENCE_ADD	ADD-01_17HC001_062717_SPI_03_WB	6/27/2017	56.7	NG/G
REFERENCE_ADD	ADD-01_17HC001_062717_SPI_05_WB	6/27/2017	50.4	NG/G
REFERENCE_ADD	ADD-01_17HC002_062717_SPI_04_WB	6/27/2017	58.5	NG/G
MMSE	MMSE-1_17HC005_071917_SPI_03_WB	7/19/2017	544	NG/G
MMSE	MMSE-1_17HC005_071917_SPI_04_WB	7/19/2017	748	NG/G
MMSE	MMSE-1_17HC005_071917_SPI_05_WB	7/19/2017	564	NG/G
MMSE	MMSE-1_17PT002_062117_SPI_02_WB	6/21/2017	511	NG/G
MMSE	MMSE-1_17PT003_062117_SPI_01_WB	6/21/2017	296	NG/G
MMSW	MMSW-C_17PT001_062317_SPI_04_WB	6/23/2017	50.8	NG/G
MMSW	MMSW-C_17PT002_062317_SPI_01_WB	6/23/2017	495	NG/G
MMSW	MMSW-C_17PT002_062317_SPI_02_WB	6/23/2017	370	NG/G
MMSW	MMSW-C_17PT003_062317_SPI_03_WB	6/23/2017	330	NG/G
W-17-N	W17-N_17PT001_062517_SPI_05_WB	6/25/2017	266	NG/G
W-17-N	W17-N_17PT002_062517_SPI_03_WB	6/25/2017	329	NG/G
W-17-N	W17-N_17PT003_062417_SPI_01_WB	6/24/2017	287	NG/G
W-17-N	W17-N_17PT003_062417_SPI_02_WB	6/24/2017	324	NG/G
W-17-N	W17-N_17PT004_062517_SPI_04_WB	6/25/2017	323	NG/G
MMSW	MMSW-C_17PT005_062317_SPI_05_WB	6/23/2017	337	NG/G
MMSE	MMSE-1_072616_SPI_04_WB	7/25/2016	136	NG/G
MMSW	MMSW-C_072616_SPI_03_WB	7/25/2016	330	NG/G
W-17-N	W17-N_072616_SPI_01_WB	7/25/2016	210	NG/G
W-17-N	W17-N_072616_SPI_03_WB	7/25/2016	282	NG/G
W-17-N	W17-N_072616_SPI_04_WB	7/25/2016	480	NG/G
REFERENCE_ADD	ADD-01_072116_SPI_01_WB	7/21/2016	14.6	NG/G
REFERENCE_ADD	ADD-01_072116_SPI_02_WB	7/21/2016	24	NG/G
REFERENCE_ADD	ADD-01_072116_SPI_03_WB	7/21/2016	22.9	NG/G
REFERENCE_ADD	ADD-01_072116_SPI_04_WB	7/21/2016	60.2	NG/G
REFERENCE_ADD	ADD-01_072116_SPI_05_WB	7/21/2016	22.9	NG/G
MMSE	MMSE-01_072216_SPI_01_WB	7/22/2016	174	NG/G
MMSE	MMSE-01_072216_SPI_02_WB	7/22/2016	244	NG/G
MMSE	MMSE-01_072216_SPI_05_WB	7/22/2016	181	NG/G
MMSE	MMSE-01_072316_SPI_03_WB	7/23/2016	166	NG/G
W-17-N	W17-N_072416_SPI_02_WB	7/24/2016	278	NG/G
W-17-N	W17-N_072416_SPI_05_WB	7/24/2016	642	NG/G

Appendix A-25b
UCL Evaluation - Sample Area
Spider (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.110/9/2017 4:14:34 PM
From File	SPI-meHg_NS RWB.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

FINAL_RESU (mmse)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	136	Mean	356.4
Maximum	748	Median	270
SD	216.2	Std. Error of Mean	68.37
Coefficient of Variation	0.607	Skewness	0.668

Normal GOF Test

Shapiro Wilk Test Statistic	0.867	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	481.7	95% Adjusted-CLT UCL (Chen-1995)	484.3
		95% Modified-t UCL (Johnson-1978)	484.1

Gamma GOF Test

A-D Test Statistic	0.566	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.732	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.093	k star (bias corrected MLE)	2.231
Theta hat (MLE)	115.2	Theta star (bias corrected MLE)	159.7
nu hat (MLE)	61.85	nu star (bias corrected)	44.63
MLE Mean (bias corrected)	356.4	MLE Sd (bias corrected)	238.6
		Approximate Chi Square Value (0.05)	30.31
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	28.27

Appendix A-25b
UCL Evaluation - Sample Area
Spider (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	524.8	95% Adjusted Gamma UCL (use when n<50)	562.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.913	Mean of logged Data	5.706
Maximum of Logged Data	6.617	SD of logged Data	0.618

Assuming Lognormal Distribution

95% H-UCL	596.5	90% Chebyshev (MVUE) UCL	570.4
95% Chebyshev (MVUE) UCL	667.4	97.5% Chebyshev (MVUE) UCL	802.2
99% Chebyshev (MVUE) UCL	1067		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	468.9	95% Jackknife UCL	481.7
95% Standard Bootstrap UCL	463.2	95% Bootstrap-t UCL	509.2
95% Hall's Bootstrap UCL	460.5	95% Percentile Bootstrap UCL	467.1
95% BCA Bootstrap UCL	479.8		
90% Chebyshev(Mean, Sd) UCL	561.5	95% Chebyshev(Mean, Sd) UCL	654.4
97.5% Chebyshev(Mean, Sd) UCL	783.4	99% Chebyshev(Mean, Sd) UCL	1037

Suggested UCL to Use

95% Student's-t UCL	481.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-25b
UCL Evaluation - Sample Area
Spider (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

FINAL_RESU (mmsw)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	50.8	Mean	275.6
Maximum	495	Median	302
SD	125.5	Std. Error of Mean	39.69
Coefficient of Variation	0.455	Skewness	-0.137

Normal GOF Test

Shapiro Wilk Test Statistic	0.977	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	348.3	95% Adjusted-CLT UCL (Chen-1995)	339
		95% Modified-t UCL (Johnson-1978)	348.1

Gamma GOF Test

A-D Test Statistic	0.448	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.73	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.202	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.702	k star (bias corrected MLE)	2.658
Theta hat (MLE)	74.44	Theta star (bias corrected MLE)	103.7
nu hat (MLE)	74.04	nu star (bias corrected)	53.16
MLE Mean (bias corrected)	275.6	MLE Sd (bias corrected)	169
		Approximate Chi Square Value (0.05)	37.41
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	35.13

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	391.6	95% Adjusted Gamma UCL (use when n<50)	417.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.844	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.193	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Appendix A-25b
UCL Evaluation - Sample Area
Spider (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.928	Mean of logged Data	5.478
Maximum of Logged Data	6.205	SD of logged Data	0.642

Assuming Lognormal Distribution

95% H-UCL	495.6	90% Chebyshev (MVUE) UCL	467.1
95% Chebyshev (MVUE) UCL	548.6	97.5% Chebyshev (MVUE) UCL	661.6
99% Chebyshev (MVUE) UCL	883.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	340.9	95% Jackknife UCL	348.3
95% Standard Bootstrap UCL	336.1	95% Bootstrap-t UCL	346.3
95% Hall's Bootstrap UCL	348.2	95% Percentile Bootstrap UCL	339.4
95% BCA Bootstrap UCL	332.6		
90% Chebyshev(Mean, Sd) UCL	394.7	95% Chebyshev(Mean, Sd) UCL	448.6
97.5% Chebyshev(Mean, Sd) UCL	523.5	99% Chebyshev(Mean, Sd) UCL	670.5

Suggested UCL to Use

95% Student's-t UCL	348.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

FINAL_RESU (reference_add)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	14.6	Mean	44.29
Maximum	73.2	Median	53.55
SD	20.87	Std. Error of Mean	6.601
Coefficient of Variation	0.471	Skewness	-0.265

Appendix A-25b
UCL Evaluation - Sample Area
Spider (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.864	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.234	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	56.39	95% Adjusted-CLT UCL (Chen-1995)	54.56
		95% Modified-t UCL (Johnson-1978)	56.3

Gamma GOF Test

A-D Test Statistic	0.858	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.729	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.267	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.058	k star (bias corrected MLE)	2.907
Theta hat (MLE)	10.92	Theta star (bias corrected MLE)	15.24
nu hat (MLE)	81.15	nu star (bias corrected)	58.14
MLE Mean (bias corrected)	44.29	MLE Sd (bias corrected)	25.98
		Approximate Chi Square Value (0.05)	41.61
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	39.19

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	61.88	95% Adjusted Gamma UCL (use when n<50)	65.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.84	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.275	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.681	Mean of logged Data	3.662
Maximum of Logged Data	4.293	SD of logged Data	0.568

Assuming Lognormal Distribution

95% H-UCL	70.99	90% Chebyshev (MVUE) UCL	69.71
95% Chebyshev (MVUE) UCL	80.93	97.5% Chebyshev (MVUE) UCL	96.49
99% Chebyshev (MVUE) UCL	127.1		

Appendix A-25b
UCL Evaluation - Sample Area
Spider (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	55.15	95% Jackknife UCL	56.39
95% Standard Bootstrap UCL	54.5	95% Bootstrap-t UCL	56.03
95% Hall's Bootstrap UCL	53.49	95% Percentile Bootstrap UCL	54.7
95% BCA Bootstrap UCL	53.78		
90% Chebyshev(Mean, Sd) UCL	64.09	95% Chebyshev(Mean, Sd) UCL	73.06
97.5% Chebyshev(Mean, Sd) UCL	85.51	99% Chebyshev(Mean, Sd) UCL	110

Suggested UCL to Use

95% Student's-t UCL	56.39

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

FINAL_RESU (w-17-n)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	210	Mean	342.1
Maximum	642	Median	305
SD	126.4	Std. Error of Mean	39.97
Coefficient of Variation	0.37	Skewness	1.8

Normal GOF Test

Shapiro Wilk Test Statistic	0.784	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.341	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	415.4	95% Adjusted-CLT UCL (Chen-1995)	432.2
		95% Modified-t UCL (Johnson-1978)	419.2

Appendix A-25b
UCL Evaluation - Sample Area
Spider (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.777	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.308	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.267	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	10.19	k star (bias corrected MLE)	7.201
Theta hat (MLE)	33.57	Theta star (bias corrected MLE)	47.51
nu hat (MLE)	203.8	nu star (bias corrected)	144
MLE Mean (bias corrected)	342.1	MLE Sd (bias corrected)	127.5
		Approximate Chi Square Value (0.05)	117.3
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	113.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	420.1	95% Adjusted Gamma UCL (use when n<50)	435.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.88	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.286	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.347	Mean of logged Data	5.785
Maximum of Logged Data	6.465	SD of logged Data	0.317

Assuming Lognormal Distribution

95% H-UCL	422.7	90% Chebyshev (MVUE) UCL	443.8
95% Chebyshev (MVUE) UCL	490.6	97.5% Chebyshev (MVUE) UCL	555.6
99% Chebyshev (MVUE) UCL	683.2		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	407.9	95% Jackknife UCL	415.4
95% Standard Bootstrap UCL	404.3	95% Bootstrap-t UCL	534.5
95% Hall's Bootstrap UCL	845.7	95% Percentile Bootstrap UCL	405.6
95% BCA Bootstrap UCL	431.6		
90% Chebyshev(Mean, Sd) UCL	462	95% Chebyshev(Mean, Sd) UCL	516.3
97.5% Chebyshev(Mean, Sd) UCL	591.7	99% Chebyshev(Mean, Sd) UCL	739.8

Appendix A-25b
UCL Evaluation - Sample Area
Spider (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	415.4	or 95% Modified-t UCL	419.2
or 95% H-UCL	422.7		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Appendix A-26a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Tomcod	ID	DATE	Mercury	UOM
NON-REF	BO-04_17SN001_091717_MUM_01_WB	9/17/2017	63.4	NG/G
NON-REF	BO-04_100316_MUM_01_WB	10/3/2016	234	NG/G
NON-REF	BO-04_100316_MUM_02_WB	10/3/2016	57.7	NG/G
NON-REF	BO-04_100316_MUM_03_WB	10/3/2016	146	NG/G
NON-REF	BO-04_100316_MUM_04_WB	10/3/2016	67.3	NG/G
NON-REF	BO-04_100316_MUM_05_WB	10/3/2016	214	NG/G
NON-REF	BO-04_100316_MUM_06_WB	10/3/2016	76	NG/G
NON-REF	BO-04_100316_MUM_07_WB	10/3/2016	76	NG/G
NON-REF	BO-04_100316_MUM_08_WB	10/3/2016	75	NG/G
NON-REF	BO-04_100316_MUM_09_WB	10/3/2016	60.6	NG/G
NON-REF	BO-04_100316_MUM_10_WB	10/3/2016	52.4	NG/G
NON-REF	BO-04_100316_MUM_11_WB	10/3/2016	94.3	NG/G
NON-REF	BO-04_100316_MUM_12_WB	10/3/2016	200	NG/G
NON-REF	BO-04_100316_MUM_13_WB	10/3/2016	55	NG/G
NON-REF	BO-04_100316_MUM_14_WB	10/3/2016	66.7	NG/G
NON-REF	BO-04_100316_MUM_15_WB	10/3/2016	58.1	NG/G
NON-REF	BO-04_100316_MUM_16_WB	10/3/2016	61.7	NG/G
NON-REF	BO-04_100316_MUM_17_WB	10/3/2016	108	NG/G
NON-REF	BO-04_100316_MUM_18_WB	10/3/2016	85.9	NG/G
NON-REF	BO-04_100316_MUM_19_WB	10/3/2016	59.3	NG/G
NON-REF	BO-04_100316_MUM_20_WB	10/3/2016	63.9	NG/G
NON-REF	ES-13_17SN001_091417_RAS_01_WB	9/14/2017	30.7	NG/G
NON-REF	ES-13_17SN001_091417_RAS_02_WB	9/14/2017	87.8	NG/G
NON-REF	ES-13_17SN001_091417_RAS_03_WB	9/14/2017	42.2	NG/G
NON-REF	ES-13_17SN001_091417_RAS_04_WB	9/14/2017	35.5	NG/G
NON-REF	ES-13_17SN001_091417_RAS_05_WB	9/14/2017	29.9	NG/G
NON-REF	ES-13_17SN001_091417_RAS_06_WB	9/14/2017	76.7	NG/G
NON-REF	ES-13_17SN001_091417_RAS_07_WB	9/14/2017	78.8	NG/G
NON-REF	ES-13_17SN001_091417_RAS_08_WB	9/14/2017	32.7	NG/G
NON-REF	ES-13_17SN001_091417_RAS_09_WB	9/14/2017	26.4	NG/G
NON-REF	ES-13_17SN001_091417_RAS_10_WB	9/14/2017	37.4	NG/G
NON-REF	ES-13_17SN001_091417_RAS_11_WB	9/14/2017	37.5	NG/G
NON-REF	ES-13_17SN001_091417_RAS_12_WB	9/14/2017	29.8	NG/G
NON-REF	ES-13_17SN001_091417_RAS_13_WB	9/14/2017	63.1	NG/G
NON-REF	ES-13_17SN001_091417_RAS_14_WB	9/14/2017	43.5	NG/G
NON-REF	ES-13_17SN001_091417_RAS_15_WB	9/14/2017	39.1	NG/G
NON-REF	ES-13_17SN001_091417_RAS_16_WB	9/14/2017	34.8	NG/G
NON-REF	ES-13_17SN001_091417_RAS_17_WB	9/14/2017	56.6	NG/G
NON-REF	ES-13_17SN001_091417_RAS_18_WB	9/14/2017	40.2	NG/G
NON-REF	ES-13_17SN001_091417_RAS_19_WB	9/14/2017	38.1	NG/G
NON-REF	ES-13_17SN001_091417_RAS_20_WB	9/14/2017	30.1	NG/G
NON-REF	ES-13_092116_RAS_01_WB	9/21/2016	38.4	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_01_WB	9/14/2017	78.6	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_02_WB	9/14/2017	92.6	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_03_WB	9/14/2017	68.2	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_04_WB	9/14/2017	174	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_05_WB	9/14/2017	92.2	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_06_WB	9/14/2017	83.2	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_07_WB	9/14/2017	207	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_08_WB	9/14/2017	128	NG/G

Appendix A-26a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Tomcod	ID	DATE	Mercury	UOM
NON-REF	ES-FP_17SN001_091417_RAS_09_WB	9/14/2017	185	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_10_WB	9/14/2017	156	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_11_WB	9/14/2017	75.7	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_12_WB	9/14/2017	43	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_13_WB	9/14/2017	36.6	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_14_WB	9/14/2017	39	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_15_WB	9/14/2017	34.2	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_16_WB	9/14/2017	52	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_17_WB	9/14/2017	34.1	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_18_WB	9/14/2017	42.5	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_19_WB	9/14/2017	31.7	NG/G
NON-REF	ES-FP_17SN001_091417_RAS_20_WB	9/14/2017	43.6	NG/G
NON-REF	ES-FP_092716_RAS_01_WB	9/27/2016	93.6	NG/G
NON-REF	ES-FP_092716_RAS_02_WB	9/27/2016	113	NG/G
NON-REF	ES-FP_092716_RAS_03_WB	9/27/2016	49.3	NG/G
NON-REF	ES-FP_092716_RAS_04_WB	9/27/2016	84.6	NG/G
NON-REF	ES-FP_092716_RAS_05_WB	9/27/2016	60.5	NG/G
NON-REF	ES-FP_092716_RAS_06_WB	9/27/2016	48.7	NG/G
NON-REF	ES-FP_092716_RAS_07_WB	9/27/2016	36.2	NG/G
NON-REF	ES-FP_092716_RAS_08_WB	9/27/2016	108	NG/G
NON-REF	ES-FP_092716_RAS_09_WB	9/27/2016	78.4	NG/G
NON-REF	ES-FP_092716_RAS_10_WB	9/27/2016	35.4	NG/G
NON-REF	ES-FP_092716_RAS_11_WB	9/27/2016	74.1	NG/G
NON-REF	ES-FP_092716_RAS_12_WB	9/27/2016	54.7	NG/G
NON-REF	ES-FP_092716_RAS_13_WB	9/27/2016	56	NG/G
NON-REF	ES-FP_092716_RAS_14_WB	9/27/2016	31.4	NG/G
NON-REF	ES-FP_092716_RAS_15_WB	9/27/2016	64	NG/G
NON-REF	ES-FP_092716_RAS_16_WB	9/27/2016	60.7	NG/G
NON-REF	ES-FP_092716_RAS_17_WB	9/27/2016	44.4	NG/G
NON-REF	ES-FP_092716_RAS_18_WB	9/27/2016	27.1	NG/G
NON-REF	ES-FP_092716_RAS_19_WB	9/27/2016	33.4	NG/G
NON-REF	ES-FP_092716_RAS_20_WB	9/27/2016	39.8	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_01_WB	9/12/2017	5.17	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_02_WB	9/12/2017	8.36	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_03_WB	9/12/2017	5.05	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_04_WB	9/12/2017	7.11	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_05_WB	9/12/2017	7.57	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_06_WB	9/12/2017	6.46	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_07_WB	9/12/2017	7.7	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_08_WB	9/12/2017	7.6	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_09_WB	9/12/2017	6.16	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_10_WB	9/12/2017	6.74	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_11_WB	9/12/2017	6.7	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_12_WB	9/12/2017	4.81	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_13_WB	9/12/2017	5.65	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_14_WB	9/12/2017	6.1	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_15_WB	9/12/2017	5.08	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_16_WB	9/12/2017	6.6	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_17_WB	9/12/2017	5.85	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_18_WB	9/12/2017	7.84	NG/G

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UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Tomcod	ID	DATE	Mercury	UOM
REFERENCE	FRB-01_17SN001_091217_MUM_19_WB	9/12/2017	6.53	NG/G
REFERENCE	FRB-01_17SN001_091217_MUM_20_WB	9/12/2017	4.44	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_01_WB	9/12/2017	18.1	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_02_WB	9/12/2017	14.6	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_03_WB	9/12/2017	6.88	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_04_WB	9/12/2017	22.2	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_05_WB	9/12/2017	10.8	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_06_WB	9/12/2017	14.5	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_07_WB	9/12/2017	26.2	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_08_WB	9/12/2017	24.6	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_09_WB	9/12/2017	8.2	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_10_WB	9/12/2017	10.6	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_11_WB	9/12/2017	10.9	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_12_WB	9/12/2017	6.57	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_13_WB	9/12/2017	9.38	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_14_WB	9/12/2017	19	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_15_WB	9/12/2017	7.29	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_16_WB	9/12/2017	15.7	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_17_WB	9/12/2017	12.2	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_18_WB	9/12/2017	7.36	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_19_WB	9/12/2017	7.98	NG/G
REFERENCE	FRB-01_17SN001_091217_RAS_20_WB	9/12/2017	11.8	NG/G
REFERENCE	FRB-01_092816_MUM_01_WB	9/28/2016	6.49	NG/G
REFERENCE	FRB-01_092816_MUM_02_WB	9/28/2016	9.83	NG/G
REFERENCE	FRB-01_092816_MUM_03_WB	9/28/2016	6.77	NG/G
REFERENCE	FRB-01_092816_MUM_04_WB	9/28/2016	5.16	NG/G
REFERENCE	FRB-01_092816_MUM_05_WB	9/28/2016	6.9	NG/G
REFERENCE	FRB-01_092816_MUM_06_WB	9/28/2016	7.83	NG/G
REFERENCE	FRB-01_092816_MUM_07_WB	9/28/2016	9.29	NG/G
REFERENCE	FRB-01_092816_MUM_08_WB	9/28/2016	5.76	NG/G
REFERENCE	FRB-01_092816_MUM_09_WB	9/28/2016	7.05	NG/G
REFERENCE	FRB-01_092816_MUM_10_WB	9/28/2016	8.37	NG/G
REFERENCE	FRB-01_092816_MUM_11_WB	9/28/2016	13.5	NG/G
REFERENCE	FRB-01_092816_MUM_12_WB	9/28/2016	7.67	NG/G
REFERENCE	FRB-01_092816_MUM_13_WB	9/28/2016	9.38	NG/G
REFERENCE	FRB-01_092816_MUM_14_WB	9/28/2016	7.9	NG/G
REFERENCE	FRB-01_092816_MUM_15_WB	9/28/2016	8.19	NG/G
REFERENCE	FRB-01_092816_MUM_16_WB	9/28/2016	8.01	NG/G
REFERENCE	FRB-01_092816_MUM_17_WB	9/28/2016	8.58	NG/G
REFERENCE	FRB-01_092816_MUM_18_WB	9/28/2016	11.1	NG/G
REFERENCE	FRB-01_092816_MUM_19_WB	9/28/2016	4.94	NG/G
REFERENCE	FRB-01_092816_MUM_20_WB	9/28/2016	8.43	NG/G
REFERENCE	FRB-01_092816_RAS_01_WB	9/28/2016	5.46	NG/G
REFERENCE	FRB-01_092816_RAS_02_WB	9/28/2016	5.96	NG/G
REFERENCE	FRB-01_092816_RAS_03_WB	9/28/2016	7.27	NG/G
REFERENCE	FRB-01_092816_RAS_04_WB	9/28/2016	6.37	NG/G
REFERENCE	FRB-01_092816_RAS_05_WB	9/28/2016	6.5	NG/G
REFERENCE	FRB-01_092816_RAS_06_WB	9/28/2016	7.62	NG/G
REFERENCE	FRB-01_092816_RAS_07_WB	9/28/2016	5.07	NG/G
REFERENCE	FRB-01_092816_RAS_08_WB	9/28/2016	8	NG/G

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UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Tomcod	ID	DATE	Mercury	UOM
REFERENCE	FRB-01_092816_RAS_09_WB	9/28/2016	7.03	NG/G
REFERENCE	FRB-01_092816_RAS_10_WB	9/28/2016	6.89	NG/G
REFERENCE	FRB-01_092816_RAS_11_WB	9/28/2016	6.46	NG/G
REFERENCE	FRB-01_092816_RAS_12_WB	9/28/2016	6.6	NG/G
REFERENCE	FRB-01_092816_RAS_13_WB	9/28/2016	6.79	NG/G
REFERENCE	FRB-01_092816_RAS_14_WB	9/28/2016	6.67	NG/G
REFERENCE	FRB-01_092816_RAS_15_WB	9/28/2016	8.37	NG/G
REFERENCE	FRB-01_092816_RAS_16_WB	9/28/2016	6.19	NG/G
REFERENCE	FRB-01_092816_RAS_17_WB	9/28/2016	5.72	NG/G
REFERENCE	FRB-01_092816_RAS_18_WB	9/28/2016	8.26	NG/G
REFERENCE	FRB-01_092816_RAS_19_WB	9/28/2016	7.35	NG/G
REFERENCE	FRB-01_092816_RAS_20_WB	9/28/2016	6.52	NG/G
NON-REF	MMMC-01_17MT001_091817_MUM_01_WB	9/18/2017	51.4	NG/G
NON-REF	MMMC-01_17MT001_092017_MUM_02_WB	9/20/2017	137	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_06_WB	9/20/2017	109	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_07_WB	9/20/2017	122	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_08_WB	9/20/2017	107	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_09_WB	9/20/2017	88.2	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_10_WB	9/20/2017	207	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_11_WB	9/20/2017	94.4	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_12_WB	9/20/2017	73.2	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_13_WB	9/20/2017	104	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_14_WB	9/20/2017	150	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_15_WB	9/20/2017	145	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_16_WB	9/20/2017	72.4	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_17_WB	9/20/2017	136	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_18_WB	9/20/2017	112	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_19_WB	9/20/2017	100	NG/G
NON-REF	MMMC-01_17MT003_092017_MUM_20_WB	9/20/2017	256	NG/G
NON-REF	MMMC-01_17MT004_092017_MUM_03_WB	9/20/2017	173	NG/G
NON-REF	MMMC-01_17MT004_092017_MUM_04_WB	9/20/2017	109	NG/G
NON-REF	MMMC-01_092316_MUM_01_WB	9/23/2016	177	NG/G
NON-REF	MMMC-01_092316_MUM_02_WB	9/23/2016	249	NG/G
NON-REF	MMMC-01_092316_MUM_03_WB	9/23/2016	140	NG/G
NON-REF	MMMC-01_092316_MUM_04_WB	9/23/2016	121	NG/G
NON-REF	OB-01_17MT001_091817_MUM_01_WB	9/18/2017	86.9	NG/G
NON-REF	OB-01_17MT001_091917_MUM_09_WB	9/19/2017	79.6	NG/G
NON-REF	OB-01_17MT001_091917_MUM_10_WB	9/19/2017	242	NG/G
NON-REF	OB-01_17MT001_091917_MUM_11_WB	9/19/2017	83.4	NG/G
NON-REF	OB-01_17MT001_091917_MUM_12_WB	9/19/2017	130	NG/G
NON-REF	OB-01_17MT001_091917_MUM_13_WB	9/19/2017	127	NG/G
NON-REF	OB-01_17MT002_091817_MUM_02_WB	9/18/2017	86.1	NG/G
NON-REF	OB-01_17MT002_091817_MUM_03_WB	9/18/2017	103	NG/G
NON-REF	OB-01_17MT002_091817_MUM_04_WB	9/18/2017	154	NG/G
NON-REF	OB-01_17MT002_091817_MUM_05_WB	9/18/2017	110	NG/G
NON-REF	OB-01_17MT002_091817_MUM_06_WB	9/18/2017	109	NG/G
NON-REF	OB-01_17MT002_091817_MUM_07_WB	9/18/2017	37.4	NG/G
NON-REF	OB-01_17MT002_091817_MUM_08_WB	9/18/2017	87.2	NG/G
NON-REF	OB-01_17MT002_091917_MUM_14_WB	9/19/2017	237	NG/G
NON-REF	OB-01_17MT002_091917_MUM_15_WB	9/19/2017	118	NG/G

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UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Tomcod	ID	DATE	Mercury	UOM
NON-REF	OB-01_17SN001_091617_RAS_01_WB	9/16/2017	45.3	NG/G
NON-REF	OB-01_17SN001_091617_RAS_02_WB	9/16/2017	36	NG/G
NON-REF	OB-01_17SN001_091617_RAS_03_WB	9/16/2017	72	NG/G
NON-REF	OB-01_17SN001_091617_RAS_04_WB	9/16/2017	77.4	NG/G
NON-REF	OB-01_17SN001_091617_RAS_05_WB	9/16/2017	46.5	NG/G
NON-REF	OB-01_17SN001_091617_RAS_06_WB	9/16/2017	39.7	NG/G
NON-REF	OB-01_17SN001_091617_RAS_07_WB	9/16/2017	52.1	NG/G
NON-REF	OB-01_17SN001_091617_RAS_08_WB	9/16/2017	42.7	NG/G
NON-REF	OB-01_17SN001_091617_RAS_09_WB	9/16/2017	38.2	NG/G
NON-REF	OB-01_17SN001_091617_RAS_10_WB	9/16/2017	47.5	NG/G
NON-REF	OB-01_17SN001_091617_RAS_11_WB	9/16/2017	61.7	NG/G
NON-REF	OB-01_17SN001_091617_RAS_12_WB	9/16/2017	42.5	NG/G
NON-REF	OB-01_17SN001_091617_RAS_13_WB	9/16/2017	49.8	NG/G
NON-REF	OB-01_17SN001_091617_RAS_14_WB	9/16/2017	49.6	NG/G
NON-REF	OB-01_17SN001_091617_RAS_15_WB	9/16/2017	45.3	NG/G
NON-REF	OB-01_17SN001_091617_RAS_16_WB	9/16/2017	49.2	NG/G
NON-REF	OB-01_17SN001_091617_RAS_17_WB	9/16/2017	46.9	NG/G
NON-REF	OB-01_17SN001_091617_RAS_18_WB	9/16/2017	44.8	NG/G
NON-REF	OB-01_17SN001_091617_RAS_19_WB	9/16/2017	47.8	NG/G
NON-REF	OB-01_17SN001_091617_RAS_20_WB	9/16/2017	45.3	NG/G
NON-REF	OB-01_092516_MUM_01_WB	9/25/2016	134	NG/G
NON-REF	OB-01_092116_RAS_06_WB	9/21/2016	146	NG/G
NON-REF	OB-01_092116_RAS_07_WB	9/21/2016	140	NG/G
NON-REF	OB-01_092116_RAS_08_WB	9/21/2016	75.3	NG/G
NON-REF	OB-01_092116_RAS_09_WB	9/21/2016	90.8	NG/G
NON-REF	OB-01_092116_RAS_10_WB	9/21/2016	94.6	NG/G
NON-REF	OB-01_092116_RAS_11_WB	9/21/2016	95.4	NG/G
NON-REF	OB-01_092116_RAS_12_WB	9/21/2016	116	NG/G
NON-REF	OB-01_092116_RAS_13_WB	9/21/2016	79.5	NG/G
NON-REF	OB-01_092116_RAS_14_WB	9/21/2016	31.8	NG/G
NON-REF	OB-01_092116_RAS_15_WB	9/21/2016	33.6	NG/G
NON-REF	OB-01_092116_RAS_16_WB	9/21/2016	102	NG/G
NON-REF	OB-01_092116_RAS_17_WB	9/21/2016	103	NG/G
NON-REF	OB-01_092116_RAS_18_WB	9/21/2016	44.2	NG/G
NON-REF	OB-01_092116_RAS_19_WB	9/21/2016	58.2	NG/G
NON-REF	OB-01_092116_RAS_20_WB	9/21/2016	82.8	NG/G
NON-REF	OB-01_092116_RAS_01_WB	9/21/2016	44.5	NG/G
NON-REF	OB-01_092116_RAS_02_WB	9/21/2016	54.9	NG/G
NON-REF	OB-01_092116_RAS_03_WB	9/21/2016	55.6	NG/G
NON-REF	OB-01_092116_RAS_04_WB	9/21/2016	47.5	NG/G
NON-REF	OB-01_092116_RAS_05_WB	9/21/2016	81.9	NG/G
NON-REF	OB-05_17SN001_091517_MUM_01_WB	9/15/2017	150	NG/G
NON-REF	OB-05_17SN001_091517_MUM_02_WB	9/15/2017	114	NG/G
NON-REF	OB-05_17SN001_091517_MUM_03_WB	9/15/2017	121	NG/G
NON-REF	OB-05_17SN001_091517_MUM_04_WB	9/15/2017	117	NG/G
NON-REF	OB-05_17SN001_091517_MUM_05_WB	9/15/2017	65.2	NG/G
NON-REF	OB-05_17SN001_091517_MUM_06_WB	9/15/2017	76.5	NG/G
NON-REF	OB-05_17SN001_091517_MUM_07_WB	9/15/2017	71.5	NG/G
NON-REF	OB-05_17SN001_091517_MUM_08_WB	9/15/2017	77.6	NG/G
NON-REF	OB-05_17SN001_091517_MUM_09_WB	9/15/2017	74.1	NG/G

Appendix A-26a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Tomcod	ID	DATE	Mercury	UOM
NON-REF	OB-05_17SN001_091517_MUM_10_WB	9/15/2017	74.6	NG/G
NON-REF	OB-05_17SN001_091517_MUM_11_WB	9/15/2017	77.1	NG/G
NON-REF	OB-05_17SN001_091517_MUM_12_WB	9/15/2017	80.8	NG/G
NON-REF	OB-05_17SN001_091517_MUM_13_WB	9/15/2017	76.9	NG/G
NON-REF	OB-05_17SN001_091517_MUM_14_WB	9/15/2017	81.3	NG/G
NON-REF	OB-05_17SN001_091517_MUM_15_WB	9/15/2017	77.6	NG/G
NON-REF	OB-05_17SN001_091517_MUM_16_WB	9/15/2017	65	NG/G
NON-REF	OB-05_17SN001_091517_MUM_17_WB	9/15/2017	66.5	NG/G
NON-REF	OB-05_17SN001_091517_MUM_18_WB	9/15/2017	69.9	NG/G
NON-REF	OB-05_17SN001_091517_MUM_19_WB	9/15/2017	76.5	NG/G
NON-REF	OB-05_17SN001_091517_MUM_20_WB	9/15/2017	62.6	NG/G
NON-REF	OB-05_17SN001_091517_RAS_01_WB	9/15/2017	72.1	NG/G
NON-REF	OB-05_17SN001_091517_RAS_02_WB	9/15/2017	64.4	NG/G
NON-REF	OB-05_17SN001_091517_RAS_03_WB	9/15/2017	83.5	NG/G
NON-REF	OB-05_17SN001_091517_RAS_04_WB	9/15/2017	96.5	NG/G
NON-REF	OB-05_17SN001_091517_RAS_05_WB	9/15/2017	83.9	NG/G
NON-REF	OB-05_092516_MUM_01_WB	9/25/2016	111	NG/G
NON-REF	OB-05_092516_MUM_02_WB	9/25/2016	125	NG/G
NON-REF	OB-05_092516_MUM_03_WB	9/25/2016	113	NG/G
NON-REF	OB-05_092516_MUM_04_WB	9/25/2016	82.1	NG/G
NON-REF	OB-05_092516_MUM_05_WB	9/25/2016	96.1	NG/G
NON-REF	OB-05_092516_MUM_06_WB	9/25/2016	114	NG/G
NON-REF	OB-05_100316_MUM_07_WB	10/3/2016	106	NG/G
NON-REF	OB-05_100316_MUM_08_WB	10/3/2016	83.2	NG/G
NON-REF	OB-05_100316_MUM_09_WB	10/3/2016	83.4	NG/G
NON-REF	OB-05_100316_MUM_10_WB	10/3/2016	92.6	NG/G
NON-REF	OB-05_100316_MUM_11_WB	10/3/2016	88.2	NG/G
NON-REF	OB-05_100316_MUM_12_WB	10/3/2016	69.4	NG/G
NON-REF	OB-05_100316_MUM_13_WB	10/3/2016	98.5	NG/G
NON-REF	OB-05_100316_MUM_14_WB	10/3/2016	71.3	NG/G
NON-REF	OB-05_100316_MUM_15_WB	10/3/2016	48.9	NG/G
NON-REF	OB-05_100316_MUM_16_WB	10/3/2016	89.9	NG/G
NON-REF	OB-05_100316_MUM_17_WB	10/3/2016	71.6	NG/G
NON-REF	OB-05_100316_MUM_18_WB	10/3/2016	66.2	NG/G
NON-REF	OB-05_100316_MUM_19_WB	10/3/2016	95.8	NG/G
NON-REF	OB-05_100316_MUM_20_WB	10/3/2016	87.6	NG/G
NON-REF	OB-05_092116_RAS_01_WB	9/21/2016	201	NG/G

Appendix A-26b
UCL Evaluation - Sample Area for Atlantic tomcod
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.111/15/2017 11:19:23 AM
From File	2017-11-14 PEN_BI21 BERA_foragefish.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

resuse_Hg(ng/g) (non-ref)

General Statistics

Total Number of Observations	207	Number of Distinct Observations	182
		Number of Missing Observations	0
Minimum	26.4	Mean	83.97
Maximum	256	Median	76
SD	46.39	Std. Error of Mean	3.224
Coefficient of Variation	0.552	Skewness	1.514

Normal GOF Test

Shapiro Wilk Test Statistic	0.857	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.13	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.062	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	89.3	95% Adjusted-CLT UCL (Chen-1995)	89.64
		95% Modified-t UCL (Johnson-1978)	89.36

Gamma GOF Test

A-D Test Statistic	1.447	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0616	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0631	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.954	k star (bias corrected MLE)	3.9
Theta hat (MLE)	21.24	Theta star (bias corrected MLE)	21.53
nu hat (MLE)	1637	nu star (bias corrected)	1614
MLE Mean (bias corrected)	83.97	MLE Sd (bias corrected)	42.52
		Approximate Chi Square Value (0.05)	1522
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	1521

Appendix A-26b
UCL Evaluation - Sample Area for Atlantic tomcod
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	89.06	95% Adjusted Gamma UCL (use when n<50)	89.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.965	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.00237	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0495	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.062	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.273	Mean of logged Data	4.299
Maximum of Logged Data	5.545	SD of logged Data	0.508

Assuming Lognormal Distribution

95% H-UCL	89.29	90% Chebyshev (MVUE) UCL	93.1
95% Chebyshev (MVUE) UCL	97.35	97.5% Chebyshev (MVUE) UCL	103.3
99% Chebyshev (MVUE) UCL	114.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	89.27	95% Jackknife UCL	89.3
95% Standard Bootstrap UCL	89.28	95% Bootstrap-t UCL	89.58
95% Hall's Bootstrap UCL	89.62	95% Percentile Bootstrap UCL	89.15
95% BCA Bootstrap UCL	89.46		
90% Chebyshev(Mean, Sd) UCL	93.64	95% Chebyshev(Mean, Sd) UCL	98.02
97.5% Chebyshev(Mean, Sd) UCL	104.1	99% Chebyshev(Mean, Sd) UCL	116.1

Suggested UCL to Use

95% Approximate Gamma UCL	89.06

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

resuse_Hg(ng/g) (reference)

Appendix A-26b
UCL Evaluation - Sample Area for Atlantic tomcod
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	80	Number of Distinct Observations	76
		Number of Missing Observations	0
Minimum	4.44	Mean	8.608
Maximum	26.2	Median	7.32
SD	4.219	Std. Error of Mean	0.472
Coefficient of Variation	0.49	Skewness	2.471

Normal GOF Test

Shapiro Wilk Test Statistic	0.707	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.267	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.393	95% Adjusted-CLT UCL (Chen-1995)	9.523
		95% Modified-t UCL (Johnson-1978)	9.415

Gamma GOF Test

A-D Test Statistic	4.503	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.218	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0999	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.391	k star (bias corrected MLE)	6.16
Theta hat (MLE)	1.347	Theta star (bias corrected MLE)	1.397
nu hat (MLE)	1023	nu star (bias corrected)	985.6
MLE Mean (bias corrected)	8.608	MLE Sd (bias corrected)	3.468
		Approximate Chi Square Value (0.05)	913.7
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	912.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9.285	95% Adjusted Gamma UCL (use when n<50)	9.298

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	6.3254E-9	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.186	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Appendix A-26b
UCL Evaluation - Sample Area for Atlantic tomcod
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	1.491	Mean of logged Data	2.072
Maximum of Logged Data	3.266	SD of logged Data	0.371

Assuming Lognormal Distribution

95% H-UCL	9.166	90% Chebyshev (MVUE) UCL	9.59
95% Chebyshev (MVUE) UCL	10.08	97.5% Chebyshev (MVUE) UCL	10.77
99% Chebyshev (MVUE) UCL	12.11		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	9.384	95% Jackknife UCL	9.393
95% Standard Bootstrap UCL	9.403	95% Bootstrap-t UCL	9.556
95% Hall's Bootstrap UCL	9.585	95% Percentile Bootstrap UCL	9.379
95% BCA Bootstrap UCL	9.488		
90% Chebyshev(Mean, Sd) UCL	10.02	95% Chebyshev(Mean, Sd) UCL	10.66
97.5% Chebyshev(Mean, Sd) UCL	11.55	99% Chebyshev(Mean, Sd) UCL	13.3

Suggested UCL to Use

95% Student's-t UCL	9.393	or 95% Modified-t UCL	9.415

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-27a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Belted Kingfisher

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Belted Kingf	MED_T	ID	DATE	Length (cm	Mercury	UOM
NON-REF	Mummichog	BO-04_100316_MUM_01_WB	10/3/2016	9	234	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_02_WB	10/3/2016	6.6	57.7	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_03_WB	10/3/2016	8.1	146	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_04_WB	10/3/2016	6.8	67.3	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_05_WB	10/3/2016	7.9	214	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_06_WB	10/3/2016	6.9	76	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_07_WB	10/3/2016	6.9	76	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_08_WB	10/3/2016	7.1	75	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_09_WB	10/3/2016	6.4	60.6	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_10_WB	10/3/2016	5.35	52.4	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_11_WB	10/3/2016	6.1	94.3	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_12_WB	10/3/2016	7	200	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_13_WB	10/3/2016	6.5	55	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_14_WB	10/3/2016	6.4	66.7	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_15_WB	10/3/2016	6.6	58.1	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_16_WB	10/3/2016	5.55	61.7	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_17_WB	10/3/2016	6.4	108	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_18_WB	10/3/2016	6.1	85.9	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_19_WB	10/3/2016	5.9	59.3	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_20_WB	10/3/2016	5.8	63.9	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_01_WB	9/14/2017	8.5	30.7	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_02_WB	9/14/2017	10.9	87.8	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_03_WB	9/14/2017	8.95	42.2	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_04_WB	9/14/2017	8.55	35.5	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_05_WB	9/14/2017	7.65	29.9	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_06_WB	9/14/2017	11.5	76.7	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_07_WB	9/14/2017	7.75	78.8	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_08_WB	9/14/2017	9.2	32.7	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_09_WB	9/14/2017	8.6	26.4	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_10_WB	9/14/2017	7.1	37.4	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_11_WB	9/14/2017	8.27	37.5	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_12_WB	9/14/2017	8.27	29.8	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_13_WB	9/14/2017	8.37	63.1	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_14_WB	9/14/2017	8	43.5	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_15_WB	9/14/2017	8.27	39.1	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_16_WB	9/14/2017	7.78	34.8	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_17_WB	9/14/2017	8.33	56.6	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_18_WB	9/14/2017	8.23	40.2	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_19_WB	9/14/2017	8.95	38.1	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_20_WB	9/14/2017	8.25	30.1	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_01_WB	9/14/2017	12.5	78.6	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_02_WB	9/14/2017	12.3	92.6	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_03_WB	9/14/2017	11	68.2	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_04_WB	9/14/2017	11.6	174	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_05_WB	9/14/2017	11.7	92.2	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_06_WB	9/14/2017	11.1	83.2	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_07_WB	9/14/2017	11.6	207	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_08_WB	9/14/2017	11.6	128	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_09_WB	9/14/2017	11.1	185	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_10_WB	9/14/2017	11.2	156	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_11_WB	9/14/2017	11.6	75.7	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_12_WB	9/14/2017	9.55	43	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_13_WB	9/14/2017	9.85	36.6	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_14_WB	9/14/2017	10.15	39	NG/G

Appendix A-27a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Belted Kingfisher

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Belted Kingf	MED_T	ID	DATE	Length (cm	Mercury	UOM
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_15_WB	9/14/2017	10.25	34.2	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_16_WB	9/14/2017	9.6	52	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_17_WB	9/14/2017	10.85	34.1	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_18_WB	9/14/2017	9.2	42.5	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_19_WB	9/14/2017	9.1	31.7	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_20_WB	9/14/2017	11.1	43.6	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_01_WB	9/27/2016	12	93.6	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_02_WB	9/27/2016	12.2	113	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_03_WB	9/27/2016	10.7	49.3	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_04_WB	9/27/2016	13.4	84.6	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_05_WB	9/27/2016	9.5	60.5	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_06_WB	9/27/2016	10.7	48.7	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_07_WB	9/27/2016	10.7	36.2	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_08_WB	9/27/2016	12.4	108	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_09_WB	9/27/2016	13.2	78.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_10_WB	9/27/2016	10.1	35.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_11_WB	9/27/2016	12.7	74.1	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_12_WB	9/27/2016	15	54.7	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_13_WB	9/27/2016	11.5	56	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_14_WB	9/27/2016	11.2	31.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_15_WB	9/27/2016	10.1	64	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_16_WB	9/27/2016	10.6	60.7	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_17_WB	9/27/2016	10	44.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_18_WB	9/27/2016	10	27.1	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_19_WB	9/27/2016	9.7	33.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_20_WB	9/27/2016	10	39.8	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_01_WB	9/12/2017	5.08	5.17	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_02_WB	9/12/2017	4.83	8.36	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_03_WB	9/12/2017	4.75	5.05	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_04_WB	9/12/2017	4.43	7.11	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_05_WB	9/12/2017	5.03	7.57	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_06_WB	9/12/2017	4.48	6.46	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_07_WB	9/12/2017	5	7.7	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_08_WB	9/12/2017	4.83	7.6	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_09_WB	9/12/2017	4.48	6.16	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_10_WB	9/12/2017	4.45	6.74	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_11_WB	9/12/2017	4	6.7	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_12_WB	9/12/2017	3.88	4.81	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_13_WB	9/12/2017	4.02	5.65	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_14_WB	9/12/2017	3.93	6.1	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_15_WB	9/12/2017	3.83	5.08	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_16_WB	9/12/2017	3.92	6.6	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_17_WB	9/12/2017	3.84	5.85	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_18_WB	9/12/2017	4.58	7.84	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_19_WB	9/12/2017	4.75	6.53	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_20_WB	9/12/2017	4.28	4.44	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_01_WB	9/12/2017	11.5	18.1	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_02_WB	9/12/2017	12	14.6	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_03_WB	9/12/2017	8.4	6.88	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_04_WB	9/12/2017	11.2	22.2	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_05_WB	9/12/2017	8.9	10.8	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_06_WB	9/12/2017	11.6	14.5	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_07_WB	9/12/2017	10.9	26.2	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_08_WB	9/12/2017	11.8	24.6	NG/G

Appendix A-27a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Belted Kingfisher

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Belted Kingf	MED_T	ID	DATE	Length (cm	Mercury	UOM
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_09_WB	9/12/2017	8.45	8.2	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_10_WB	9/12/2017	9.2	10.6	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_11_WB	9/12/2017	8.9	10.9	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_12_WB	9/12/2017	10.5	6.57	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_13_WB	9/12/2017	9.15	9.38	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_14_WB	9/12/2017	10.5	19	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_15_WB	9/12/2017	8.9	7.29	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_16_WB	9/12/2017	10.3	15.7	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_17_WB	9/12/2017	8.35	12.2	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_18_WB	9/12/2017	9	7.36	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_19_WB	9/12/2017	8.8	7.98	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_20_WB	9/12/2017	9.5	11.8	NG/G
REF	Mummichog	FRB-01_092816_MUM_01_WB	9/28/2016	4.36	6.49	NG/G
REF	Mummichog	FRB-01_092816_MUM_02_WB	9/28/2016	4.1	9.83	NG/G
REF	Mummichog	FRB-01_092816_MUM_03_WB	9/28/2016	4.425	6.77	NG/G
REF	Mummichog	FRB-01_092816_MUM_04_WB	9/28/2016	4.55	5.16	NG/G
REF	Mummichog	FRB-01_092816_MUM_05_WB	9/28/2016	4.6	6.9	NG/G
REF	Mummichog	FRB-01_092816_MUM_06_WB	9/28/2016	4.7	7.83	NG/G
REF	Mummichog	FRB-01_092816_MUM_07_WB	9/28/2016	4.22	9.29	NG/G
REF	Mummichog	FRB-01_092816_MUM_08_WB	9/28/2016	4.35	5.76	NG/G
REF	Mummichog	FRB-01_092816_MUM_09_WB	9/28/2016	5.45	7.05	NG/G
REF	Mummichog	FRB-01_092816_MUM_10_WB	9/28/2016	4.04	8.37	NG/G
REF	Mummichog	FRB-01_092816_MUM_11_WB	9/28/2016	7.3	13.5	NG/G
REF	Mummichog	FRB-01_092816_MUM_12_WB	9/28/2016	5.03	7.67	NG/G
REF	Mummichog	FRB-01_092816_MUM_13_WB	9/28/2016	4.5	9.38	NG/G
REF	Mummichog	FRB-01_092816_MUM_14_WB	9/28/2016	5.33	7.9	NG/G
REF	Mummichog	FRB-01_092816_MUM_15_WB	9/28/2016	3.95	8.19	NG/G
REF	Mummichog	FRB-01_092816_MUM_16_WB	9/28/2016	5.43	8.01	NG/G
REF	Mummichog	FRB-01_092816_MUM_17_WB	9/28/2016	4.06	8.58	NG/G
REF	Mummichog	FRB-01_092816_MUM_18_WB	9/28/2016	5.45	11.1	NG/G
REF	Mummichog	FRB-01_092816_MUM_19_WB	9/28/2016	4.32	4.94	NG/G
REF	Mummichog	FRB-01_092816_MUM_20_WB	9/28/2016	3.8	8.43	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_01_WB	9/28/2016	7.6	5.46	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_02_WB	9/28/2016	7.5	5.96	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_03_WB	9/28/2016	7.4	7.27	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_04_WB	9/28/2016	7.25	6.37	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_05_WB	9/28/2016	7.75	6.5	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_06_WB	9/28/2016	8.1	7.62	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_07_WB	9/28/2016	8.2	5.07	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_08_WB	9/28/2016	7.5	8	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_09_WB	9/28/2016	7.7	7.03	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_10_WB	9/28/2016	7.55	6.89	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_11_WB	9/28/2016	7.23	6.46	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_12_WB	9/28/2016	7.5	6.6	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_13_WB	9/28/2016	7.3	6.79	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_14_WB	9/28/2016	7.75	6.67	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_15_WB	9/28/2016	7.35	8.37	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_16_WB	9/28/2016	7	6.19	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_17_WB	9/28/2016	6.75	5.72	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_18_WB	9/28/2016	9.1	8.26	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_19_WB	9/28/2016	6.43	7.35	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_20_WB	9/28/2016	7.73	6.52	NG/G
NON-REF	Mummichog	MMMC-01_17MT001_091817_MUM_01_WB	9/18/2017	6.8	51.4	NG/G
NON-REF	Mummichog	MMMC-01_17MT001_092017_MUM_02_WB	9/20/2017	7.4	137	NG/G

Appendix A-27a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Belted Kingfisher

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Belted Kingf	MED_T	ID	DATE	Length (cm	Mercury	UOM
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_06_WB	9/20/2017	9.2	109	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_07_WB	9/20/2017	9.4	122	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_08_WB	9/20/2017	9.2	107	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_09_WB	9/20/2017	8	88.2	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_10_WB	9/20/2017	8.5	207	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_11_WB	9/20/2017	8.2	94.4	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_12_WB	9/20/2017	8.5	73.2	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_13_WB	9/20/2017	8	104	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_14_WB	9/20/2017	8	150	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_15_WB	9/20/2017	8.1	145	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_16_WB	9/20/2017	8.1	72.4	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_17_WB	9/20/2017	8.5	136	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_18_WB	9/20/2017	8.2	112	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_19_WB	9/20/2017	8	100	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_20_WB	9/20/2017	7.9	256	NG/G
NON-REF	Mummichog	MMMC-01_17MT004_092017_MUM_03_WB	9/20/2017	8.1	173	NG/G
NON-REF	Mummichog	MMMC-01_17MT004_092017_MUM_04_WB	9/20/2017	7.2	109	NG/G
NON-REF	Mummichog	MMMC-01_092316_MUM_01_WB	9/23/2016	7.4	177	NG/G
NON-REF	Mummichog	MMMC-01_092316_MUM_02_WB	9/23/2016	7.9	249	NG/G
NON-REF	Mummichog	MMMC-01_092316_MUM_03_WB	9/23/2016	5.5	140	NG/G
NON-REF	Mummichog	MMMC-01_092316_MUM_04_WB	9/23/2016	7.3	121	NG/G
NON-REF	Mummichog	OB-01_17MT001_091817_MUM_01_WB	9/18/2017	9.3	86.9	NG/G
NON-REF	Mummichog	OB-01_17MT001_091917_MUM_09_WB	9/19/2017	8	79.6	NG/G
NON-REF	Mummichog	OB-01_17MT001_091917_MUM_10_WB	9/19/2017	8.1	242	NG/G
NON-REF	Mummichog	OB-01_17MT001_091917_MUM_11_WB	9/19/2017	7.8	83.4	NG/G
NON-REF	Mummichog	OB-01_17MT001_091917_MUM_12_WB	9/19/2017	7.8	130	NG/G
NON-REF	Mummichog	OB-01_17MT001_091917_MUM_13_WB	9/19/2017	6.5	127	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_02_WB	9/18/2017	7.8	86.1	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_03_WB	9/18/2017	8	103	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_04_WB	9/18/2017	7.9	154	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_05_WB	9/18/2017	8	110	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_06_WB	9/18/2017	7.8	109	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_07_WB	9/18/2017	7	37.4	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_08_WB	9/18/2017	6.2	87.2	NG/G
NON-REF	Mummichog	OB-01_17MT002_091917_MUM_14_WB	9/19/2017	9.7	237	NG/G
NON-REF	Mummichog	OB-01_17MT002_091917_MUM_15_WB	9/19/2017	7.8	118	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_01_WB	9/16/2017	14	45.3	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_02_WB	9/16/2017	14.4	36	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_03_WB	9/16/2017	13.2	72	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_04_WB	9/16/2017	14.1	77.4	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_05_WB	9/16/2017	14.8	46.5	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_06_WB	9/16/2017	13.1	39.7	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_07_WB	9/16/2017	7.83	52.1	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_08_WB	9/16/2017	7.03	42.7	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_09_WB	9/16/2017	6.6	38.2	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_10_WB	9/16/2017	7.13	47.5	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_11_WB	9/16/2017	7.7	61.7	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_12_WB	9/16/2017	7.33	42.5	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_13_WB	9/16/2017	6.68	49.8	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_14_WB	9/16/2017	7.07	49.6	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_15_WB	9/16/2017	6.73	45.3	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_16_WB	9/16/2017	6.8	49.2	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_17_WB	9/16/2017	6.8	46.9	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_18_WB	9/16/2017	6.55	44.8	NG/G

Appendix A-27a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Belted Kingfisher

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Belted Kingf	MED_T	ID	DATE	Length (cm	Mercury	UOM
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_19_WB	9/16/2017	6.25	47.8	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_20_WB	9/16/2017	6.25	45.3	NG/G
NON-REF	Mummichog	OB-01_092516_MUM_01_WB	9/25/2016	6.9	134	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_13_WB	9/21/2016	14.5	79.5	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_15_WB	9/21/2016	17.7	33.6	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_19_WB	9/21/2016	16	58.2	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_02_WB	9/21/2016	15	54.9	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_04_WB	9/21/2016	10.5	47.5	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_01_WB	9/15/2017	8.8	150	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_02_WB	9/15/2017	8.7	114	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_03_WB	9/15/2017	8.4	121	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_04_WB	9/15/2017	8.9	117	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_05_WB	9/15/2017	5.83	65.2	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_06_WB	9/15/2017	5.63	76.5	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_07_WB	9/15/2017	5.47	71.5	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_08_WB	9/15/2017	5.37	77.6	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_09_WB	9/15/2017	5.63	74.1	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_10_WB	9/15/2017	5.13	74.6	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_11_WB	9/15/2017	5.1	77.1	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_12_WB	9/15/2017	5.43	80.8	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_13_WB	9/15/2017	5.37	76.9	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_14_WB	9/15/2017	5.1	81.3	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_15_WB	9/15/2017	5	77.6	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_16_WB	9/15/2017	5.43	65	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_17_WB	9/15/2017	4.95	66.5	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_18_WB	9/15/2017	5.05	69.9	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_19_WB	9/15/2017	5	76.5	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_20_WB	9/15/2017	4.96	62.6	NG/G
NON-REF	Rainbow Smelt	OB-05_17SN001_091517_RAS_01_WB	9/15/2017	8.5	72.1	NG/G
NON-REF	Rainbow Smelt	OB-05_17SN001_091517_RAS_02_WB	9/15/2017	7.83	64.4	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_01_WB	9/25/2016	4.83	111	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_02_WB	9/25/2016	5.43	125	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_03_WB	9/25/2016	5.43	113	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_04_WB	9/25/2016	5.43	82.1	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_05_WB	9/25/2016	5.2	96.1	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_06_WB	9/25/2016	5.43	114	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_07_WB	10/3/2016	5.5	106	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_08_WB	10/3/2016	6.4	83.2	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_09_WB	10/3/2016	6.5	83.4	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_10_WB	10/3/2016	6.1	92.6	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_11_WB	10/3/2016	5.3	88.2	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_12_WB	10/3/2016	5.7	69.4	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_13_WB	10/3/2016	5.65	98.5	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_14_WB	10/3/2016	5.05	71.3	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_15_WB	10/3/2016	5	48.9	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_16_WB	10/3/2016	5.25	89.9	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_17_WB	10/3/2016	5	71.6	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_18_WB	10/3/2016	5.5	66.2	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_19_WB	10/3/2016	5.25	95.8	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_20_WB	10/3/2016	5.2	87.6	NG/G

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/12/2018 4:37:47 PM
From File	2018-01-12 ffish_kingfish.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury_ng/g (bo-04)

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	52.4	Mean	95.6
Maximum	234	Median	71.15
SD	56.54	Std. Error of Mean	12.64
Coefficient of Variation	0.591	Skewness	1.647

Normal GOF Test

Shapiro Wilk Test Statistic	0.715	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.286	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	117.5	95% Adjusted-CLT UCL (Chen-1995)	121.4
		95% Modified-t UCL (Johnson-1978)	118.2

Gamma GOF Test

A-D Test Statistic	1.817	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.263	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.195	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.193	k star (bias corrected MLE)	3.598
Theta hat (MLE)	22.8	Theta star (bias corrected MLE)	26.57
nu hat (MLE)	167.7	nu star (bias corrected)	143.9
MLE Mean (bias corrected)	95.6	MLE Sd (bias corrected)	50.4
		Approximate Chi Square Value (0.05)	117.2
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	115.3

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	117.4	95% Adjusted Gamma UCL (use when n<50)	119.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.818	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.238	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.959	Mean of logged Data	4.436
Maximum of Logged Data	5.455	SD of logged Data	0.474

Assuming Lognormal Distribution

95% H-UCL	117.4	90% Chebyshev (MVUE) UCL	124.8
95% Chebyshev (MVUE) UCL	138.8	97.5% Chebyshev (MVUE) UCL	158.2
99% Chebyshev (MVUE) UCL	196.3		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	116.4	95% Jackknife UCL	117.5
95% Standard Bootstrap UCL	115.8	95% Bootstrap-t UCL	126.4
95% Hall's Bootstrap UCL	116.5	95% Percentile Bootstrap UCL	115.6
95% BCA Bootstrap UCL	123.1		
90% Chebyshev(Mean, Sd) UCL	133.5	95% Chebyshev(Mean, Sd) UCL	150.7
97.5% Chebyshev(Mean, Sd) UCL	174.6	99% Chebyshev(Mean, Sd) UCL	221.4

Suggested UCL to Use

95% Student's-t UCL	117.5	or 95% Modified-t UCL	118.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (es-13)

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	26.4	Mean	44.55
Maximum	87.8	Median	37.8
SD	18.13	Std. Error of Mean	4.054
Coefficient of Variation	0.407	Skewness	1.374

Normal GOF Test

Shapiro Wilk Test Statistic	0.8	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.273	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	51.55	95% Adjusted-CLT UCL (Chen-1995)	52.54
		95% Modified-t UCL (Johnson-1978)	51.76

Gamma GOF Test

A-D Test Statistic	1.237	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.743	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.229	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.194	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.826	k star (bias corrected MLE)	6.685
Theta hat (MLE)	5.692	Theta star (bias corrected MLE)	6.663
nu hat (MLE)	313	nu star (bias corrected)	267.4
MLE Mean (bias corrected)	44.55	MLE Sd (bias corrected)	17.23
		Approximate Chi Square Value (0.05)	230.5
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	227.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	51.67	95% Adjusted Gamma UCL (use when n<50)	52.28

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.88	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.203	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	3.273	Mean of logged Data	3.731
Maximum of Logged Data	4.475	SD of logged Data	0.354

Assuming Lognormal Distribution

95% H-UCL	51.82	90% Chebyshev (MVUE) UCL	55.01
95% Chebyshev (MVUE) UCL	59.87	97.5% Chebyshev (MVUE) UCL	66.62
99% Chebyshev (MVUE) UCL	79.86		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	51.21	95% Jackknife UCL	51.55
95% Standard Bootstrap UCL	51.12	95% Bootstrap-t UCL	53.9
95% Hall's Bootstrap UCL	51.26	95% Percentile Bootstrap UCL	51.49
95% BCA Bootstrap UCL	52.89		
90% Chebyshev(Mean, Sd) UCL	56.71	95% Chebyshev(Mean, Sd) UCL	62.21
97.5% Chebyshev(Mean, Sd) UCL	69.86	99% Chebyshev(Mean, Sd) UCL	84.88

Suggested UCL to Use

95% Student's-t UCL	51.55	or 95% Modified-t UCL	51.76

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (es-fp)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	27.1	Mean	72.26
Maximum	207	Median	58.25
SD	44.59	Std. Error of Mean	7.05
Coefficient of Variation	0.617	Skewness	1.548

Normal GOF Test

Shapiro Wilk Test Statistic	0.821	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.156	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	84.14	95% Adjusted-CLT UCL (Chen-1995)	85.7
		95% Modified-t UCL (Johnson-1978)	84.43

Gamma GOF Test

A-D Test Statistic	0.971	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.117	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.451	k star (bias corrected MLE)	3.209
Theta hat (MLE)	20.94	Theta star (bias corrected MLE)	22.52
nu hat (MLE)	276.1	nu star (bias corrected)	256.7
MLE Mean (bias corrected)	72.26	MLE Sd (bias corrected)	40.34
		Approximate Chi Square Value (0.05)	220.6
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	219.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	84.09	95% Adjusted Gamma UCL (use when n<50)	84.57

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.108	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.3	Mean of logged Data	4.128
Maximum of Logged Data	5.333	SD of logged Data	0.538

Assuming Lognormal Distribution

95% H-UCL	84.88	90% Chebyshev (MVUE) UCL	90.7
95% Chebyshev (MVUE) UCL	99.41	97.5% Chebyshev (MVUE) UCL	111.5
99% Chebyshev (MVUE) UCL	135.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	83.86	95% Jackknife UCL	84.14
95% Standard Bootstrap UCL	83.67	95% Bootstrap-t UCL	87.83
95% Hall's Bootstrap UCL	85.87	95% Percentile Bootstrap UCL	84.6
95% BCA Bootstrap UCL	86.26		
90% Chebyshev(Mean, Sd) UCL	93.41	95% Chebyshev(Mean, Sd) UCL	103
97.5% Chebyshev(Mean, Sd) UCL	116.3	99% Chebyshev(Mean, Sd) UCL	142.4

Suggested UCL to Use

95% Adjusted Gamma UCL	84.57

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (frb-01(ref))

General Statistics

Total Number of Observations	80	Number of Distinct Observations	76
		Number of Missing Observations	0
Minimum	4.44	Mean	8.608
Maximum	26.2	Median	7.32
SD	4.219	Std. Error of Mean	0.472
Coefficient of Variation	0.49	Skewness	2.471

Normal GOF Test

Shapiro Wilk Test Statistic	0.707	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.267	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.393	95% Adjusted-CLT UCL (Chen-1995)	9.523
		95% Modified-t UCL (Johnson-1978)	9.415

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	4.503	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.218	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.0999	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.391	k star (bias corrected MLE)	6.16
Theta hat (MLE)	1.347	Theta star (bias corrected MLE)	1.397
nu hat (MLE)	1023	nu star (bias corrected)	985.6
MLE Mean (bias corrected)	8.608	MLE Sd (bias corrected)	3.468
		Approximate Chi Square Value (0.05)	913.7
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	912.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9.285	95% Adjusted Gamma UCL (use when n<50)	9.298

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	6.3254E-9	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.186	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0991	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.491	Mean of logged Data	2.072
Maximum of Logged Data	3.266	SD of logged Data	0.371

Assuming Lognormal Distribution

95% H-UCL	9.166	90% Chebyshev (MVUE) UCL	9.59
95% Chebyshev (MVUE) UCL	10.08	97.5% Chebyshev (MVUE) UCL	10.77
99% Chebyshev (MVUE) UCL	12.11		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	9.384	95% Jackknife UCL	9.393
95% Standard Bootstrap UCL	9.401	95% Bootstrap-t UCL	9.606
95% Hall's Bootstrap UCL	9.533	95% Percentile Bootstrap UCL	9.41
95% BCA Bootstrap UCL	9.507		
90% Chebyshev(Mean, Sd) UCL	10.02	95% Chebyshev(Mean, Sd) UCL	10.66
97.5% Chebyshev(Mean, Sd) UCL	11.55	99% Chebyshev(Mean, Sd) UCL	13.3

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	9.393	or 95% Modified-t UCL	9.415

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (mm)

General Statistics

Total Number of Observations	23	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	51.4	Mean	131.9
Maximum	256	Median	121
SD	52.2	Std. Error of Mean	10.88
Coefficient of Variation	0.396	Skewness	1.028

Normal GOF Test

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.147	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.18	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	150.6	95% Adjusted-CLT UCL (Chen-1995)	152.3
		95% Modified-t UCL (Johnson-1978)	151

Gamma GOF Test

A-D Test Statistic	0.3	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0997	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.182	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.2	k star (bias corrected MLE)	6.289
Theta hat (MLE)	18.32	Theta star (bias corrected MLE)	20.97
nu hat (MLE)	331.2	nu star (bias corrected)	289.3
MLE Mean (bias corrected)	131.9	MLE Sd (bias corrected)	52.59
		Approximate Chi Square Value (0.05)	250.9
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	248.3

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	152.1	95% Adjusted Gamma UCL (use when n<50)	153.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0851	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.18	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.94	Mean of logged Data	4.811
Maximum of Logged Data	5.545	SD of logged Data	0.386

Assuming Lognormal Distribution

95% H-UCL	154.5	90% Chebyshev (MVUE) UCL	164.5
95% Chebyshev (MVUE) UCL	179.3	97.5% Chebyshev (MVUE) UCL	199.8
99% Chebyshev (MVUE) UCL	240.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	149.8	95% Jackknife UCL	150.6
95% Standard Bootstrap UCL	149.2	95% Bootstrap-t UCL	155.2
95% Hall's Bootstrap UCL	155.4	95% Percentile Bootstrap UCL	149.8
95% BCA Bootstrap UCL	152.3		
90% Chebyshev(Mean, Sd) UCL	164.5	95% Chebyshev(Mean, Sd) UCL	179.3
97.5% Chebyshev(Mean, Sd) UCL	199.9	99% Chebyshev(Mean, Sd) UCL	240.2

Suggested UCL to Use

95% Student's-t UCL	150.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (ob-01)

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	39	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	33.6	Mean	78.88
Maximum	242	Median	58.2
SD	49.6	Std. Error of Mean	7.942
Coefficient of Variation	0.629	Skewness	1.911

Normal GOF Test

Shapiro Wilk Test Statistic	0.774	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.939	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.193	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.14	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	92.27	95% Adjusted-CLT UCL (Chen-1995)	94.54
		95% Modified-t UCL (Johnson-1978)	92.67

Gamma GOF Test

A-D Test Statistic	1.522	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.196	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.142	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.577	k star (bias corrected MLE)	3.319
Theta hat (MLE)	22.05	Theta star (bias corrected MLE)	23.77
nu hat (MLE)	279	nu star (bias corrected)	258.9
MLE Mean (bias corrected)	78.88	MLE Sd (bias corrected)	43.3
		Approximate Chi Square Value (0.05)	222.6
Adjusted Level of Significance	0.0437	Adjusted Chi Square Value	221.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	91.72	95% Adjusted Gamma UCL (use when n<50)	92.27

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.939	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.189	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.14	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	3.515	Mean of logged Data	4.222
Maximum of Logged Data	5.489	SD of logged Data	0.52

Assuming Lognormal Distribution

95% H-UCL	91.79	90% Chebyshev (MVUE) UCL	98.07
95% Chebyshev (MVUE) UCL	107.3	97.5% Chebyshev (MVUE) UCL	120.1
99% Chebyshev (MVUE) UCL	145.3		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	91.94	95% Jackknife UCL	92.27
95% Standard Bootstrap UCL	91.69	95% Bootstrap-t UCL	96.63
95% Hall's Bootstrap UCL	98.43	95% Percentile Bootstrap UCL	92.71
95% BCA Bootstrap UCL	94.37		
90% Chebyshev(Mean, Sd) UCL	102.7	95% Chebyshev(Mean, Sd) UCL	113.5
97.5% Chebyshev(Mean, Sd) UCL	128.5	99% Chebyshev(Mean, Sd) UCL	157.9

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	113.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (ob-04)

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	47.5	Mean	51.2
Maximum	54.9	Median	51.2

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable Mercury_ng/g (ob-04) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Mercury_ng/g (ob-05)

General Statistics

Total Number of Observations	42	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	48.9	Mean	85.86
Maximum	150	Median	79.2
SD	20.82	Std. Error of Mean	3.213
Coefficient of Variation	0.243	Skewness	1.014

Normal GOF Test

Shapiro Wilk Test Statistic	0.882	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.942	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.166	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.135	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	91.26	95% Adjusted-CLT UCL (Chen-1995)	91.68
		95% Modified-t UCL (Johnson-1978)	91.35

Gamma GOF Test

A-D Test Statistic	0.881	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.139	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.136	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	19.01	k star (bias corrected MLE)	17.67
Theta hat (MLE)	4.515	Theta star (bias corrected MLE)	4.858
nu hat (MLE)	1597	nu star (bias corrected)	1484
MLE Mean (bias corrected)	85.86	MLE Sd (bias corrected)	20.42
		Approximate Chi Square Value (0.05)	1396
Adjusted Level of Significance	0.0443	Adjusted Chi Square Value	1393

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	91.3	95% Adjusted Gamma UCL (use when n<50)	91.5

Appendix A-27b
UCL Evaluation - Sample Area for Belted Kingfisher
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.923	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.942	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.127	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.135	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.89	Mean of logged Data	4.426
Maximum of Logged Data	5.011	SD of logged Data	0.23

Assuming Lognormal Distribution

95% H-UCL	91.35	90% Chebyshev (MVUE) UCL	95.01
95% Chebyshev (MVUE) UCL	99.18	97.5% Chebyshev (MVUE) UCL	105
99% Chebyshev (MVUE) UCL	116.4		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	91.14	95% Jackknife UCL	91.26
95% Standard Bootstrap UCL	91.16	95% Bootstrap-t UCL	91.52
95% Hall's Bootstrap UCL	91.95	95% Percentile Bootstrap UCL	91.11
95% BCA Bootstrap UCL	91.33		
90% Chebyshev(Mean, Sd) UCL	95.5	95% Chebyshev(Mean, Sd) UCL	99.86
97.5% Chebyshev(Mean, Sd) UCL	105.9	99% Chebyshev(Mean, Sd) UCL	117.8

Suggested UCL to Use

95% Student's-t UCL	91.26	or 95% Modified-t UCL	91.35
or 95% H-UCL	91.35		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Appendix A-28a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Bald Eagle - All Data

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Bald Eagle	MED_T	ID	DATE	Length (cm)	Mercury	UOM
NON-REF	Rainbow Smelt	ES-13_092116_RAS_01_WB	9/21/2016	19	38.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_12_WB	9/27/2016	15	54.7	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_06_WB	9/21/2016	19	146	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_07_WB	9/21/2016	21.1	140	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_08_WB	9/21/2016	18.5	75.3	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_09_WB	9/21/2016	18.2	90.8	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_10_WB	9/21/2016	21.2	94.6	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_11_WB	9/21/2016	21.2	95.4	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_12_WB	9/21/2016	18.9	116	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_14_WB	9/21/2016	19.6	31.8	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_15_WB	9/21/2016	17.7	33.6	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_16_WB	9/21/2016	20.1	102	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_17_WB	9/21/2016	18.1	103	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_18_WB	9/21/2016	18.4	44.2	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_19_WB	9/21/2016	16	58.2	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_20_WB	9/21/2016	19.3	82.8	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_01_WB	9/21/2016	20.2	44.5	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_02_WB	9/21/2016	15	54.9	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_03_WB	9/21/2016	19.5	55.6	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_05_WB	9/21/2016	22.9	81.9	NG/G
NON-REF	Rainbow Smelt	OB-05_092116_RAS_01_WB	9/21/2016	20.2	201	NG/G

Appendix A-28b
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Bald Eagle - Length Defined Data Set

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Bald Eagle	MED_T	ID	DATE	Length (cm)	Mercury	UOM
NON-REF	Rainbow Smelt	ES-13_092116_RAS_01_WB	9/21/2016	19	38.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_12_WB	9/27/2016	15	54.7	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_06_WB	9/21/2016	19	146	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_07_WB	9/21/2016	21.1	140	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_08_WB	9/21/2016	18.5	75.3	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_09_WB	9/21/2016	18.2	90.8	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_10_WB	9/21/2016	21.2	94.6	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_11_WB	9/21/2016	21.2	95.4	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_12_WB	9/21/2016	18.9	116	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_14_WB	9/21/2016	19.6	31.8	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_15_WB	9/21/2016	17.7	33.6	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_16_WB	9/21/2016	20.1	102	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_17_WB	9/21/2016	18.1	103	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_18_WB	9/21/2016	18.4	44.2	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_19_WB	9/21/2016	16	58.2	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_20_WB	9/21/2016	19.3	82.8	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_01_WB	9/21/2016	20.2	44.5	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_02_WB	9/21/2016	15	54.9	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_03_WB	9/21/2016	19.5	55.6	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_05_WB	9/21/2016	22.9	81.9	NG/G
NON-REF	Rainbow Smelt	OB-05_092116_RAS_01_WB	9/21/2016	20.2	201	NG/G

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/15/2018 10:00:59 AM
From File	2018-01-12 ffish_eagle.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury_ng/g (bo-04)

	General Statistics		
Total Number of Observations	21	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	52.4	Mean	94.06
Maximum	234	Median	67.3
SD	55.56	Std. Error of Mean	12.12
Coefficient of Variation	0.591	Skewness	1.722
	Normal GOF Test		
Shapiro Wilk Test Statistic	0.701	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.908	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.294	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.188	Data Not Normal at 5% Significance Level	
	Data Not Normal at 5% Significance Level		
	Assuming Normal Distribution		
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	115	95% Adjusted-CLT UCL (Chen-1995)	118.9
		95% Modified-t UCL (Johnson-1978)	115.7
	Gamma GOF Test		
A-D Test Statistic	2.03	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.27	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.19	Data Not Gamma Distributed at 5% Significance Level	
	Data Not Gamma Distributed at 5% Significance Level		
	Gamma Statistics		
k hat (MLE)	4.277	k star (bias corrected MLE)	3.698
Theta hat (MLE)	21.99	Theta star (bias corrected MLE)	25.44
nu hat (MLE)	179.6	nu star (bias corrected)	155.3
MLE Mean (bias corrected)	94.06	MLE Sd (bias corrected)	48.91
		Approximate Chi Square Value (0.05)	127.5
Adjusted Level of Significance	0.0383	Adjusted Chi Square Value	125.6

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	114.6	95% Adjusted Gamma UCL (use when n<50)	116.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.806	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.245	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.188	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.959	Mean of logged Data	4.423
Maximum of Logged Data	5.455	SD of logged Data	0.466

Assuming Lognormal Distribution

95% H-UCL	113.9	90% Chebyshev (MVUE) UCL	121.5
95% Chebyshev (MVUE) UCL	134.7	97.5% Chebyshev (MVUE) UCL	153
99% Chebyshev (MVUE) UCL	188.9		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	114	95% Jackknife UCL	115
95% Standard Bootstrap UCL	113.4	95% Bootstrap-t UCL	125.1
95% Hall's Bootstrap UCL	114	95% Percentile Bootstrap UCL	114.2
95% BCA Bootstrap UCL	118.7		
90% Chebyshev(Mean, Sd) UCL	130.4	95% Chebyshev(Mean, Sd) UCL	146.9
97.5% Chebyshev(Mean, Sd) UCL	169.8	99% Chebyshev(Mean, Sd) UCL	214.7

Suggested UCL to Use

95% Student's-t UCL	115	or 95% Modified-t UCL	115.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Mercury_ng/g (es-13)

General Statistics

Total Number of Observations	21	Number of Distinct Observations	21
		Number of Missing Observations	0
Minimum	26.4	Mean	44.25
Maximum	87.8	Median	38.1
SD	17.72	Std. Error of Mean	3.867
Coefficient of Variation	0.4	Skewness	1.443

Normal GOF Test

Shapiro Wilk Test Statistic	0.791	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.279	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.188	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	50.92	95% Adjusted-CLT UCL (Chen-1995)	51.91
		95% Modified-t UCL (Johnson-1978)	51.12

Gamma GOF Test

A-D Test Statistic	1.356	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.744	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.235	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.19	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.148	k star (bias corrected MLE)	7.016
Theta hat (MLE)	5.431	Theta star (bias corrected MLE)	6.308
nu hat (MLE)	342.2	nu star (bias corrected)	294.7
MLE Mean (bias corrected)	44.25	MLE Sd (bias corrected)	16.71
		Approximate Chi Square Value (0.05)	255.9
Adjusted Level of Significance	0.0383	Adjusted Chi Square Value	253.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	50.96	95% Adjusted Gamma UCL (use when n<50)	51.51

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.188	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	3.273	Mean of logged Data	3.727
Maximum of Logged Data	4.475	SD of logged Data	0.346

Assuming Lognormal Distribution

95% H-UCL	50.97	90% Chebyshev (MVUE) UCL	54.14
95% Chebyshev (MVUE) UCL	58.74	97.5% Chebyshev (MVUE) UCL	65.11
99% Chebyshev (MVUE) UCL	77.64		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	50.61	95% Jackknife UCL	50.92
95% Standard Bootstrap UCL	50.44	95% Bootstrap-t UCL	53.31
95% Hall's Bootstrap UCL	50.96	95% Percentile Bootstrap UCL	50.87
95% BCA Bootstrap UCL	52.3		
90% Chebyshev(Mean, Sd) UCL	55.85	95% Chebyshev(Mean, Sd) UCL	61.11
97.5% Chebyshev(Mean, Sd) UCL	68.4	99% Chebyshev(Mean, Sd) UCL	82.73

Suggested UCL to Use

95% Student's-t UCL	50.92	or 95% Modified-t UCL	51.12

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (es-fp)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	27.1	Mean	72.26
Maximum	207	Median	58.25
SD	44.59	Std. Error of Mean	7.05
Coefficient of Variation	0.617	Skewness	1.548

Normal GOF Test

Shapiro Wilk Test Statistic	0.821	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.156	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	84.14	95% Adjusted-CLT UCL (Chen-1995)	85.7
		95% Modified-t UCL (Johnson-1978)	84.43

Gamma GOF Test

A-D Test Statistic	0.971	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.117	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.451	k star (bias corrected MLE)	3.209
Theta hat (MLE)	20.94	Theta star (bias corrected MLE)	22.52
nu hat (MLE)	276.1	nu star (bias corrected)	256.7
MLE Mean (bias corrected)	72.26	MLE Sd (bias corrected)	40.34
		Approximate Chi Square Value (0.05)	220.6
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	219.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	84.09	95% Adjusted Gamma UCL (use when n<50)	84.57

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.108	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.3	Mean of logged Data	4.128
Maximum of Logged Data	5.333	SD of logged Data	0.538

Assuming Lognormal Distribution

95% H-UCL	84.88	90% Chebyshev (MVUE) UCL	90.7
95% Chebyshev (MVUE) UCL	99.41	97.5% Chebyshev (MVUE) UCL	111.5
99% Chebyshev (MVUE) UCL	135.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	83.86	95% Jackknife UCL	84.14
95% Standard Bootstrap UCL	83.74	95% Bootstrap-t UCL	86.81
95% Hall's Bootstrap UCL	85.51	95% Percentile Bootstrap UCL	83.4
95% BCA Bootstrap UCL	86.21		
90% Chebyshev(Mean, Sd) UCL	93.41	95% Chebyshev(Mean, Sd) UCL	103
97.5% Chebyshev(Mean, Sd) UCL	116.3	99% Chebyshev(Mean, Sd) UCL	142.4

Suggested UCL to Use

95% Adjusted Gamma UCL	84.57

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (frb-ref)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	76
		Number of Missing Observations	0
Minimum	4.44	Mean	8.608
Maximum	26.2	Median	7.32
SD	4.219	Std. Error of Mean	0.472
Coefficient of Variation	0.49	Skewness	2.471

Normal GOF Test

Shapiro Wilk Test Statistic	0.707	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.267	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.393	95% Adjusted-CLT UCL (Chen-1995)	9.523
		95% Modified-t UCL (Johnson-1978)	9.415

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	4.503	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.218	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0999	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.391	k star (bias corrected MLE)	6.16
Theta hat (MLE)	1.347	Theta star (bias corrected MLE)	1.397
nu hat (MLE)	1023	nu star (bias corrected)	985.6
MLE Mean (bias corrected)	8.608	MLE Sd (bias corrected)	3.468
		Approximate Chi Square Value (0.05)	913.7
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	912.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9.285	95% Adjusted Gamma UCL (use when n<50)	9.298

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	6.3254E-9	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.186	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.491	Mean of logged Data	2.072
Maximum of Logged Data	3.266	SD of logged Data	0.371

Assuming Lognormal Distribution

95% H-UCL	9.166	90% Chebyshev (MVUE) UCL	9.59
95% Chebyshev (MVUE) UCL	10.08	97.5% Chebyshev (MVUE) UCL	10.77
99% Chebyshev (MVUE) UCL	12.11		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	9.384	95% Jackknife UCL	9.393
95% Standard Bootstrap UCL	9.371	95% Bootstrap-t UCL	9.672
95% Hall's Bootstrap UCL	9.604	95% Percentile Bootstrap UCL	9.406
95% BCA Bootstrap UCL	9.582		
90% Chebyshev(Mean, Sd) UCL	10.02	95% Chebyshev(Mean, Sd) UCL	10.66
97.5% Chebyshev(Mean, Sd) UCL	11.55	99% Chebyshev(Mean, Sd) UCL	13.3

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	9.393	or 95% Modified-t UCL	9.415

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (mm)

General Statistics

Total Number of Observations	23	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	51.4	Mean	131.9
Maximum	256	Median	121
SD	52.2	Std. Error of Mean	10.88
Coefficient of Variation	0.396	Skewness	1.028

Normal GOF Test

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.147	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.18	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	150.6	95% Adjusted-CLT UCL (Chen-1995)	152.3
		95% Modified-t UCL (Johnson-1978)	151

Gamma GOF Test

A-D Test Statistic	0.3	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0997	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.182	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.2	k star (bias corrected MLE)	6.289
Theta hat (MLE)	18.32	Theta star (bias corrected MLE)	20.97
nu hat (MLE)	331.2	nu star (bias corrected)	289.3
MLE Mean (bias corrected)	131.9	MLE Sd (bias corrected)	52.59
		Approximate Chi Square Value (0.05)	250.9
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	248.3

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	152.1	95% Adjusted Gamma UCL (use when n<50)	153.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0851	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.18	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.94	Mean of logged Data	4.811
Maximum of Logged Data	5.545	SD of logged Data	0.386

Assuming Lognormal Distribution

95% H-UCL	154.5	90% Chebyshev (MVUE) UCL	164.5
95% Chebyshev (MVUE) UCL	179.3	97.5% Chebyshev (MVUE) UCL	199.8
99% Chebyshev (MVUE) UCL	240.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	149.8	95% Jackknife UCL	150.6
95% Standard Bootstrap UCL	149.2	95% Bootstrap-t UCL	154
95% Hall's Bootstrap UCL	154	95% Percentile Bootstrap UCL	149.8
95% BCA Bootstrap UCL	152.6		
90% Chebyshev(Mean, Sd) UCL	164.5	95% Chebyshev(Mean, Sd) UCL	179.3
97.5% Chebyshev(Mean, Sd) UCL	199.9	99% Chebyshev(Mean, Sd) UCL	240.2

Suggested UCL to Use

95% Student's-t UCL	150.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Mercury_ng/g (ob-01)

General Statistics

Total Number of Observations	51	Number of Distinct Observations	48
		Number of Missing Observations	0
Minimum	31.8	Mean	82.32
Maximum	242	Median	77.4
SD	46.42	Std. Error of Mean	6.5
Coefficient of Variation	0.564	Skewness	1.617

Normal GOF Test

Shapiro Wilk Test Statistic	0.839	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	3.2281E-7	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.154	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	93.21	95% Adjusted-CLT UCL (Chen-1995)	94.58
		95% Modified-t UCL (Johnson-1978)	93.45

Gamma GOF Test

A-D Test Statistic	1.071	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.164	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.125	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.934	k star (bias corrected MLE)	3.716
Theta hat (MLE)	20.92	Theta star (bias corrected MLE)	22.15
nu hat (MLE)	401.3	nu star (bias corrected)	379
MLE Mean (bias corrected)	82.32	MLE Sd (bias corrected)	42.7
		Approximate Chi Square Value (0.05)	334.9
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	333.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	93.16	95% Adjusted Gamma UCL (use when n<50)	93.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0203	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.159	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.459	Mean of logged Data	4.278
Maximum of Logged Data	5.489	SD of logged Data	0.508

Assuming Lognormal Distribution

95% H-UCL	93.95	90% Chebyshev (MVUE) UCL	100.2
95% Chebyshev (MVUE) UCL	108.5	97.5% Chebyshev (MVUE) UCL	120.1
99% Chebyshev (MVUE) UCL	142.8		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	93.01	95% Jackknife UCL	93.21
95% Standard Bootstrap UCL	93.04	95% Bootstrap-t UCL	95.75
95% Hall's Bootstrap UCL	95.89	95% Percentile Bootstrap UCL	93.16
95% BCA Bootstrap UCL	94.52		
90% Chebyshev(Mean, Sd) UCL	101.8	95% Chebyshev(Mean, Sd) UCL	110.6
97.5% Chebyshev(Mean, Sd) UCL	122.9	99% Chebyshev(Mean, Sd) UCL	147

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	110.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (ob-04)

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	44.5	Mean	56.88
Maximum	81.9	Median	54.9
SD	14.77	Std. Error of Mean	6.606
Coefficient of Variation	0.26	Skewness	1.671

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.824	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.335	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	70.96	95% Adjusted-CLT UCL (Chen-1995)	73.02
		95% Modified-t UCL (Johnson-1978)	71.79

Gamma GOF Test

A-D Test Statistic	0.469	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.313	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	21.12	k star (bias corrected MLE)	8.581
Theta hat (MLE)	2.693	Theta star (bias corrected MLE)	6.628
nu hat (MLE)	211.2	nu star (bias corrected)	85.81
MLE Mean (bias corrected)	56.88	MLE Sd (bias corrected)	19.42
		Approximate Chi Square Value (0.05)	65.46
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	57.74

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	74.57	95% Adjusted Gamma UCL (use when n<50)	84.54

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.298	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.343	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.795	Mean of logged Data	4.017
Maximum of Logged Data	4.405	SD of logged Data	0.237

Assuming Lognormal Distribution

95% H-UCL	74.73	90% Chebyshev (MVUE) UCL	74.82
95% Chebyshev (MVUE) UCL	82.98	97.5% Chebyshev (MVUE) UCL	94.31
99% Chebyshev (MVUE) UCL	116.6		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	67.75	95% Jackknife UCL	70.96
95% Standard Bootstrap UCL	66.69	95% Bootstrap-t UCL	86.53
95% Hall's Bootstrap UCL	114.5	95% Percentile Bootstrap UCL	65.98
95% BCA Bootstrap UCL	69.76		
90% Chebyshev(Mean, Sd) UCL	76.7	95% Chebyshev(Mean, Sd) UCL	85.68
97.5% Chebyshev(Mean, Sd) UCL	98.14	99% Chebyshev(Mean, Sd) UCL	122.6

Suggested UCL to Use

95% Student's-t UCL	70.96

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (ob-05)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	48.9	Mean	88.5
Maximum	201	Median	81.7
SD	26.18	Std. Error of Mean	3.86
Coefficient of Variation	0.296	Skewness	2.124

Normal GOF Test

Shapiro Wilk Test Statistic	0.833	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.178	Lilliefors GOF Test
5% Lilliefors Critical Value	0.129	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	94.98	95% Adjusted-CLT UCL (Chen-1995)	96.14
		95% Modified-t UCL (Johnson-1978)	95.18

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	1.161	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.154	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.13	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	14.62	k star (bias corrected MLE)	13.68
Theta hat (MLE)	6.053	Theta star (bias corrected MLE)	6.468
nu hat (MLE)	1345	nu star (bias corrected)	1259
MLE Mean (bias corrected)	88.5	MLE Sd (bias corrected)	23.93
		Approximate Chi Square Value (0.05)	1177
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	1175

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	94.61	95% Adjusted Gamma UCL (use when n<50)	94.82

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.947	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.138	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.129	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.89	Mean of logged Data	4.448
Maximum of Logged Data	5.303	SD of logged Data	0.255

Assuming Lognormal Distribution

95% H-UCL	94.5	90% Chebyshev (MVUE) UCL	98.35
95% Chebyshev (MVUE) UCL	102.9	97.5% Chebyshev (MVUE) UCL	109.3
99% Chebyshev (MVUE) UCL	121.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	94.85	95% Jackknife UCL	94.98
95% Standard Bootstrap UCL	94.79	95% Bootstrap-t UCL	96.86
95% Hall's Bootstrap UCL	98.46	95% Percentile Bootstrap UCL	95.07
95% BCA Bootstrap UCL	96.62		
90% Chebyshev(Mean, Sd) UCL	100.1	95% Chebyshev(Mean, Sd) UCL	105.3
97.5% Chebyshev(Mean, Sd) UCL	112.6	99% Chebyshev(Mean, Sd) UCL	126.9

Appendix A-28c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	94.98	or 95% Modified-t UCL	95.18
or 95% H-UCL	94.5		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Appendix A-28d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/16/2018 9:52:11 AM
From File	28_Forage Fish_Bald Eagle 041618 INPUT.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (es-13)

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	38.4	Mean	38.4
Maximum	38.4	Median	38.4

Warning: This data set only has 1 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable Mercury (es-13) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Mercury (es-fp)

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	54.7	Mean	54.7
Maximum	54.7	Median	54.7

Warning: This data set only has 1 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable Mercury (es-fp) was not processed!

Appendix A-28d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Mercury (ob-01)

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	31.8	Mean	86.69
Maximum	146	Median	92.7
SD	35.59	Std. Error of Mean	9.512
Coefficient of Variation	0.411	Skewness	-0.0439

Normal GOF Test

Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.117	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.226	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	103.5	95% Adjusted-CLT UCL (Chen-1995)	102.2
		95% Modified-t UCL (Johnson-1978)	103.5

Gamma GOF Test

A-D Test Statistic	0.46	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.738	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.171	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.229	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-28d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	5.332	k star (bias corrected MLE)	4.237
Theta hat (MLE)	16.26	Theta star (bias corrected MLE)	20.46
nu hat (MLE)	149.3	nu star (bias corrected)	118.6
MLE Mean (bias corrected)	86.69	MLE Sd (bias corrected)	42.12
		Approximate Chi Square Value (0.05)	94.48
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	91.63

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	108.9	95% Adjusted Gamma UCL (use when n<50)	112.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.187	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.459	Mean of logged Data	4.366
Maximum of Logged Data	4.984	SD of logged Data	0.486

Assuming Lognormal Distribution

95% H-UCL	116.1	90% Chebyshev (MVUE) UCL	122.8
95% Chebyshev (MVUE) UCL	138.7	97.5% Chebyshev (MVUE) UCL	160.8
99% Chebyshev (MVUE) UCL	204.2		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	102.3	95% Jackknife UCL	103.5
95% Standard Bootstrap UCL	101.9	95% Bootstrap-t UCL	103
95% Hall's Bootstrap UCL	102.4	95% Percentile Bootstrap UCL	101.3
95% BCA Bootstrap UCL	102.1		
90% Chebyshev(Mean, Sd) UCL	115.2	95% Chebyshev(Mean, Sd) UCL	128.2
97.5% Chebyshev(Mean, Sd) UCL	146.1	99% Chebyshev(Mean, Sd) UCL	181.3

Appendix A-28d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL 103.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Mercury (ob-04)

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	44.5	Mean	59.23
Maximum	81.9	Median	55.25
SD	15.95	Std. Error of Mean	7.973
Coefficient of Variation	0.269	Skewness	1.371

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.874	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.34	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	77.99	95% Adjusted-CLT UCL (Chen-1995)	78.18
		95% Modified-t UCL (Johnson-1978)	78.9

Appendix A-28d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.4	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.331	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	20.03	k star (bias corrected MLE)	5.174
Theta hat (MLE)	2.957	Theta star (bias corrected MLE)	11.45
nu hat (MLE)	160.2	nu star (bias corrected)	41.39
MLE Mean (bias corrected)	59.23	MLE Sd (bias corrected)	26.04
		Approximate Chi Square Value (0.05)	27.64
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	88.67	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.915	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.309	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.795	Mean of logged Data	4.056
Maximum of Logged Data	4.405	SD of logged Data	0.254

Assuming Lognormal Distribution

95% H-UCL	87.69	90% Chebyshev (MVUE) UCL	81.62
95% Chebyshev (MVUE) UCL	91.79	97.5% Chebyshev (MVUE) UCL	105.9
99% Chebyshev (MVUE) UCL	133.6		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-28d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	72.34	95% Jackknife UCL	77.99
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	83.14	95% Chebyshev(Mean, Sd) UCL	93.98
97.5% Chebyshev(Mean, Sd) UCL	109	99% Chebyshev(Mean, Sd) UCL	138.6

Suggested UCL to Use

95% Student's-t UCL	77.99

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (ob-05)

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	201	Mean	201
Maximum	201	Median	201

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable Mercury (ob-05) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Appendix A-29a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Mink	MED_T	ID	DATE	Length (cm	Mercury	UOM
NON-REF	Mummichog	BO-04_100316_MUM_01_WB	10/3/2016	9	234	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_02_WB	10/3/2016	6.6	57.7	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_03_WB	10/3/2016	8.1	146	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_04_WB	10/3/2016	6.8	67.3	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_05_WB	10/3/2016	7.9	214	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_06_WB	10/3/2016	6.9	76	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_07_WB	10/3/2016	6.9	76	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_08_WB	10/3/2016	7.1	75	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_09_WB	10/3/2016	6.4	60.6	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_10_WB	10/3/2016	5.35	52.4	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_11_WB	10/3/2016	6.1	94.3	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_12_WB	10/3/2016	7	200	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_13_WB	10/3/2016	6.5	55	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_14_WB	10/3/2016	6.4	66.7	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_15_WB	10/3/2016	6.6	58.1	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_16_WB	10/3/2016	5.55	61.7	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_17_WB	10/3/2016	6.4	108	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_18_WB	10/3/2016	6.1	85.9	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_19_WB	10/3/2016	5.9	59.3	NG/G
NON-REF	Mummichog	BO-04_100316_MUM_20_WB	10/3/2016	5.8	63.9	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_01_WB	9/14/2017	8.5	30.7	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_02_WB	9/14/2017	10.9	87.8	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_03_WB	9/14/2017	8.95	42.2	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_04_WB	9/14/2017	8.55	35.5	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_05_WB	9/14/2017	7.65	29.9	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_06_WB	9/14/2017	11.5	76.7	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_07_WB	9/14/2017	7.75	78.8	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_08_WB	9/14/2017	9.2	32.7	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_09_WB	9/14/2017	8.6	26.4	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_10_WB	9/14/2017	7.1	37.4	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_11_WB	9/14/2017	8.27	37.5	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_12_WB	9/14/2017	8.27	29.8	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_13_WB	9/14/2017	8.37	63.1	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_14_WB	9/14/2017	8	43.5	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_15_WB	9/14/2017	8.27	39.1	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_16_WB	9/14/2017	7.78	34.8	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_17_WB	9/14/2017	8.33	56.6	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_18_WB	9/14/2017	8.23	40.2	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_19_WB	9/14/2017	8.95	38.1	NG/G
NON-REF	Rainbow Smelt	ES-13_17SN001_091417_RAS_20_WB	9/14/2017	8.25	30.1	NG/G
NON-REF	Rainbow Smelt	ES-13_092116_RAS_01_WB	9/21/2016	19	38.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_01_WB	9/14/2017	12.5	78.6	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_02_WB	9/14/2017	12.3	92.6	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_03_WB	9/14/2017	11	68.2	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_04_WB	9/14/2017	11.6	174	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_05_WB	9/14/2017	11.7	92.2	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_06_WB	9/14/2017	11.1	83.2	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_07_WB	9/14/2017	11.6	207	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_08_WB	9/14/2017	11.6	128	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_09_WB	9/14/2017	11.1	185	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_10_WB	9/14/2017	11.2	156	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_11_WB	9/14/2017	11.6	75.7	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_12_WB	9/14/2017	9.55	43	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_13_WB	9/14/2017	9.85	36.6	NG/G

Appendix A-29a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Mink	MED_T	ID	DATE	Length (cm	Mercury	UOM
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_14_WB	9/14/2017	10.15	39	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_15_WB	9/14/2017	10.25	34.2	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_16_WB	9/14/2017	9.6	52	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_17_WB	9/14/2017	10.85	34.1	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_18_WB	9/14/2017	9.2	42.5	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_19_WB	9/14/2017	9.1	31.7	NG/G
NON-REF	Rainbow Smelt	ES-FP_17SN001_091417_RAS_20_WB	9/14/2017	11.1	43.6	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_01_WB	9/27/2016	12	93.6	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_02_WB	9/27/2016	12.2	113	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_03_WB	9/27/2016	10.7	49.3	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_04_WB	9/27/2016	13.4	84.6	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_05_WB	9/27/2016	9.5	60.5	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_06_WB	9/27/2016	10.7	48.7	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_07_WB	9/27/2016	10.7	36.2	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_08_WB	9/27/2016	12.4	108	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_09_WB	9/27/2016	13.2	78.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_10_WB	9/27/2016	10.1	35.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_11_WB	9/27/2016	12.7	74.1	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_12_WB	9/27/2016	15	54.7	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_13_WB	9/27/2016	11.5	56	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_14_WB	9/27/2016	11.2	31.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_15_WB	9/27/2016	10.1	64	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_16_WB	9/27/2016	10.6	60.7	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_17_WB	9/27/2016	10	44.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_18_WB	9/27/2016	10	27.1	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_19_WB	9/27/2016	9.7	33.4	NG/G
NON-REF	Rainbow Smelt	ES-FP_092716_RAS_20_WB	9/27/2016	10	39.8	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_01_WB	9/12/2017	5.08	5.17	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_02_WB	9/12/2017	4.83	8.36	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_03_WB	9/12/2017	4.75	5.05	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_04_WB	9/12/2017	4.43	7.11	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_05_WB	9/12/2017	5.03	7.57	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_06_WB	9/12/2017	4.48	6.46	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_07_WB	9/12/2017	5	7.7	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_08_WB	9/12/2017	4.83	7.6	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_09_WB	9/12/2017	4.48	6.16	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_10_WB	9/12/2017	4.45	6.74	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_11_WB	9/12/2017	4	6.7	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_12_WB	9/12/2017	3.88	4.81	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_13_WB	9/12/2017	4.02	5.65	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_14_WB	9/12/2017	3.93	6.1	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_15_WB	9/12/2017	3.83	5.08	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_16_WB	9/12/2017	3.92	6.6	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_17_WB	9/12/2017	3.84	5.85	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_18_WB	9/12/2017	4.58	7.84	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_19_WB	9/12/2017	4.75	6.53	NG/G
REF	Mummichog	FRB-01_17SN001_091217_MUM_20_WB	9/12/2017	4.28	4.44	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_01_WB	9/12/2017	11.5	18.1	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_02_WB	9/12/2017	12	14.6	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_03_WB	9/12/2017	8.4	6.88	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_04_WB	9/12/2017	11.2	22.2	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_05_WB	9/12/2017	8.9	10.8	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_06_WB	9/12/2017	11.6	14.5	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_07_WB	9/12/2017	10.9	26.2	NG/G

Appendix A-29a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Mink	MED_T	ID	DATE	Length (cm	Mercury	UOM
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_08_WB	9/12/2017	11.8	24.6	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_09_WB	9/12/2017	8.45	8.2	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_10_WB	9/12/2017	9.2	10.6	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_11_WB	9/12/2017	8.9	10.9	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_12_WB	9/12/2017	10.5	6.57	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_13_WB	9/12/2017	9.15	9.38	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_14_WB	9/12/2017	10.5	19	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_15_WB	9/12/2017	8.9	7.29	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_16_WB	9/12/2017	10.3	15.7	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_17_WB	9/12/2017	8.35	12.2	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_18_WB	9/12/2017	9	7.36	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_19_WB	9/12/2017	8.8	7.98	NG/G
REF	Rainbow Smelt	FRB-01_17SN001_091217_RAS_20_WB	9/12/2017	9.5	11.8	NG/G
REF	Mummichog	FRB-01_092816_MUM_01_WB	9/28/2016	4.36	6.49	NG/G
REF	Mummichog	FRB-01_092816_MUM_02_WB	9/28/2016	4.1	9.83	NG/G
REF	Mummichog	FRB-01_092816_MUM_03_WB	9/28/2016	4.425	6.77	NG/G
REF	Mummichog	FRB-01_092816_MUM_04_WB	9/28/2016	4.55	5.16	NG/G
REF	Mummichog	FRB-01_092816_MUM_05_WB	9/28/2016	4.6	6.9	NG/G
REF	Mummichog	FRB-01_092816_MUM_06_WB	9/28/2016	4.7	7.83	NG/G
REF	Mummichog	FRB-01_092816_MUM_07_WB	9/28/2016	4.22	9.29	NG/G
REF	Mummichog	FRB-01_092816_MUM_08_WB	9/28/2016	4.35	5.76	NG/G
REF	Mummichog	FRB-01_092816_MUM_09_WB	9/28/2016	5.45	7.05	NG/G
REF	Mummichog	FRB-01_092816_MUM_10_WB	9/28/2016	4.04	8.37	NG/G
REF	Mummichog	FRB-01_092816_MUM_11_WB	9/28/2016	7.3	13.5	NG/G
REF	Mummichog	FRB-01_092816_MUM_12_WB	9/28/2016	5.03	7.67	NG/G
REF	Mummichog	FRB-01_092816_MUM_13_WB	9/28/2016	4.5	9.38	NG/G
REF	Mummichog	FRB-01_092816_MUM_14_WB	9/28/2016	5.33	7.9	NG/G
REF	Mummichog	FRB-01_092816_MUM_15_WB	9/28/2016	3.95	8.19	NG/G
REF	Mummichog	FRB-01_092816_MUM_16_WB	9/28/2016	5.43	8.01	NG/G
REF	Mummichog	FRB-01_092816_MUM_17_WB	9/28/2016	4.06	8.58	NG/G
REF	Mummichog	FRB-01_092816_MUM_18_WB	9/28/2016	5.45	11.1	NG/G
REF	Mummichog	FRB-01_092816_MUM_19_WB	9/28/2016	4.32	4.94	NG/G
REF	Mummichog	FRB-01_092816_MUM_20_WB	9/28/2016	3.8	8.43	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_01_WB	9/28/2016	7.6	5.46	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_02_WB	9/28/2016	7.5	5.96	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_03_WB	9/28/2016	7.4	7.27	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_04_WB	9/28/2016	7.25	6.37	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_05_WB	9/28/2016	7.75	6.5	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_06_WB	9/28/2016	8.1	7.62	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_07_WB	9/28/2016	8.2	5.07	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_08_WB	9/28/2016	7.5	8	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_09_WB	9/28/2016	7.7	7.03	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_10_WB	9/28/2016	7.55	6.89	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_11_WB	9/28/2016	7.23	6.46	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_12_WB	9/28/2016	7.5	6.6	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_13_WB	9/28/2016	7.3	6.79	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_14_WB	9/28/2016	7.75	6.67	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_15_WB	9/28/2016	7.35	8.37	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_16_WB	9/28/2016	7	6.19	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_17_WB	9/28/2016	6.75	5.72	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_18_WB	9/28/2016	9.1	8.26	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_19_WB	9/28/2016	6.43	7.35	NG/G
REF	Rainbow Smelt	FRB-01_092816_RAS_20_WB	9/28/2016	7.73	6.52	NG/G
NON-REF	Mummichog	MMMC-01_17MT001_091817_MUM_01_WB	9/18/2017	6.8	51.4	NG/G

Appendix A-29a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Mink	MED_T	ID	DATE	Length (cm	Mercury	UOM
NON-REF	Mummichog	MMMC-01_17MT001_092017_MUM_02_WB	9/20/2017	7.4	137	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_06_WB	9/20/2017	9.2	109	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_07_WB	9/20/2017	9.4	122	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_08_WB	9/20/2017	9.2	107	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_09_WB	9/20/2017	8	88.2	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_10_WB	9/20/2017	8.5	207	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_11_WB	9/20/2017	8.2	94.4	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_12_WB	9/20/2017	8.5	73.2	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_13_WB	9/20/2017	8	104	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_14_WB	9/20/2017	8	150	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_15_WB	9/20/2017	8.1	145	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_16_WB	9/20/2017	8.1	72.4	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_17_WB	9/20/2017	8.5	136	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_18_WB	9/20/2017	8.2	112	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_19_WB	9/20/2017	8	100	NG/G
NON-REF	Mummichog	MMMC-01_17MT003_092017_MUM_20_WB	9/20/2017	7.9	256	NG/G
NON-REF	Mummichog	MMMC-01_17MT004_092017_MUM_03_WB	9/20/2017	8.1	173	NG/G
NON-REF	Mummichog	MMMC-01_17MT004_092017_MUM_04_WB	9/20/2017	7.2	109	NG/G
NON-REF	Mummichog	MMMC-01_092316_MUM_01_WB	9/23/2016	7.4	177	NG/G
NON-REF	Mummichog	MMMC-01_092316_MUM_02_WB	9/23/2016	7.9	249	NG/G
NON-REF	Mummichog	MMMC-01_092316_MUM_03_WB	9/23/2016	5.5	140	NG/G
NON-REF	Mummichog	MMMC-01_092316_MUM_04_WB	9/23/2016	7.3	121	NG/G
NON-REF	Mummichog	OB-01_17MT001_091817_MUM_01_WB	9/18/2017	9.3	86.9	NG/G
NON-REF	Mummichog	OB-01_17MT001_091917_MUM_09_WB	9/19/2017	8	79.6	NG/G
NON-REF	Mummichog	OB-01_17MT001_091917_MUM_10_WB	9/19/2017	8.1	242	NG/G
NON-REF	Mummichog	OB-01_17MT001_091917_MUM_11_WB	9/19/2017	7.8	83.4	NG/G
NON-REF	Mummichog	OB-01_17MT001_091917_MUM_12_WB	9/19/2017	7.8	130	NG/G
NON-REF	Mummichog	OB-01_17MT001_091917_MUM_13_WB	9/19/2017	6.5	127	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_02_WB	9/18/2017	7.8	86.1	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_03_WB	9/18/2017	8	103	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_04_WB	9/18/2017	7.9	154	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_05_WB	9/18/2017	8	110	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_06_WB	9/18/2017	7.8	109	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_07_WB	9/18/2017	7	37.4	NG/G
NON-REF	Mummichog	OB-01_17MT002_091817_MUM_08_WB	9/18/2017	6.2	87.2	NG/G
NON-REF	Mummichog	OB-01_17MT002_091917_MUM_14_WB	9/19/2017	9.7	237	NG/G
NON-REF	Mummichog	OB-01_17MT002_091917_MUM_15_WB	9/19/2017	7.8	118	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_01_WB	9/16/2017	14	45.3	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_02_WB	9/16/2017	14.4	36	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_03_WB	9/16/2017	13.2	72	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_04_WB	9/16/2017	14.1	77.4	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_05_WB	9/16/2017	14.8	46.5	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_06_WB	9/16/2017	13.1	39.7	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_07_WB	9/16/2017	7.83	52.1	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_08_WB	9/16/2017	7.03	42.7	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_09_WB	9/16/2017	6.6	38.2	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_10_WB	9/16/2017	7.13	47.5	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_11_WB	9/16/2017	7.7	61.7	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_12_WB	9/16/2017	7.33	42.5	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_13_WB	9/16/2017	6.68	49.8	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_14_WB	9/16/2017	7.07	49.6	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_15_WB	9/16/2017	6.73	45.3	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_16_WB	9/16/2017	6.8	49.2	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_17_WB	9/16/2017	6.8	46.9	NG/G

Appendix A-29a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Mink	MED_T	ID	DATE	Length (cm	Mercury	UOM
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_18_WB	9/16/2017	6.55	44.8	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_19_WB	9/16/2017	6.25	47.8	NG/G
NON-REF	Rainbow Smelt	OB-01_17SN001_091617_RAS_20_WB	9/16/2017	6.25	45.3	NG/G
NON-REF	Mummichog	OB-01_092516_MUM_01_WB	9/25/2016	6.9	134	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_06_WB	9/21/2016	19	146	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_07_WB	9/21/2016	21.1	140	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_08_WB	9/21/2016	18.5	75.3	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_09_WB	9/21/2016	18.2	90.8	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_10_WB	9/21/2016	21.2	94.6	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_11_WB	9/21/2016	21.2	95.4	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_12_WB	9/21/2016	18.9	116	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_13_WB	9/21/2016	14.5	79.5	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_14_WB	9/21/2016	19.6	31.8	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_15_WB	9/21/2016	17.7	33.6	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_16_WB	9/21/2016	20.1	102	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_17_WB	9/21/2016	18.1	103	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_18_WB	9/21/2016	18.4	44.2	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_19_WB	9/21/2016	16	58.2	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_20_WB	9/21/2016	19.3	82.8	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_01_WB	9/21/2016	20.2	44.5	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_02_WB	9/21/2016	15	54.9	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_03_WB	9/21/2016	19.5	55.6	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_04_WB	9/21/2016	10.5	47.5	NG/G
NON-REF	Rainbow Smelt	OB-01_092116_RAS_05_WB	9/21/2016	22.9	81.9	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_01_WB	9/15/2017	8.8	150	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_02_WB	9/15/2017	8.7	114	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_03_WB	9/15/2017	8.4	121	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_04_WB	9/15/2017	8.9	117	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_05_WB	9/15/2017	5.83	65.2	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_06_WB	9/15/2017	5.63	76.5	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_07_WB	9/15/2017	5.47	71.5	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_08_WB	9/15/2017	5.37	77.6	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_09_WB	9/15/2017	5.63	74.1	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_10_WB	9/15/2017	5.13	74.6	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_11_WB	9/15/2017	5.1	77.1	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_12_WB	9/15/2017	5.43	80.8	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_13_WB	9/15/2017	5.37	76.9	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_14_WB	9/15/2017	5.1	81.3	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_15_WB	9/15/2017	5	77.6	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_16_WB	9/15/2017	5.43	65	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_17_WB	9/15/2017	4.95	66.5	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_18_WB	9/15/2017	5.05	69.9	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_19_WB	9/15/2017	5	76.5	NG/G
NON-REF	Mummichog	OB-05_17SN001_091517_MUM_20_WB	9/15/2017	4.96	62.6	NG/G
NON-REF	Rainbow Smelt	OB-05_17SN001_091517_RAS_01_WB	9/15/2017	8.5	72.1	NG/G
NON-REF	Rainbow Smelt	OB-05_17SN001_091517_RAS_02_WB	9/15/2017	7.83	64.4	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_01_WB	9/25/2016	4.83	111	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_02_WB	9/25/2016	5.43	125	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_03_WB	9/25/2016	5.43	113	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_04_WB	9/25/2016	5.43	82.1	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_05_WB	42638	5.2	96.1	NG/G
NON-REF	Mummichog	OB-05_092516_MUM_06_WB	42638	5.43	114	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_07_WB	42646	5.5	106	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_08_WB	42646	6.4	83.2	NG/G

Appendix A-29a
UCL Evaluation - ProUCL Input
Forage fish (Mummichog and Smelt) for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Mink	MED_T	ID	DATE	Length (cm	Mercury	UOM
NON-REF	Mummichog	OB-05_100316_MUM_09_WB	42646	6.5	83.4	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_10_WB	42646	6.1	92.6	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_11_WB	42646	5.3	88.2	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_12_WB	42646	5.7	69.4	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_13_WB	42646	5.65	98.5	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_14_WB	42646	5.05	71.3	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_15_WB	42646	5	48.9	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_16_WB	42646	5.25	89.9	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_17_WB	42646	5	71.6	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_18_WB	42646	5.5	66.2	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_19_WB	42646	5.25	95.8	NG/G
NON-REF	Mummichog	OB-05_100316_MUM_20_WB	42646	5.2	87.6	NG/G
NON-REF	Rainbow Smelt	OB-05_092116_RAS_01_WB	42634	20.2	201	NG/G

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/15/2018 10:04:40 AM
From File	2018-01-12 ffish_mink_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury_ng/g (bo-04)

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	52.4	Mean	95.6
Maximum	234	Median	71.15
SD	56.54	Std. Error of Mean	12.64
Coefficient of Variation	0.591	Skewness	1.647

Normal GOF Test

Shapiro Wilk Test Statistic	0.715	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.286	Lilliefors GOF Test
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	117.5	95% Adjusted-CLT UCL (Chen-1995)	121.4
		95% Modified-t UCL (Johnson-1978)	118.2

Gamma GOF Test

A-D Test Statistic	1.817	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.263	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.195	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	4.193	k star (bias corrected MLE)	3.598
Theta hat (MLE)	22.8	Theta star (bias corrected MLE)	26.57
nu hat (MLE)	167.7	nu star (bias corrected)	143.9
MLE Mean (bias corrected)	95.6	MLE Sd (bias corrected)	50.4
		Approximate Chi Square Value (0.05)	117.2
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	115.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	117.4	95% Adjusted Gamma UCL (use when n<50)	119.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.818	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.238	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.959	Mean of logged Data	4.436
Maximum of Logged Data	5.455	SD of logged Data	0.474

Assuming Lognormal Distribution

95% H-UCL	117.4	90% Chebyshev (MVUE) UCL	124.8
95% Chebyshev (MVUE) UCL	138.8	97.5% Chebyshev (MVUE) UCL	158.2
99% Chebyshev (MVUE) UCL	196.3		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	116.4	95% Jackknife UCL	117.5
95% Standard Bootstrap UCL	115.4	95% Bootstrap-t UCL	127.4
95% Hall's Bootstrap UCL	114.9	95% Percentile Bootstrap UCL	117.2
95% BCA Bootstrap UCL	121.7		
90% Chebyshev(Mean, Sd) UCL	133.5	95% Chebyshev(Mean, Sd) UCL	150.7
97.5% Chebyshev(Mean, Sd) UCL	174.6	99% Chebyshev(Mean, Sd) UCL	221.4

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	117.5	or 95% Modified-t UCL	118.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (es-13)

General Statistics

Total Number of Observations	21	Number of Distinct Observations	21
		Number of Missing Observations	0
Minimum	26.4	Mean	44.25
Maximum	87.8	Median	38.1
SD	17.72	Std. Error of Mean	3.867
Coefficient of Variation	0.4	Skewness	1.443

Normal GOF Test

Shapiro Wilk Test Statistic	0.791	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.279	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.188	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	50.92	95% Adjusted-CLT UCL (Chen-1995)	51.91
		95% Modified-t UCL (Johnson-1978)	51.12

Gamma GOF Test

A-D Test Statistic	1.356	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.744	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.235	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.19	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	8.148	k star (bias corrected MLE)	7.016
Theta hat (MLE)	5.431	Theta star (bias corrected MLE)	6.308
nu hat (MLE)	342.2	nu star (bias corrected)	294.7
MLE Mean (bias corrected)	44.25	MLE Sd (bias corrected)	16.71
		Approximate Chi Square Value (0.05)	255.9
Adjusted Level of Significance	0.0383	Adjusted Chi Square Value	253.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	50.96	95% Adjusted Gamma UCL (use when n<50)	51.51

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.188	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.273	Mean of logged Data	3.727
Maximum of Logged Data	4.475	SD of logged Data	0.346

Assuming Lognormal Distribution

95% H-UCL	50.97	90% Chebyshev (MVUE) UCL	54.14
95% Chebyshev (MVUE) UCL	58.74	97.5% Chebyshev (MVUE) UCL	65.11
99% Chebyshev (MVUE) UCL	77.64		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	50.61	95% Jackknife UCL	50.92
95% Standard Bootstrap UCL	50.55	95% Bootstrap-t UCL	53.48
95% Hall's Bootstrap UCL	51.07	95% Percentile Bootstrap UCL	50.86
95% BCA Bootstrap UCL	52.14		
90% Chebyshev(Mean, Sd) UCL	55.85	95% Chebyshev(Mean, Sd) UCL	61.11
97.5% Chebyshev(Mean, Sd) UCL	68.4	99% Chebyshev(Mean, Sd) UCL	82.73

Suggested UCL to Use

95% Student's-t UCL	50.92	or 95% Modified-t UCL	51.12

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (es-fp)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	27.1	Mean	72.26
Maximum	207	Median	58.25
SD	44.59	Std. Error of Mean	7.05
Coefficient of Variation	0.617	Skewness	1.548

Normal GOF Test

Shapiro Wilk Test Statistic	0.821	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.156	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	84.14	95% Adjusted-CLT UCL (Chen-1995)	85.7
		95% Modified-t UCL (Johnson-1978)	84.43

Gamma GOF Test

A-D Test Statistic	0.971	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.117	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	3.451	k star (bias corrected MLE)	3.209
Theta hat (MLE)	20.94	Theta star (bias corrected MLE)	22.52
nu hat (MLE)	276.1	nu star (bias corrected)	256.7
MLE Mean (bias corrected)	72.26	MLE Sd (bias corrected)	40.34
		Approximate Chi Square Value (0.05)	220.6
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	219.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	84.09	95% Adjusted Gamma UCL (use when n<50)	84.57

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.108	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.3	Mean of logged Data	4.128
Maximum of Logged Data	5.333	SD of logged Data	0.538

Assuming Lognormal Distribution

95% H-UCL	84.88	90% Chebyshev (MVUE) UCL	90.7
95% Chebyshev (MVUE) UCL	99.41	97.5% Chebyshev (MVUE) UCL	111.5
99% Chebyshev (MVUE) UCL	135.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	83.86	95% Jackknife UCL	84.14
95% Standard Bootstrap UCL	83.67	95% Bootstrap-t UCL	85.71
95% Hall's Bootstrap UCL	86.41	95% Percentile Bootstrap UCL	83.69
95% BCA Bootstrap UCL	85.47		
90% Chebyshev(Mean, Sd) UCL	93.41	95% Chebyshev(Mean, Sd) UCL	103
97.5% Chebyshev(Mean, Sd) UCL	116.3	99% Chebyshev(Mean, Sd) UCL	142.4

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Adjusted Gamma UCL	84.57

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (frb-ref)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	76
		Number of Missing Observations	0
Minimum	4.44	Mean	8.608
Maximum	26.2	Median	7.32
SD	4.219	Std. Error of Mean	0.472
Coefficient of Variation	0.49	Skewness	2.471

Normal GOF Test

Shapiro Wilk Test Statistic	0.707	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.267	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	9.393	95% Adjusted-CLT UCL (Chen-1995)	9.523
		95% Modified-t UCL (Johnson-1978)	9.415

Gamma GOF Test

A-D Test Statistic	4.503	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.218	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0999	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	6.391	k star (bias corrected MLE)	6.16
Theta hat (MLE)	1.347	Theta star (bias corrected MLE)	1.397
nu hat (MLE)	1023	nu star (bias corrected)	985.6
MLE Mean (bias corrected)	8.608	MLE Sd (bias corrected)	3.468
		Approximate Chi Square Value (0.05)	913.7
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	912.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9.285	95% Adjusted Gamma UCL (use when n<50)	9.298

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	6.3254E-9	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.186	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.491	Mean of logged Data	2.072
Maximum of Logged Data	3.266	SD of logged Data	0.371

Assuming Lognormal Distribution

95% H-UCL	9.166	90% Chebyshev (MVUE) UCL	9.59
95% Chebyshev (MVUE) UCL	10.08	97.5% Chebyshev (MVUE) UCL	10.77
99% Chebyshev (MVUE) UCL	12.11		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	9.384	95% Jackknife UCL	9.393
95% Standard Bootstrap UCL	9.387	95% Bootstrap-t UCL	9.572
95% Hall's Bootstrap UCL	9.658	95% Percentile Bootstrap UCL	9.422
95% BCA Bootstrap UCL	9.566		
90% Chebyshev(Mean, Sd) UCL	10.02	95% Chebyshev(Mean, Sd) UCL	10.66
97.5% Chebyshev(Mean, Sd) UCL	11.55	99% Chebyshev(Mean, Sd) UCL	13.3

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	9.393	or 95% Modified-t UCL	9.415

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (mm)

General Statistics

Total Number of Observations	23	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	51.4	Mean	131.9
Maximum	256	Median	121
SD	52.2	Std. Error of Mean	10.88
Coefficient of Variation	0.396	Skewness	1.028

Normal GOF Test

Shapiro Wilk Test Statistic	0.916	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.914	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.147	Lilliefors GOF Test
5% Lilliefors Critical Value	0.18	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	150.6	95% Adjusted-CLT UCL (Chen-1995)	152.3
		95% Modified-t UCL (Johnson-1978)	151

Gamma GOF Test

A-D Test Statistic	0.3	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0997	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.182	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	7.2	k star (bias corrected MLE)	6.289
Theta hat (MLE)	18.32	Theta star (bias corrected MLE)	20.97
nu hat (MLE)	331.2	nu star (bias corrected)	289.3
MLE Mean (bias corrected)	131.9	MLE Sd (bias corrected)	52.59
		Approximate Chi Square Value (0.05)	250.9
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	248.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	152.1	95% Adjusted Gamma UCL (use when n<50)	153.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0851	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.18	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.94	Mean of logged Data	4.811
Maximum of Logged Data	5.545	SD of logged Data	0.386

Assuming Lognormal Distribution

95% H-UCL	154.5	90% Chebyshev (MVUE) UCL	164.5
95% Chebyshev (MVUE) UCL	179.3	97.5% Chebyshev (MVUE) UCL	199.8
99% Chebyshev (MVUE) UCL	240.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	149.8	95% Jackknife UCL	150.6
95% Standard Bootstrap UCL	149.2	95% Bootstrap-t UCL	154.5
95% Hall's Bootstrap UCL	153.5	95% Percentile Bootstrap UCL	151.1
95% BCA Bootstrap UCL	151.5		
90% Chebyshev(Mean, Sd) UCL	164.5	95% Chebyshev(Mean, Sd) UCL	179.3
97.5% Chebyshev(Mean, Sd) UCL	199.9	99% Chebyshev(Mean, Sd) UCL	240.2

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	150.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (ob-01)

General Statistics

Total Number of Observations	51	Number of Distinct Observations	48
		Number of Missing Observations	0
Minimum	31.8	Mean	82.32
Maximum	242	Median	77.4
SD	46.42	Std. Error of Mean	6.5
Coefficient of Variation	0.564	Skewness	1.617

Normal GOF Test

Shapiro Wilk Test Statistic	0.839	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	3.2281E-7	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.154	Lilliefors GOF Test
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	93.21	95% Adjusted-CLT UCL (Chen-1995)	94.58
		95% Modified-t UCL (Johnson-1978)	93.45

Gamma GOF Test

A-D Test Statistic	1.071	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.164	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.125	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	3.934	k star (bias corrected MLE)	3.716
Theta hat (MLE)	20.92	Theta star (bias corrected MLE)	22.15
nu hat (MLE)	401.3	nu star (bias corrected)	379
MLE Mean (bias corrected)	82.32	MLE Sd (bias corrected)	42.7
		Approximate Chi Square Value (0.05)	334.9
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	333.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	93.16	95% Adjusted Gamma UCL (use when n<50)	93.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0203	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.159	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.459	Mean of logged Data	4.278
Maximum of Logged Data	5.489	SD of logged Data	0.508

Assuming Lognormal Distribution

95% H-UCL	93.95	90% Chebyshev (MVUE) UCL	100.2
95% Chebyshev (MVUE) UCL	108.5	97.5% Chebyshev (MVUE) UCL	120.1
99% Chebyshev (MVUE) UCL	142.8		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	93.01	95% Jackknife UCL	93.21
95% Standard Bootstrap UCL	92.87	95% Bootstrap-t UCL	95.53
95% Hall's Bootstrap UCL	96.07	95% Percentile Bootstrap UCL	93.81
95% BCA Bootstrap UCL	95.33		
90% Chebyshev(Mean, Sd) UCL	101.8	95% Chebyshev(Mean, Sd) UCL	110.6
97.5% Chebyshev(Mean, Sd) UCL	122.9	99% Chebyshev(Mean, Sd) UCL	147

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	110.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (ob-04)

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	44.5	Mean	56.88
Maximum	81.9	Median	54.9
SD	14.77	Std. Error of Mean	6.606
Coefficient of Variation	0.26	Skewness	1.671

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.824	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.335	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	70.96	95% Adjusted-CLT UCL (Chen-1995)	73.02
		95% Modified-t UCL (Johnson-1978)	71.79

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.469	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.313	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	21.12	k star (bias corrected MLE)	8.581
Theta hat (MLE)	2.693	Theta star (bias corrected MLE)	6.628
nu hat (MLE)	211.2	nu star (bias corrected)	85.81
MLE Mean (bias corrected)	56.88	MLE Sd (bias corrected)	19.42
		Approximate Chi Square Value (0.05)	65.46
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	57.74

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	74.57	95% Adjusted Gamma UCL (use when n<50)	84.54

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.298	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.343	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.795	Mean of logged Data	4.017
Maximum of Logged Data	4.405	SD of logged Data	0.237

Assuming Lognormal Distribution

95% H-UCL	74.73	90% Chebyshev (MVUE) UCL	74.82
95% Chebyshev (MVUE) UCL	82.98	97.5% Chebyshev (MVUE) UCL	94.31
99% Chebyshev (MVUE) UCL	116.6		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	67.75	95% Jackknife UCL	70.96
95% Standard Bootstrap UCL	66.74	95% Bootstrap-t UCL	86.53
95% Hall's Bootstrap UCL	115.1	95% Percentile Bootstrap UCL	67.54
95% BCA Bootstrap UCL	71.24		
90% Chebyshev(Mean, Sd) UCL	76.7	95% Chebyshev(Mean, Sd) UCL	85.68
97.5% Chebyshev(Mean, Sd) UCL	98.14	99% Chebyshev(Mean, Sd) UCL	122.6

Suggested UCL to Use

95% Student's-t UCL 70.96

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (ob-05)

General Statistics

Total Number of Observations	43	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	48.9	Mean	88.53
Maximum	201	Median	80.8
SD	27.05	Std. Error of Mean	4.125
Coefficient of Variation	0.306	Skewness	2.065

Normal GOF Test

Shapiro Wilk Test Statistic	0.832	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.943	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.18	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.134	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	95.47	95% Adjusted-CLT UCL (Chen-1995)	96.71
		95% Modified-t UCL (Johnson-1978)	95.69

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
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Gamma GOF Test

A-D Test Statistic	1.2	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.156	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.135	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	13.74	k star (bias corrected MLE)	12.79
Theta hat (MLE)	6.445	Theta star (bias corrected MLE)	6.92
nu hat (MLE)	1181	nu star (bias corrected)	1100
MLE Mean (bias corrected)	88.53	MLE Sd (bias corrected)	24.75
		Approximate Chi Square Value (0.05)	1024
Adjusted Level of Significance	0.0444	Adjusted Chi Square Value	1022

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	95.1	95% Adjusted Gamma UCL (use when n<50)	95.34

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.944	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.943	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.139	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.134	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.89	Mean of logged Data	4.447
Maximum of Logged Data	5.303	SD of logged Data	0.263

Assuming Lognormal Distribution

95% H-UCL	94.84	90% Chebyshev (MVUE) UCL	99.06
95% Chebyshev (MVUE) UCL	103.9	97.5% Chebyshev (MVUE) UCL	110.7
99% Chebyshev (MVUE) UCL	124		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-29b
UCL Evaluation - Sample Area for Mink
Forage fish (Mummichog and Smelt)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	95.32	95% Jackknife UCL	95.47
95% Standard Bootstrap UCL	95.14	95% Bootstrap-t UCL	97.75
95% Hall's Bootstrap UCL	100.1	95% Percentile Bootstrap UCL	95.2
95% BCA Bootstrap UCL	95.97		
90% Chebyshev(Mean, Sd) UCL	100.9	95% Chebyshev(Mean, Sd) UCL	106.5
97.5% Chebyshev(Mean, Sd) UCL	114.3	99% Chebyshev(Mean, Sd) UCL	129.6

Suggested UCL to Use

95% Student's-t UCL	95.47	or 95% Modified-t UCL	95.69
or 95% H-UCL	94.84		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Appendix A-30a
UCL Evaluation - ProUCL Input
Predatory fish (Eel and Tomcod) for Bald Eagle - All Data

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Bald Eagle	Location ID	ES_SA	MED_T	ID	DATE	Length (cm)	Mercury	UOM
NON-REF	BO-04_17ET000	BO-04	Eel	BO-04_17ET002_060517_EEL_01_WB	6/5/2017	30.9	389	NG/G
NON-REF	BO-04_17ET000	BO-04	Eel	BO-04_17ET002_060517_EEL_02_WB	6/5/2017	35.8	1320	NG/G
NON-REF	BO-04_17ET000	BO-04	Eel	BO-04_17ET002_060517_EEL_03_WB	6/5/2017	30.6	732	NG/G
NON-REF	BO-04_17ET000	BO-04	Eel	BO-04_17ET003_060517_EEL_04_WB	6/5/2017	26	430	NG/G
NON-REF	BO-04_17ET000	BO-04	Eel	BO-04_17ET004_060517_EEL_05_WB	6/5/2017	28.8	391	NG/G
NON-REF	BO-04_17ET000	BO-04	Eel	BO-04_17ET005_060517_EEL_06_WB	6/5/2017	28.5	422	NG/G
NON-REF	BO-04_17ET000	BO-04	Tomcod	BO-04_17ET008_091717_TOM_01_WB	9/17/2017	13	104	NG/G
NON-REF	BO-04_17ET000	BO-04	Eel	BO-04_17ET009_060517_EEL_07_WB	6/5/2017	29.5	643	NG/G
NON-REF	BO-04_17ET001	BO-04	Tomcod	BO-04_17ET010_091717_TOM_02_WB	9/17/2017	10.8	148	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET012_060517_EEL_08_WB	6/5/2017	29.6	488	NG/G
NON-REF	BO-04_17ET001	BO-04	Tomcod	BO-04_17ET014_091717_TOM_03_WB	9/17/2017	12.5	123	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET015_060517_EEL_09_WB	6/5/2017	28.6	485	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET015_060517_EEL_10_WB	6/5/2017	31	540	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET015_060517_EEL_11_WB	6/5/2017	31.9	483	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET015_060517_EEL_12_WB	6/5/2017	32.4	589	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET015_060517_EEL_13_WB	6/5/2017	32.2	519	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET015_060517_EEL_14_WB	6/5/2017	29.4	648	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET015_060517_EEL_15_WB	6/5/2017	32.4	489	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET016_060517_EEL_16_WB	6/5/2017	28.5	604	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET016_060517_EEL_17_WB	6/5/2017	31.1	493	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET017_060517_EEL_18_WB	6/5/2017	29.8	679	NG/G
NON-REF	BO-04_17ET001	BO-04	Eel	BO-04_17ET018_060517_EEL_19_WB	6/5/2017	34.8	294	NG/G
NON-REF	BO-04_17ET002	BO-04	Eel	BO-04_17ET020_060517_EEL_20_WB	6/5/2017	28.6	386	NG/G
NON-REF	BO-04_17ET002	BO-04	Tomcod	BO-04_17ET025_092017_TOM_04_WB	9/20/2017	11.7	152	NG/G
NON-REF	BO-04_17ET002	BO-04	Tomcod	BO-04_17ET026_092017_TOM_05_WB	9/20/2017	18.7	199	NG/G
NON-REF	BO-04_17ET003	BO-04	Tomcod	BO-04_17ET030_092017_TOM_06_WB	9/20/2017	10.3	224	NG/G
NON-REF	BO-04_17ET003	BO-04	Tomcod	BO-04_17ET035_092017_TOM_07_WB	9/20/2017	10.7	173	NG/G
NON-REF	BO-04_17ET004	BO-04	Tomcod	BO-04_17ET041_092017_TOM_08_WB	9/20/2017	12.1	162	NG/G
NON-REF	BO-04a	BO-04	Tomcod	BO-04_092516_TOM_01_WB	9/25/2016	18.6	304	NG/G
NON-REF	BO-04a	BO-04	Tomcod	BO-04_092516_TOM_02_WB	9/25/2016	14.4	315	NG/G
NON-REF	BO-04a	BO-04	Tomcod	BO-04_092516_TOM_03_WB	9/25/2016	11.6	195	NG/G
NON-REF	BO-04a	BO-04	Tomcod	BO-04_092516_TOM_04_WB	9/25/2016	14.3	312	NG/G
NON-REF	BO-04d	BO-04	Eel	BO-04_080516_EEL_01_WB	8/5/2016	40	1370	NG/G
NON-REF	ES-13_17ET717	ES-13	Tomcod	ES-13_17ET717_091817_TOM_11_WB	9/18/2017	24.7	172	NG/G
NON-REF	ES-13_17ET718	ES-13	Tomcod	ES-13_17ET718_091817_TOM_02_WB	9/18/2017	20.1	114	NG/G
NON-REF	ES-13_17ET719	ES-13	Tomcod	ES-13_17ET719_091817_TOM_03_WB	9/18/2017	13.2	52.8	NG/G
NON-REF	ES-13_17ET719	ES-13	Tomcod	ES-13_17ET719_091817_TOM_04_WB	9/18/2017	10.9	36	NG/G
NON-REF	ES-13_17ET719	ES-13	Tomcod	ES-13_17ET719_091817_TOM_05_WB	9/18/2017	13.3	45.5	NG/G
NON-REF	ES-13_17ET719	ES-13	Tomcod	ES-13_17ET719_091817_TOM_06_WB	9/18/2017	12.8	32.7	NG/G
NON-REF	ES-13_17ET722	ES-13	Tomcod	ES-13_17ET722_091817_TOM_07_WB	9/18/2017	12.5	52.2	NG/G
NON-REF	ES-13_17ET722	ES-13	Tomcod	ES-13_17ET722_091817_TOM_08_WB	9/18/2017	14	60.2	NG/G
NON-REF	ES-13_17ET723	ES-13	Tomcod	ES-13_17ET723_091817_TOM_09_WB	9/18/2017	22.4	239	NG/G
NON-REF	ES-13_17ET723	ES-13	Tomcod	ES-13_17ET723_091817_TOM_10_WB	9/18/2017	23.1	209	NG/G
NON-REF	ES-13_17LT012	ES-13	Tomcod	ES-13_17LT012_091317_TOM_01_WB	9/13/2017	29.1	226	NG/G
NON-REF	ES-13a	ES-13	Tomcod	ES-13_092916_TOM_08_WB	9/29/2016	19.4	211	NG/G
NON-REF	ES-13a	ES-13	Tomcod	ES-13_093016_TOM_09_WB	9/30/2016	23.8	103	NG/G
NON-REF	ES-13b	ES-13	Tomcod	ES-13_092716_TOM_03_WB	9/27/2016	13.7	65	NG/G
NON-REF	ES-13c	ES-13	Tomcod	ES-13_092916_TOM_06_WB	9/29/2016	16.8	142	NG/G
NON-REF	ES-13d	ES-13	Tomcod	ES-13_092716_TOM_04_WB	9/27/2016	16.6	164	NG/G
NON-REF	ES-13e	ES-13	Tomcod	ES-13_093016_TOM_10_WB	9/30/2016	18.9	113	NG/G
NON-REF	ES-13e	ES-13	Tomcod	ES-13_093016_TOM_11_WB	9/30/2016	13.9	56.5	NG/G
NON-REF	ES-13f	ES-13	Tomcod	ES-13_092916_TOM_07_WB	9/29/2016	20.4	129	NG/G
NON-REF	ES-13g	ES-13	Tomcod	ES-13_092716_TOM_01_WB	9/27/2016	14.6	59.2	NG/G
NON-REF	ES-13i	ES-13	Tomcod	ES-13_092716_TOM_05_WB	9/27/2016	14.7	80.4	NG/G
NON-REF	ES-13l	ES-13	Tomcod	ES-13_092716_TOM_02_WB	9/27/2016	14.4	76.1	NG/G
NON-REF	ES-FP_17ET658	ES-FP	Tomcod	ES-FP_17ET658_091517_TOM_01_WB	9/15/2017	14.4	37.2	NG/G
NON-REF	ES-FPa	ES-FP	Tomcod	ES-FP_100116_TOM_02_WB	10/1/2016	20.9	74.3	NG/G
NON-REF	ES-FPe	ES-FP	Tomcod	ES-FP_092716_TOM_01_WB	9/27/2016	23.2	55.5	NG/G
REF	FRB-01c	FRB&OV-04-REF	Tomcod	FRB-01_092916_TOM_01_WB	9/29/2016	15.2	36.5	NG/G
NON-REF	OB-01_17ET001	OB-01	Tomcod	OB-01_17ET001_091617_TOM_01_WB	9/16/2017	23.9	274	NG/G
NON-REF	OB-01_17ET001	OB-01	Tomcod	OB-01_17ET001_091617_TOM_02_WB	9/16/2017	19.8	382	NG/G
NON-REF	OB-01_17ET001	OB-01	Tomcod	OB-01_17ET001_091617_TOM_03_WB	9/16/2017	21	389	NG/G
NON-REF	OB-01_17ET001	OB-01	Tomcod	OB-01_17ET001_091617_TOM_04_WB	9/16/2017	21.9	233	NG/G
NON-REF	OB-01_17ET001	OB-01	Tomcod	OB-01_17ET001_091617_TOM_05_WB	9/16/2017	19.4	190	NG/G
NON-REF	OB-01_17ET001	OB-01	Tomcod	OB-01_17ET001_091617_TOM_06_WB	9/16/2017	13.6	66	NG/G
NON-REF	OB-01_17ET001	OB-01	Tomcod	OB-01_17ET001_091617_TOM_07_WB	9/16/2017	17.2	308	NG/G
NON-REF	OB-01_17ET001	OB-01	Tomcod	OB-01_17ET001_091617_TOM_08_WB	9/16/2017	18	413	NG/G
NON-REF	OB-01_17ET001	OB-01	Tomcod	OB-01_17ET001_091617_TOM_09_WB	9/16/2017	13.6	78.7	NG/G
NON-REF	OB-01_17ET002	OB-01	Tomcod	OB-01_17ET002_091617_TOM_10_WB	9/16/2017	23.2	205	NG/G
NON-REF	OB-01_17ET002	OB-01	Tomcod	OB-01_17ET002_091617_TOM_11_WB	9/16/2017	12.8	70	NG/G
NON-REF	OB-01_17ET002	OB-01	Tomcod	OB-01_17ET002_091617_TOM_12_WB	9/16/2017	12.6	49.7	NG/G
NON-REF	OB-01_17ET003	OB-01	Tomcod	OB-01_17ET003_091617_TOM_13_WB	9/16/2017	18.5	231	NG/G
NON-REF	OB-01_17ET004	OB-01	Tomcod	OB-01_17ET004_091617_TOM_14_WB	9/16/2017	11.9	50.1	NG/G
NON-REF	OB-01_17ET004	OB-01	Tomcod	OB-01_17ET004_091617_TOM_15_WB	9/16/2017	12.1	81.1	NG/G
NON-REF	OB-01_17ET004	OB-01	Tomcod	OB-01_17ET004_091617_TOM_16_WB	9/16/2017	13.8	77.3	NG/G
NON-REF	OB-01_17ET005	OB-01	Tomcod	OB-01_17ET005_091617_TOM_17_WB	9/16/2017	11.6	65.7	NG/G

Appendix A-30a
UCL Evaluation - ProUCL Input
Predatory fish (Eel and Tomcod) for Bald Eagle - All Data

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Bald Eagle	Location ID	ES_SA	MED_T	ID	DATE	Length (cm)	Mercury	UOM
NON-REF	OB-01_17ET006	OB-01	Tomcod	OB-01_17ET006_091617_TOM_18_WB	9/16/2017	18.6	136	NG/G
NON-REF	OB-01_17ET007	OB-01	Tomcod	OB-01_17ET007_091617_TOM_19_WB	9/16/2017	18.4	160	NG/G
NON-REF	OB-01_17ET008	OB-01	Tomcod	OB-01_17ET008_091617_TOM_20_WB	9/16/2017	21.9	182	NG/G
NON-REF	OB-01a	OB-01	Eel	OB-01_080216_EEL_01_WB	8/2/2016	39	394	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_01_WB	9/24/2016	20.2	115	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_02_WB	9/24/2016	15	215	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_03_WB	9/24/2016	19.5	232	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_04_WB	9/24/2016	10.5	170	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_05_WB	9/24/2016	22.9	69	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_06_WB	9/24/2016	19	159	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_07_WB	9/24/2016	21.1	76	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_08_WB	9/24/2016	18.5	174	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_09_WB	9/24/2016	18.2	196	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_10_WB	9/24/2016	21.2	82.1	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_11_WB	9/24/2016	21.2	89.5	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_12_WB	9/24/2016	18.9	89.5	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_13_WB	9/24/2016	14.5	179	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_14_WB	9/24/2016	19.6	280	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_15_WB	9/24/2016	17.7	276	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_16_WB	9/24/2016	20.1	188	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_17_WB	9/24/2016	18.1	155	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_18_WB	9/24/2016	18.4	212	NG/G
NON-REF	OB-01d	OB-01	Tomcod	OB-01_092416_TOM_19_WB	9/24/2016	16	245	NG/G
NON-REF	OB-05-17ET010(	OB-05	Eel	OB-05_17ET100_060517_EEL_01_WB	6/5/2017	35.1	468	NG/G
NON-REF	OB-05-17ET010(	OB-05	Eel	OB-05_17ET100_060517_EEL_02_WB	6/5/2017	35.6	322	NG/G
NON-REF	OB-05-17ET010(	OB-05	Eel	OB-05_17ET100_060517_EEL_03_WB	6/5/2017	28.6	293	NG/G
NON-REF	OB-05-17ET010:	OB-05	Eel	OB-05_17ET101_060517_EEL_10_WB	6/5/2017	32	528	NG/G
NON-REF	OB-05-17ET010:	OB-05	Eel	OB-05_17ET101_060517_EEL_11_WB	6/5/2017	29.7	316	NG/G
NON-REF	OB-05-17ET010‹	OB-05	Eel	OB-05_17ET104_060517_EEL_08_WB	6/5/2017	32.3	249	NG/G
NON-REF	OB-05-17ET010‹	OB-05	Eel	OB-05_17ET104_060517_EEL_09_WB	6/5/2017	27.7	417	NG/G
NON-REF	OB-05-17ET011(	OB-05	Eel	OB-05_17ET110_060517_EEL_06_WB	6/5/2017	31.5	224	NG/G
NON-REF	OB-05-17ET011(	OB-05	Eel	OB-05_17ET110_060517_EEL_07_WB	6/5/2017	28.1	92.1	NG/G
NON-REF	OB-05-17ET011:	OB-05	Eel	OB-05_17ET111_060517_EEL_04_WB	6/5/2017	31.2	706	NG/G
NON-REF	OB-05-17ET011:	OB-05	Eel	OB-05_17ET111_060517_EEL_05_WB	6/5/2017	35.9	381	NG/G
NON-REF	OB-05_17ET002	OB-05	Tomcod	OB-05_17ET002_091717_TOM_01_WB	9/17/2017	15.1	268	NG/G
NON-REF	OB-05_17ET002	OB-05	Tomcod	OB-05_17ET002_091717_TOM_02_WB	9/17/2017	9.4	139	NG/G
NON-REF	OB-05_17ET002	OB-05	Tomcod	OB-05_17ET002_091817_TOM_16_WB	9/18/2017	11.1	71.9	NG/G
NON-REF	OB-05_17ET003	OB-05	Tomcod	OB-05_17ET003_091717_TOM_03_WB	9/17/2017	11.7	70.7	NG/G
NON-REF	OB-05_17ET003	OB-05	Tomcod	OB-05_17ET003_091717_TOM_04_WB	9/17/2017	10	122	NG/G
NON-REF	OB-05_17ET003	OB-05	Tomcod	OB-05_17ET003_091817_TOM_17_WB	9/18/2017	17.2	173	NG/G
NON-REF	OB-05_17ET003	OB-05	Tomcod	OB-05_17ET003_091817_TOM_18_WB	9/18/2017	11.5	152	NG/G
NON-REF	OB-05_17ET005	OB-05	Tomcod	OB-05_17ET005_091817_TOM_19_WB	9/18/2017	10.4	78.4	NG/G
NON-REF	OB-05_17ET008	OB-05	Tomcod	OB-05_17ET008_091817_TOM_20_WB	9/18/2017	12.7	72.7	NG/G
NON-REF	OB-05_17ET009	OB-05	Tomcod	OB-05_17ET009_091717_TOM_05_WB	9/17/2017	21.8	379	NG/G
NON-REF	OB-05_17ET010	OB-05	Tomcod	OB-05_17ET010_091717_TOM_06_WB	9/17/2017	11.8	99.8	NG/G
NON-REF	OB-05_17ET011	OB-05	Tomcod	OB-05_17ET011_091717_TOM_07_WB	9/17/2017	13	90.7	NG/G
NON-REF	OB-05_17ET012	OB-05	Tomcod	OB-05_17ET012_091717_TOM_08_WB	9/17/2017	12.3	230	NG/G
NON-REF	OB-05_17ET012	OB-05	Tomcod	OB-05_17ET012_091717_TOM_09_WB	9/17/2017	11.6	118	NG/G
NON-REF	OB-05_17ET013	OB-05	Tomcod	OB-05_17ET013_091717_TOM_10_WB	9/17/2017	19.4	227	NG/G
NON-REF	OB-05_17ET013	OB-05	Tomcod	OB-05_17ET013_091717_TOM_11_WB	9/17/2017	10.9	124	NG/G
NON-REF	OB-05_17ET014	OB-05	Tomcod	OB-05_17ET014_091717_TOM_12_WB	9/17/2017	12.3	103	NG/G
NON-REF	OB-05_17ET014	OB-05	Tomcod	OB-05_17ET014_091717_TOM_13_WB	9/17/2017	19.8	159	NG/G
NON-REF	OB-05_17ET014	OB-05	Tomcod	OB-05_17ET014_091717_TOM_14_WB	9/17/2017	13	126	NG/G
NON-REF	OB-05_17ET014	OB-05	Tomcod	OB-05_17ET014_091717_TOM_15_WB	9/17/2017	17	315	NG/G
NON-REF	OB-05_17ET141	OB-05	Eel	OB-05_17ET141_060617_EEL_12_WB	6/6/2017	34.9	234	NG/G
NON-REF	OB-05_17ET141	OB-05	Eel	OB-05_17ET141_060617_EEL_13_WB	6/6/2017	33.6	201	NG/G
NON-REF	OB-05_17ET141	OB-05	Eel	OB-05_17ET141_060617_EEL_14_WB	6/6/2017	32.9	277	NG/G
NON-REF	OB-05_17ET141	OB-05	Eel	OB-05_17ET141_060617_EEL_15_WB	6/6/2017	30.3	124	NG/G
NON-REF	OB-05_17ET141	OB-05	Eel	OB-05_17ET141_060617_EEL_16_WB	6/6/2017	28.2	110	NG/G
NON-REF	OB-05_17ET141	OB-05	Eel	OB-05_17ET141_060617_EEL_17_WB	6/6/2017	27.5	80	NG/G
NON-REF	OB-05_17ET141	OB-05	Eel	OB-05_17ET141_060617_EEL_18_WB	6/6/2017	28.4	116	NG/G
NON-REF	OB-05_17ET141	OB-05	Eel	OB-05_17ET141_060617_EEL_19_WB	6/6/2017	27.4	303	NG/G
NON-REF	OB-05_17ET141	OB-05	Eel	OB-05_17ET141_060617_EEL_20_WB	6/6/2017	28.6	221	NG/G
NON-REF	OB-05a	OB-05	Tomcod	OB-05_092516_TOM_16_WB	9/25/2016	12.2	149	NG/G
NON-REF	OB-05a	OB-05	Tomcod	OB-05_092516_TOM_17_WB	9/25/2016	13.3	275	NG/G
NON-REF	OB-05b	OB-05	Tomcod	OB-05_092516_TOM_06_WB	9/25/2016	18.6	154	NG/G
NON-REF	OB-05d	OB-05	Tomcod	OB-05_092516_TOM_13_WB	9/25/2016	12.6	105	NG/G
NON-REF	OB-05e	OB-05	Tomcod	OB-05_092516_TOM_01_WB	9/25/2016	16.6	158	NG/G
NON-REF	OB-05f	OB-05	Tomcod	OB-05_092516_TOM_02_WB	9/25/2016	9.8	105	NG/G
NON-REF	OB-05g	OB-05	Tomcod	OB-05_092516_TOM_03_WB	9/25/2016	12.2	80.6	NG/G
NON-REF	OB-05g	OB-05	Tomcod	OB-05_092516_TOM_04_WB	9/25/2016	13.3	142	NG/G
NON-REF	OB-05h	OB-05	Tomcod	OB-05_092516_TOM_05_WB	9/25/2016	13.7	109	NG/G
NON-REF	OB-05i	OB-05	Eel	OB-05_080516_EEL_05_WB	8/5/2016	38	428	NG/G
NON-REF	OB-05j	OB-05	Tomcod	OB-05_092516_TOM_12_WB	9/25/2016	15	253	NG/G
NON-REF	OB-05l	OB-05	Eel	OB-05_080316_EEL_02_WB	8/3/2016	39	579	NG/G
NON-REF	OB-05m	OB-05	Tomcod	OB-05_092516_TOM_14_WB	9/25/2016	16.6	201	NG/G

Appendix A-30a
UCL Evaluation - ProUCL Input
Predatory fish (Eel and Tomcod) for Bald Eagle - All Data

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Bald Eagle	Location ID	ES_SA	MED_T	ID	DATE	Length (cm)	Mercury	UOM
NON-REF	OB-05m	OB-05	Tomcod	OB-05_092516_TOM_15_WB	9/25/2016	9.8	213	NG/G
NON-REF	OB-05n	OB-05	Eel	OB-05_080316_EEL_04_WB	8/3/2016	34	461	NG/G
NON-REF	OB-05o	OB-05	Tomcod	OB-05_092516_TOM_08_WB	9/25/2016	18.5	146	NG/G
NON-REF	OB-05p	OB-05	Tomcod	OB-05_092516_TOM_09_WB	9/25/2016	19	246	NG/G
NON-REF	OB-05q	OB-05	Tomcod	OB-05_092516_TOM_18_WB	9/25/2016	11.7	161	NG/G
NON-REF	OB-05s	OB-05	Eel	OB-05_080316_EEL_01_WB	8/3/2016	38	391	NG/G
NON-REF	OB-05t	OB-05	Tomcod	OB-05_092516_TOM_10_WB	9/25/2016	13.4	135	NG/G
NON-REF	OB-05t	OB-05	Tomcod	OB-05_092516_TOM_11_WB	9/25/2016	17.5	117	NG/G
NON-REF	OB-05u	OB-05	Tomcod	OB-05_092516_TOM_07_WB	9/25/2016	20.1	194	NG/G
NON-REF	OB-05v	OB-05	Eel	OB-05_080316_EEL_03_WB	8/3/2016	37	485	NG/G
REF	OV-04_17ET015	FRB&OV-04-REF	Eel	OV-04_17ET015_060917_EEL_01_WB	6/9/2017	37.2	306	NG/G
REF	OV-04_17ET628	FRB&OV-04-REF	Eel	OV-04_17ET628_072817_EEL_02_WB	7/28/2017	36.6	320	NG/G
REF	OV-04_17ET628	FRB&OV-04-REF	Eel	OV-04_17ET628_072817_EEL_03_WB	7/28/2017	35.5	176	NG/G
REF	OV-04_17ET628	FRB&OV-04-REF	Eel	OV-04_17ET628_072817_EEL_04_WB	7/28/2017	33.7	161	NG/G
REF	OV-04_17ET628	FRB&OV-04-REF	Eel	OV-04_17ET628_072817_EEL_05_WB	7/28/2017	32.9	153	NG/G
REF	OV-04_17ET628	FRB&OV-04-REF	Eel	OV-04_17ET628_072817_EEL_06_WB	7/28/2017	31.2	142	NG/G

Appendix A-30b
UCL Evaluation - ProUCL Input
Predatory fish (Eel and Tomcod) for Bald Eagle - Length Defined Data Set

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Bald Eagle	ES_SA	MED_T	ID	DATE	Length (cm)	Mercury	UOM
NON-REF	BO-04	Eel	BO-04_17ET002_060517_EEL_01_WB	6/5/2017	30.9	389	NG/G
NON-REF	BO-04	Eel	BO-04_17ET002_060517_EEL_02_WB	6/5/2017	35.8	1320	NG/G
NON-REF	BO-04	Eel	BO-04_17ET002_060517_EEL_03_WB	6/5/2017	30.6	732	NG/G
NON-REF	BO-04	Eel	BO-04_17ET003_060517_EEL_04_WB	6/5/2017	26	430	NG/G
NON-REF	BO-04	Eel	BO-04_17ET004_060517_EEL_05_WB	6/5/2017	28.8	391	NG/G
NON-REF	BO-04	Eel	BO-04_17ET005_060517_EEL_06_WB	6/5/2017	28.5	422	NG/G
NON-REF	BO-04	Eel	BO-04_17ET009_060517_EEL_07_WB	6/5/2017	29.5	643	NG/G
NON-REF	BO-04	Eel	BO-04_17ET012_060517_EEL_08_WB	6/5/2017	29.6	488	NG/G
NON-REF	BO-04	Eel	BO-04_17ET015_060517_EEL_09_WB	6/5/2017	28.6	485	NG/G
NON-REF	BO-04	Eel	BO-04_17ET015_060517_EEL_10_WB	6/5/2017	31	540	NG/G
NON-REF	BO-04	Eel	BO-04_17ET015_060517_EEL_11_WB	6/5/2017	31.9	483	NG/G
NON-REF	BO-04	Eel	BO-04_17ET015_060517_EEL_12_WB	6/5/2017	32.4	589	NG/G
NON-REF	BO-04	Eel	BO-04_17ET015_060517_EEL_13_WB	6/5/2017	32.2	519	NG/G
NON-REF	BO-04	Eel	BO-04_17ET015_060517_EEL_14_WB	6/5/2017	29.4	648	NG/G
NON-REF	BO-04	Eel	BO-04_17ET015_060517_EEL_15_WB	6/5/2017	32.4	489	NG/G
NON-REF	BO-04	Eel	BO-04_17ET016_060517_EEL_16_WB	6/5/2017	28.5	604	NG/G
NON-REF	BO-04	Eel	BO-04_17ET016_060517_EEL_17_WB	6/5/2017	31.1	493	NG/G
NON-REF	BO-04	Eel	BO-04_17ET017_060517_EEL_18_WB	6/5/2017	29.8	679	NG/G
NON-REF	BO-04	Eel	BO-04_17ET018_060517_EEL_19_WB	6/5/2017	34.8	294	NG/G
NON-REF	BO-04	Eel	BO-04_17ET020_060517_EEL_20_WB	6/5/2017	28.6	386	NG/G
NON-REF	BO-04	Tomcod	BO-04_17ET026_092017_TOM_05_WB	9/20/2017	18.7	199	NG/G
NON-REF	BO-04	Tomcod	BO-04_092516_TOM_01_WB	9/25/2016	18.6	304	NG/G
NON-REF	BO-04	Eel	BO-04_080516_EEL_01_WB	8/5/2016	40	1370	NG/G
NON-REF	ES-13	Tomcod	ES-13_17ET717_091817_TOM_11_WB	9/18/2017	24.7	172	NG/G
NON-REF	ES-13	Tomcod	ES-13_17ET718_091817_TOM_02_WB	9/18/2017	20.1	114	NG/G
NON-REF	ES-13	Tomcod	ES-13_17ET723_091817_TOM_09_WB	9/18/2017	22.4	239	NG/G
NON-REF	ES-13	Tomcod	ES-13_17ET723_091817_TOM_10_WB	9/18/2017	23.1	209	NG/G
NON-REF	ES-13	Tomcod	ES-13_17LT012_091317_TOM_01_WB	9/13/2017	29.1	226	NG/G
NON-REF	ES-13	Tomcod	ES-13_092916_TOM_08_WB	9/29/2016	19.4	211	NG/G
NON-REF	ES-13	Tomcod	ES-13_093016_TOM_09_WB	9/30/2016	23.8	103	NG/G
NON-REF	ES-13	Tomcod	ES-13_092916_TOM_06_WB	9/29/2016	16.8	142	NG/G
NON-REF	ES-13	Tomcod	ES-13_092716_TOM_04_WB	9/27/2016	16.6	164	NG/G
NON-REF	ES-13	Tomcod	ES-13_093016_TOM_10_WB	9/30/2016	18.9	113	NG/G
NON-REF	ES-13	Tomcod	ES-13_092916_TOM_07_WB	9/29/2016	20.4	129	NG/G
NON-REF	ES-FP	Tomcod	ES-FP_100116_TOM_02_WB	10/1/2016	20.9	74.3	NG/G
NON-REF	ES-FP	Tomcod	ES-FP_092716_TOM_01_WB	9/27/2016	23.2	55.5	NG/G
REF	FRB&OV-04-REF	Tomcod	FRB-01_092916_TOM_01_WB	9/29/2016	15.2	36.5	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET001_091617_TOM_01_WB	9/16/2017	23.9	274	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET001_091617_TOM_02_WB	9/16/2017	19.8	382	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET001_091617_TOM_03_WB	9/16/2017	21	389	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET001_091617_TOM_04_WB	9/16/2017	21.9	233	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET001_091617_TOM_05_WB	9/16/2017	19.4	190	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET001_091617_TOM_07_WB	9/16/2017	17.2	308	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET001_091617_TOM_08_WB	9/16/2017	18	413	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET002_091617_TOM_10_WB	9/16/2017	23.2	205	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET003_091617_TOM_13_WB	9/16/2017	18.5	231	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET006_091617_TOM_18_WB	9/16/2017	18.6	136	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET007_091617_TOM_19_WB	9/16/2017	18.4	160	NG/G
NON-REF	OB-01	Tomcod	OB-01_17ET008_091617_TOM_20_WB	9/16/2017	21.9	182	NG/G
NON-REF	OB-01	Eel	OB-01_080216_EEL_01_WB	8/2/2016	39	394	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_01_WB	9/24/2016	20.2	115	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_02_WB	9/24/2016	15	215	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_03_WB	9/24/2016	19.5	232	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_05_WB	9/24/2016	22.9	69	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_06_WB	9/24/2016	19	159	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_07_WB	9/24/2016	21.1	76	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_08_WB	9/24/2016	18.5	174	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_09_WB	9/24/2016	18.2	196	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_10_WB	9/24/2016	21.2	82.1	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_11_WB	9/24/2016	21.2	89.5	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_12_WB	9/24/2016	18.9	89.5	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_14_WB	9/24/2016	19.6	280	NG/G

Appendix A-30b
UCL Evaluation - ProUCL Input
Predatory fish (Eel and Tomcod) for Bald Eagle - Length Defined Data Set

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Bald Eagle	ES_SA	MED_T	ID	DATE	Length (cm)	Mercury	UOM
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_15_WB	9/24/2016	17.7	276	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_16_WB	9/24/2016	20.1	188	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_17_WB	9/24/2016	18.1	155	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_18_WB	9/24/2016	18.4	212	NG/G
NON-REF	OB-01	Tomcod	OB-01_092416_TOM_19_WB	9/24/2016	16	245	NG/G
NON-REF	OB-05	Eel	OB-05_17ET100_060517_EEL_01_WB	6/5/2017	35.1	468	NG/G
NON-REF	OB-05	Eel	OB-05_17ET100_060517_EEL_02_WB	6/5/2017	35.6	322	NG/G
NON-REF	OB-05	Eel	OB-05_17ET100_060517_EEL_03_WB	6/5/2017	28.6	293	NG/G
NON-REF	OB-05	Eel	OB-05_17ET101_060517_EEL_10_WB	6/5/2017	32	528	NG/G
NON-REF	OB-05	Eel	OB-05_17ET101_060517_EEL_11_WB	6/5/2017	29.7	316	NG/G
NON-REF	OB-05	Eel	OB-05_17ET104_060517_EEL_08_WB	6/5/2017	32.3	249	NG/G
NON-REF	OB-05	Eel	OB-05_17ET104_060517_EEL_09_WB	6/5/2017	27.7	417	NG/G
NON-REF	OB-05	Eel	OB-05_17ET110_060517_EEL_06_WB	6/5/2017	31.5	224	NG/G
NON-REF	OB-05	Eel	OB-05_17ET110_060517_EEL_07_WB	6/5/2017	28.1	92.1	NG/G
NON-REF	OB-05	Eel	OB-05_17ET111_060517_EEL_04_WB	6/5/2017	31.2	706	NG/G
NON-REF	OB-05	Eel	OB-05_17ET111_060517_EEL_05_WB	6/5/2017	35.9	381	NG/G
NON-REF	OB-05	Tomcod	OB-05_17ET002_091717_TOM_01_WB	9/17/2017	15.1	268	NG/G
NON-REF	OB-05	Tomcod	OB-05_17ET003_091817_TOM_17_WB	9/18/2017	17.2	173	NG/G
NON-REF	OB-05	Tomcod	OB-05_17ET009_091717_TOM_05_WB	9/17/2017	21.8	379	NG/G
NON-REF	OB-05	Tomcod	OB-05_17ET013_091717_TOM_10_WB	9/17/2017	19.4	227	NG/G
NON-REF	OB-05	Tomcod	OB-05_17ET014_091717_TOM_13_WB	9/17/2017	19.8	159	NG/G
NON-REF	OB-05	Tomcod	OB-05_17ET014_091717_TOM_15_WB	9/17/2017	17	315	NG/G
NON-REF	OB-05	Eel	OB-05_17ET141_060617_EEL_12_WB	6/6/2017	34.9	234	NG/G
NON-REF	OB-05	Eel	OB-05_17ET141_060617_EEL_13_WB	6/6/2017	33.6	201	NG/G
NON-REF	OB-05	Eel	OB-05_17ET141_060617_EEL_14_WB	6/6/2017	32.9	277	NG/G
NON-REF	OB-05	Eel	OB-05_17ET141_060617_EEL_15_WB	6/6/2017	30.3	124	NG/G
NON-REF	OB-05	Eel	OB-05_17ET141_060617_EEL_16_WB	6/6/2017	28.2	110	NG/G
NON-REF	OB-05	Eel	OB-05_17ET141_060617_EEL_17_WB	6/6/2017	27.5	80	NG/G
NON-REF	OB-05	Eel	OB-05_17ET141_060617_EEL_18_WB	6/6/2017	28.4	116	NG/G
NON-REF	OB-05	Eel	OB-05_17ET141_060617_EEL_19_WB	6/6/2017	27.4	303	NG/G
NON-REF	OB-05	Eel	OB-05_17ET141_060617_EEL_20_WB	6/6/2017	28.6	221	NG/G
NON-REF	OB-05	Tomcod	OB-05_092516_TOM_06_WB	9/25/2016	18.6	154	NG/G
NON-REF	OB-05	Tomcod	OB-05_092516_TOM_01_WB	9/25/2016	16.6	158	NG/G
NON-REF	OB-05	Eel	OB-05_080516_EEL_05_WB	8/5/2016	38	428	NG/G
NON-REF	OB-05	Tomcod	OB-05_092516_TOM_12_WB	9/25/2016	15	253	NG/G
NON-REF	OB-05	Eel	OB-05_080316_EEL_02_WB	8/3/2016	39	579	NG/G
NON-REF	OB-05	Tomcod	OB-05_092516_TOM_14_WB	9/25/2016	16.6	201	NG/G
NON-REF	OB-05	Eel	OB-05_080316_EEL_04_WB	8/3/2016	34	461	NG/G
NON-REF	OB-05	Tomcod	OB-05_092516_TOM_08_WB	9/25/2016	18.5	146	NG/G
NON-REF	OB-05	Tomcod	OB-05_092516_TOM_09_WB	9/25/2016	19	246	NG/G
NON-REF	OB-05	Eel	OB-05_080316_EEL_01_WB	8/3/2016	38	391	NG/G
NON-REF	OB-05	Tomcod	OB-05_092516_TOM_11_WB	9/25/2016	17.5	117	NG/G
NON-REF	OB-05	Tomcod	OB-05_092516_TOM_07_WB	9/25/2016	20.1	194	NG/G
NON-REF	OB-05	Eel	OB-05_080316_EEL_03_WB	8/3/2016	37	485	NG/G
REF	FRB&OV-04-REF	Eel	OV-04_17ET015_060917_EEL_01_WB	6/9/2017	37.2	306	NG/G
REF	FRB&OV-04-REF	Eel	OV-04_17ET628_072817_EEL_02_WB	7/28/2017	36.6	320	NG/G
REF	FRB&OV-04-REF	Eel	OV-04_17ET628_072817_EEL_03_WB	7/28/2017	35.5	176	NG/G
REF	FRB&OV-04-REF	Eel	OV-04_17ET628_072817_EEL_04_WB	7/28/2017	33.7	161	NG/G
REF	FRB&OV-04-REF	Eel	OV-04_17ET628_072817_EEL_05_WB	7/28/2017	32.9	153	NG/G
REF	FRB&OV-04-REF	Eel	OV-04_17ET628_072817_EEL_06_WB	7/28/2017	31.2	142	NG/G

Appendix A-30c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/15/2018 10:06:24 AM
From File	2018-01-12 pfish_eagle.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury_ng/g (bo-04)

General Statistics

Total Number of Observations	33	Number of Distinct Observations	33
		Number of Missing Observations	0
Minimum	104	Mean	448.6
Maximum	1370	Median	422
SD	291.3	Std. Error of Mean	50.71
Coefficient of Variation	0.649	Skewness	1.713

Normal GOF Test

Shapiro Wilk Test Statistic	0.835	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.931	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.136	Lilliefors GOF Test
5% Lilliefors Critical Value	0.152	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	534.5	95% Adjusted-CLT UCL (Chen-1995)	548.2
		95% Modified-t UCL (Johnson-1978)	537.1

Gamma GOF Test

A-D Test Statistic	0.454	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0883	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.154	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.826	k star (bias corrected MLE)	2.59
Theta hat (MLE)	158.7	Theta star (bias corrected MLE)	173.2
nu hat (MLE)	186.5	nu star (bias corrected)	170.9
MLE Mean (bias corrected)	448.6	MLE Sd (bias corrected)	278.8
		Approximate Chi Square Value (0.05)	141.7
Adjusted Level of Significance	0.0419	Adjusted Chi Square Value	140.3

Appendix A-30c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	541.2	95% Adjusted Gamma UCL (use when n<50)	546.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.129	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.152	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.644	Mean of logged Data	5.919
Maximum of Logged Data	7.223	SD of logged Data	0.633

Assuming Lognormal Distribution

95% H-UCL	571.9	90% Chebyshev (MVUE) UCL	611.2
95% Chebyshev (MVUE) UCL	683.6	97.5% Chebyshev (MVUE) UCL	784
99% Chebyshev (MVUE) UCL	981.4		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	532	95% Jackknife UCL	534.5
95% Standard Bootstrap UCL	530.4	95% Bootstrap-t UCL	561.2
95% Hall's Bootstrap UCL	598.8	95% Percentile Bootstrap UCL	533.5
95% BCA Bootstrap UCL	547.3		
90% Chebyshev(Mean, Sd) UCL	600.8	95% Chebyshev(Mean, Sd) UCL	669.7
97.5% Chebyshev(Mean, Sd) UCL	765.3	99% Chebyshev(Mean, Sd) UCL	953.2

Suggested UCL to Use

95% Student's-t UCL	534.5

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-30c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Mercury_ng/g (es-13)

General Statistics

Total Number of Observations	22	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	32.7	Mean	110.8
Maximum	239	Median	91.7
SD	66.37	Std. Error of Mean	14.15
Coefficient of Variation	0.599	Skewness	0.686

Normal GOF Test

Shapiro Wilk Test Statistic	0.893	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.177	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.184	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	135.2	95% Adjusted-CLT UCL (Chen-1995)	136.3
		95% Modified-t UCL (Johnson-1978)	135.5

Gamma GOF Test

A-D Test Statistic	0.512	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.149	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.187	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.969	k star (bias corrected MLE)	2.595
Theta hat (MLE)	37.33	Theta star (bias corrected MLE)	42.72
nu hat (MLE)	130.7	nu star (bias corrected)	114.2
MLE Mean (bias corrected)	110.8	MLE Sd (bias corrected)	68.81
		Approximate Chi Square Value (0.05)	90.51
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	88.93

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	139.8	95% Adjusted Gamma UCL (use when n<50)	142.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.947	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.911	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.126	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.184	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Appendix A-30c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	3.487	Mean of logged Data	4.53
Maximum of Logged Data	5.476	SD of logged Data	0.62

Assuming Lognormal Distribution

95% H-UCL	149.7	90% Chebyshev (MVUE) UCL	158
95% Chebyshev (MVUE) UCL	179.1	97.5% Chebyshev (MVUE) UCL	208.5
99% Chebyshev (MVUE) UCL	266.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	134.1	95% Jackknife UCL	135.2
95% Standard Bootstrap UCL	133.7	95% Bootstrap-t UCL	137.4
95% Hall's Bootstrap UCL	133.7	95% Percentile Bootstrap UCL	132.6
95% BCA Bootstrap UCL	137		
90% Chebyshev(Mean, Sd) UCL	153.3	95% Chebyshev(Mean, Sd) UCL	172.5
97.5% Chebyshev(Mean, Sd) UCL	199.2	99% Chebyshev(Mean, Sd) UCL	251.6

Suggested UCL to Use

95% Student's-t UCL	135.2

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (es-fp)

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	37.2	Mean	55.67
Maximum	74.3	Median	55.5
SD	18.55	Std. Error of Mean	10.71
Coefficient of Variation	0.333	Skewness	0.0404

**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**

Appendix A-30c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	1	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.176	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	86.94	95% Adjusted-CLT UCL (Chen-1995)	73.55
		95% Modified-t UCL (Johnson-1978)	86.98

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	12.95	k star (bias corrected MLE)	N/A
Theta hat (MLE)	4.299	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	77.69	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.992	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.208	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.616	Mean of logged Data	3.98
Maximum of Logged Data	4.308	SD of logged Data	0.347

Assuming Lognormal Distribution

95% H-UCL	175.9	90% Chebyshev (MVUE) UCL	88.72
95% Chebyshev (MVUE) UCL	103.7	97.5% Chebyshev (MVUE) UCL	124.4
99% Chebyshev (MVUE) UCL	165.2		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	73.28	95% Jackknife UCL	86.94
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	87.8	95% Chebyshev(Mean, Sd) UCL	102.4
97.5% Chebyshev(Mean, Sd) UCL	122.6	99% Chebyshev(Mean, Sd) UCL	162.2

Suggested UCL to Use

95% Student's-t UCL	86.94

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (frb-ref)

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	36.5	Mean	36.5
Maximum	36.5	Median	36.5

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable Mercury_ng/g (frb-ref) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Mercury_ng/g (ob-01)

General Statistics

Total Number of Observations	40	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	49.7	Mean	180.9
Maximum	413	Median	176.5
SD	101.8	Std. Error of Mean	16.09
Coefficient of Variation	0.563	Skewness	0.696

Appendix A-30c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.911	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.141	Lilliefors GOF Test
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	208.1	95% Adjusted-CLT UCL (Chen-1995)	209.3
		95% Modified-t UCL (Johnson-1978)	208.4

Gamma GOF Test

A-D Test Statistic	0.688	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.145	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.132	k star (bias corrected MLE)	2.914
Theta hat (MLE)	57.77	Theta star (bias corrected MLE)	62.1
nu hat (MLE)	250.6	nu star (bias corrected)	233.1
MLE Mean (bias corrected)	180.9	MLE Sd (bias corrected)	106
		Approximate Chi Square Value (0.05)	198.8
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	197.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	212.2	95% Adjusted Gamma UCL (use when n<50)	213.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.933	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.136	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.906	Mean of logged Data	5.03
Maximum of Logged Data	6.023	SD of logged Data	0.609

Assuming Lognormal Distribution

95% H-UCL	223.9	90% Chebyshev (MVUE) UCL	239.6
95% Chebyshev (MVUE) UCL	265.2	97.5% Chebyshev (MVUE) UCL	300.8
99% Chebyshev (MVUE) UCL	370.6		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	207.4	95% Jackknife UCL	208.1
95% Standard Bootstrap UCL	207.6	95% Bootstrap-t UCL	211.5
95% Hall's Bootstrap UCL	208.3	95% Percentile Bootstrap UCL	207.6
95% BCA Bootstrap UCL	209.2		
90% Chebyshev(Mean, Sd) UCL	229.2	95% Chebyshev(Mean, Sd) UCL	251.1
97.5% Chebyshev(Mean, Sd) UCL	281.5	99% Chebyshev(Mean, Sd) UCL	341.1

Suggested UCL to Use

95% Adjusted Gamma UCL	213.5

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury_ng/g (ob-05)

General Statistics

Total Number of Observations	63	Number of Distinct Observations	60
		Number of Missing Observations	0
Minimum	70.7	Mean	223.3
Maximum	706	Median	173
SD	140.5	Std. Error of Mean	17.7
Coefficient of Variation	0.629	Skewness	1.31

Normal GOF Test

Shapiro Wilk Test Statistic	0.867	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	2.0774E-7	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.163	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.111	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	252.9	95% Adjusted-CLT UCL (Chen-1995)	255.6
		95% Modified-t UCL (Johnson-1978)	253.4

Appendix A-30c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.885	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.125	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.113	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.016	k star (bias corrected MLE)	2.883
Theta hat (MLE)	74.05	Theta star (bias corrected MLE)	77.47
nu hat (MLE)	380	nu star (bias corrected)	363.2
MLE Mean (bias corrected)	223.3	MLE Sd (bias corrected)	131.5
		Approximate Chi Square Value (0.05)	320.1
Adjusted Level of Significance	0.0462	Adjusted Chi Square Value	319.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	253.4	95% Adjusted Gamma UCL (use when n<50)	254.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.958	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0713	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0939	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.111	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.258	Mean of logged Data	5.234
Maximum of Logged Data	6.56	SD of logged Data	0.59

Assuming Lognormal Distribution

95% H-UCL	257.7	90% Chebyshev (MVUE) UCL	275.5
95% Chebyshev (MVUE) UCL	299.6	97.5% Chebyshev (MVUE) UCL	333
99% Chebyshev (MVUE) UCL	398.6		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	252.4	95% Jackknife UCL	252.9
95% Standard Bootstrap UCL	252.1	95% Bootstrap-t UCL	255.1
95% Hall's Bootstrap UCL	257.1	95% Percentile Bootstrap UCL	253.8
95% BCA Bootstrap UCL	256.4		
90% Chebyshev(Mean, Sd) UCL	276.4	95% Chebyshev(Mean, Sd) UCL	300.5
97.5% Chebyshev(Mean, Sd) UCL	333.9	99% Chebyshev(Mean, Sd) UCL	399.4

Suggested UCL to Use

95% H-UCL	257.7

Appendix A-30c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Mercury_ng/g (ov-04)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	142	Mean	209.7
Maximum	320	Median	168.5
SD	80.93	Std. Error of Mean	33.04
Coefficient of Variation	0.386	Skewness	0.901

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.769	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.328	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	276.2	95% Adjusted-CLT UCL (Chen-1995)	277
		95% Modified-t UCL (Johnson-1978)	278.3

Gamma GOF Test

A-D Test Statistic	0.727	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.32	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Appendix A-30c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	8.908	k star (bias corrected MLE)	4.565
Theta hat (MLE)	23.54	Theta star (bias corrected MLE)	45.93
nu hat (MLE)	106.9	nu star (bias corrected)	54.78
MLE Mean (bias corrected)	209.7	MLE Sd (bias corrected)	98.13
		Approximate Chi Square Value (0.05)	38.78
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	33.98

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	296.2	95% Adjusted Gamma UCL (use when n<50)	338.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.804	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.294	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.956	Mean of logged Data	5.288
Maximum of Logged Data	5.768	SD of logged Data	0.362

Assuming Lognormal Distribution

95% H-UCL	308.5	90% Chebyshev (MVUE) UCL	301.5
95% Chebyshev (MVUE) UCL	343.4	97.5% Chebyshev (MVUE) UCL	401.6
99% Chebyshev (MVUE) UCL	515.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	264	95% Jackknife UCL	276.2
95% Standard Bootstrap UCL	259.4	95% Bootstrap-t UCL	543.4
95% Hall's Bootstrap UCL	784.9	95% Percentile Bootstrap UCL	261
95% BCA Bootstrap UCL	264.3		
90% Chebyshev(Mean, Sd) UCL	308.8	95% Chebyshev(Mean, Sd) UCL	353.7
97.5% Chebyshev(Mean, Sd) UCL	416	99% Chebyshev(Mean, Sd) UCL	538.4

Suggested UCL to Use

95% Adjusted Gamma UCL	338.1

Recommended UCL exceeds the maximum observation

Appendix A-30c
UCL Evaluation - Sample Area for Bald Eagle - All Data
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-30d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/13/2018 3:51:15 PM
From File	30_Predatory Fish_Bald Eagle 041318 LengthC INPUT.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (bo-04)

General Statistics

Total Number of Observations	23	Number of Distinct Observations	23
		Number of Missing Observations	0
Minimum	199	Mean	560.7
Maximum	1370	Median	489
SD	279.1	Std. Error of Mean	58.2
Coefficient of Variation	0.498	Skewness	1.992

Normal GOF Test

Shapiro Wilk Test Statistic	0.773	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.18	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	660.7	95% Adjusted-CLT UCL (Chen-1995)	682.3
		95% Modified-t UCL (Johnson-1978)	664.7

Gamma GOF Test

A-D Test Statistic	0.848	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.746	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.142	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.182	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Appendix A-30d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	5.523	k star (bias corrected MLE)	4.832
Theta hat (MLE)	101.5	Theta star (bias corrected MLE)	116.1
nu hat (MLE)	254.1	nu star (bias corrected)	222.3
MLE Mean (bias corrected)	560.7	MLE Sd (bias corrected)	255.1
		Approximate Chi Square Value (0.05)	188.7
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	186.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	660.3	95% Adjusted Gamma UCL (use when n<50)	668.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.939	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.914	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.125	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.18	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.293	Mean of logged Data	6.236
Maximum of Logged Data	7.223	SD of logged Data	0.427

Assuming Lognormal Distribution

95% H-UCL	666	90% Chebyshev (MVUE) UCL	710.4
95% Chebyshev (MVUE) UCL	779.7	97.5% Chebyshev (MVUE) UCL	876.1
99% Chebyshev (MVUE) UCL	1065		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	656.5	95% Jackknife UCL	660.7
95% Standard Bootstrap UCL	654.5	95% Bootstrap-t UCL	742.1
95% Hall's Bootstrap UCL	1258	95% Percentile Bootstrap UCL	661.7
95% BCA Bootstrap UCL	689.7		
90% Chebyshev(Mean, Sd) UCL	735.3	95% Chebyshev(Mean, Sd) UCL	814.4
97.5% Chebyshev(Mean, Sd) UCL	924.2	99% Chebyshev(Mean, Sd) UCL	1140

Suggested UCL to Use

95% Adjusted Gamma UCL	668.2

Appendix A-30d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (es-13)

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	0
Minimum	103	Mean	165.6
Maximum	239	Median	164
SD	49.26	Std. Error of Mean	14.85
Coefficient of Variation	0.297	Skewness	0.203

Normal GOF Test

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.174	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	192.6	95% Adjusted-CLT UCL (Chen-1995)	191
		95% Modified-t UCL (Johnson-1978)	192.7

Gamma GOF Test

A-D Test Statistic	0.398	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.19	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.255	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-30d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	12.25	k star (bias corrected MLE)	8.967
Theta hat (MLE)	13.53	Theta star (bias corrected MLE)	18.47
nu hat (MLE)	269.4	nu star (bias corrected)	197.3
MLE Mean (bias corrected)	165.6	MLE Sd (bias corrected)	55.31
		Approximate Chi Square Value (0.05)	165.8
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	161.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	197.1	95% Adjusted Gamma UCL (use when n<50)	202.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.921	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.18	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.251	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.635	Mean of logged Data	5.068
Maximum of Logged Data	5.476	SD of logged Data	0.304

Assuming Lognormal Distribution

95% H-UCL	200.8	90% Chebyshev (MVUE) UCL	211.7
95% Chebyshev (MVUE) UCL	232.5	97.5% Chebyshev (MVUE) UCL	261.4
99% Chebyshev (MVUE) UCL	318.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	190.1	95% Jackknife UCL	192.6
95% Standard Bootstrap UCL	189.1	95% Bootstrap-t UCL	194.1
95% Hall's Bootstrap UCL	188	95% Percentile Bootstrap UCL	189.2
95% BCA Bootstrap UCL	190.8		
90% Chebyshev(Mean, Sd) UCL	210.2	95% Chebyshev(Mean, Sd) UCL	230.4
97.5% Chebyshev(Mean, Sd) UCL	258.4	99% Chebyshev(Mean, Sd) UCL	313.4

Suggested UCL to Use

95% Student's-t UCL	192.6

Appendix A-30d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (es-fp)

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	55.5	Mean	64.9
Maximum	74.3	Median	64.9

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable Mercury (es-fp) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Mercury (frb&ov-04-ref)

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	36.5	Mean	184.9
Maximum	320	Median	161
SD	98.7	Std. Error of Mean	37.3
Coefficient of Variation	0.534	Skewness	0.205

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Appendix A-30d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.25	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	257.4	95% Adjusted-CLT UCL (Chen-1995)	249.4
		95% Modified-t UCL (Johnson-1978)	257.9

Gamma GOF Test

A-D Test Statistic	0.49	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.712	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.26	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.314	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.043	k star (bias corrected MLE)	1.834
Theta hat (MLE)	60.77	Theta star (bias corrected MLE)	100.8
nu hat (MLE)	42.61	nu star (bias corrected)	25.68
MLE Mean (bias corrected)	184.9	MLE Sd (bias corrected)	136.5
		Approximate Chi Square Value (0.05)	15.13
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	12.75

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	313.8	95% Adjusted Gamma UCL (use when n<50)	372.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.83	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.307	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.304	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.597	Mean of logged Data	5.047
Maximum of Logged Data	5.768	SD of logged Data	0.719

Appendix A-30d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Lognormal Distribution

95% H-UCL	479.2	90% Chebyshev (MVUE) UCL	351.5
95% Chebyshev (MVUE) UCL	423.3	97.5% Chebyshev (MVUE) UCL	522.9
99% Chebyshev (MVUE) UCL	718.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	246.3	95% Jackknife UCL	257.4
95% Standard Bootstrap UCL	242.7	95% Bootstrap-t UCL	287.1
95% Hall's Bootstrap UCL	363.5	95% Percentile Bootstrap UCL	246
95% BCA Bootstrap UCL	246		
90% Chebyshev(Mean, Sd) UCL	296.8	95% Chebyshev(Mean, Sd) UCL	347.5
97.5% Chebyshev(Mean, Sd) UCL	417.9	99% Chebyshev(Mean, Sd) UCL	556.1

Suggested UCL to Use

95% Student's-t UCL	257.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (ob-01)

General Statistics

Total Number of Observations	30	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	69	Mean	211.7
Maximum	413	Median	200.5
SD	96.73	Std. Error of Mean	17.66
Coefficient of Variation	0.457	Skewness	0.547

Normal GOF Test

Shapiro Wilk Test Statistic	0.939	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.113	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.159	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Appendix A-30d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	241.7	95% Adjusted-CLT UCL (Chen-1995)	242.6
		95% Modified-t UCL (Johnson-1978)	242

Gamma GOF Test

A-D Test Statistic	0.333	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0952	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.16	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.677	k star (bias corrected MLE)	4.232
Theta hat (MLE)	45.26	Theta star (bias corrected MLE)	50.02
nu hat (MLE)	280.6	nu star (bias corrected)	253.9
MLE Mean (bias corrected)	211.7	MLE Sd (bias corrected)	102.9
		Approximate Chi Square Value (0.05)	218
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	216.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	246.5	95% Adjusted Gamma UCL (use when n<50)	248.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.946	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.11	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.159	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.234	Mean of logged Data	5.244
Maximum of Logged Data	6.023	SD of logged Data	0.498

Assuming Lognormal Distribution

95% H-UCL	256.9	90% Chebyshev (MVUE) UCL	274.3
95% Chebyshev (MVUE) UCL	301.8	97.5% Chebyshev (MVUE) UCL	340
99% Chebyshev (MVUE) UCL	415.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-30d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	240.7	95% Jackknife UCL	241.7
95% Standard Bootstrap UCL	240.7	95% Bootstrap-t UCL	245
95% Hall's Bootstrap UCL	243.4	95% Percentile Bootstrap UCL	241
95% BCA Bootstrap UCL	243.4		
90% Chebyshev(Mean, Sd) UCL	264.6	95% Chebyshev(Mean, Sd) UCL	288.6
97.5% Chebyshev(Mean, Sd) UCL	322	99% Chebyshev(Mean, Sd) UCL	387.4

Suggested UCL to Use

95% Student's-t UCL	241.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (ob-05)

General Statistics

Total Number of Observations	39	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	80	Mean	282
Maximum	706	Median	249
SD	146.1	Std. Error of Mean	23.4
Coefficient of Variation	0.518	Skewness	0.902

Normal GOF Test

Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.939	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.117	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.14	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	321.4	95% Adjusted-CLT UCL (Chen-1995)	324.1
		95% Modified-t UCL (Johnson-1978)	322

Appendix A-30d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.163	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0648	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.142	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.93	k star (bias corrected MLE)	3.645
Theta hat (MLE)	71.75	Theta star (bias corrected MLE)	77.36
nu hat (MLE)	306.5	nu star (bias corrected)	284.3
MLE Mean (bias corrected)	282	MLE Sd (bias corrected)	147.7
		Approximate Chi Square Value (0.05)	246.2
Adjusted Level of Significance	0.0437	Adjusted Chi Square Value	244.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	325.5	95% Adjusted Gamma UCL (use when n<50)	327.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.939	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0713	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.14	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.382	Mean of logged Data	5.509
Maximum of Logged Data	6.56	SD of logged Data	0.533

Assuming Lognormal Distribution

95% H-UCL	336.7	90% Chebyshev (MVUE) UCL	360
95% Chebyshev (MVUE) UCL	394.6	97.5% Chebyshev (MVUE) UCL	442.7
99% Chebyshev (MVUE) UCL	537.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-30d
UCL Evaluation - Sample Area for Bald Eagle - Length Defined Data Set
Predatory fish (Eel and Tomcod)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	320.4	95% Jackknife UCL	321.4
95% Standard Bootstrap UCL	321.2	95% Bootstrap-t UCL	327.2
95% Hall's Bootstrap UCL	326.8	95% Percentile Bootstrap UCL	321.5
95% BCA Bootstrap UCL	323.6		
90% Chebyshev(Mean, Sd) UCL	352.2	95% Chebyshev(Mean, Sd) UCL	384
97.5% Chebyshev(Mean, Sd) UCL	428.1	99% Chebyshev(Mean, Sd) UCL	514.8

Suggested UCL to Use

95% Student's-t UCL	321.4

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-31a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Belted Kingfisher

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Mercury	UOM
BO-04	BO-05.2016	2016	1793	NG/G
BO-04	BO-05.2017	2017	78.8	NG/G
ES-13	ES-13.2016	2016	416	NG/G
ES-13	ES-13.2017	2017	586	NG/G
ES-13	SVE-02INT.2017	2017	245	NG/G
ES-13	VE-10-01-C.2017	2017	801	NG/G
ES-13	VE-10-01-E.2017	2017	765	NG/G
ES-13	VE-MU4-GC-1-E.2017	2017	264	NG/G
ES-13	VE-MU4-GC-1-F.2017	2017	672	NG/G
ES-13	W-61-High.2016	2016	593	NG/G
ES-13	W-61-High.2017	2017	166	NG/G
ES-13	W-61-Intertidal.2016	2016	1163	NG/G
ES-13	W-61-Intertidal.2017	2017	529	NG/G
ES-13	W-61-Low.2016	2016	926	NG/G
ES-13	W-61-Low.2017	2017	844	NG/G
ES-FP	ES-FP.2017	2017	12.3	NG/G
ES-FP	ES-FP-W.2017	2017	31.0	NG/G
MM	MM-04-01-C.2017	2017	743	NG/G
MM	MM-04-01-F.2017	2017	756	NG/G
MM	MM-50.2016	2016	37.0	NG/G
MM	MM-64.2016	2016	484	NG/G
MM	MM-64THRU67.2017	2017	425	NG/G
MM	MM-65.2016	2016	821	NG/G
MM	MM-C3-A.2017	2017	1413	NG/G
MM	MM-MR.2017	2017	154	NG/G
MM	MM-MR-INT.2017	2017	932	NG/G
MM	MMPOLY.2016	2016	554	NG/G
MM	MMSE-1_N1.2017	2017	1851	NG/G
MM	MMSE-1_N2.2017	2017	398	NG/G
MM	MMSE-1_S1.2017	2017	282	NG/G
MM	MMSE-1_S2.2017	2017	320	NG/G
MM	MMSW-C_N.2017	2017	899	NG/G
MM	MMSW-C_S.2017	2017	965	NG/G
MM	MMSW-C_SW.2017	2017	207	NG/G
MM	MM-T1-C1-A.2017	2017	740	NG/G
MM	MM-T1-C1-B.2017	2017	765	NG/G
MM	MM-T1-C2-B.2017	2017	813	NG/G
MM	MM-T1-C2-D.2017	2017	793	NG/G
MM	MM-T1-C3-B.2017	2017	168	NG/G
MM	MM-T1-C4.2017	2017	1029	NG/G
MM	MM-T1-C5.2017	2017	887	NG/G
MM	MM-T1-C6.2017	2017	164	NG/G
MM	MM-T2-C1-B.2017	2017	372	NG/G
MM	MM-T2-C2-A.2017	2017	1246	NG/G
MM	MM-T2-C3-A.2017	2017	1503	NG/G

Appendix A-31a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Belted Kingfisher

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Mercury	UOM
MM	MM-T2-C4-B.2017	2017	51.7	NG/G
MM	MM-T2-C5-A.2017	2017	306	NG/G
MM	MM-T2-C6-A.2017	2017	734	NG/G
MM	MM-T2-C7-A.2017	2017	76.6	NG/G
MM	MM-T2-C8-B.2017	2017	643	NG/G
MM	MM-T3-C1.2017	2017	71.1	NG/G
MM	MM-T3-C2-C.2017	2017	570	NG/G
MM	MM-T3-C2-F.2017	2017	845	NG/G
MM	MM-T3-C3-B2.2017	2017	328	NG/G
MM	MM-T3-C3-C.2017	2017	330	NG/G
MM	MM-T3-C4-C.2017	2017	867	NG/G
MM	MM-T3-C4-D.2017	2017	791	NG/G
MM	MM-T3-C5-C.2017	2017	905	NG/G
MM	MM-T3-C6.2017	2017	438	NG/G
MM	MM-T3-C7.2017	2017	256	NG/G
MM	MM-T5-C1.2017	2017	1008	NG/G
MM	MM-T5-C2.2017	2017	82.1	NG/G
MM	MM-T5-C3.2017	2017	948	NG/G
MM	W-21-High.2016	2016	929	NG/G
MM	W-21-High.2017	2017	802	NG/G
MM	W-21-Intertidal.2016	2016	543	NG/G
MM	W-21-Intertidal.2017	2017	780	NG/G
MM	W-21-Low.2016	2016	704	NG/G
MM	W-21-Low.2017	2017	873	NG/G
MM	W-21-Mid.2016	2016	869	NG/G
MM	W-21-Mid.2017	2017	927	NG/G
MM	W-21-UM-Central-C.2016	2016	617	NG/G
MM	W-21-UM-Central-C.2017	2017	265	NG/G
MM	W-21-UM-East-C.2016	2016	751	NG/G
MM	W-21-UM-East-C.2017	2017	1008	NG/G
MM	W-21-UM-West-A.2016	2016	434	NG/G
MM	W-21-UM-West-A.2017	2017	165	NG/G
MM	W-65-High.2016	2016	84.3	NG/G
MM	W-65-High.2017	2017	201	NG/G
MM	W-65-Intertidal.2016	2016	41.6	NG/G
MM	W-65-Intertidal.2017	2017	197	NG/G
MM	W-65-Low.2016	2016	32.5	NG/G
MM	W-65-Low.2017	2017	1049	NG/G
MM	W-65-Mid.2016	2016	225	NG/G
MM	W-65-Mid.2017	2017	161	NG/G
MM	W-MM-01.2017	2017	1786	NG/G
MM	W-MM-02.2017	2017	448	NG/G
MM	W-MM-03.2017	2017	113	NG/G
MM	W-MM-04.2017	2017	519	NG/G
MM	W-MM-05.2017	2017	691	NG/G

Appendix A-31a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Belted Kingfisher

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Mercury	UOM
MM	W-MM-06.2017	2017	620	NG/G
MM	W-MM-07.2017	2017	560	NG/G
MM	W-MM-08.2017	2017	793	NG/G
MM	W-MM-11.2017	2017	1067	NG/G
MM	W-MM-12.2017	2017	418	NG/G
MM	W-MM-13.2017	2017	307	NG/G
MM	W-MM-14.2017	2017	635	NG/G
MM	W-MM-TP.2017	2017	152	NG/G
OB-01	MM-04-01-C.2017	2017	743	NG/G
OB-01	MM-04-01-F.2017	2017	756	NG/G
OB-01	MMPOLY.2016	2016	554	NG/G
OB-01	MMSE-1_N1.2017	2017	1851	NG/G
OB-01	MM-T1-C1-A.2017	2017	740	NG/G
OB-01	MM-T1-C1-B.2017	2017	765	NG/G
OB-01	MM-T1-C2-B.2017	2017	813	NG/G
OB-01	MM-T1-C2-D.2017	2017	793	NG/G
OB-01	MM-T1-C3-B.2017	2017	168	NG/G
OB-01	MM-T1-C4.2017	2017	1029	NG/G
OB-01	MM-T1-C5.2017	2017	887	NG/G
OB-01	MM-T1-C6.2017	2017	164	NG/G
OB-01	W-17-High.2017	2017	1053	NG/G
OB-01	W-MM-01.2017	2017	1786	NG/G
OB-01	W-MM-02.2017	2017	448	NG/G
OB-01	W-MM-TP.2017	2017	152	NG/G
OB-04	OB-04.2017	2017	151	NG/G
OB-04	W-14-INTA.2017	2017	110	NG/G
OB-04	WP-02-01-B.2017	2017	586	NG/G
OB-04	WP-02-01-D.2017	2017	542	NG/G
OB-05	OB-05.2016	2016	755	NG/G
OB-05	OB-05.2017	2017	981	NG/G
OB-05	ON-10-01-B.2017	2017	626	NG/G
OB-05	ON-10-01-C.2017	2017	1331	NG/G
OB-05	PBR-19-A.2017	2017	1613	NG/G
OB-05	W-104-INTA.2017	2017	797	NG/G
OB-05	W-104-INTB.2017	2017	780	NG/G
OB-05	W-63-INT.2017	2017	1073	NG/G
OB-05	W-63-Intertidal.2016	2016	1123	NG/G

Appendix A-31b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/29/2018 3:39:06 PM
From File	2018_01_29 Sediment_BFK.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

IPWC_Hg (bo-04)

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	78.8	Mean	935.9
Maximum	1793	Median	935.9

Warning: This data set only has 2 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable IPWC_Hg (bo-04) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

IPWC_Hg (es-13)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	166.4	Mean	613
Maximum	1163	Median	593
SD	291.5	Std. Error of Mean	80.84
Coefficient of Variation	0.475	Skewness	0.119

Normal GOF Test

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.115	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Appendix A-31b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	757.1	95% Adjusted-CLT UCL (Chen-1995)	748.9
		95% Modified-t UCL (Johnson-1978)	757.6

Gamma GOF Test

A-D Test Statistic	0.334	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.737	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.147	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.238	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.926	k star (bias corrected MLE)	3.071
Theta hat (MLE)	156.2	Theta star (bias corrected MLE)	199.6
nu hat (MLE)	102.1	nu star (bias corrected)	79.85
MLE Mean (bias corrected)	613	MLE Sd (bias corrected)	349.8
		Approximate Chi Square Value (0.05)	60.26
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	57.84

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	812.3	95% Adjusted Gamma UCL (use when n<50)	846.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.182	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.115	Mean of logged Data	6.286
Maximum of Logged Data	7.059	SD of logged Data	0.578

Assuming Lognormal Distribution

95% H-UCL	916.9	90% Chebyshev (MVUE) UCL	936.2
95% Chebyshev (MVUE) UCL	1077	97.5% Chebyshev (MVUE) UCL	1272
99% Chebyshev (MVUE) UCL	1656		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	746	95% Jackknife UCL	757.1
95% Standard Bootstrap UCL	740.6	95% Bootstrap-t UCL	768.2
95% Hall's Bootstrap UCL	754.9	95% Percentile Bootstrap UCL	744.2
95% BCA Bootstrap UCL	749.2		
90% Chebyshev(Mean, Sd) UCL	855.6	95% Chebyshev(Mean, Sd) UCL	965.4
97.5% Chebyshev(Mean, Sd) UCL	1118	99% Chebyshev(Mean, Sd) UCL	1417

Suggested UCL to Use

95% Student's-t UCL 757.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (es-fp)

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	12.31	Mean	21.67
Maximum	31.04	Median	21.67

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable IPWC_Hg (es-fp) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

IPWC_Hg (mm)

General Statistics

Total Number of Observations	81	Number of Distinct Observations	80
		Number of Missing Observations	0
Minimum	32.5	Mean	601.7
Maximum	1851	Median	617
SD	398.4	Std. Error of Mean	44.27
Coefficient of Variation	0.662	Skewness	0.717

Appendix A-31b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.931	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	2.5822E-4	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0857	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0985	Data appear Normal at 5% Significance Level	

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	675.4	95% Adjusted-CLT UCL (Chen-1995)	678.3
		95% Modified-t UCL (Johnson-1978)	676

Gamma GOF Test

A-D Test Statistic	1.468	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.767	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.132	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.101	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.727	k star (bias corrected MLE)	1.671
Theta hat (MLE)	348.5	Theta star (bias corrected MLE)	360.1
nu hat (MLE)	279.7	nu star (bias corrected)	270.7
MLE Mean (bias corrected)	601.7	MLE Sd (bias corrected)	465.5
		Approximate Chi Square Value (0.05)	233.6
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	233

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	697.3	95% Adjusted Gamma UCL (use when n<50)	699.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.892	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	1.2119E-7	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.149	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0985	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.481	Mean of logged Data	6.083
Maximum of Logged Data	7.524	SD of logged Data	0.934

Assuming Lognormal Distribution

95% H-UCL	850.4	90% Chebyshev (MVUE) UCL	918.2
95% Chebyshev (MVUE) UCL	1029	97.5% Chebyshev (MVUE) UCL	1184
99% Chebyshev (MVUE) UCL	1487		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	674.5	95% Jackknife UCL	675.4
95% Standard Bootstrap UCL	674.3	95% Bootstrap-t UCL	681.3
95% Hall's Bootstrap UCL	684.2	95% Percentile Bootstrap UCL	675.1
95% BCA Bootstrap UCL	676.3		
90% Chebyshev(Mean, Sd) UCL	734.5	95% Chebyshev(Mean, Sd) UCL	794.7
97.5% Chebyshev(Mean, Sd) UCL	878.2	99% Chebyshev(Mean, Sd) UCL	1042

Suggested UCL to Use

95% Student's-t UCL 675.4

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (ob-01)

General Statistics

Total Number of Observations	16	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	151.8	Mean	793.8
Maximum	1851	Median	760.5
SD	491.2	Std. Error of Mean	122.8
Coefficient of Variation	0.619	Skewness	0.884

Normal GOF Test

Shapiro Wilk Test Statistic	0.883	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.174	Lilliefors GOF Test
5% Lilliefors Critical Value	0.213	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1009	95% Adjusted-CLT UCL (Chen-1995)	1025
		95% Modified-t UCL (Johnson-1978)	1014

Appendix A-31b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.742	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.232	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.217	Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.372	k star (bias corrected MLE)	1.969
Theta hat (MLE)	334.7	Theta star (bias corrected MLE)	403.2
nu hat (MLE)	75.9	nu star (bias corrected)	63
MLE Mean (bias corrected)	793.8	MLE Sd (bias corrected)	565.7
		Approximate Chi Square Value (0.05)	45.75
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	44.07

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1093	95% Adjusted Gamma UCL (use when n<50)	1135

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.86	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.268	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.213	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.023	Mean of logged Data	6.452
Maximum of Logged Data	7.524	SD of logged Data	0.767

Assuming Lognormal Distribution

95% H-UCL	1359	90% Chebyshev (MVUE) UCL	1341
95% Chebyshev (MVUE) UCL	1572	97.5% Chebyshev (MVUE) UCL	1893
99% Chebyshev (MVUE) UCL	2523		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	995.8	95% Jackknife UCL	1009
95% Standard Bootstrap UCL	991.8	95% Bootstrap-t UCL	1063
95% Hall's Bootstrap UCL	1185	95% Percentile Bootstrap UCL	996.7
95% BCA Bootstrap UCL	997.4		
90% Chebyshev(Mean, Sd) UCL	1162	95% Chebyshev(Mean, Sd) UCL	1329
97.5% Chebyshev(Mean, Sd) UCL	1561	99% Chebyshev(Mean, Sd) UCL	2016

Appendix A-31b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL 1009

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (ob-04)

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	110.3	Mean	347.4
Maximum	586	Median	346.7
SD	251.5	Std. Error of Mean	125.7
Coefficient of Variation	0.724	Skewness	0.00331

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.812	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.283	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	643.4	95% Adjusted-CLT UCL (Chen-1995)	554.5
		95% Modified-t UCL (Johnson-1978)	643.4

Gamma GOF Test

A-D Test Statistic	0.526	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.322	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-31b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.127	k star (bias corrected MLE)	0.698
Theta hat (MLE)	163.3	Theta star (bias corrected MLE)	497.4
nu hat (MLE)	17.02	nu star (bias corrected)	5.587
MLE Mean (bias corrected)	347.4	MLE Sd (bias corrected)	415.7
		Approximate Chi Square Value (0.05)	1.433
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1355	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.833	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.291	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.703	Mean of logged Data	5.597
Maximum of Logged Data	6.373	SD of logged Data	0.862

Assuming Lognormal Distribution

95% H-UCL	6985	90% Chebyshev (MVUE) UCL	780.9
95% Chebyshev (MVUE) UCL	975.5	97.5% Chebyshev (MVUE) UCL	1246
99% Chebyshev (MVUE) UCL	1776		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	554.3	95% Jackknife UCL	643.4
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	724.7	95% Chebyshev(Mean, Sd) UCL	895.5
97.5% Chebyshev(Mean, Sd) UCL	1133	99% Chebyshev(Mean, Sd) UCL	1599

Suggested UCL to Use

95% Student's-t UCL	643.4

Recommended UCL exceeds the maximum observation

Appendix A-31b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (ob-05)

General Statistics

Total Number of Observations	9	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	626.2	Mean	1009
Maximum	1613	Median	981.2
SD	315.1	Std. Error of Mean	105
Coefficient of Variation	0.312	Skewness	0.83

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.193	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1204	95% Adjusted-CLT UCL (Chen-1995)	1213
		95% Modified-t UCL (Johnson-1978)	1209

Gamma GOF Test

A-D Test Statistic	0.248	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.722	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.201	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-31b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	12.27	k star (bias corrected MLE)	8.251
Theta hat (MLE)	82.24	Theta star (bias corrected MLE)	122.3
nu hat (MLE)	220.8	nu star (bias corrected)	148.5
MLE Mean (bias corrected)	1009	MLE Sd (bias corrected)	351.2
		Approximate Chi Square Value (0.05)	121.4
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	116.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1235	95% Adjusted Gamma UCL (use when n<50)	1290

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.968	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.184	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.44	Mean of logged Data	6.875
Maximum of Logged Data	7.386	SD of logged Data	0.302

Assuming Lognormal Distribution

95% H-UCL	1256	90% Chebyshev (MVUE) UCL	1314
95% Chebyshev (MVUE) UCL	1453	97.5% Chebyshev (MVUE) UCL	1645
99% Chebyshev (MVUE) UCL	2024		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1182	95% Jackknife UCL	1204
95% Standard Bootstrap UCL	1172	95% Bootstrap-t UCL	1257
95% Hall's Bootstrap UCL	1285	95% Percentile Bootstrap UCL	1181
95% BCA Bootstrap UCL	1195		
90% Chebyshev(Mean, Sd) UCL	1324	95% Chebyshev(Mean, Sd) UCL	1467
97.5% Chebyshev(Mean, Sd) UCL	1665	99% Chebyshev(Mean, Sd) UCL	2054

Suggested UCL to Use

95% Student's-t UCL 1204

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-32a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Belted Kingfisher

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	Location ID	ID	Year	Methyl Mercury	UOM
BO-04	BO-05	BO-05.2016	2016	7.86	NG/G
BO-04	BO-05	BO-05.2017	2017	2.50	NG/G
ES-13	ES-13	ES-13.2016	2016	16.8	NG/G
ES-13	ES-13	ES-13.2017	2017	7.43	NG/G
ES-13	SVE-02INT	SVE-02INT.2017	2017	3.93	NG/G
ES-13	VE-10-01-E	VE-10-01-E.2017	2017	24.6	NG/G
ES-13	W-61-High	W-61-High.2016	2016	4.87	NG/G
ES-13	W-61-High	W-61-High.2017	2017	6.50	NG/G
ES-13	W-61-Intertidal	W-61-Intertidal.2016	2016	5.59	NG/G
ES-13	W-61-Intertidal	W-61-Intertidal.2017	2017	6.83	NG/G
ES-13	W-61-Low	W-61-Low.2016	2016	18.8	NG/G
ES-13	W-61-Low	W-61-Low.2017	2017	17.1	NG/G
ES-FP	ES-FP	ES-FP.2017	2017	1.00	NG/G
ES-FP	ES-FP-W	ES-FP-W.2017	2017	0.900	NG/G
MM	MM-04-01-F	MM-04-01-F.2017	2017	10.5	NG/G
MM	MM-50	MM-50.2016	2016	0.387	NG/G
MM	MM-64	MM-64.2016	2016	2.17	NG/G
MM	MM-64THRU67	MM-64THRU67.2017	2017	3.48	NG/G
MM	MM-65	MM-65.2016	2016	12.5	NG/G
MM	MM-MR	MM-MR.2017	2017	1.53	NG/G
MM	MM-MR-INT	MM-MR-INT.2017	2017	3.47	NG/G
MM	MMPOLY	MMPOLY.2016	2016	7.83	NG/G
MM	MMSE-1_N1	MMSE-1_N1.2017	2017	13.1	NG/G
MM	MMSE-1_N2	MMSE-1_N2.2017	2017	5.27	NG/G
MM	MMSE-1_S1	MMSE-1_S1.2017	2017	14.0	NG/G
MM	MMSE-1_S2	MMSE-1_S2.2017	2017	4.63	NG/G
MM	MMSW-C_N	MMSW-C_N.2017	2017	17.1	NG/G
MM	MMSW-C_S	MMSW-C_S.2017	2017	3.90	NG/G
MM	MMSW-C_SW	MMSW-C_SW.2017	2017	2.87	NG/G
MM	W-21-High	W-21-High.2016	2016	15.8	NG/G
MM	W-21-High	W-21-High.2017	2017	3.27	NG/G
MM	W-21-Intertidal	W-21-Intertidal.2016	2016	2.36	NG/G
MM	W-21-Intertidal	W-21-Intertidal.2017	2017	3.20	NG/G
MM	W-21-Low	W-21-Low.2016	2016	2.68	NG/G
MM	W-21-Low	W-21-Low.2017	2017	4.33	NG/G
MM	W-21-Mid	W-21-Mid.2016	2016	2.77	NG/G
MM	W-21-Mid	W-21-Mid.2017	2017	3.90	NG/G
MM	/-21-UM-Central-	W-21-UM-Central-C.2016	2016	7.02	NG/G
MM	/-21-UM-Central-	W-21-UM-Central-C.2017	2017	14.2	NG/G
MM	W-21-UM-East-C	W-21-UM-East-C.2016	2016	1.28	NG/G
MM	W-21-UM-East-C	W-21-UM-East-C.2017	2017	18.9	NG/G
MM	N-21-UM-West-/	W-21-UM-West-A.2016	2016	0.713	NG/G
MM	N-21-UM-West-/	W-21-UM-West-A.2017	2017	3.10	NG/G
MM	W-65-High	W-65-High.2016	2016	0.116	NG/G
MM	W-65-High	W-65-High.2017	2017	17.9	NG/G
MM	W-65-Intertidal	W-65-Intertidal.2016	2016	0.207	NG/G
MM	W-65-Intertidal	W-65-Intertidal.2017	2017	2.77	NG/G
MM	W-65-Low	W-65-Low.2016	2016	0.0335	NG/G
MM	W-65-Low	W-65-Low.2017	2017	5.67	NG/G

Appendix A-32a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Belted Kingfisher

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	Location ID	ID	Year	Methyl Mercury	UOM
MM	W-65-Mid	W-65-Mid.2016	2016	5.27	NG/G
MM	W-65-Mid	W-65-Mid.2017	2017	14.3	NG/G
MM	W-MM-01	W-MM-01.2017	2017	30.1	NG/G
MM	W-MM-02	W-MM-02.2017	2017	19.2	NG/G
MM	W-MM-03	W-MM-03.2017	2017	3.73	NG/G
MM	W-MM-04	W-MM-04.2017	2017	6.77	NG/G
MM	W-MM-05	W-MM-05.2017	2017	14.9	NG/G
MM	W-MM-06	W-MM-06.2017	2017	12.8	NG/G
MM	W-MM-07	W-MM-07.2017	2017	11.7	NG/G
MM	W-MM-08	W-MM-08.2017	2017	17.4	NG/G
MM	W-MM-11	W-MM-11.2017	2017	15.9	NG/G
MM	W-MM-12	W-MM-12.2017	2017	7.73	NG/G
MM	W-MM-13	W-MM-13.2017	2017	10.9	NG/G
MM	W-MM-14	W-MM-14.2017	2017	19.0	NG/G
MM	W-MM-TP	W-MM-TP.2017	2017	1.93	NG/G
OB-01	MM-04-01-F	MM-04-01-F.2017	2017	10.5	NG/G
OB-01	MMPOLY	MMPOLY.2016	2016	7.83	NG/G
OB-01	MMSE-1_N1	MMSE-1_N1.2017	2017	13.1	NG/G
OB-01	W-17-High	W-17-High.2017	2017	16.3	NG/G
OB-01	W-MM-01	W-MM-01.2017	2017	30.1	NG/G
OB-01	W-MM-02	W-MM-02.2017	2017	19.2	NG/G
OB-01	W-MM-TP	W-MM-TP.2017	2017	1.93	NG/G
OB-04	OB-04	OB-04.2017	2017	4.30	NG/G
OB-04	W-14-INTA	W-14-INTA.2017	2017	3.73	NG/G
OB-04	WP-02-01-D	WP-02-01-D.2017	2017	11.9	NG/G
OB-05	OB-05	OB-05.2016	2016	11.3	NG/G
OB-05	OB-05	OB-05.2017	2017	5.77	NG/G
OB-05	ON-10-01-C	ON-10-01-C.2017	2017	32.9	NG/G
OB-05	W-104-INTA	W-104-INTA.2017	2017	10.2	NG/G
OB-05	W-104-INTB	W-104-INTB.2017	2017	4.77	NG/G
OB-05	W-63-INT	W-63-INT.2017	2017	17.5	NG/G
OB-05	W-63-Intertidal	W-63-Intertidal.2016	2016	11.2	NG/G

Appendix A-32b
UCL Evaluation - Sample Area for Belted Kingfisher Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/29/2018 3:37:32 PM
From File	2018_01_29 Sediment_BFK.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

IPWC_MeHg (bo-04)

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	2.5	Mean	5.18
Maximum	7.86	Median	5.18

Warning: This data set only has 2 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable IPWC_MeHg (bo-04) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

IPWC_MeHg (es-13)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	3
Minimum	3.933	Mean	11.24
Maximum	24.57	Median	7.133
SD	7.32	Std. Error of Mean	2.315
Coefficient of Variation	0.651	Skewness	0.741

Normal GOF Test

Shapiro Wilk Test Statistic	0.844	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.299	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Appendix A-32b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	15.49	95% Adjusted-CLT UCL (Chen-1995)	15.63
		95% Modified-t UCL (Johnson-1978)	15.58

Gamma GOF Test

A-D Test Statistic	0.673	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.733	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.268	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.269	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.748	k star (bias corrected MLE)	1.99
Theta hat (MLE)	4.091	Theta star (bias corrected MLE)	5.648
nu hat (MLE)	54.96	nu star (bias corrected)	39.81
MLE Mean (bias corrected)	11.24	MLE Sd (bias corrected)	7.969
		Approximate Chi Square Value (0.05)	26.35
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	24.46

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	16.98	95% Adjusted Gamma UCL (use when n<50)	18.29

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.893	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.232	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.369	Mean of logged Data	2.227
Maximum of Logged Data	3.201	SD of logged Data	0.654

Assuming Lognormal Distribution

95% H-UCL	19.61	90% Chebyshev (MVUE) UCL	18.35
95% Chebyshev (MVUE) UCL	21.59	97.5% Chebyshev (MVUE) UCL	26.08
99% Chebyshev (MVUE) UCL	34.91		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-32b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	15.05	95% Jackknife UCL	15.49
95% Standard Bootstrap UCL	14.85	95% Bootstrap-t UCL	15.81
95% Hall's Bootstrap UCL	14.4	95% Percentile Bootstrap UCL	15.04
95% BCA Bootstrap UCL	15.21		
90% Chebyshev(Mean, Sd) UCL	18.19	95% Chebyshev(Mean, Sd) UCL	21.33
97.5% Chebyshev(Mean, Sd) UCL	25.7	99% Chebyshev(Mean, Sd) UCL	34.28

Suggested UCL to Use

95% Student's-t UCL	15.49

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (es-fp)

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	0.9	Mean	0.95
Maximum	1	Median	0.95

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable IPWC_MeHg (es-fp) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

IPWC_MeHg (mm)

General Statistics

Total Number of Observations	50	Number of Distinct Observations	49
		Number of Missing Observations	31
Minimum	0.0335	Mean	8.093
Maximum	30.13	Median	5.268
SD	6.871	Std. Error of Mean	0.972
Coefficient of Variation	0.849	Skewness	0.936

Appendix A-32b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.885	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.947	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.179	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.125	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.722	95% Adjusted-CLT UCL (Chen-1995)	9.829
		95% Modified-t UCL (Johnson-1978)	9.743

Gamma GOF Test

A-D Test Statistic	0.707	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.779	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.108	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.129	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.026	k star (bias corrected MLE)	0.978
Theta hat (MLE)	7.886	Theta star (bias corrected MLE)	8.275
nu hat (MLE)	102.6	nu star (bias corrected)	97.8
MLE Mean (bias corrected)	8.093	MLE Sd (bias corrected)	8.183
		Approximate Chi Square Value (0.05)	75.99
Adjusted Level of Significance	0.0452	Adjusted Chi Square Value	75.42

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	10.42	95% Adjusted Gamma UCL (use when n<50)	10.49

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.867	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.947	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.146	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.125	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.396	Mean of logged Data	1.53
Maximum of Logged Data	3.406	SD of logged Data	1.377

Assuming Lognormal Distribution

95% H-UCL	20.6	90% Chebyshev (MVUE) UCL	20.17
95% Chebyshev (MVUE) UCL	24.1	97.5% Chebyshev (MVUE) UCL	29.55
99% Chebyshev (MVUE) UCL	40.26		

Appendix A-32b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	9.691	95% Jackknife UCL	9.722
95% Standard Bootstrap UCL	9.638	95% Bootstrap-t UCL	9.743
95% Hall's Bootstrap UCL	9.905	95% Percentile Bootstrap UCL	9.794
95% BCA Bootstrap UCL	9.914		
90% Chebyshev(Mean, Sd) UCL	11.01	95% Chebyshev(Mean, Sd) UCL	12.33
97.5% Chebyshev(Mean, Sd) UCL	14.16	99% Chebyshev(Mean, Sd) UCL	17.76

Suggested UCL to Use

95% Approximate Gamma UCL	10.42

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (ob-01)

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	9
Minimum	1.933	Mean	14.15
Maximum	30.13	Median	13.1
SD	9.031	Std. Error of Mean	3.413
Coefficient of Variation	0.638	Skewness	0.665

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.144	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Appendix A-32b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	20.78	95% Adjusted-CLT UCL (Chen-1995)	20.68
		95% Modified-t UCL (Johnson-1978)	20.93

Gamma GOF Test

A-D Test Statistic	0.227	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.714	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.148	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.315	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.151	k star (bias corrected MLE)	1.324
Theta hat (MLE)	6.581	Theta star (bias corrected MLE)	10.69
nu hat (MLE)	30.11	nu star (bias corrected)	18.54
MLE Mean (bias corrected)	14.15	MLE Sd (bias corrected)	12.3
		Approximate Chi Square Value (0.05)	9.781
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	7.935

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	26.82	95% Adjusted Gamma UCL (use when n<50)	33.06

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.899	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.206	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.659	Mean of logged Data	2.4
Maximum of Logged Data	3.406	SD of logged Data	0.881

Assuming Lognormal Distribution

95% H-UCL	54.5	90% Chebyshev (MVUE) UCL	30.41
95% Chebyshev (MVUE) UCL	37.31	97.5% Chebyshev (MVUE) UCL	46.9
99% Chebyshev (MVUE) UCL	65.72		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-32b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	19.77	95% Jackknife UCL	20.78
95% Standard Bootstrap UCL	19.48	95% Bootstrap-t UCL	22.1
95% Hall's Bootstrap UCL	23.94	95% Percentile Bootstrap UCL	19.77
95% BCA Bootstrap UCL	20.1		
90% Chebyshev(Mean, Sd) UCL	24.39	95% Chebyshev(Mean, Sd) UCL	29.03
97.5% Chebyshev(Mean, Sd) UCL	35.47	99% Chebyshev(Mean, Sd) UCL	48.11

Suggested UCL to Use

95% Student's-t UCL 20.78

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (ob-04)

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	1
Minimum	3.733	Mean	6.656
Maximum	11.93	Median	4.3
SD	4.579	Std. Error of Mean	2.644
Coefficient of Variation	0.688	Skewness	1.702

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.802	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.363	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.38	95% Adjusted-CLT UCL (Chen-1995)	13.78
		95% Modified-t UCL (Johnson-1978)	14.81

Gamma GOF Test

Not Enough Data to Perform GOF Test

Appendix A-32b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	3.638	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.83	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	21.83	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.84	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.345	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.317	Mean of logged Data	1.752
Maximum of Logged Data	2.479	SD of logged Data	0.634

Assuming Lognormal Distribution

95% H-UCL	285.3	90% Chebyshev (MVUE) UCL	13.43
95% Chebyshev (MVUE) UCL	16.54	97.5% Chebyshev (MVUE) UCL	20.86
99% Chebyshev (MVUE) UCL	29.35		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	11	95% Jackknife UCL	14.38
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	14.59	95% Chebyshev(Mean, Sd) UCL	18.18
97.5% Chebyshev(Mean, Sd) UCL	23.17	99% Chebyshev(Mean, Sd) UCL	32.96

Suggested UCL to Use

95% Student's-t UCL	14.38

Recommended UCL exceeds the maximum observation

Appendix A-32b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (ob-05)

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	2
Minimum	4.767	Mean	13.38
Maximum	32.9	Median	11.2
SD	9.573	Std. Error of Mean	3.618
Coefficient of Variation	0.716	Skewness	1.698

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.822	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.3	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	20.41	95% Adjusted-CLT UCL (Chen-1995)	21.81
		95% Modified-t UCL (Johnson-1978)	20.79

Gamma GOF Test

A-D Test Statistic	0.339	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.713	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.243	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.314	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-32b
UCL Evaluation - Sample Area for Belted Kingfisher
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	2.801	k star (bias corrected MLE)	1.696
Theta hat (MLE)	4.776	Theta star (bias corrected MLE)	7.889
nu hat (MLE)	39.21	nu star (bias corrected)	23.74
MLE Mean (bias corrected)	13.38	MLE Sd (bias corrected)	10.27
		Approximate Chi Square Value (0.05)	13.65
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	11.41

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	23.26	95% Adjusted Gamma UCL (use when n<50)	27.83

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.202	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.562	Mean of logged Data	2.404
Maximum of Logged Data	3.493	SD of logged Data	0.651

Assuming Lognormal Distribution

95% H-UCL	28.7	90% Chebyshev (MVUE) UCL	23.04
95% Chebyshev (MVUE) UCL	27.49	97.5% Chebyshev (MVUE) UCL	33.67
99% Chebyshev (MVUE) UCL	45.79		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	19.33	95% Jackknife UCL	20.41
95% Standard Bootstrap UCL	18.95	95% Bootstrap-t UCL	28.83
95% Hall's Bootstrap UCL	52.66	95% Percentile Bootstrap UCL	19.58
95% BCA Bootstrap UCL	20.64		
90% Chebyshev(Mean, Sd) UCL	24.23	95% Chebyshev(Mean, Sd) UCL	29.15
97.5% Chebyshev(Mean, Sd) UCL	35.97	99% Chebyshev(Mean, Sd) UCL	49.38

Suggested UCL to Use

95% Student's-t UCL	20.41

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-33a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	Location ID	ID	Year	Mercury	UOM
BO-04	BO-05	BO-05.2016	2016	1793	NG/G
BO-04	HA-01	HA-01.2016	2016	438	NG/G
BO-04	BO-05	BO-05.2017	2017	78.8	NG/G
BO-04	PBR-18-E	PBR-18-E.2017	2017	931	NG/G
BO-04	PBR-18-I	PBR-18-I.2017	2017	786	NG/G
ES-13	EC-37ABCDE	EC-37ABCDE.2016	2016	842	NG/G
ES-13	EC-39ABC	EC-39ABC.2016	2016	737	NG/G
ES-13	EC-40AB	EC-40AB.2016	2016	650	NG/G
ES-13	ES-13	ES-13.2016	2016	416	NG/G
ES-13	VE-50	VE-50.2016	2016	1670	NG/G
ES-13	VE-53	VE-53.2016	2016	994	NG/G
ES-13	VE-59	VE-59.2016	2016	1010	NG/G
ES-13	VE-60	VE-60.2016	2016	1420	NG/G
ES-13	VN-56	VN-56.2016	2016	1340	NG/G
ES-13	VN-73	VN-73.2016	2016	876	NG/G
ES-13	VN-80	VN-80.2016	2016	1170	NG/G
ES-13	W-61-High	W-61-High.2016	2016	593	NG/G
ES-13	W-61-Intertidal	W-61-Intertidal.2016	2016	1163	NG/G
ES-13	W-61-Low	W-61-Low.2016	2016	926	NG/G
ES-13	ES-13	ES-13.2017	2017	586	NG/G
ES-13	OR-01-04	OR-01-04.2017	2017	915	NG/G
ES-13	OR-01-05	OR-01-05.2017	2017	817	NG/G
ES-13	OR-02-03	OR-02-03.2017	2017	782	NG/G
ES-13	OR-C1-A	OR-C1-A.2017	2017	804	NG/G
ES-13	OR-T1-C1-B	OR-T1-C1-B.2017	2017	804	NG/G
ES-13	OR-T1-C1-D	OR-T1-C1-D.2017	2017	611	NG/G
ES-13	OR-T1-C2-B	OR-T1-C2-B.2017	2017	755	NG/G
ES-13	OR-T1-C2-C	OR-T1-C2-C.2017	2017	712	NG/G
ES-13	OR-T1-C3-A	OR-T1-C3-A.2017	2017	840	NG/G
ES-13	OR-T1-C3-C	OR-T1-C3-C.2017	2017	760	NG/G
ES-13	OR-T1-C5-A	OR-T1-C5-A.2017	2017	746	NG/G
ES-13	OR-T1-C5-C	OR-T1-C5-C.2017	2017	645	NG/G
ES-13	SVE-02INT	SVE-02INT.2017	2017	245	NG/G
ES-13	VE-09-01-B	VE-09-01-B.2017	2017	744	NG/G
ES-13	VE-09-01-E	VE-09-01-E.2017	2017	732	NG/G
ES-13	VE-10-01-C	VE-10-01-C.2017	2017	801	NG/G
ES-13	VE-10-01-E	VE-10-01-E.2017	2017	765	NG/G
ES-13	VE-58THRU60	VE-58THRU60.2017	2017	675	NG/G
ES-13	VE-MU4-GC-1-E	VE-MU4-GC-1-E.2017	2017	264	NG/G
ES-13	VE-MU4-GC-1-F	VE-MU4-GC-1-F.2017	2017	672	NG/G
ES-13	VI-W	VI-W.2017	2017	92.2	NG/G
ES-13	VN-03-01-B	VN-03-01-B.2017	2017	717	NG/G
ES-13	VN-03-01-D	VN-03-01-D.2017	2017	723	NG/G
ES-13	VN-08-01-B	VN-08-01-B.2017	2017	896	NG/G
ES-13	VN-08-01-E	VN-08-01-E.2017	2017	869	NG/G
ES-13	VN-MU3-GC-1-D	VN-MU3-GC-1-D.2017	2017	702	NG/G
ES-13	VN-MU3-GC-1-G	VN-MU3-GC-1-G.2017	2017	789	NG/G
ES-13	W-108-A	W-108-A.2017	2017	363	NG/G
ES-13	W-61-High	W-61-High.2017	2017	166	NG/G
ES-13	W-61-Intertidal	W-61-Intertidal.2017	2017	529	NG/G
ES-13	W-61-Low	W-61-Low.2017	2017	844	NG/G
ES-FP	CJ-14THRU16	CJ-14THRU16.2016	2016	27.2	NG/G
ES-FP	ES-13	ES-13.2016	2016	416	NG/G

Appendix A-33a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	Location ID	ID	Year	Mercury	UOM
ES-FP	W-61-High	W-61-High.2016	2016	593	NG/G
ES-FP	W-61-Intertidal	W-61-Intertidal.2016	2016	1163	NG/G
ES-FP	W-61-Low	W-61-Low.2016	2016	926	NG/G
ES-FP	ES-13	ES-13.2017	2017	586	NG/G
ES-FP	ES-FP	ES-FP.2017	2017	12.3	NG/G
ES-FP	ES-FP-W	ES-FP-W.2017	2017	31.0	NG/G
ES-FP	SVE-02INT	SVE-02INT.2017	2017	245	NG/G
ES-FP	VE-MU4-GC-1-E	VE-MU4-GC-1-E.2017	2017	264	NG/G
ES-FP	VE-MU4-GC-1-F	VE-MU4-GC-1-F.2017	2017	672	NG/G
ES-FP	W-61-High	W-61-High.2017	2017	166	NG/G
ES-FP	W-61-Intertidal	W-61-Intertidal.2017	2017	529	NG/G
ES-FP	W-61-Low	W-61-Low.2017	2017	844	NG/G
MM	BU-24R	BU-24R.2016	2016	82.0	NG/G
MM	BU-51	BU-51.2016	2016	806	NG/G
MM	MM-50	MM-50.2016	2016	37.0	NG/G
MM	MM-51	MM-51.2016	2016	1140	NG/G
MM	MM-52	MM-52.2016	2016	781	NG/G
MM	MM-53	MM-53.2016	2016	809	NG/G
MM	MM-54	MM-54.2016	2016	33.6	NG/G
MM	MM-55	MM-55.2016	2016	750	NG/G
MM	MM-56	MM-56.2016	2016	33.7	NG/G
MM	MM-62	MM-62.2016	2016	714	NG/G
MM	MM-64	MM-64.2016	2016	484	NG/G
MM	MM-65	MM-65.2016	2016	821	NG/G
MM	MM-66	MM-66.2016	2016	137	NG/G
MM	MM-67	MM-67.2016	2016	206	NG/G
MM	MM-68	MM-68.2016	2016	45.8	NG/G
MM	MM-69	MM-69.2016	2016	711	NG/G
MM	MM-70	MM-70.2016	2016	74.6	NG/G
MM	MM-71	MM-71.2016	2016	1040	NG/G
MM	MMPOLY	MMPOLY.2016	2016	554	NG/G
MM	W-17-High-2016	W-17-High-2016.2016	2016	1266	NG/G
MM	W-17-Intertidal	W-17-Intertidal.2016	2016	518	NG/G
MM	W-17-Low	W-17-Low.2016	2016	471	NG/G
MM	W-17-Mid-2016	W-17-Mid-2016.2016	2016	1179	NG/G
MM	W17-N	W17-N.2016	2016	476	NG/G
MM	W-21-High	W-21-High.2016	2016	929	NG/G
MM	W-21-Intertidal	W-21-Intertidal.2016	2016	543	NG/G
MM	W-21-Low	W-21-Low.2016	2016	704	NG/G
MM	W-21-Mid	W-21-Mid.2016	2016	869	NG/G
MM	W-21-UM-Central-C	W-21-UM-Central-C.2016	2016	617	NG/G
MM	W-21-UM-East-C	W-21-UM-East-C.2016	2016	751	NG/G
MM	W-21-UM-South	W-21-UM-South.2016	2016	267	NG/G
MM	W-21-UM-West-A	W-21-UM-West-A.2016	2016	434	NG/G
MM	W-65-High	W-65-High.2016	2016	84.3	NG/G
MM	W-65-Intertidal	W-65-Intertidal.2016	2016	41.6	NG/G
MM	W-65-Low	W-65-Low.2016	2016	32.5	NG/G
MM	W-65-Mid	W-65-Mid.2016	2016	225	NG/G
MM	BU-01-01-C	BU-01-01-C.2017	2017	873	NG/G
MM	BU-08-01-A	BU-08-01-A.2017	2017	641	NG/G
MM	BU-08-01-E	BU-08-01-E.2017	2017	599	NG/G
MM	BU-08-02	BU-08-02.2017	2017	598	NG/G
MM	BU-50THRU52	BU-50THRU52.2017	2017	513	NG/G

Appendix A-33a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	Location ID	ID	Year	Mercury	UOM
MM	FF-08-01-B	FF-08-01-B.2017	2017	772	NG/G
MM	FF-08-02-G	FF-08-02-G.2017	2017	637	NG/G
MM	FF-08-02-J	FF-08-02-J.2017	2017	1086	NG/G
MM	MM-04-01-C	MM-04-01-C.2017	2017	743	NG/G
MM	MM-04-01-F	MM-04-01-F.2017	2017	756	NG/G
MM	MM-50THRU56	MM-50THRU56.2017	2017	450	NG/G
MM	MM-64THRU67	MM-64THRU67.2017	2017	425	NG/G
MM	MM-C1-C	MM-C1-C.2017	2017	773	NG/G
MM	MM-C2-C	MM-C2-C.2017	2017	812	NG/G
MM	MM-C3-A	MM-C3-A.2017	2017	1413	NG/G
MM	MM-MR	MM-MR.2017	2017	154	NG/G
MM	MM-MR-INT	MM-MR-INT.2017	2017	932	NG/G
MM	MMSE-1_N1	MMSE-1_N1.2017	2017	1851	NG/G
MM	MMSE-1_N2	MMSE-1_N2.2017	2017	398	NG/G
MM	MMSE-1_S1	MMSE-1_S1.2017	2017	282	NG/G
MM	MMSE-1_S2	MMSE-1_S2.2017	2017	320	NG/G
MM	MMSW-C_N	MMSW-C_N.2017	2017	899	NG/G
MM	MMSW-C_S	MMSW-C_S.2017	2017	965	NG/G
MM	MMSW-C_SW	MMSW-C_SW.2017	2017	207	NG/G
MM	MM-T1-C1-A	MM-T1-C1-A.2017	2017	740	NG/G
MM	MM-T1-C1-B	MM-T1-C1-B.2017	2017	765	NG/G
MM	MM-T1-C2-B	MM-T1-C2-B.2017	2017	813	NG/G
MM	MM-T1-C2-D	MM-T1-C2-D.2017	2017	793	NG/G
MM	MM-T1-C3-B	MM-T1-C3-B.2017	2017	168	NG/G
MM	MM-T1-C4	MM-T1-C4.2017	2017	1029	NG/G
MM	MM-T1-C5	MM-T1-C5.2017	2017	887	NG/G
MM	MM-T1-C6	MM-T1-C6.2017	2017	164	NG/G
MM	MM-T2-C1-B	MM-T2-C1-B.2017	2017	372	NG/G
MM	MM-T2-C2-A	MM-T2-C2-A.2017	2017	1246	NG/G
MM	MM-T2-C3-A	MM-T2-C3-A.2017	2017	1503	NG/G
MM	MM-T2-C4-B	MM-T2-C4-B.2017	2017	51.7	NG/G
MM	MM-T2-C5-A	MM-T2-C5-A.2017	2017	306	NG/G
MM	MM-T2-C6-A	MM-T2-C6-A.2017	2017	734	NG/G
MM	MM-T2-C7-A	MM-T2-C7-A.2017	2017	76.6	NG/G
MM	MM-T2-C8-B	MM-T2-C8-B.2017	2017	643	NG/G
MM	MM-T3-C1	MM-T3-C1.2017	2017	71.1	NG/G
MM	MM-T3-C2-C	MM-T3-C2-C.2017	2017	570	NG/G
MM	MM-T3-C2-F	MM-T3-C2-F.2017	2017	845	NG/G
MM	MM-T3-C3-B2	MM-T3-C3-B2.2017	2017	328	NG/G
MM	MM-T3-C3-C	MM-T3-C3-C.2017	2017	330	NG/G
MM	MM-T3-C4-C	MM-T3-C4-C.2017	2017	867	NG/G
MM	MM-T3-C4-D	MM-T3-C4-D.2017	2017	791	NG/G
MM	MM-T3-C5-C	MM-T3-C5-C.2017	2017	905	NG/G
MM	MM-T3-C6	MM-T3-C6.2017	2017	438	NG/G
MM	MM-T3-C7	MM-T3-C7.2017	2017	256	NG/G
MM	MM-T4-C1	MM-T4-C1.2017	2017	915	NG/G
MM	MM-T4-C2-D	MM-T4-C2-D.2017	2017	598	NG/G
MM	MM-T4-C2-F	MM-T4-C2-F.2017	2017	632	NG/G
MM	MM-T4-C3-C	MM-T4-C3-C.2017	2017	799	NG/G
MM	MM-T4-C4-A	MM-T4-C4-A.2017	2017	882	NG/G
MM	MM-T4-C5	MM-T4-C5.2017	2017	941	NG/G
MM	MM-T4-C6	MM-T4-C6.2017	2017	1215	NG/G
MM	MM-T4-C7	MM-T4-C7.2017	2017	538	NG/G

Appendix A-33a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	Location ID	ID	Year	Mercury	UOM
MM	MM-T5-C1	MM-T5-C1.2017	2017	1008	NG/G
MM	MM-T5-C2	MM-T5-C2.2017	2017	82.1	NG/G
MM	MM-T5-C3	MM-T5-C3.2017	2017	948	NG/G
MM	W-17-High	W-17-High.2017	2017	1053	NG/G
MM	W-17-Intertidal	W-17-Intertidal.2017	2017	590	NG/G
MM	W-17-Low	W-17-Low.2017	2017	998	NG/G
MM	W-17-Mid	W-17-Mid.2017	2017	1269	NG/G
MM	W-17-NE	W-17-NE.2017	2017	705	NG/G
MM	W-17-NW	W-17-NW.2017	2017	403	NG/G
MM	W-21-High	W-21-High.2017	2017	802	NG/G
MM	W-21-Intertidal	W-21-Intertidal.2017	2017	780	NG/G
MM	W-21-Low	W-21-Low.2017	2017	873	NG/G
MM	W-21-Mid	W-21-Mid.2017	2017	927	NG/G
MM	W-21-UM-Central-C	W-21-UM-Central-C.2017	2017	265	NG/G
MM	W-21-UM-East-C	W-21-UM-East-C.2017	2017	1008	NG/G
MM	W-21-UM-South	W-21-UM-South.2017	2017	419	NG/G
MM	W-21-UM-West-A	W-21-UM-West-A.2017	2017	165	NG/G
MM	W-65-High	W-65-High.2017	2017	201	NG/G
MM	W-65-Intertidal	W-65-Intertidal.2017	2017	197	NG/G
MM	W-65-Low	W-65-Low.2017	2017	1049	NG/G
MM	W-65-Mid	W-65-Mid.2017	2017	161	NG/G
MM	W-MM-01	W-MM-01.2017	2017	1786	NG/G
MM	W-MM-02	W-MM-02.2017	2017	448	NG/G
MM	W-MM-03	W-MM-03.2017	2017	113	NG/G
MM	W-MM-04	W-MM-04.2017	2017	519	NG/G
MM	W-MM-05	W-MM-05.2017	2017	691	NG/G
MM	W-MM-06	W-MM-06.2017	2017	620	NG/G
MM	W-MM-07	W-MM-07.2017	2017	560	NG/G
MM	W-MM-08	W-MM-08.2017	2017	793	NG/G
MM	W-MM-09	W-MM-09.2017	2017	575	NG/G
MM	W-MM-10	W-MM-10.2017	2017	226	NG/G
MM	W-MM-11	W-MM-11.2017	2017	1067	NG/G
MM	W-MM-12	W-MM-12.2017	2017	418	NG/G
MM	W-MM-13	W-MM-13.2017	2017	307	NG/G
MM	W-MM-14	W-MM-14.2017	2017	635	NG/G
MM	W-MM-15	W-MM-15.2017	2017	258	NG/G
MM	W-MM-16	W-MM-16.2017	2017	357	NG/G
MM	W-MM-17	W-MM-17.2017	2017	190	NG/G
MM	W-MM-18	W-MM-18.2017	2017	623	NG/G
MM	W-MM-19	W-MM-19.2017	2017	410	NG/G
MM	W-MM-20	W-MM-20.2017	2017	734	NG/G
MM	W-MM-21	W-MM-21.2017	2017	720	NG/G
MM	W-MM-22	W-MM-22.2017	2017	456	NG/G
MM	W-MM-23	W-MM-23.2017	2017	754	NG/G
MM	W-MM-TP	W-MM-TP.2017	2017	152	NG/G
OB-01	BU-24R	BU-24R.2016	2016	82.0	NG/G
OB-01	BU-51	BU-51.2016	2016	806	NG/G
OB-01	MM-50	MM-50.2016	2016	37.0	NG/G
OB-01	MM-51	MM-51.2016	2016	1140	NG/G
OB-01	MM-52	MM-52.2016	2016	781	NG/G
OB-01	MM-53	MM-53.2016	2016	809	NG/G
OB-01	MM-54	MM-54.2016	2016	33.6	NG/G
OB-01	MM-64	MM-64.2016	2016	484	NG/G

Appendix A-33a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	Location ID	ID	Year	Mercury	UOM
OB-01	MM-65	MM-65.2016	2016	821	NG/G
OB-01	MM-66	MM-66.2016	2016	137	NG/G
OB-01	MM-67	MM-67.2016	2016	206	NG/G
OB-01	MM-68	MM-68.2016	2016	45.8	NG/G
OB-01	MM-69	MM-69.2016	2016	711	NG/G
OB-01	MMPOLY	MMPOLY.2016	2016	554	NG/G
OB-01	W-17-High-2016	W-17-High-2016.2016	2016	1266	NG/G
OB-01	W-17-Intertidal	W-17-Intertidal.2016	2016	518	NG/G
OB-01	W-17-Low	W-17-Low.2016	2016	471	NG/G
OB-01	W-17-Mid-2016	W-17-Mid-2016.2016	2016	1179	NG/G
OB-01	W17-N	W17-N.2016	2016	476	NG/G
OB-01	W-21-High	W-21-High.2016	2016	929	NG/G
OB-01	W-21-Intertidal	W-21-Intertidal.2016	2016	543	NG/G
OB-01	W-21-Low	W-21-Low.2016	2016	704	NG/G
OB-01	W-21-Mid	W-21-Mid.2016	2016	869	NG/G
OB-01	W-21-UM-Central-C	W-21-UM-Central-C.2016	2016	617	NG/G
OB-01	W-21-UM-East-C	W-21-UM-East-C.2016	2016	751	NG/G
OB-01	W-21-UM-West-A	W-21-UM-West-A.2016	2016	434	NG/G
OB-01	W-65-High	W-65-High.2016	2016	84.3	NG/G
OB-01	W-65-Intertidal	W-65-Intertidal.2016	2016	41.6	NG/G
OB-01	W-65-Low	W-65-Low.2016	2016	32.5	NG/G
OB-01	W-65-Mid	W-65-Mid.2016	2016	225	NG/G
OB-01	BU-01-01-C	BU-01-01-C.2017	2017	873	NG/G
OB-01	BU-08-01-A	BU-08-01-A.2017	2017	641	NG/G
OB-01	BU-08-01-E	BU-08-01-E.2017	2017	599	NG/G
OB-01	BU-08-02	BU-08-02.2017	2017	598	NG/G
OB-01	BU-50THRU52	BU-50THRU52.2017	2017	513	NG/G
OB-01	FF-08-01-B	FF-08-01-B.2017	2017	772	NG/G
OB-01	FF-08-02-G	FF-08-02-G.2017	2017	637	NG/G
OB-01	FF-08-02-J	FF-08-02-J.2017	2017	1086	NG/G
OB-01	MM-04-01-C	MM-04-01-C.2017	2017	743	NG/G
OB-01	MM-04-01-F	MM-04-01-F.2017	2017	756	NG/G
OB-01	MM-50THRU56	MM-50THRU56.2017	2017	450	NG/G
OB-01	MM-64THRU67	MM-64THRU67.2017	2017	425	NG/G
OB-01	MM-C2-C	MM-C2-C.2017	2017	812	NG/G
OB-01	MM-C3-A	MM-C3-A.2017	2017	1413	NG/G
OB-01	MM-MR	MM-MR.2017	2017	154	NG/G
OB-01	MM-MR-INT	MM-MR-INT.2017	2017	932	NG/G
OB-01	MMSE-1_N1	MMSE-1_N1.2017	2017	1851	NG/G
OB-01	MMSE-1_N2	MMSE-1_N2.2017	2017	398	NG/G
OB-01	MMSE-1_S1	MMSE-1_S1.2017	2017	282	NG/G
OB-01	MMSE-1_S2	MMSE-1_S2.2017	2017	320	NG/G
OB-01	MMSW-C_N	MMSW-C_N.2017	2017	899	NG/G
OB-01	MMSW-C_S	MMSW-C_S.2017	2017	965	NG/G
OB-01	MMSW-C_SW	MMSW-C_SW.2017	2017	207	NG/G
OB-01	MM-T1-C1-A	MM-T1-C1-A.2017	2017	740	NG/G
OB-01	MM-T1-C1-B	MM-T1-C1-B.2017	2017	765	NG/G
OB-01	MM-T1-C2-B	MM-T1-C2-B.2017	2017	813	NG/G
OB-01	MM-T1-C2-D	MM-T1-C2-D.2017	2017	793	NG/G
OB-01	MM-T1-C3-B	MM-T1-C3-B.2017	2017	168	NG/G
OB-01	MM-T1-C4	MM-T1-C4.2017	2017	1029	NG/G
OB-01	MM-T1-C5	MM-T1-C5.2017	2017	887	NG/G
OB-01	MM-T1-C6	MM-T1-C6.2017	2017	164	NG/G

Appendix A-33a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	Location ID	ID	Year	Mercury	UOM
OB-01	MM-T2-C1-B	MM-T2-C1-B.2017	2017	372	NG/G
OB-01	MM-T2-C2-A	MM-T2-C2-A.2017	2017	1246	NG/G
OB-01	MM-T2-C3-A	MM-T2-C3-A.2017	2017	1503	NG/G
OB-01	MM-T2-C4-B	MM-T2-C4-B.2017	2017	51.7	NG/G
OB-01	MM-T2-C5-A	MM-T2-C5-A.2017	2017	306	NG/G
OB-01	MM-T2-C6-A	MM-T2-C6-A.2017	2017	734	NG/G
OB-01	MM-T2-C7-A	MM-T2-C7-A.2017	2017	76.6	NG/G
OB-01	MM-T2-C8-B	MM-T2-C8-B.2017	2017	643	NG/G
OB-01	MM-T3-C1	MM-T3-C1.2017	2017	71.1	NG/G
OB-01	MM-T3-C2-C	MM-T3-C2-C.2017	2017	570	NG/G
OB-01	MM-T3-C2-F	MM-T3-C2-F.2017	2017	845	NG/G
OB-01	MM-T3-C3-B2	MM-T3-C3-B2.2017	2017	328	NG/G
OB-01	MM-T3-C3-C	MM-T3-C3-C.2017	2017	330	NG/G
OB-01	MM-T3-C4-C	MM-T3-C4-C.2017	2017	867	NG/G
OB-01	MM-T3-C4-D	MM-T3-C4-D.2017	2017	791	NG/G
OB-01	MM-T3-C5-C	MM-T3-C5-C.2017	2017	905	NG/G
OB-01	MM-T3-C6	MM-T3-C6.2017	2017	438	NG/G
OB-01	MM-T3-C7	MM-T3-C7.2017	2017	256	NG/G
OB-01	MM-T4-C1	MM-T4-C1.2017	2017	915	NG/G
OB-01	MM-T4-C2-D	MM-T4-C2-D.2017	2017	598	NG/G
OB-01	MM-T4-C2-F	MM-T4-C2-F.2017	2017	632	NG/G
OB-01	MM-T4-C3-C	MM-T4-C3-C.2017	2017	799	NG/G
OB-01	MM-T4-C4-A	MM-T4-C4-A.2017	2017	882	NG/G
OB-01	MM-T4-C5	MM-T4-C5.2017	2017	941	NG/G
OB-01	MM-T4-C6	MM-T4-C6.2017	2017	1215	NG/G
OB-01	MM-T4-C7	MM-T4-C7.2017	2017	538	NG/G
OB-01	MM-T5-C1	MM-T5-C1.2017	2017	1008	NG/G
OB-01	MM-T5-C2	MM-T5-C2.2017	2017	82.1	NG/G
OB-01	MM-T5-C3	MM-T5-C3.2017	2017	948	NG/G
OB-01	W-17-High	W-17-High.2017	2017	1053	NG/G
OB-01	W-17-Intertidal	W-17-Intertidal.2017	2017	590	NG/G
OB-01	W-17-Low	W-17-Low.2017	2017	998	NG/G
OB-01	W-17-Mid	W-17-Mid.2017	2017	1269	NG/G
OB-01	W-17-NE	W-17-NE.2017	2017	705	NG/G
OB-01	W-17-NW	W-17-NW.2017	2017	403	NG/G
OB-01	W-21-High	W-21-High.2017	2017	802	NG/G
OB-01	W-21-Intertidal	W-21-Intertidal.2017	2017	780	NG/G
OB-01	W-21-Low	W-21-Low.2017	2017	873	NG/G
OB-01	W-21-Mid	W-21-Mid.2017	2017	927	NG/G
OB-01	W-21-UM-Central-C	W-21-UM-Central-C.2017	2017	265	NG/G
OB-01	W-21-UM-East-C	W-21-UM-East-C.2017	2017	1008	NG/G
OB-01	W-21-UM-West-A	W-21-UM-West-A.2017	2017	165	NG/G
OB-01	W-65-High	W-65-High.2017	2017	201	NG/G
OB-01	W-65-Intertidal	W-65-Intertidal.2017	2017	197	NG/G
OB-01	W-65-Low	W-65-Low.2017	2017	1049	NG/G
OB-01	W-65-Mid	W-65-Mid.2017	2017	161	NG/G
OB-01	W-MM-01	W-MM-01.2017	2017	1786	NG/G
OB-01	W-MM-02	W-MM-02.2017	2017	448	NG/G
OB-01	W-MM-03	W-MM-03.2017	2017	113	NG/G
OB-01	W-MM-04	W-MM-04.2017	2017	519	NG/G
OB-01	W-MM-05	W-MM-05.2017	2017	691	NG/G
OB-01	W-MM-06	W-MM-06.2017	2017	620	NG/G
OB-01	W-MM-07	W-MM-07.2017	2017	560	NG/G

Appendix A-33a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	Location ID	ID	Year	Mercury	UOM
OB-01	W-MM-08	W-MM-08.2017	2017	793	NG/G
OB-01	W-MM-09	W-MM-09.2017	2017	575	NG/G
OB-01	W-MM-10	W-MM-10.2017	2017	226	NG/G
OB-01	W-MM-11	W-MM-11.2017	2017	1067	NG/G
OB-01	W-MM-12	W-MM-12.2017	2017	418	NG/G
OB-01	W-MM-13	W-MM-13.2017	2017	307	NG/G
OB-01	W-MM-14	W-MM-14.2017	2017	635	NG/G
OB-01	W-MM-15	W-MM-15.2017	2017	258	NG/G
OB-01	W-MM-16	W-MM-16.2017	2017	357	NG/G
OB-01	W-MM-17	W-MM-17.2017	2017	190	NG/G
OB-01	W-MM-18	W-MM-18.2017	2017	623	NG/G
OB-01	W-MM-19	W-MM-19.2017	2017	410	NG/G
OB-01	W-MM-20	W-MM-20.2017	2017	734	NG/G
OB-01	W-MM-TP	W-MM-TP.2017	2017	152	NG/G
OB-04	OB-05	OB-05.2016	2016	755	NG/G
OB-04	W-63-Intertidal	W-63-Intertidal.2016	2016	1123	NG/G
OB-04	OB-04	OB-04.2017	2017	151	NG/G
OB-04	OB-05	OB-05.2017	2017	981	NG/G
OB-04	ON-10-01-B	ON-10-01-B.2017	2017	626	NG/G
OB-04	ON-10-01-C	ON-10-01-C.2017	2017	1331	NG/G
OB-04	PBR-19-A	PBR-19-A.2017	2017	1613	NG/G
OB-04	W-103-INTA	W-103-INTA.2017	2017	857	NG/G
OB-04	W-104-INTA	W-104-INTA.2017	2017	797	NG/G
OB-04	W-104-INTB	W-104-INTB.2017	2017	780	NG/G
OB-04	W-14-INTA	W-14-INTA.2017	2017	110	NG/G
OB-04	W-63-INT	W-63-INT.2017	2017	1073	NG/G
OB-04	WP-02-01-B	WP-02-01-B.2017	2017	586	NG/G
OB-04	WP-02-01-D	WP-02-01-D.2017	2017	542	NG/G
OB-05	HA-01	HA-01.2016	2016	438	NG/G
OB-05	OB-05	OB-05.2016	2016	755	NG/G
OB-05	W-63-Intertidal	W-63-Intertidal.2016	2016	1123	NG/G
OB-05	OB-04	OB-04.2017	2017	151	NG/G
OB-05	OB-05	OB-05.2017	2017	981	NG/G
OB-05	ON-10-01-B	ON-10-01-B.2017	2017	626	NG/G
OB-05	ON-10-01-C	ON-10-01-C.2017	2017	1331	NG/G
OB-05	PBR-18-E	PBR-18-E.2017	2017	931	NG/G
OB-05	PBR-18-I	PBR-18-I.2017	2017	786	NG/G
OB-05	PBR-19-A	PBR-19-A.2017	2017	1613	NG/G
OB-05	W-104-INTA	W-104-INTA.2017	2017	797	NG/G
OB-05	W-104-INTB	W-104-INTB.2017	2017	780	NG/G
OB-05	W-14-INTA	W-14-INTA.2017	2017	110	NG/G
OB-05	W-63-INT	W-63-INT.2017	2017	1073	NG/G
OB-05	WP-02-01-B	WP-02-01-B.2017	2017	586	NG/G
OB-05	WP-02-01-D	WP-02-01-D.2017	2017	542	NG/G

Appendix A-33b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/30/2018 9:32:44 AM
From File	2018_01_29 Sediment_Eagle_v2.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

IPWC_Hg (bo-04)

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	78.8	Mean	805.2
Maximum	1793	Median	785.6
SD	643.1	Std. Error of Mean	287.6
Coefficient of Variation	0.799	Skewness	0.835

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.223	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1418	95% Adjusted-CLT UCL (Chen-1995)	1393
		95% Modified-t UCL (Johnson-1978)	1436

Gamma GOF Test

A-D Test Statistic	0.241	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.688	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.202	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.362	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.385	k star (bias corrected MLE)	0.687

Appendix A-33b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Theta hat (MLE)	581.3	Theta star (bias corrected MLE)	1171
nu hat (MLE)	13.85	nu star (bias corrected)	6.874
MLE Mean (bias corrected)	805.2	MLE Sd (bias corrected)	971.2
		Approximate Chi Square Value (0.05)	2.102
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	1.141

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2634	95% Adjusted Gamma UCL (use when n<50)	4853

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.231	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.343	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.367	Mean of logged Data	6.289
Maximum of Logged Data	7.492	SD of logged Data	1.186

Assuming Lognormal Distribution

95% H-UCL	32244	90% Chebyshev (MVUE) UCL	2255
95% Chebyshev (MVUE) UCL	2867	97.5% Chebyshev (MVUE) UCL	3717
99% Chebyshev (MVUE) UCL	5385		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1278	95% Jackknife UCL	1418
95% Standard Bootstrap UCL	1215	95% Bootstrap-t UCL	1562
95% Hall's Bootstrap UCL	1917	95% Percentile Bootstrap UCL	1247
95% BCA Bootstrap UCL	1251		
90% Chebyshev(Mean, Sd) UCL	1668	95% Chebyshev(Mean, Sd) UCL	2059
97.5% Chebyshev(Mean, Sd) UCL	2601	99% Chebyshev(Mean, Sd) UCL	3667

Suggested UCL to Use

95% Student's-t UCL 1418

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (es-13)

Appendix A-33b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	46	Number of Distinct Observations	46
		Number of Missing Observations	0
Minimum	92.16	Mean	764.6
Maximum	1670	Median	757.3
SD	296	Std. Error of Mean	43.65
Coefficient of Variation	0.387	Skewness	0.413

Normal GOF Test

Shapiro Wilk Test Statistic	0.936	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.141	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.129	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	837.9	95% Adjusted-CLT UCL (Chen-1995)	839.2
		95% Modified-t UCL (Johnson-1978)	838.3

Gamma GOF Test

A-D Test Statistic	2.213	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.193	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.131	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.131	k star (bias corrected MLE)	4.811
Theta hat (MLE)	149	Theta star (bias corrected MLE)	158.9
nu hat (MLE)	472	nu star (bias corrected)	442.6
MLE Mean (bias corrected)	764.6	MLE Sd (bias corrected)	348.6
		Approximate Chi Square Value (0.05)	394.8
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	393.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	857.1	95% Adjusted Gamma UCL (use when n<50)	860.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.814	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.229	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.129	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Appendix A-33b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	4.524	Mean of logged Data	6.539
Maximum of Logged Data	7.421	SD of logged Data	0.519

Assuming Lognormal Distribution

95% H-UCL	915.9	90% Chebyshev (MVUE) UCL	978.8
95% Chebyshev (MVUE) UCL	1065	97.5% Chebyshev (MVUE) UCL	1185
99% Chebyshev (MVUE) UCL	1420		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	836.3	95% Jackknife UCL	837.9
95% Standard Bootstrap UCL	834.8	95% Bootstrap-t UCL	840.8
95% Hall's Bootstrap UCL	844.3	95% Percentile Bootstrap UCL	837.7
95% BCA Bootstrap UCL	836.7		
90% Chebyshev(Mean, Sd) UCL	895.5	95% Chebyshev(Mean, Sd) UCL	954.8
97.5% Chebyshev(Mean, Sd) UCL	1037	99% Chebyshev(Mean, Sd) UCL	1199

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	954.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (es-fp)

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	12.31	Mean	462.4
Maximum	1163	Median	472.5
SD	360.2	Std. Error of Mean	96.26
Coefficient of Variation	0.779	Skewness	0.412

Normal GOF Test

Shapiro Wilk Test Statistic	0.946	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.137	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.226	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Appendix A-33b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	632.9	95% Adjusted-CLT UCL (Chen-1995)	632.1
		95% Modified-t UCL (Johnson-1978)	634.7

Gamma GOF Test

A-D Test Statistic	0.568	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.761	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.182	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.235	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.979	k star (bias corrected MLE)	0.817
Theta hat (MLE)	472.3	Theta star (bias corrected MLE)	566.1
nu hat (MLE)	27.41	nu star (bias corrected)	22.87
MLE Mean (bias corrected)	462.4	MLE Sd (bias corrected)	511.7
		Approximate Chi Square Value (0.05)	13
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	12.02

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	814	95% Adjusted Gamma UCL (use when n<50)	880.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.842	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.202	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.51	Mean of logged Data	5.546
Maximum of Logged Data	7.059	SD of logged Data	1.45

Assuming Lognormal Distribution

95% H-UCL	3110	90% Chebyshev (MVUE) UCL	1484
95% Chebyshev (MVUE) UCL	1865	97.5% Chebyshev (MVUE) UCL	2393
99% Chebyshev (MVUE) UCL	3431		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	620.8	95% Jackknife UCL	632.9
95% Standard Bootstrap UCL	616	95% Bootstrap-t UCL	646.3
95% Hall's Bootstrap UCL	629.1	95% Percentile Bootstrap UCL	623

95% BCA Bootstrap UCL	632.3		
90% Chebyshev(Mean, Sd) UCL	751.2	95% Chebyshev(Mean, Sd) UCL	882
97.5% Chebyshev(Mean, Sd) UCL	1064	99% Chebyshev(Mean, Sd) UCL	1420

Suggested UCL to Use

95% Student's-t UCL	632.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (mm)

General Statistics

Total Number of Observations	139	Number of Distinct Observations	137
		Number of Missing Observations	0
Minimum	32.5	Mean	613.6
Maximum	1851	Median	623.2
SD	368.9	Std. Error of Mean	31.29
Coefficient of Variation	0.601	Skewness	0.487

Normal GOF Test

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	4.7794E-4	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.0576	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0755	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	665.4	95% Adjusted-CLT UCL (Chen-1995)	666.5
		95% Modified-t UCL (Johnson-1978)	665.6

Gamma GOF Test

A-D Test Statistic	3.184	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.766	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.122	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0805	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.906	k star (bias corrected MLE)	1.869
Theta hat (MLE)	322	Theta star (bias corrected MLE)	328.2
nu hat (MLE)	529.8	nu star (bias corrected)	519.7

Appendix A-33b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

MLE Mean (bias corrected)	613.6	MLE Sd (bias corrected)	448.8
		Approximate Chi Square Value (0.05)	467.8
Adjusted Level of Significance	0.0483	Adjusted Chi Square Value	467.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	681.6	95% Adjusted Gamma UCL (use when n<50)	682.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.857	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.158	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0755	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.481	Mean of logged Data	6.135
Maximum of Logged Data	7.524	SD of logged Data	0.905

Assuming Lognormal Distribution

95% H-UCL	817.7	90% Chebyshev (MVUE) UCL	878.8
95% Chebyshev (MVUE) UCL	963.3	97.5% Chebyshev (MVUE) UCL	1081
99% Chebyshev (MVUE) UCL	1311		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	665.1	95% Jackknife UCL	665.4
95% Standard Bootstrap UCL	663.7	95% Bootstrap-t UCL	669.1
95% Hall's Bootstrap UCL	665.6	95% Percentile Bootstrap UCL	665.4
95% BCA Bootstrap UCL	665.3		
90% Chebyshev(Mean, Sd) UCL	707.5	95% Chebyshev(Mean, Sd) UCL	750
97.5% Chebyshev(Mean, Sd) UCL	809	99% Chebyshev(Mean, Sd) UCL	924.9

Suggested UCL to Use

95% Student's-t UCL	665.4

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-33b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

IPWC_Hg (ob-01)

General Statistics

Total Number of Observations	128	Number of Distinct Observations	126
		Number of Missing Observations	0
Minimum	32.5	Mean	619.5
Maximum	1851	Median	621.6
SD	373.3	Std. Error of Mean	32.99
Coefficient of Variation	0.603	Skewness	0.513

Normal GOF Test

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	9.9523E-4	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.0579	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0787	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	674.1	95% Adjusted-CLT UCL (Chen-1995)	675.3
		95% Modified-t UCL (Johnson-1978)	674.4

Gamma GOF Test

A-D Test Statistic	2.628	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.766	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.116	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.0834	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.94	k star (bias corrected MLE)	1.9
Theta hat (MLE)	319.2	Theta star (bias corrected MLE)	326
nu hat (MLE)	496.7	nu star (bias corrected)	486.4
MLE Mean (bias corrected)	619.5	MLE Sd (bias corrected)	449.4
		Approximate Chi Square Value (0.05)	436.3
Adjusted Level of Significance	0.0481	Adjusted Chi Square Value	435.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	690.7	95% Adjusted Gamma UCL (use when n<50)	691.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.867	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.158	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0787	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.481	Mean of logged Data	6.15
Maximum of Logged Data	7.524	SD of logged Data	0.89

Assuming Lognormal Distribution

95% H-UCL	821.5	90% Chebyshev (MVUE) UCL	884.1
95% Chebyshev (MVUE) UCL	970.5	97.5% Chebyshev (MVUE) UCL	1090
99% Chebyshev (MVUE) UCL	1326		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	673.7	95% Jackknife UCL	674.1
95% Standard Bootstrap UCL	673.1	95% Bootstrap-t UCL	673.8
95% Hall's Bootstrap UCL	673.8	95% Percentile Bootstrap UCL	674.9
95% BCA Bootstrap UCL	673.5		
90% Chebyshev(Mean, Sd) UCL	718.4	95% Chebyshev(Mean, Sd) UCL	763.3
97.5% Chebyshev(Mean, Sd) UCL	825.5	99% Chebyshev(Mean, Sd) UCL	947.7

Suggested UCL to Use

95% Student's-t UCL	674.1

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (ob-04)

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	110.3	Mean	808.9
Maximum	1613	Median	788.5
SD	411.1	Std. Error of Mean	109.9
Coefficient of Variation	0.508	Skewness	0.0693

Normal GOF Test

Shapiro Wilk Test Statistic	0.974	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level

Lilliefors Test Statistic	0.116	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.226	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1004	95% Adjusted-CLT UCL (Chen-1995)	991.8
		95% Modified-t UCL (Johnson-1978)	1004

Gamma GOF Test

A-D Test Statistic	0.66	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.198	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.231	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.728	k star (bias corrected MLE)	2.191
Theta hat (MLE)	296.6	Theta star (bias corrected MLE)	369.2
nu hat (MLE)	76.38	nu star (bias corrected)	61.34
MLE Mean (bias corrected)	808.9	MLE Sd (bias corrected)	546.5
		Approximate Chi Square Value (0.05)	44.33
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	42.42

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1119	95% Adjusted Gamma UCL (use when n<50)	1170

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.818	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.251	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.226	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.703	Mean of logged Data	6.501
Maximum of Logged Data	7.386	SD of logged Data	0.762

Assuming Lognormal Distribution

95% H-UCL	1486	90% Chebyshev (MVUE) UCL	1429
95% Chebyshev (MVUE) UCL	1683	97.5% Chebyshev (MVUE) UCL	2036
99% Chebyshev (MVUE) UCL	2728		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-33b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	989.7	95% Jackknife UCL	1004
95% Standard Bootstrap UCL	980.9	95% Bootstrap-t UCL	998.2
95% Hall's Bootstrap UCL	1023	95% Percentile Bootstrap UCL	991.5
95% BCA Bootstrap UCL	993.8		
90% Chebyshev(Mean, Sd) UCL	1139	95% Chebyshev(Mean, Sd) UCL	1288
97.5% Chebyshev(Mean, Sd) UCL	1495	99% Chebyshev(Mean, Sd) UCL	1902

Suggested UCL to Use

95% Student's-t UCL 1004

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (ob-05)

General Statistics

Total Number of Observations	16	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	110.3	Mean	788.9
Maximum	1613	Median	782.7
SD	395.1	Std. Error of Mean	98.78
Coefficient of Variation	0.501	Skewness	0.179

Normal GOF Test

Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.117	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.213	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	962.1	95% Adjusted-CLT UCL (Chen-1995)	956.1
		95% Modified-t UCL (Johnson-1978)	962.8

Gamma GOF Test

A-D Test Statistic	0.583	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.174	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.217	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-33b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	2.934	k star (bias corrected MLE)	2.425
Theta hat (MLE)	268.9	Theta star (bias corrected MLE)	325.3
nu hat (MLE)	93.88	nu star (bias corrected)	77.61
MLE Mean (bias corrected)	788.9	MLE Sd (bias corrected)	506.6
		Approximate Chi Square Value (0.05)	58.32
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	56.41

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1050	95% Adjusted Gamma UCL (use when n<50)	1085

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.84	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.206	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.703	Mean of logged Data	6.491
Maximum of Logged Data	7.386	SD of logged Data	0.721

Assuming Lognormal Distribution

95% H-UCL	1313	90% Chebyshev (MVUE) UCL	1318
95% Chebyshev (MVUE) UCL	1536	97.5% Chebyshev (MVUE) UCL	1838
99% Chebyshev (MVUE) UCL	2431		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	951.4	95% Jackknife UCL	962.1
95% Standard Bootstrap UCL	944.8	95% Bootstrap-t UCL	967
95% Hall's Bootstrap UCL	967	95% Percentile Bootstrap UCL	944.6
95% BCA Bootstrap UCL	961.4		
90% Chebyshev(Mean, Sd) UCL	1085	95% Chebyshev(Mean, Sd) UCL	1220
97.5% Chebyshev(Mean, Sd) UCL	1406	99% Chebyshev(Mean, Sd) UCL	1772

Suggested UCL to Use

95% Student's-t UCL	962.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-34a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Methyl Mercury	UOM
BO-04	BO-05.2016	2016	7.86	NG/G
BO-04	BO-05.2017	2017	2.50	NG/G
ES-13	ES-13.2016	2016	16.8	NG/G
ES-13	VE-50.2016	2016	7.00	NG/G
ES-13	VE-53.2016	2016	13.6	NG/G
ES-13	VE-59.2016	2016	9.93	NG/G
ES-13	VE-60.2016	2016	14.6	NG/G
ES-13	VN-56.2016	2016	7.81	NG/G
ES-13	VN-73.2016	2016	8.52	NG/G
ES-13	VN-80.2016	2016	5.95	NG/G
ES-13	W-61-High.2016	2016	4.87	NG/G
ES-13	W-61-Intertidal.2016	2016	5.59	NG/G
ES-13	W-61-Low.2016	2016	18.8	NG/G
ES-13	ES-13.2017	2017	7.43	NG/G
ES-13	OR-01-04.2017	2017	10.1	NG/G
ES-13	OR-01-05.2017	2017	12.2	NG/G
ES-13	OR-02-03.2017	2017	4.50	NG/G
ES-13	SVE-02INT.2017	2017	3.93	NG/G
ES-13	VE-09-01-E.2017	2017	13.2	NG/G
ES-13	VE-10-01-E.2017	2017	24.6	NG/G
ES-13	VE-58THRU60.2017	2017	5.40	NG/G
ES-13	VI-W.2017	2017	2.27	NG/G
ES-13	VN-03-01-D.2017	2017	14.6	NG/G
ES-13	VN-08-01-E.2017	2017	13.5	NG/G
ES-13	W-108-A.2017	2017	3.07	NG/G
ES-13	W-61-High.2017	2017	6.50	NG/G
ES-13	W-61-Intertidal.2017	2017	6.83	NG/G
ES-13	W-61-Low.2017	2017	17.1	NG/G
ES-FP	CJ-14THRU16.2016	2016	0.244	NG/G
ES-FP	ES-13.2016	2016	16.8	NG/G
ES-FP	W-61-High.2016	2016	4.87	NG/G
ES-FP	W-61-Intertidal.2016	2016	5.59	NG/G
ES-FP	W-61-Low.2016	2016	18.8	NG/G
ES-FP	ES-13.2017	2017	7.43	NG/G
ES-FP	ES-FP.2017	2017	1.00	NG/G
ES-FP	ES-FP-W.2017	2017	0.90	NG/G

Appendix A-34a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Methyl Mercury	UOM
ES-FP	SVE-02INT.2017	2017	3.93	NG/G
ES-FP	W-61-High.2017	2017	6.50	NG/G
ES-FP	W-61-Intertidal.2017	2017	6.83	NG/G
ES-FP	W-61-Low.2017	2017	17.1	NG/G
MM	BU-51.2016	2016	5.46	NG/G
MM	MM-50.2016	2016	0.387	NG/G
MM	MM-51.2016	2016	2.30	NG/G
MM	MM-52.2016	2016	1.46	NG/G
MM	MM-53.2016	2016	5.17	NG/G
MM	MM-54.2016	2016	0.433	NG/G
MM	MM-55.2016	2016	6.71	NG/G
MM	MM-56.2016	2016	0.393	NG/G
MM	MM-62.2016	2016	8.69	NG/G
MM	MM-64.2016	2016	2.17	NG/G
MM	MM-65.2016	2016	12.5	NG/G
MM	MM-66.2016	2016	0.509	NG/G
MM	MM-67.2016	2016	0.517	NG/G
MM	MM-68.2016	2016	0.203	NG/G
MM	MM-69.2016	2016	4.41	NG/G
MM	MM-70.2016	2016	0.824	NG/G
MM	MM-71.2016	2016	4.52	NG/G
MM	MMPOLY.2016	2016	7.83	NG/G
MM	W-17-High-2016.2016	2016	22.2	NG/G
MM	W-17-Intertidal.2016	2016	2.20	NG/G
MM	W-17-Low.2016	2016	2.85	NG/G
MM	W-17-Mid-2016.2016	2016	3.01	NG/G
MM	W17-N.2016	2016	50.7	NG/G
MM	W-21-High.2016	2016	15.8	NG/G
MM	W-21-Intertidal.2016	2016	2.36	NG/G
MM	W-21-Low.2016	2016	2.68	NG/G
MM	W-21-Mid.2016	2016	2.77	NG/G
MM	W-21-UM-Central-C.2016	2016	7.02	NG/G
MM	W-21-UM-East-C.2016	2016	1.28	NG/G
MM	W-21-UM-South.2016	2016	3.47	NG/G
MM	W-21-UM-West-A.2016	2016	0.713	NG/G
MM	W-65-High.2016	2016	0.116	NG/G
MM	W-65-Intertidal.2016	2016	0.207	NG/G
MM	W-65-Low.2016	2016	0.0335	NG/G
MM	W-65-Mid.2016	2016	5.27	NG/G

Appendix A-34a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Methyl Mercury	UOM
MM	BU-08-01-E.2017	2017	14.3	NG/G
MM	BU-50THRU52.2017	2017	5.10	NG/G
MM	FF-08-02-G.2017	2017	13.4	NG/G
MM	MM-04-01-F.2017	2017	10.5	NG/G
MM	MM-50THRU56.2017	2017	1.70	NG/G
MM	MM-64THRU67.2017	2017	3.48	NG/G
MM	MM-MR.2017	2017	1.53	NG/G
MM	MM-MR-INT.2017	2017	3.47	NG/G
MM	MMSE-1_N1.2017	2017	13.1	NG/G
MM	MMSE-1_N2.2017	2017	5.27	NG/G
MM	MMSE-1_S1.2017	2017	14.0	NG/G
MM	MMSE-1_S2.2017	2017	4.63	NG/G
MM	MMSW-C_N.2017	2017	17.1	NG/G
MM	MMSW-C_S.2017	2017	3.90	NG/G
MM	MMSW-C_SW.2017	2017	2.87	NG/G
MM	W-17-High.2017	2017	16.3	NG/G
MM	W-17-Intertidal.2017	2017	5.17	NG/G
MM	W-17-Low.2017	2017	9.10	NG/G
MM	W-17-Mid.2017	2017	11.8	NG/G
MM	W-17-NE.2017	2017	37.3	NG/G
MM	W-17-NW.2017	2017	6.67	NG/G
MM	W-21-High.2017	2017	3.27	NG/G
MM	W-21-Intertidal.2017	2017	3.20	NG/G
MM	W-21-Low.2017	2017	4.33	NG/G
MM	W-21-Mid.2017	2017	3.90	NG/G
MM	W-21-UM-Central-C.2017	2017	14.2	NG/G
MM	W-21-UM-East-C.2017	2017	18.9	NG/G
MM	W-21-UM-South.2017	2017	5.40	NG/G
MM	W-21-UM-West-A.2017	2017	3.10	NG/G
MM	W-65-High.2017	2017	17.9	NG/G
MM	W-65-Intertidal.2017	2017	2.77	NG/G
MM	W-65-Low.2017	2017	5.67	NG/G
MM	W-65-Mid.2017	2017	14.3	NG/G
MM	W-MM-01.2017	2017	30.1	NG/G
MM	W-MM-02.2017	2017	19.2	NG/G
MM	W-MM-03.2017	2017	3.73	NG/G
MM	W-MM-04.2017	2017	6.77	NG/G
MM	W-MM-05.2017	2017	14.9	NG/G
MM	W-MM-06.2017	2017	12.8	NG/G

Appendix A-34a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Methyl Mercury	UOM
MM	W-MM-07.2017	2017	11.7	NG/G
MM	W-MM-08.2017	2017	17.4	NG/G
MM	W-MM-09.2017	2017	2.43	NG/G
MM	W-MM-10.2017	2017	2.27	NG/G
MM	W-MM-11.2017	2017	15.9	NG/G
MM	W-MM-12.2017	2017	7.73	NG/G
MM	W-MM-13.2017	2017	10.9	NG/G
MM	W-MM-14.2017	2017	19.0	NG/G
MM	W-MM-15.2017	2017	3.40	NG/G
MM	W-MM-16.2017	2017	0.867	NG/G
MM	W-MM-17.2017	2017	8.47	NG/G
MM	W-MM-18.2017	2017	26.3	NG/G
MM	W-MM-19.2017	2017	16.1	NG/G
MM	W-MM-20.2017	2017	2.63	NG/G
MM	W-MM-21.2017	2017	2.00	NG/G
MM	W-MM-22.2017	2017	20.0	NG/G
MM	W-MM-23.2017	2017	8.29	NG/G
MM	W-MM-TP.2017	2017	1.93	NG/G
OB-01	BU-51.2016	2016	5.46	NG/G
OB-01	MM-50.2016	2016	0.387	NG/G
OB-01	MM-51.2016	2016	2.30	NG/G
OB-01	MM-52.2016	2016	1.46	NG/G
OB-01	MM-53.2016	2016	5.17	NG/G
OB-01	MM-54.2016	2016	0.433	NG/G
OB-01	MM-64.2016	2016	2.17	NG/G
OB-01	MM-65.2016	2016	12.5	NG/G
OB-01	MM-66.2016	2016	0.509	NG/G
OB-01	MM-67.2016	2016	0.517	NG/G
OB-01	MM-68.2016	2016	0.203	NG/G
OB-01	MM-69.2016	2016	4.41	NG/G
OB-01	MMPOLY.2016	2016	7.83	NG/G
OB-01	W-17-High-2016.2016	2016	22.2	NG/G
OB-01	W-17-Intertidal.2016	2016	2.20	NG/G
OB-01	W-17-Low.2016	2016	2.85	NG/G
OB-01	W-17-Mid-2016.2016	2016	3.01	NG/G
OB-01	W17-N.2016	2016	50.7	NG/G
OB-01	W-21-High.2016	2016	15.8	NG/G
OB-01	W-21-Intertidal.2016	2016	2.36	NG/G
OB-01	W-21-Low.2016	2016	2.68	NG/G

Appendix A-34a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Methyl Mercury	UOM
OB-01	W-21-Mid.2016	2016	2.77	NG/G
OB-01	W-21-UM-Central-C.2016	2016	7.02	NG/G
OB-01	W-21-UM-East-C.2016	2016	1.28	NG/G
OB-01	W-21-UM-West-A.2016	2016	0.713	NG/G
OB-01	W-65-High.2016	2016	0.116	NG/G
OB-01	W-65-Intertidal.2016	2016	0.207	NG/G
OB-01	W-65-Low.2016	2016	0.0335	NG/G
OB-01	W-65-Mid.2016	2016	5.27	NG/G
OB-01	BU-08-01-E.2017	2017	14.3	NG/G
OB-01	BU-50THRU52.2017	2017	5.10	NG/G
OB-01	FF-08-02-G.2017	2017	13.4	NG/G
OB-01	MM-04-01-F.2017	2017	10.5	NG/G
OB-01	MM-50THRU56.2017	2017	1.70	NG/G
OB-01	MM-64THRU67.2017	2017	3.48	NG/G
OB-01	MM-MR.2017	2017	1.53	NG/G
OB-01	MM-MR-INT.2017	2017	3.47	NG/G
OB-01	MMSE-1_N1.2017	2017	13.1	NG/G
OB-01	MMSE-1_N2.2017	2017	5.27	NG/G
OB-01	MMSE-1_S1.2017	2017	14.0	NG/G
OB-01	MMSE-1_S2.2017	2017	4.63	NG/G
OB-01	MMSW-C_N.2017	2017	17.1	NG/G
OB-01	MMSW-C_S.2017	2017	3.90	NG/G
OB-01	MMSW-C_SW.2017	2017	2.87	NG/G
OB-01	W-17-High.2017	2017	16.3	NG/G
OB-01	W-17-Intertidal.2017	2017	5.17	NG/G
OB-01	W-17-Low.2017	2017	9.10	NG/G
OB-01	W-17-Mid.2017	2017	11.8	NG/G
OB-01	W-17-NE.2017	2017	37.3	NG/G
OB-01	W-17-NW.2017	2017	6.67	NG/G
OB-01	W-21-High.2017	2017	3.27	NG/G
OB-01	W-21-Intertidal.2017	2017	3.20	NG/G
OB-01	W-21-Low.2017	2017	4.33	NG/G
OB-01	W-21-Mid.2017	2017	3.90	NG/G
OB-01	W-21-UM-Central-C.2017	2017	14.2	NG/G
OB-01	W-21-UM-East-C.2017	2017	18.9	NG/G
OB-01	W-21-UM-West-A.2017	2017	3.10	NG/G
OB-01	W-65-High.2017	2017	17.9	NG/G
OB-01	W-65-Intertidal.2017	2017	2.77	NG/G
OB-01	W-65-Low.2017	2017	5.67	NG/G

Appendix A-34a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Methyl Mercury	UOM
OB-01	W-65-Mid.2017	2017	14.3	NG/G
OB-01	W-MM-01.2017	2017	30.1	NG/G
OB-01	W-MM-02.2017	2017	19.2	NG/G
OB-01	W-MM-03.2017	2017	3.73	NG/G
OB-01	W-MM-04.2017	2017	6.77	NG/G
OB-01	W-MM-05.2017	2017	14.9	NG/G
OB-01	W-MM-06.2017	2017	12.8	NG/G
OB-01	W-MM-07.2017	2017	11.7	NG/G
OB-01	W-MM-08.2017	2017	17.4	NG/G
OB-01	W-MM-09.2017	2017	2.43	NG/G
OB-01	W-MM-10.2017	2017	2.27	NG/G
OB-01	W-MM-11.2017	2017	15.9	NG/G
OB-01	W-MM-12.2017	2017	7.73	NG/G
OB-01	W-MM-13.2017	2017	10.9	NG/G
OB-01	W-MM-14.2017	2017	19.0	NG/G
OB-01	W-MM-15.2017	2017	3.40	NG/G
OB-01	W-MM-16.2017	2017	0.867	NG/G
OB-01	W-MM-17.2017	2017	8.47	NG/G
OB-01	W-MM-18.2017	2017	26.3	NG/G
OB-01	W-MM-19.2017	2017	16.1	NG/G
OB-01	W-MM-20.2017	2017	2.63	NG/G
OB-01	W-MM-TP.2017	2017	1.93	NG/G
OB-04	OB-05.2016	2016	11.3	NG/G
OB-04	W-63-Intertidal.2016	2016	11.2	NG/G
OB-04	OB-04.2017	2017	4.30	NG/G
OB-04	OB-05.2017	2017	5.77	NG/G
OB-04	ON-10-01-C.2017	2017	32.9	NG/G
OB-04	W-103-INTA.2017	2017	10.6	NG/G
OB-04	W-104-INTA.2017	2017	10.2	NG/G
OB-04	W-104-INTB.2017	2017	4.77	NG/G
OB-04	W-14-INTA.2017	2017	3.73	NG/G
OB-04	W-63-INT.2017	2017	17.5	NG/G
OB-04	WP-02-01-D.2017	2017	11.9	NG/G
OB-05	OB-05.2016	2016	11.3	NG/G
OB-05	W-63-Intertidal.2016	2016	11.2	NG/G
OB-05	OB-04.2017	2017	4.30	NG/G
OB-05	OB-05.2017	2017	5.77	NG/G
OB-05	ON-10-01-C.2017	2017	32.9	NG/G
OB-05	W-104-INTA.2017	2017	10.2	NG/G

Appendix A-34a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Bald Eagle

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Methyl Mercury	UOM
OB-05	W-104-INTB.2017	2017	4.77	NG/G
OB-05	W-14-INTA.2017	2017	3.73	NG/G
OB-05	W-63-INT.2017	2017	17.5	NG/G
OB-05	WP-02-01-D.2017	2017	11.9	NG/G

Appendix A-34b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/30/2018 9:33:13 AM
From File	2018_01_29 Sediment_Eagle_v2.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

IPWC_MeHg (bo-04)

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	3
Minimum	2.5	Mean	5.18
Maximum	7.86	Median	5.18

Warning: This data set only has 2 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable IPWC_MeHg (bo-04) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

IPWC_MeHg (es-13)

General Statistics

Total Number of Observations	26	Number of Distinct Observations	26
		Number of Missing Observations	20
Minimum	2.267	Mean	9.948
Maximum	24.57	Median	8.165
SD	5.557	Std. Error of Mean	1.09
Coefficient of Variation	0.559	Skewness	0.806

Normal GOF Test

Shapiro Wilk Test Statistic	0.935	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.92	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.15	Lilliefors GOF Test
5% Lilliefors Critical Value	0.17	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL | 95% UCLs (Adjusted for Skewness)

Appendix A-34b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

95% Student's-t UCL	11.81	95% Adjusted-CLT UCL (Chen-1995)	11.92
		95% Modified-t UCL (Johnson-1978)	11.84

Gamma GOF Test

A-D Test Statistic	0.247	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.11	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.172	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.295	k star (bias corrected MLE)	2.94
Theta hat (MLE)	3.019	Theta star (bias corrected MLE)	3.383
nu hat (MLE)	171.3	nu star (bias corrected)	152.9
MLE Mean (bias corrected)	9.948	MLE Sd (bias corrected)	5.801
		Approximate Chi Square Value (0.05)	125.3
Adjusted Level of Significance	0.0398	Adjusted Chi Square Value	123.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	12.14	95% Adjusted Gamma UCL (use when n<50)	12.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.117	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.17	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.818	Mean of logged Data	2.138
Maximum of Logged Data	3.201	SD of logged Data	0.596

Assuming Lognormal Distribution

95% H-UCL	12.94	90% Chebyshev (MVUE) UCL	13.78
95% Chebyshev (MVUE) UCL	15.47	97.5% Chebyshev (MVUE) UCL	17.82
99% Chebyshev (MVUE) UCL	22.43		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	11.74	95% Jackknife UCL	11.81
95% Standard Bootstrap UCL	11.69	95% Bootstrap-t UCL	11.93
95% Hall's Bootstrap UCL	12.02	95% Percentile Bootstrap UCL	11.81
95% BCA Bootstrap UCL	11.9		
90% Chebyshev(Mean, Sd) UCL	13.22	95% Chebyshev(Mean, Sd) UCL	14.7

Appendix A-34b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

97.5% Chebyshev(Mean, Sd) UCL	16.75	99% Chebyshev(Mean, Sd) UCL	20.79

Suggested UCL to Use

95% Student's-t UCL	11.81

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (es-fp)

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	2
Minimum	0.244	Mean	7.5
Maximum	18.8	Median	6.045
SD	6.533	Std. Error of Mean	1.886
Coefficient of Variation	0.871	Skewness	0.828

Normal GOF Test

Shapiro Wilk Test Statistic	0.853	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.254	Lilliefors GOF Test
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	10.89	95% Adjusted-CLT UCL (Chen-1995)	11.08
		95% Modified-t UCL (Johnson-1978)	10.96

Gamma GOF Test

A-D Test Statistic	0.409	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.151	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.252	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.04	k star (bias corrected MLE)	0.836
Theta hat (MLE)	7.21	Theta star (bias corrected MLE)	8.974
nu hat (MLE)	24.97	nu star (bias corrected)	20.06
MLE Mean (bias corrected)	7.5	MLE Sd (bias corrected)	8.204
		Approximate Chi Square Value (0.05)	10.89

Adjusted Level of Significance	0.029	Adjusted Chi Square Value	9.878

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	13.81	95% Adjusted Gamma UCL (use when n<50)	15.23

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.885	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.222	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.411	Mean of logged Data	1.463
Maximum of Logged Data	2.934	SD of logged Data	1.332

Assuming Lognormal Distribution

95% H-UCL	43.67	90% Chebyshev (MVUE) UCL	21.03
95% Chebyshev (MVUE) UCL	26.34	97.5% Chebyshev (MVUE) UCL	33.7
99% Chebyshev (MVUE) UCL	48.17		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	10.6	95% Jackknife UCL	10.89
95% Standard Bootstrap UCL	10.43	95% Bootstrap-t UCL	11.62
95% Hall's Bootstrap UCL	10.55	95% Percentile Bootstrap UCL	10.61
95% BCA Bootstrap UCL	10.85		
90% Chebyshev(Mean, Sd) UCL	13.16	95% Chebyshev(Mean, Sd) UCL	15.72
97.5% Chebyshev(Mean, Sd) UCL	19.28	99% Chebyshev(Mean, Sd) UCL	26.27

Suggested UCL to Use

95% Adjusted Gamma UCL	15.23

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (mm)

General Statistics

Total Number of Observations	92	Number of Distinct Observations	90
		Number of Missing Observations	47

Appendix A-34b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Minimum	0.0335	Mean	8.148
Maximum	50.7	Median	5.133
SD	8.592	Std. Error of Mean	0.896
Coefficient of Variation	1.055	Skewness	2.159

Normal GOF Test

Shapiro Wilk Test Statistic	0.796	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.19	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0926	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.636	95% Adjusted-CLT UCL (Chen-1995)	9.837
		95% Modified-t UCL (Johnson-1978)	9.67

Gamma GOF Test

A-D Test Statistic	0.416	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.786	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0676	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0962	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.937	k star (bias corrected MLE)	0.914
Theta hat (MLE)	8.692	Theta star (bias corrected MLE)	8.913
nu hat (MLE)	172.5	nu star (bias corrected)	168.2
MLE Mean (bias corrected)	8.148	MLE Sd (bias corrected)	8.522
		Approximate Chi Square Value (0.05)	139.2
Adjusted Level of Significance	0.0474	Adjusted Chi Square Value	138.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	9.845	95% Adjusted Gamma UCL (use when n<50)	9.874

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.938	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	3.3621E-4	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.103	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0926	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.396	Mean of logged Data	1.477
Maximum of Logged Data	3.926	SD of logged Data	1.332

Appendix A-34b
UCL Evaluation - Sample Area for Bald Eagle Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Lognormal Distribution

95% H-UCL	15.28	90% Chebyshev (MVUE) UCL	16.19
95% Chebyshev (MVUE) UCL	18.78	97.5% Chebyshev (MVUE) UCL	22.39
99% Chebyshev (MVUE) UCL	29.47		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	9.621	95% Jackknife UCL	9.636
95% Standard Bootstrap UCL	9.618	95% Bootstrap-t UCL	9.834
95% Hall's Bootstrap UCL	9.907	95% Percentile Bootstrap UCL	9.727
95% BCA Bootstrap UCL	9.718		
90% Chebyshev(Mean, Sd) UCL	10.84	95% Chebyshev(Mean, Sd) UCL	12.05
97.5% Chebyshev(Mean, Sd) UCL	13.74	99% Chebyshev(Mean, Sd) UCL	17.06

Suggested UCL to Use

95% Approximate Gamma UCL	9.845

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (ob-01)

General Statistics

Total Number of Observations	82	Number of Distinct Observations	80
		Number of Missing Observations	46
Minimum	0.0335	Mean	8.406
Maximum	50.7	Median	5.133
SD	8.871	Std. Error of Mean	0.98
Coefficient of Variation	1.055	Skewness	2.113

Normal GOF Test

Shapiro Wilk Test Statistic	0.796	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	3.331E-16	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.194	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.098	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	10.04	95% Adjusted-CLT UCL (Chen-1995)	10.26
		95% Modified-t UCL (Johnson-1978)	10.07

Appendix A-34b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.513	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.786	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0712	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.102	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.922	k star (bias corrected MLE)	0.896
Theta hat (MLE)	9.118	Theta star (bias corrected MLE)	9.379
nu hat (MLE)	151.2	nu star (bias corrected)	147
MLE Mean (bias corrected)	8.406	MLE Sd (bias corrected)	8.879
		Approximate Chi Square Value (0.05)	120
Adjusted Level of Significance	0.0471	Adjusted Chi Square Value	119.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	10.3	95% Adjusted Gamma UCL (use when n<50)	10.34

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	2.9308E-4	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.098	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.396	Mean of logged Data	1.497
Maximum of Logged Data	3.926	SD of logged Data	1.355

Assuming Lognormal Distribution

95% H-UCL	16.54	90% Chebyshev (MVUE) UCL	17.45
95% Chebyshev (MVUE) UCL	20.39	97.5% Chebyshev (MVUE) UCL	24.47
99% Chebyshev (MVUE) UCL	32.48		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	10.02	95% Jackknife UCL	10.04
95% Standard Bootstrap UCL	10.04	95% Bootstrap-t UCL	10.31
95% Hall's Bootstrap UCL	10.39	95% Percentile Bootstrap UCL	9.986
95% BCA Bootstrap UCL	10.28		
90% Chebyshev(Mean, Sd) UCL	11.34	95% Chebyshev(Mean, Sd) UCL	12.68
97.5% Chebyshev(Mean, Sd) UCL	14.52	99% Chebyshev(Mean, Sd) UCL	18.15

Appendix A-34b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Approximate Gamma UCL 10.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (ob-04)

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	3
Minimum	3.733	Mean	11.29
Maximum	32.9	Median	10.57
SD	8.29	Std. Error of Mean	2.499
Coefficient of Variation	0.734	Skewness	1.956

Normal GOF Test

Shapiro Wilk Test Statistic	0.784	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.287	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	15.82	95% Adjusted-CLT UCL (Chen-1995)	16.97
		95% Modified-t UCL (Johnson-1978)	16.06

Gamma GOF Test

A-D Test Statistic	0.467	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.201	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.258	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.636	k star (bias corrected MLE)	1.977
Theta hat (MLE)	4.283	Theta star (bias corrected MLE)	5.708
nu hat (MLE)	57.98	nu star (bias corrected)	43.5
MLE Mean (bias corrected)	11.29	MLE Sd (bias corrected)	8.027
		Approximate Chi Square Value (0.05)	29.38
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	27.5

Appendix A-34b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	16.71	95% Adjusted Gamma UCL (use when n<50)	17.86

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.934	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.195	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.251	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.317	Mean of logged Data	2.222
Maximum of Logged Data	3.493	SD of logged Data	0.653

Assuming Lognormal Distribution

95% H-UCL	18.71	90% Chebyshev (MVUE) UCL	17.97
95% Chebyshev (MVUE) UCL	21.06	97.5% Chebyshev (MVUE) UCL	25.34
99% Chebyshev (MVUE) UCL	33.75		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	15.4	95% Jackknife UCL	15.82
95% Standard Bootstrap UCL	15.16	95% Bootstrap-t UCL	19.2
95% Hall's Bootstrap UCL	36.57	95% Percentile Bootstrap UCL	15.62
95% BCA Bootstrap UCL	17.11		
90% Chebyshev(Mean, Sd) UCL	18.79	95% Chebyshev(Mean, Sd) UCL	22.18
97.5% Chebyshev(Mean, Sd) UCL	26.9	99% Chebyshev(Mean, Sd) UCL	36.16

Suggested UCL to Use

95% Adjusted Gamma UCL	17.86

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (ob-05)

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	6
Minimum	3.733	Mean	11.36
Maximum	32.9	Median	10.68

Appendix A-34b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SD	8.735	Std. Error of Mean	2.762
Coefficient of Variation	0.769	Skewness	1.87

Normal GOF Test

Shapiro Wilk Test Statistic	0.794	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	16.42	95% Adjusted-CLT UCL (Chen-1995)	17.65
		95% Modified-t UCL (Johnson-1978)	16.7

Gamma GOF Test

A-D Test Statistic	0.412	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.185	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.269	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.411	k star (bias corrected MLE)	1.755
Theta hat (MLE)	4.711	Theta star (bias corrected MLE)	6.474
nu hat (MLE)	48.23	nu star (bias corrected)	35.09
MLE Mean (bias corrected)	11.36	MLE Sd (bias corrected)	8.576
		Approximate Chi Square Value (0.05)	22.54
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	20.81

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	17.69	95% Adjusted Gamma UCL (use when n<50)	19.16

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.938	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.164	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.317	Mean of logged Data	2.209
Maximum of Logged Data	3.493	SD of logged Data	0.686

Assuming Lognormal Distribution

95% H-UCL	20.45	90% Chebyshev (MVUE) UCL	18.73

Appendix A-34b
UCL Evaluation - Sample Area for Bald Eagle
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

95% Chebyshev (MVUE) UCL	22.13	97.5% Chebyshev (MVUE) UCL	26.86
99% Chebyshev (MVUE) UCL	36.14		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	15.9	95% Jackknife UCL	16.42
95% Standard Bootstrap UCL	15.62	95% Bootstrap-t UCL	20.18
95% Hall's Bootstrap UCL	38.51	95% Percentile Bootstrap UCL	16.18
95% BCA Bootstrap UCL	17.76		
90% Chebyshev(Mean, Sd) UCL	19.65	95% Chebyshev(Mean, Sd) UCL	23.4
97.5% Chebyshev(Mean, Sd) UCL	28.61	99% Chebyshev(Mean, Sd) UCL	38.84

Suggested UCL to Use

95% Adjusted Gamma UCL	19.16

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-35a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Mercury	UOM
BO-04	BO-05.2016	2016	1793	NG/G
BO-04	BO-05.2017	2017	78.8	NG/G
ES-13	ES-13.2016	2016	416	NG/G
ES-13	W-61-High.2016	2016	593	NG/G
ES-13	EC-40AB.2016	2016	650	NG/G
ES-13	W-61-Low.2016	2016	926	NG/G
ES-13	VE-53.2016	2016	994	NG/G
ES-13	W-61-Intertidal.2016	2016	1163	NG/G
ES-13	VI-W.2017	2017	92.2	NG/G
ES-13	W-61-High.2017	2017	166	NG/G
ES-13	SVE-02INT.2017	2017	245	NG/G
ES-13	VE-MU4-GC-1-E.2017	2017	264	NG/G
ES-13	W-61-Intertidal.2017	2017	529	NG/G
ES-13	ES-13.2017	2017	586	NG/G
ES-13	VE-MU4-GC-1-F.2017	2017	672	NG/G
ES-13	VE-10-01-E.2017	2017	765	NG/G
ES-13	VE-10-01-C.2017	2017	801	NG/G
ES-13	W-61-Low.2017	2017	844	NG/G
ES-FP	ESFP.2017	2017	12.3	NG/G
ES-FP	ES-FP.2017	2017	12.3	NG/G
ES-FP	ES-FP-W.2017	2017	31.0	NG/G
MM	W-65-Low.2016	2016	32.5	NG/G
MM	MM-50.2016	2016	37.0	NG/G
MM	W-65-Intertidal.2016	2016	41.6	NG/G
MM	W-65-High.2016	2016	84.3	NG/G
MM	MM-66.2016	2016	137	NG/G
MM	W-65-Mid.2016	2016	225	NG/G
MM	W-21-UM-West-A.2016	2016	434	NG/G
MM	MM-64.2016	2016	484	NG/G
MM	W-21-Intertidal.2016	2016	543	NG/G
MM	MMPOLY.2016	2016	554	NG/G
MM	W-21-UM-Central-C.2016	2016	617	NG/G
MM	W-21-Low.2016	2016	704	NG/G
MM	W-21-UM-East-C.2016	2016	751	NG/G
MM	MM-65.2016	2016	821	NG/G
MM	W-21-Mid.2016	2016	869	NG/G
MM	W-21-High.2016	2016	929	NG/G
MM	MM-51.2016	2016	1140	NG/G
MM	MM-T2-C4-B.2017	2017	51.7	NG/G

Appendix A-35a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Mercury	UOM
MM	MM-T3-C1.2017	2017	71.1	NG/G
MM	MM-T2-C7-A.2017	2017	76.6	NG/G
MM	MM-T5-C2.2017	2017	82.1	NG/G
MM	W-MM-03.2017	2017	113	NG/G
MM	W-MM-TP.2017	2017	152	NG/G
MM	MM-MR.2017	2017	154	NG/G
MM	W-65-Mid.2017	2017	161	NG/G
MM	MM-T1-C6.2017	2017	164	NG/G
MM	W-21-UM-West-A.2017	2017	165	NG/G
MM	MM-T1-C3-B.2017	2017	168	NG/G
MM	W-65-Intertidal.2017	2017	197	NG/G
MM	W-65-High.2017	2017	201	NG/G
MM	MMSW-C_SW.2017	2017	207	NG/G
MM	W-MM-10.2017	2017	226	NG/G
MM	MM-T3-C7.2017	2017	256	NG/G
MM	W-MM-15.2017	2017	258	NG/G
MM	W-21-UM-Central-C.2017	2017	265	NG/G
MM	MMSE-1_S1.2017	2017	282	NG/G
MM	MM-T2-C5-A.2017	2017	306	NG/G
MM	W-MM-13.2017	2017	307	NG/G
MM	MMSE-1_S2.2017	2017	320	NG/G
MM	MM-T3-C3-B2.2017	2017	328	NG/G
MM	MM-T3-C3-C.2017	2017	330	NG/G
MM	MM-T2-C1-B.2017	2017	372	NG/G
MM	MMSE-1_N2.2017	2017	398	NG/G
MM	W-MM-12.2017	2017	418	NG/G
MM	MM-64THRU67.2017	2017	425	NG/G
MM	MM-T3-C6.2017	2017	438	NG/G
MM	W-MM-02.2017	2017	448	NG/G
MM	W-MM-04.2017	2017	519	NG/G
MM	W-MM-07.2017	2017	560	NG/G
MM	MM-T3-C2-C.2017	2017	570	NG/G
MM	W-MM-09.2017	2017	575	NG/G
MM	W-MM-06.2017	2017	620	NG/G
MM	W-MM-14.2017	2017	635	NG/G
MM	MM-T2-C8-B.2017	2017	643	NG/G
MM	W-MM-05.2017	2017	691	NG/G
MM	MM-T2-C6-A.2017	2017	734	NG/G
MM	MM-T1-C1-A.2017	2017	740	NG/G

Appendix A-35a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Mercury	UOM
MM	MM-04-01-C.2017	2017	743	NG/G
MM	MM-04-01-F.2017	2017	756	NG/G
MM	MM-T1-C1-B.2017	2017	765	NG/G
MM	W-21-Intertidal.2017	2017	780	NG/G
MM	MM-T3-C4-D.2017	2017	791	NG/G
MM	W-MM-08.2017	2017	793	NG/G
MM	MM-T1-C2-D.2017	2017	793	NG/G
MM	W-21-High.2017	2017	802	NG/G
MM	MM-T1-C2-B.2017	2017	813	NG/G
MM	MM-T3-C2-F.2017	2017	845	NG/G
MM	MM-T3-C4-C.2017	2017	867	NG/G
MM	W-21-Low.2017	2017	873	NG/G
MM	MM-T1-C5.2017	2017	887	NG/G
MM	MMSW-C_N.2017	2017	899	NG/G
MM	MM-T3-C5-C.2017	2017	905	NG/G
MM	W-21-Mid.2017	2017	927	NG/G
MM	MM-MR-INT.2017	2017	932	NG/G
MM	MM-T5-C3.2017	2017	948	NG/G
MM	MMSW-C_S.2017	2017	965	NG/G
MM	MM-T5-C1.2017	2017	1008	NG/G
MM	W-21-UM-East-C.2017	2017	1008	NG/G
MM	MM-T1-C4.2017	2017	1029	NG/G
MM	W-65-Low.2017	2017	1049	NG/G
MM	W-MM-11.2017	2017	1067	NG/G
MM	MM-T2-C2-A.2017	2017	1246	NG/G
MM	MM-C3-A.2017	2017	1413	NG/G
MM	MM-T2-C3-A.2017	2017	1503	NG/G
MM	W-MM-01.2017	2017	1786	NG/G
MM	MMSE-1_N1.2017	2017	1851	NG/G
OB-01	W-65-Low.2016	2016	32.5	NG/G
OB-01	MM-50.2016	2016	37.0	NG/G
OB-01	W-65-Intertidal.2016	2016	41.6	NG/G
OB-01	W-65-High.2016	2016	84.3	NG/G
OB-01	W-65-Mid.2016	2016	225	NG/G
OB-01	W-17-Low.2016	2016	471	NG/G
OB-01	W-17-Intertidal.2016	2016	518	NG/G
OB-01	MMPOLY.2016	2016	554	NG/G
OB-01	W-17-Mid-2016.2016	2016	1179	NG/G
OB-01	MM-T2-C4-B.2017	2017	51.7	NG/G

Appendix A-35a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Mercury	UOM
OB-01	MM-T2-C7-A.2017	2017	76.6	NG/G
OB-01	MM-T5-C2.2017	2017	82.1	NG/G
OB-01	W-MM-03.2017	2017	113	NG/G
OB-01	W-MM-TP.2017	2017	152	NG/G
OB-01	MM-MR.2017	2017	154	NG/G
OB-01	W-65-Mid.2017	2017	161	NG/G
OB-01	MM-T1-C6.2017	2017	164	NG/G
OB-01	MM-T1-C3-B.2017	2017	168	NG/G
OB-01	W-65-Intertidal.2017	2017	197	NG/G
OB-01	W-65-High.2017	2017	201	NG/G
OB-01	MMSE-1_S1.2017	2017	282	NG/G
OB-01	MM-T2-C5-A.2017	2017	306	NG/G
OB-01	W-MM-13.2017	2017	307	NG/G
OB-01	MMSE-1_S2.2017	2017	320	NG/G
OB-01	MM-T2-C1-B.2017	2017	372	NG/G
OB-01	MMSE-1_N2.2017	2017	398	NG/G
OB-01	W-MM-12.2017	2017	418	NG/G
OB-01	W-MM-02.2017	2017	448	NG/G
OB-01	W-MM-04.2017	2017	519	NG/G
OB-01	W-17-Intertidal.2017	2017	590	NG/G
OB-01	FF-08-02-G.2017	2017	637	NG/G
OB-01	MM-T2-C8-B.2017	2017	643	NG/G
OB-01	MM-T2-C6-A.2017	2017	734	NG/G
OB-01	MM-T1-C1-A.2017	2017	740	NG/G
OB-01	MM-04-01-C.2017	2017	743	NG/G
OB-01	MM-04-01-F.2017	2017	756	NG/G
OB-01	MM-T1-C1-B.2017	2017	765	NG/G
OB-01	FF-08-01-B.2017	2017	772	NG/G
OB-01	MM-T1-C2-D.2017	2017	793	NG/G
OB-01	MM-T1-C2-B.2017	2017	813	NG/G
OB-01	MM-T1-C5.2017	2017	887	NG/G
OB-01	MM-MR-INT.2017	2017	932	NG/G
OB-01	MM-T5-C3.2017	2017	948	NG/G
OB-01	W-17-Low.2017	2017	998	NG/G
OB-01	MM-T5-C1.2017	2017	1008	NG/G
OB-01	MM-T1-C4.2017	2017	1029	NG/G
OB-01	W-65-Low.2017	2017	1049	NG/G
OB-01	W-17-High.2017	2017	1053	NG/G
OB-01	W-MM-11.2017	2017	1067	NG/G

Appendix A-35a
UCL Evaluation - ProUCL Input
Sediment Mercury Data Set for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Mercury	UOM
OB-01	FF-08-02-J.2017	2017	1086	NG/G
OB-01	MM-T2-C2-A.2017	2017	1246	NG/G
OB-01	W-17-Mid.2017	2017	1269	NG/G
OB-01	MM-T2-C3-A.2017	2017	1503	NG/G
OB-01	W-MM-01.2017	2017	1786	NG/G
OB-01	MMSE-1_N1.2017	2017	1851	NG/G
OB-04	W-14-INTA.2017	2017	110	NG/G
OB-04	OB-04.2017	2017	151	NG/G
OB-04	WP-02-01-D.2017	2017	542	NG/G
OB-04	WP-02-01-B.2017	2017	586	NG/G
OB-05	OB-05.2016	2016	755	NG/G
OB-05	W-63-Intertidal.2016	2016	1123	NG/G
OB-05	ON-10-01-B.2017	2017	626	NG/G
OB-05	W-104-INTB.2017	2017	780	NG/G
OB-05	PBR-18-I.2017	2017	786	NG/G
OB-05	W-104-INTA.2017	2017	797	NG/G
OB-05	PBR-18-E.2017	2017	931	NG/G
OB-05	OB-05.2017	2017	981	NG/G
OB-05	W-63-INT.2017	2017	1073	NG/G
OB-05	ON-10-01-C.2017	2017	1331	NG/G
OB-05	PBR-19-A.2017	2017	1613	NG/G

Appendix A-35b
UCL Evaluation - Sample Area for Mink
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/30/2018 9:33:59 AM
From File	2018_01_29 Sediment_Mink_v2.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

IPWC_Hg (bo-04)

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	78.8	Mean	935.9
Maximum	1793	Median	935.9

Warning: This data set only has 2 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable IPWC_Hg (bo-04) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

IPWC_Hg (es-13)

General Statistics

Total Number of Observations	16	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	92.16	Mean	606.6
Maximum	1163	Median	621.5
SD	309.5	Std. Error of Mean	77.37
Coefficient of Variation	0.51	Skewness	-0.0729

Normal GOF Test

Shapiro Wilk Test Statistic	0.975	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.116	Lilliefors GOF Test
5% Lilliefors Critical Value	0.213	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% UCLs (Adjusted for Skewness)

Appendix A-35b
UCL Evaluation - Sample Area for Mink
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

95% Student's-t UCL	742.2	95% Adjusted-CLT UCL (Chen-1995)	732.4
		95% Modified-t UCL (Johnson-1978)	742

Gamma GOF Test

A-D Test Statistic	0.496	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.217	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.905	k star (bias corrected MLE)	2.402
Theta hat (MLE)	208.8	Theta star (bias corrected MLE)	252.5
nu hat (MLE)	92.97	nu star (bias corrected)	76.87
MLE Mean (bias corrected)	606.6	MLE Sd (bias corrected)	391.4
		Approximate Chi Square Value (0.05)	57.67
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	55.78

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	808.5	95% Adjusted Gamma UCL (use when n<50)	835.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.885	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.213	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.213	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.524	Mean of logged Data	6.226
Maximum of Logged Data	7.059	SD of logged Data	0.706

Assuming Lognormal Distribution

95% H-UCL	984.4	90% Chebyshev (MVUE) UCL	993.4
95% Chebyshev (MVUE) UCL	1155	97.5% Chebyshev (MVUE) UCL	1379
99% Chebyshev (MVUE) UCL	1820		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	733.9	95% Jackknife UCL	742.2
95% Standard Bootstrap UCL	729.9	95% Bootstrap-t UCL	738.7
95% Hall's Bootstrap UCL	737	95% Percentile Bootstrap UCL	731.9
95% BCA Bootstrap UCL	730.6		
90% Chebyshev(Mean, Sd) UCL	838.7	95% Chebyshev(Mean, Sd) UCL	943.8

Appendix A-35b
UCL Evaluation - Sample Area for Mink
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

97.5% Chebyshev(Mean, Sd) UCL	1090	99% Chebyshev(Mean, Sd) UCL	1376

Suggested UCL to Use

95% Student's-t UCL 742.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

IPWC_Hg (es-fp)

General Statistics

Total Number of Observations	3	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	12.31	Mean	18.55
Maximum	31.04	Median	12.31
SD	10.81	Std. Error of Mean	6.244
Coefficient of Variation	0.583	Skewness	1.732

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.75	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.385	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	36.78	95% Adjusted-CLT UCL (Chen-1995)	35.49
		95% Modified-t UCL (Johnson-1978)	37.83

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	5.063	k star (bias corrected MLE)	N/A

Appendix A-35b
UCL Evaluation - Sample Area for Mink
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Theta hat (MLE)	3.664	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	30.38	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.385	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.51	Mean of logged Data	2.819
Maximum of Logged Data	3.435	SD of logged Data	0.534

Assuming Lognormal Distribution

95% H-UCL	265.4	90% Chebyshev (MVUE) UCL	34.81
95% Chebyshev (MVUE) UCL	42.25	97.5% Chebyshev (MVUE) UCL	52.58
99% Chebyshev (MVUE) UCL	72.87		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	28.82	95% Jackknife UCL	N/A
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	37.28	95% Chebyshev(Mean, Sd) UCL	45.77
97.5% Chebyshev(Mean, Sd) UCL	57.55	99% Chebyshev(Mean, Sd) UCL	80.68

Suggested UCL to Use

95% Student's-t UCL	36.78

Recommended UCL exceeds the maximum observation

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

Appendix A-35b
UCL Evaluation - Sample Area for Mink
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (mm)

General Statistics

Total Number of Observations	86	Number of Distinct Observations	85
		Number of Missing Observations	0
Minimum	32.5	Mean	593.9
Maximum	1851	Median	572.3
SD	398	Std. Error of Mean	42.91
Coefficient of Variation	0.67	Skewness	0.729

Normal GOF Test

Shapiro Wilk Test Statistic	0.931	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	1.3410E-4	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.0952	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0957	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	665.2	95% Adjusted-CLT UCL (Chen-1995)	668.1
		95% Modified-t UCL (Johnson-1978)	665.8

Gamma GOF Test

A-D Test Statistic	1.316	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.768	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.124	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.098	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.726	k star (bias corrected MLE)	1.674
Theta hat (MLE)	344	Theta star (bias corrected MLE)	354.8
nu hat (MLE)	296.9	nu star (bias corrected)	287.9
MLE Mean (bias corrected)	593.9	MLE Sd (bias corrected)	459
		Approximate Chi Square Value (0.05)	249.6
Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	249

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	685	95% Adjusted Gamma UCL (use when n<50)	686.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.903	**Shapiro Wilk Lognormal GOF Test**

5% Shapiro Wilk P Value	3.3412E-7	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.143	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0957	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.481	Mean of logged Data	6.07
Maximum of Logged Data	7.524	SD of logged Data	0.926

Assuming Lognormal Distribution

95% H-UCL	825.5	90% Chebyshev (MVUE) UCL	890.4
95% Chebyshev (MVUE) UCL	995.1	97.5% Chebyshev (MVUE) UCL	1140
99% Chebyshev (MVUE) UCL	1426		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	664.5	95% Jackknife UCL	665.2
95% Standard Bootstrap UCL	664.1	95% Bootstrap-t UCL	671.6
95% Hall's Bootstrap UCL	670.5	95% Percentile Bootstrap UCL	667.6
95% BCA Bootstrap UCL	665.8		
90% Chebyshev(Mean, Sd) UCL	722.6	95% Chebyshev(Mean, Sd) UCL	780.9
97.5% Chebyshev(Mean, Sd) UCL	861.9	99% Chebyshev(Mean, Sd) UCL	1021

Suggested UCL to Use

95% Student's-t UCL	665.2

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (ob-01)

General Statistics

Total Number of Observations	55	Number of Distinct Observations	55
		Number of Missing Observations	0
Minimum	32.5	Mean	613.3
Maximum	1851	Median	554
SD	454.3	Std. Error of Mean	61.26
Coefficient of Variation	0.741	Skewness	0.707

Appendix A-35b
UCL Evaluation - Sample Area for Mink
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0.00188	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.104	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.119	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	715.8	95% Adjusted-CLT UCL (Chen-1995)	720.3
		95% Modified-t UCL (Johnson-1978)	716.8

Gamma GOF Test

A-D Test Statistic	0.734	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.77	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.128	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.122	Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.398	k star (bias corrected MLE)	1.334
Theta hat (MLE)	438.6	Theta star (bias corrected MLE)	459.7
nu hat (MLE)	153.8	nu star (bias corrected)	146.7
MLE Mean (bias corrected)	613.3	MLE Sd (bias corrected)	531
		Approximate Chi Square Value (0.05)	119.7
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	119.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	751.5	95% Adjusted Gamma UCL (use when n<50)	755.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.908	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	2.8080E-4	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.146	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.119	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.481	Mean of logged Data	6.02
Maximum of Logged Data	7.524	SD of logged Data	1.047

Assuming Lognormal Distribution

95% H-UCL	1001	90% Chebyshev (MVUE) UCL	1057
95% Chebyshev (MVUE) UCL	1218	97.5% Chebyshev (MVUE) UCL	1441
99% Chebyshev (MVUE) UCL	1880		

Appendix A-35b
UCL Evaluation - Sample Area for Mink
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	714	95% Jackknife UCL	715.8
95% Standard Bootstrap UCL	712.1	95% Bootstrap-t UCL	728.7
95% Hall's Bootstrap UCL	718.2	95% Percentile Bootstrap UCL	710.2
95% BCA Bootstrap UCL	722.3		
90% Chebyshev(Mean, Sd) UCL	797.1	95% Chebyshev(Mean, Sd) UCL	880.3
97.5% Chebyshev(Mean, Sd) UCL	995.9	99% Chebyshev(Mean, Sd) UCL	1223

Suggested UCL to Use

95% Student's-t UCL	715.8

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (ob-04)

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	110.3	Mean	347.4
Maximum	586	Median	346.7
SD	251.5	Std. Error of Mean	125.7
Coefficient of Variation	0.724	Skewness	0.00331

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.812	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.283	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Appendix A-35b
UCL Evaluation - Sample Area for Mink
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	643.4	95% Adjusted-CLT UCL (Chen-1995)	554.5
		95% Modified-t UCL (Johnson-1978)	643.4

Gamma GOF Test

A-D Test Statistic	0.526	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.322	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.127	k star (bias corrected MLE)	0.698
Theta hat (MLE)	163.3	Theta star (bias corrected MLE)	497.4
nu hat (MLE)	17.02	nu star (bias corrected)	5.587
MLE Mean (bias corrected)	347.4	MLE Sd (bias corrected)	415.7
		Approximate Chi Square Value (0.05)	1.433
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1355	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.833	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.291	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.703	Mean of logged Data	5.597
Maximum of Logged Data	6.373	SD of logged Data	0.862

Assuming Lognormal Distribution

95% H-UCL	6985	90% Chebyshev (MVUE) UCL	780.9
95% Chebyshev (MVUE) UCL	975.5	97.5% Chebyshev (MVUE) UCL	1246
99% Chebyshev (MVUE) UCL	1776		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	554.3	95% Jackknife UCL	643.4
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A

95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	724.7	95% Chebyshev(Mean, Sd) UCL	895.5
97.5% Chebyshev(Mean, Sd) UCL	1133	99% Chebyshev(Mean, Sd) UCL	1599

Suggested UCL to Use

95% Student's-t UCL	643.4

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_Hg (ob-05)

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	0
Minimum	626.2	Mean	981.4
Maximum	1613	Median	930.8
SD	290.1	Std. Error of Mean	87.48
Coefficient of Variation	0.296	Skewness	1.097

Normal GOF Test

Shapiro Wilk Test Statistic	0.909	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.192	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1140	95% Adjusted-CLT UCL (Chen-1995)	1156
		95% Modified-t UCL (Johnson-1978)	1145

Gamma GOF Test

A-D Test Statistic	0.331	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.2	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.255	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	13.93	k star (bias corrected MLE)	10.19

Appendix A-35b
UCL Evaluation - Sample Area for Mink
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Theta hat (MLE)	70.47	Theta star (bias corrected MLE)	96.32
nu hat (MLE)	306.4	nu star (bias corrected)	224.1
MLE Mean (bias corrected)	981.4	MLE Sd (bias corrected)	307.5
		Approximate Chi Square Value (0.05)	190.5
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	185.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1155	95% Adjusted Gamma UCL (use when n<50)	1186

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.958	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.186	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.251	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.44	Mean of logged Data	6.853
Maximum of Logged Data	7.386	SD of logged Data	0.277

Assuming Lognormal Distribution

95% H-UCL	1165	90% Chebyshev (MVUE) UCL	1228
95% Chebyshev (MVUE) UCL	1340	97.5% Chebyshev (MVUE) UCL	1496
99% Chebyshev (MVUE) UCL	1802		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1125	95% Jackknife UCL	1140
95% Standard Bootstrap UCL	1121	95% Bootstrap-t UCL	1199
95% Hall's Bootstrap UCL	1242	95% Percentile Bootstrap UCL	1134
95% BCA Bootstrap UCL	1150		
90% Chebyshev(Mean, Sd) UCL	1244	95% Chebyshev(Mean, Sd) UCL	1363
97.5% Chebyshev(Mean, Sd) UCL	1528	99% Chebyshev(Mean, Sd) UCL	1852

Suggested UCL to Use

95% Student's-t UCL	1140

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-36a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Methyl Mercury	UOM
BO-04	BO-05.2016	2016	7.86	NG/G
BO-04	BO-05.2017	2017	2.50	NG/G
ES-13	ES-13.2016	2016	16.8	NG/G
ES-13	VE-53.2016	2016	13.6	NG/G
ES-13	W-61-High.2016	2016	4.87	NG/G
ES-13	W-61-Intertidal.2016	2016	5.59	NG/G
ES-13	W-61-Low.2016	2016	18.8	NG/G
ES-13	ES-13.2017	2017	7.43	NG/G
ES-13	SVE-02INT.2017	2017	3.93	NG/G
ES-13	VE-10-01-E.2017	2017	24.6	NG/G
ES-13	VI-W.2017	2017	2.27	NG/G
ES-13	W-61-High.2017	2017	6.50	NG/G
ES-13	W-61-Intertidal.2017	2017	6.83	NG/G
ES-13	W-61-Low.2017	2017	17.1	NG/G
ES-FP	ESFP.2017	2017	1.00	NG/G
ES-FP	ES-FP.2017	2017	1.00	NG/G
ES-FP	ES-FP-W.2017	2017	0.900	NG/G
MM	MM-50.2016	2016	0.387	NG/G
MM	MM-51.2016	2016	2.30	NG/G
MM	MM-64.2016	2016	2.17	NG/G
MM	MM-65.2016	2016	12.5	NG/G
MM	MM-66.2016	2016	0.509	NG/G
MM	MMPOLY.2016	2016	7.83	NG/G
MM	W-21-High.2016	2016	15.8	NG/G
MM	W-21-Intertidal.2016	2016	2.36	NG/G
MM	W-21-Low.2016	2016	2.68	NG/G
MM	W-21-Mid.2016	2016	2.77	NG/G
MM	W-21-UM-Central-C.2016	2016	7.02	NG/G
MM	W-21-UM-East-C.2016	2016	1.28	NG/G
MM	W-21-UM-West-A.2016	2016	0.713	NG/G
MM	W-65-High.2016	2016	0.116	NG/G
MM	W-65-Intertidal.2016	2016	0.207	NG/G
MM	W-65-Low.2016	2016	0.0335	NG/G
MM	W-65-Mid.2016	2016	5.27	NG/G
MM	MM-04-01-F.2017	2017	10.5	NG/G
MM	MM-64THRU67.2017	2017	3.48	NG/G
MM	MM-MR.2017	2017	1.53	NG/G
MM	MM-MR-INT.2017	2017	3.47	NG/G
MM	MMSE-1_N1.2017	2017	13.1	NG/G

Appendix A-36a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Methyl Mercury	UOM
MM	MMSE-1_N2.2017	2017	5.27	NG/G
MM	MMSE-1_S1.2017	2017	14.0	NG/G
MM	MMSE-1_S2.2017	2017	4.63	NG/G
MM	MMSW-C_N.2017	2017	17.1	NG/G
MM	MMSW-C_S.2017	2017	3.90	NG/G
MM	MMSW-C_SW.2017	2017	2.87	NG/G
MM	W-21-High.2017	2017	3.27	NG/G
MM	W-21-Intertidal.2017	2017	3.20	NG/G
MM	W-21-Low.2017	2017	4.33	NG/G
MM	W-21-Mid.2017	2017	3.90	NG/G
MM	W-21-UM-Central-C.2017	2017	14.2	NG/G
MM	W-21-UM-East-C.2017	2017	18.9	NG/G
MM	W-21-UM-West-A.2017	2017	3.10	NG/G
MM	W-65-High.2017	2017	17.9	NG/G
MM	W-65-Intertidal.2017	2017	2.77	NG/G
MM	W-65-Low.2017	2017	5.67	NG/G
MM	W-65-Mid.2017	2017	14.3	NG/G
MM	W-MM-01.2017	2017	30.1	NG/G
MM	W-MM-02.2017	2017	19.2	NG/G
MM	W-MM-03.2017	2017	3.73	NG/G
MM	W-MM-04.2017	2017	6.77	NG/G
MM	W-MM-05.2017	2017	14.9	NG/G
MM	W-MM-06.2017	2017	12.8	NG/G
MM	W-MM-07.2017	2017	11.7	NG/G
MM	W-MM-08.2017	2017	17.4	NG/G
MM	W-MM-09.2017	2017	2.43	NG/G
MM	W-MM-10.2017	2017	2.27	NG/G
MM	W-MM-11.2017	2017	15.9	NG/G
MM	W-MM-12.2017	2017	7.73	NG/G
MM	W-MM-13.2017	2017	10.9	NG/G
MM	W-MM-14.2017	2017	19.0	NG/G
MM	W-MM-15.2017	2017	3.40	NG/G
MM	W-MM-TP.2017	2017	1.93	NG/G
OB-01	MM-50.2016	2016	0.387	NG/G
OB-01	MMPOLY.2016	2016	7.83	NG/G
OB-01	W-17-Intertidal.2016	2016	2.20	NG/G
OB-01	W-17-Low.2016	2016	2.85	NG/G
OB-01	W-17-Mid-2016.2016	2016	3.01	NG/G
OB-01	W-65-High.2016	2016	0.116	NG/G

Appendix A-36a
UCL Evaluation - ProUCL Input
Sediment Methyl Mercury Data Set for Mink

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Year	Methyl Mercury	UOM
OB-01	W-65-Intertidal.2016	2016	0.207	NG/G
OB-01	W-65-Low.2016	2016	0.0335	NG/G
OB-01	W-65-Mid.2016	2016	5.27	NG/G
OB-01	FF-08-02-G.2017	2017	13.4	NG/G
OB-01	MM-04-01-F.2017	2017	10.5	NG/G
OB-01	MM-MR.2017	2017	1.53	NG/G
OB-01	MM-MR-INT.2017	2017	3.47	NG/G
OB-01	MMSE-1_N1.2017	2017	13.1	NG/G
OB-01	MMSE-1_N2.2017	2017	5.27	NG/G
OB-01	MMSE-1_S1.2017	2017	14.0	NG/G
OB-01	MMSE-1_S2.2017	2017	4.63	NG/G
OB-01	W-17-High.2017	2017	16.3	NG/G
OB-01	W-17-Intertidal.2017	2017	5.17	NG/G
OB-01	W-17-Low.2017	2017	9.10	NG/G
OB-01	W-17-Mid.2017	2017	11.8	NG/G
OB-01	W-65-High.2017	2017	17.9	NG/G
OB-01	W-65-Intertidal.2017	2017	2.77	NG/G
OB-01	W-65-Low.2017	2017	5.67	NG/G
OB-01	W-65-Mid.2017	2017	14.3	NG/G
OB-01	W-MM-01.2017	2017	30.1	NG/G
OB-01	W-MM-02.2017	2017	19.2	NG/G
OB-01	W-MM-03.2017	2017	3.73	NG/G
OB-01	W-MM-04.2017	2017	6.77	NG/G
OB-01	W-MM-11.2017	2017	15.9	NG/G
OB-01	W-MM-12.2017	2017	7.73	NG/G
OB-01	W-MM-13.2017	2017	10.9	NG/G
OB-01	W-MM-TP.2017	2017	1.93	NG/G
OB-04	OB-04.2017	2017	4.30	NG/G
OB-04	W-14-INTA.2017	2017	3.73	NG/G
OB-04	WP-02-01-D.2017	2017	11.9	NG/G
OB-05	OB-05.2016	2016	11.3	NG/G
OB-05	W-63-Intertidal.2016	2016	11.2	NG/G
OB-05	OB-05.2017	2017	5.77	NG/G
OB-05	ON-10-01-C.2017	2017	32.9	NG/G
OB-05	W-104-INTA.2017	2017	10.2	NG/G
OB-05	W-104-INTB.2017	2017	4.77	NG/G
OB-05	W-63-INT.2017	2017	17.5	NG/G

Appendix A-36b
UCL Evaluation - Sample Area for Mink
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/30/2018 9:34:31 AM
From File	2018_01_29 Sediment_Mink_v2.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

IPWC_MeHg (bo-04)

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	2.5	Mean	5.18
Maximum	7.86	Median	5.18

Warning: This data set only has 2 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable IPWC_MeHg (bo-04) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

IPWC_MeHg (es-13)

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	4
Minimum	2.267	Mean	10.69
Maximum	24.57	Median	7.133
SD	7.165	Std. Error of Mean	2.068
Coefficient of Variation	0.67	Skewness	0.688

Normal GOF Test

Shapiro Wilk Test Statistic	0.894	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.859	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.259	Lilliefors GOF Test
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL | 95% UCLs (Adjusted for Skewness)

Appendix A-36b
UCL Evaluation - Sample Area for Mink Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

95% Student's-t UCL	14.41	95% Adjusted-CLT UCL (Chen-1995)	14.53
		95% Modified-t UCL (Johnson-1978)	14.47

Gamma GOF Test

A-D Test Statistic	0.413	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.201	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.248	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.346	k star (bias corrected MLE)	1.815
Theta hat (MLE)	4.556	Theta star (bias corrected MLE)	5.889
nu hat (MLE)	56.31	nu star (bias corrected)	43.57
MLE Mean (bias corrected)	10.69	MLE Sd (bias corrected)	7.935
		Approximate Chi Square Value (0.05)	29.43
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	27.67

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	15.83	95% Adjusted Gamma UCL (use when n<50)	16.83

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.157	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.818	Mean of logged Data	2.141
Maximum of Logged Data	3.201	SD of logged Data	0.732

Assuming Lognormal Distribution

95% H-UCL	19.16	90% Chebyshev (MVUE) UCL	18.01
95% Chebyshev (MVUE) UCL	21.26	97.5% Chebyshev (MVUE) UCL	25.77
99% Chebyshev (MVUE) UCL	34.63		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	14.09	95% Jackknife UCL	14.41
95% Standard Bootstrap UCL	13.97	95% Bootstrap-t UCL	15.25
95% Hall's Bootstrap UCL	14.15	95% Percentile Bootstrap UCL	14.07
95% BCA Bootstrap UCL	14.53		
90% Chebyshev(Mean, Sd) UCL	16.9	95% Chebyshev(Mean, Sd) UCL	19.71

97.5% Chebyshev(Mean, Sd) UCL	23.61	99% Chebyshev(Mean, Sd) UCL	31.27

Suggested UCL to Use

95% Student's-t UCL	14.41

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (es-fp)

General Statistics

Total Number of Observations	3	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	0.9	Mean	0.967
Maximum	1	Median	1
SD	0.0577	Std. Error of Mean	0.0333
Coefficient of Variation	0.0597	Skewness	-1.732

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.385	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.064	95% Adjusted-CLT UCL (Chen-1995)	0.986
		95% Modified-t UCL (Johnson-1978)	1.058

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	410.5	k star (bias corrected MLE)	N/A

Appendix A-36b
UCL Evaluation - Sample Area for Mink
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Theta hat (MLE)	0.00236	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	2463	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.385	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.105	Mean of logged Data	-0.0351
Maximum of Logged Data	0	SD of logged Data	0.0608

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	1.068
95% Chebyshev (MVUE) UCL	1.115	97.5% Chebyshev (MVUE) UCL	1.179
99% Chebyshev (MVUE) UCL	1.304		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1.021	95% Jackknife UCL	N/A
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.067	95% Chebyshev(Mean, Sd) UCL	1.112
97.5% Chebyshev(Mean, Sd) UCL	1.175	99% Chebyshev(Mean, Sd) UCL	1.298

Suggested UCL to Use

95% Student's-t UCL	1.064

Recommended UCL exceeds the maximum observation

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

Appendix A-36b
UCL Evaluation - Sample Area for Mink
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

IPWC_MeHg (mm)

General Statistics

Total Number of Observations	55	Number of Distinct Observations	54
		Number of Missing Observations	31
Minimum	0.0335	Mean	7.556
Maximum	30.13	Median	4.333
SD	6.772	Std. Error of Mean	0.913
Coefficient of Variation	0.896	Skewness	1.063

Normal GOF Test

Shapiro Wilk Test Statistic	0.863	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	1.3094E-6	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.196	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.119	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.084	95% Adjusted-CLT UCL (Chen-1995)	9.197
		95% Modified-t UCL (Johnson-1978)	9.106

Gamma GOF Test

A-D Test Statistic	0.747	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.779	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0998	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.123	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.003	k star (bias corrected MLE)	0.961
Theta hat (MLE)	7.529	Theta star (bias corrected MLE)	7.863
nu hat (MLE)	110.4	nu star (bias corrected)	105.7
MLE Mean (bias corrected)	7.556	MLE Sd (bias corrected)	7.708
		Approximate Chi Square Value (0.05)	82.97
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	82.43

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	9.625	95% Adjusted Gamma UCL (use when n<50)	9.688

Appendix A-36b
UCL Evaluation - Sample Area for Mink
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.889	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	2.7105E-5	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.146	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.119	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.396	Mean of logged Data	1.447
Maximum of Logged Data	3.406	SD of logged Data	1.353

Assuming Lognormal Distribution

95% H-UCL	17.91	90% Chebyshev (MVUE) UCL	17.58
95% Chebyshev (MVUE) UCL	20.87	97.5% Chebyshev (MVUE) UCL	25.45
99% Chebyshev (MVUE) UCL	34.43		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	9.057	95% Jackknife UCL	9.084
95% Standard Bootstrap UCL	9	95% Bootstrap-t UCL	9.228
95% Hall's Bootstrap UCL	9.283	95% Percentile Bootstrap UCL	9.098
95% BCA Bootstrap UCL	9.257		
90% Chebyshev(Mean, Sd) UCL	10.29	95% Chebyshev(Mean, Sd) UCL	11.54
97.5% Chebyshev(Mean, Sd) UCL	13.26	99% Chebyshev(Mean, Sd) UCL	16.64

Suggested UCL to Use

95% Approximate Gamma UCL	9.625

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (ob-01)

General Statistics

Total Number of Observations	33	Number of Distinct Observations	33
		Number of Missing Observations	22
Minimum	0.0335	Mean	8.091
Maximum	30.13	Median	5.667
SD	6.891	Std. Error of Mean	1.2
Coefficient of Variation	0.852	Skewness	1.161

Appendix A-36b
UCL Evaluation - Sample Area for Mink
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.903	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.931	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.153	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.152	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	10.12	95% Adjusted-CLT UCL (Chen-1995)	10.32
		95% Modified-t UCL (Johnson-1978)	10.16

Gamma GOF Test

A-D Test Statistic	0.532	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.779	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0924	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.158	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.935	k star (bias corrected MLE)	0.87
Theta hat (MLE)	8.655	Theta star (bias corrected MLE)	9.299
nu hat (MLE)	61.7	nu star (bias corrected)	57.43
MLE Mean (bias corrected)	8.091	MLE Sd (bias corrected)	8.674
		Approximate Chi Square Value (0.05)	41.01
Adjusted Level of Significance	0.0419	Adjusted Chi Square Value	40.29

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	11.33	95% Adjusted Gamma UCL (use when n<50)	11.53

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.839	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.931	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.173	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.152	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.396	Mean of logged Data	1.468
Maximum of Logged Data	3.406	SD of logged Data	1.537

Assuming Lognormal Distribution

95% H-UCL	33.35	90% Chebyshev (MVUE) UCL	26.74
95% Chebyshev (MVUE) UCL	32.89	97.5% Chebyshev (MVUE) UCL	41.42
99% Chebyshev (MVUE) UCL	58.18		

Appendix A-36b
UCL Evaluation - Sample Area for Mink
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	10.06	95% Jackknife UCL	10.12
95% Standard Bootstrap UCL	10.03	95% Bootstrap-t UCL	10.5
95% Hall's Bootstrap UCL	10.66	95% Percentile Bootstrap UCL	10.17
95% BCA Bootstrap UCL	10.36		
90% Chebyshev(Mean, Sd) UCL	11.69	95% Chebyshev(Mean, Sd) UCL	13.32
97.5% Chebyshev(Mean, Sd) UCL	15.58	99% Chebyshev(Mean, Sd) UCL	20.03

Suggested UCL to Use

95% Adjusted Gamma UCL	11.53

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (ob-04)

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	1
Minimum	3.733	Mean	6.656
Maximum	11.93	Median	4.3
SD	4.579	Std. Error of Mean	2.644
Coefficient of Variation	0.688	Skewness	1.702

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.802	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.363	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.38	95% Adjusted-CLT UCL (Chen-1995)	13.78

Appendix A-36b
UCL Evaluation - Sample Area for Mink
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

		95% Modified-t UCL (Johnson-1978)	14.81

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	3.638	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.83	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	21.83	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.84	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.345	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.317	Mean of logged Data	1.752
Maximum of Logged Data	2.479	SD of logged Data	0.634

Assuming Lognormal Distribution

95% H-UCL	285.3	90% Chebyshev (MVUE) UCL	13.43
95% Chebyshev (MVUE) UCL	16.54	97.5% Chebyshev (MVUE) UCL	20.86
99% Chebyshev (MVUE) UCL	29.35		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	11	95% Jackknife UCL	14.38
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	14.59	95% Chebyshev(Mean, Sd) UCL	18.18
97.5% Chebyshev(Mean, Sd) UCL	23.17	99% Chebyshev(Mean, Sd) UCL	32.96

Suggested UCL to Use

95% Student's-t UCL	14.38

Appendix A-36b
UCL Evaluation - Sample Area for Mink Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

IPWC_MeHg (ob-05)

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	4
Minimum	4.767	Mean	13.38
Maximum	32.9	Median	11.2
SD	9.573	Std. Error of Mean	3.618
Coefficient of Variation	0.716	Skewness	1.698

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.822	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.3	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	20.41	95% Adjusted-CLT UCL (Chen-1995)	21.81
		95% Modified-t UCL (Johnson-1978)	20.79

Gamma GOF Test

A-D Test Statistic	0.339	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.713	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.243	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.314	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.801	k star (bias corrected MLE)	1.696
Theta hat (MLE)	4.776	Theta star (bias corrected MLE)	7.889
nu hat (MLE)	39.21	nu star (bias corrected)	23.74

Appendix A-36b
UCL Evaluation - Sample Area for Mink
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

MLE Mean (bias corrected)	13.38	MLE Sd (bias corrected)	10.27
		Approximate Chi Square Value (0.05)	13.65
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	11.41

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	23.26	95% Adjusted Gamma UCL (use when n<50)	27.83

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.202	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.562	Mean of logged Data	2.404
Maximum of Logged Data	3.493	SD of logged Data	0.651

Assuming Lognormal Distribution

95% H-UCL	28.7	90% Chebyshev (MVUE) UCL	23.04
95% Chebyshev (MVUE) UCL	27.49	97.5% Chebyshev (MVUE) UCL	33.67
99% Chebyshev (MVUE) UCL	45.79		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	19.33	95% Jackknife UCL	20.41
95% Standard Bootstrap UCL	19.03	95% Bootstrap-t UCL	28.63
95% Hall's Bootstrap UCL	52.22	95% Percentile Bootstrap UCL	19.46
95% BCA Bootstrap UCL	20.5		
90% Chebyshev(Mean, Sd) UCL	24.23	95% Chebyshev(Mean, Sd) UCL	29.15
97.5% Chebyshev(Mean, Sd) UCL	35.97	99% Chebyshev(Mean, Sd) UCL	49.38

Suggested UCL to Use

95% Student's-t UCL	20.41

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-37a
UCL Evaluation - ProUCL Input for Red-winged blackbird
Sediment (Mercury & Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_RWB	ID	Year	Mercury	Methyl Mercury	UOM
mmse	MMSE-1_N1.2017	2017	1851	13.1	NG/G
mmse	MMSE-1_S1.2017	2017	282	14.0	NG/G
mmse	MMSE-1_S2.2017	2017	320	4.63	NG/G
mmse	W-65-High.2017	2017	201	17.9	NG/G
mmse	W-65-Mid.2017	2017	161	14.3	NG/G
mmse	W-MM-13.2017	2017	307	10.9	NG/G
mmsw	MMSW-C_N.2017	2017	899	17.1	NG/G
mmsw	MMSW-C_S.2017	2017	965	3.90	NG/G
mmsw	W-21-UM-Central-C.2017	2017	265	14.2	NG/G
mmsw	W-MM-08.2017	2017	793	17.4	NG/G
w17	W-17-HIGH_072116_SED_03	2016	1267	38.0	NG/G
w17	W-17-MID_072116_SED_03	2016	1179	5.15	NG/G
w17	W-17-NW.2017	2017	403	6.67	NG/G
mmsw	MM-T3-C5-C.2017	2017	905	NA_0	NG/G
mmsw	MM-T3-C6.2017	2017	438	NA_0	NG/G

Appendix A-37b
UCL Evaluation - Sample Area for Red-winged blackbird
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/31/2018 12:31:12 PM
From File	2018-01-31 SED_RWB_1617.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (mmse)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	161.2	Mean	520.5
Maximum	1851	Median	294.5
SD	655	Std. Error of Mean	267.4
Coefficient of Variation	1.258	Skewness	2.399

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.587	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.453	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1059	95% Adjusted-CLT UCL (Chen-1995)	1240
		95% Modified-t UCL (Johnson-1978)	1103

Gamma GOF Test

A-D Test Statistic	0.985	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.71	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.422	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.338	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.352	k star (bias corrected MLE)	0.787

Appendix A-37b
UCL Evaluation - Sample Area for Red-winged blackbird
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Theta hat (MLE)	385	Theta star (bias corrected MLE)	661.4
nu hat (MLE)	16.22	nu star (bias corrected)	9.444
MLE Mean (bias corrected)	520.5	MLE Sd (bias corrected)	586.7
		Approximate Chi Square Value (0.05)	3.597
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	2.422

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1366	95% Adjusted Gamma UCL (use when n<50)	2029

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.777	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.367	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.083	Mean of logged Data	5.841
Maximum of Logged Data	7.524	SD of logged Data	0.866

Assuming Lognormal Distribution

95% H-UCL	2078	90% Chebyshev (MVUE) UCL	952.6
95% Chebyshev (MVUE) UCL	1174	97.5% Chebyshev (MVUE) UCL	1480
99% Chebyshev (MVUE) UCL	2083		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	960.3	95% Jackknife UCL	1059
95% Standard Bootstrap UCL	926.8	95% Bootstrap-t UCL	3971
95% Hall's Bootstrap UCL	4855	95% Percentile Bootstrap UCL	1046
95% BCA Bootstrap UCL	1295		
90% Chebyshev(Mean, Sd) UCL	1323	95% Chebyshev(Mean, Sd) UCL	1686
97.5% Chebyshev(Mean, Sd) UCL	2190	99% Chebyshev(Mean, Sd) UCL	3181

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	1686

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (mmsw)

Appendix A-37b
UCL Evaluation - Sample Area for Red-winged blackbird
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	265	Mean	710.8
Maximum	965.4	Median	846
SD	289.1	Std. Error of Mean	118
Coefficient of Variation	0.407	Skewness	-0.968

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.835	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.278	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	948.6	95% Adjusted-CLT UCL (Chen-1995)	855.1
		95% Modified-t UCL (Johnson-1978)	940.9

Gamma GOF Test

A-D Test Statistic	0.662	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.322	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.337	k star (bias corrected MLE)	2.78
Theta hat (MLE)	133.2	Theta star (bias corrected MLE)	255.7
nu hat (MLE)	64.04	nu star (bias corrected)	33.36
MLE Mean (bias corrected)	710.8	MLE Sd (bias corrected)	426.4
		Approximate Chi Square Value (0.05)	21.15
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	17.73

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1121	95% Adjusted Gamma UCL (use when n<50)	1337

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.798	**Shapiro Wilk Lognormal GOF Test**

5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.319	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.58	Mean of logged Data	6.47
Maximum of Logged Data	6.873	SD of logged Data	0.524

Assuming Lognormal Distribution

95% H-UCL	1392	90% Chebyshev (MVUE) UCL	1185
95% Chebyshev (MVUE) UCL	1394	97.5% Chebyshev (MVUE) UCL	1685
99% Chebyshev (MVUE) UCL	2256		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	904.9	95% Jackknife UCL	948.6
95% Standard Bootstrap UCL	890.8	95% Bootstrap-t UCL	904.2
95% Hall's Bootstrap UCL	833	95% Percentile Bootstrap UCL	892.6
95% BCA Bootstrap UCL	864.7		
90% Chebyshev(Mean, Sd) UCL	1065	95% Chebyshev(Mean, Sd) UCL	1225
97.5% Chebyshev(Mean, Sd) UCL	1448	99% Chebyshev(Mean, Sd) UCL	1885

Suggested UCL to Use

95% Student's-t UCL	948.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Mercury (w17)

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	403	Mean	949.7
Maximum	1267	Median	1179
SD	475.4	Std. Error of Mean	274.5
Coefficient of Variation	0.501	Skewness	-1.667

Appendix A-37b
UCL Evaluation - Sample Area for Red-winged blackbird
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.825	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.352	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1751	95% Adjusted-CLT UCL (Chen-1995)	1119
		95% Modified-t UCL (Johnson-1978)	1707

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	4.414	k star (bias corrected MLE)	N/A
Theta hat (MLE)	215.1	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	26.49	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.797	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.365	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.999	Mean of logged Data	6.739
Maximum of Logged Data	7.144	SD of logged Data	0.642

Assuming Lognormal Distribution

95% H-UCL	45884	90% Chebyshev (MVUE) UCL	1984
95% Chebyshev (MVUE) UCL	2446	97.5% Chebyshev (MVUE) UCL	3088

Appendix A-37b
UCL Evaluation - Sample Area for Red-winged blackbird
Sediment (Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

99% Chebyshev (MVUE) UCL	4347

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1401	95% Jackknife UCL	1751
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1773	95% Chebyshev(Mean, Sd) UCL	2146
97.5% Chebyshev(Mean, Sd) UCL	2664	99% Chebyshev(Mean, Sd) UCL	3681

Suggested UCL to Use

95% Student's-t UCL	1751

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Appendix A-37c
UCL Evaluation - Sample Area for Red-winged blackbird
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.11/26/2018 2:35:35 PM
From File	2018-01-26 SED_RWB_1617.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Methyl Mercury (mmse)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	4.633	Mean	12.46
Maximum	17.87	Median	13.53
SD	4.447	Std. Error of Mean	1.815
Coefficient of Variation	0.357	Skewness	-1.072

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.919	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.224	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	16.11	95% Adjusted-CLT UCL (Chen-1995)	14.59
		95% Modified-t UCL (Johnson-1978)	15.98

Gamma GOF Test

A-D Test Statistic	0.567	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.269	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.672	k star (bias corrected MLE)	3.447

Appendix A-37c
UCL Evaluation - Sample Area for Red-winged blackbird
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Theta hat (MLE)	1.867	Theta star (bias corrected MLE)	3.613
nu hat (MLE)	80.07	nu star (bias corrected)	41.37
MLE Mean (bias corrected)	12.46	MLE Sd (bias corrected)	6.708
		Approximate Chi Square Value (0.05)	27.63
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	23.65

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	18.65	95% Adjusted Gamma UCL (use when n<50)	21.79

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.801	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.286	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.533	Mean of logged Data	2.445
Maximum of Logged Data	2.883	SD of logged Data	0.474

Assuming Lognormal Distribution

95% H-UCL	22.3	90% Chebyshev (MVUE) UCL	19.99
95% Chebyshev (MVUE) UCL	23.32	97.5% Chebyshev (MVUE) UCL	27.93
99% Chebyshev (MVUE) UCL	37		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	15.44	95% Jackknife UCL	16.11
95% Standard Bootstrap UCL	15.15	95% Bootstrap-t UCL	15.39
95% Hall's Bootstrap UCL	14.84	95% Percentile Bootstrap UCL	14.91
95% BCA Bootstrap UCL	14.81		
90% Chebyshev(Mean, Sd) UCL	17.9	95% Chebyshev(Mean, Sd) UCL	20.37
97.5% Chebyshev(Mean, Sd) UCL	23.79	99% Chebyshev(Mean, Sd) UCL	30.52

Suggested UCL to Use

95% Student's-t UCL	16.11

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Appendix A-37c
UCL Evaluation - Sample Area for Red-winged blackbird
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Methyl Mercury (mmsw)

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3.9	Mean	13.15
Maximum	17.4	Median	15.65
SD	6.338	Std. Error of Mean	3.169
Coefficient of Variation	0.482	Skewness	-1.703

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.793	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.314	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	20.61	95% Adjusted-CLT UCL (Chen-1995)	15.48
		95% Modified-t UCL (Johnson-1978)	20.16

Gamma GOF Test

A-D Test Statistic	0.675	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.659	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.375	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.512	k star (bias corrected MLE)	1.045
Theta hat (MLE)	3.745	Theta star (bias corrected MLE)	12.59
nu hat (MLE)	28.09	nu star (bias corrected)	8.357
MLE Mean (bias corrected)	13.15	MLE Sd (bias corrected)	12.87
		Approximate Chi Square Value (0.05)	2.943
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	37.34	95% Adjusted Gamma UCL (use when n<50)	N/A

Appendix A-37c
UCL Evaluation - Sample Area for Red-winged blackbird
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.728	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.372	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.361	Mean of logged Data	2.427
Maximum of Logged Data	2.856	SD of logged Data	0.717

Assuming Lognormal Distribution

95% H-UCL	111.6	90% Chebyshev (MVUE) UCL	27.76
95% Chebyshev (MVUE) UCL	34.16	97.5% Chebyshev (MVUE) UCL	43.04
99% Chebyshev (MVUE) UCL	60.47		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	18.36	95% Jackknife UCL	20.61
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	22.66	95% Chebyshev(Mean, Sd) UCL	26.96
97.5% Chebyshev(Mean, Sd) UCL	32.94	99% Chebyshev(Mean, Sd) UCL	44.68

Suggested UCL to Use

95% Student's-t UCL 20.61

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Methyl Mercury (w17)

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3

Appendix A-37c
UCL Evaluation - Sample Area for Red-winged blackbird
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

		Number of Missing Observations	0
Minimum	5.151	Mean	16.6
Maximum	37.99	Median	6.667
SD	18.54	Std. Error of Mean	10.7
Coefficient of Variation	1.117	Skewness	1.719

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.785	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.371	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	47.86	95% Adjusted-CLT UCL (Chen-1995)	45.56
		95% Modified-t UCL (Johnson-1978)	49.63

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	1.337	k star (bias corrected MLE)	N/A
Theta hat (MLE)	12.42	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	8.023	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.845	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.342	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.639	Mean of logged Data	2.391

Appendix A-37c
UCL Evaluation - Sample Area for Red-winged blackbird
Sediment (Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Maximum of Logged Data	3.637	SD of logged Data	1.087

Assuming Lognormal Distribution

95% H-UCL	1073768	90% Chebyshev (MVUE) UCL	41.55
95% Chebyshev (MVUE) UCL	53.26	97.5% Chebyshev (MVUE) UCL	69.53
99% Chebyshev (MVUE) UCL	101.5		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	34.21	95% Jackknife UCL	47.86
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	48.72	95% Chebyshev(Mean, Sd) UCL	63.26
97.5% Chebyshev(Mean, Sd) UCL	83.45	99% Chebyshev(Mean, Sd) UCL	123.1

Suggested UCL to Use

95% Student's-t UCL	47.86

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-38a
UCL Evaluation - ProUCL Input
Sediment Mercury and Methyl Mercury Data Set for Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

EA_Sediment	ID	Date	Mercury	D_Mercury	Methyl Mercury	D_Methyl Mercury	UOM
REFERENCE	ADD-01.2016	7/21/2016	29.6	1	0.693	1	NG/G
REFERENCE	ADD-01.2017	7/18/2017	23.92	1	4.42	1	NG/G
REFERENCE	ADD-02.2016	7/22/2016	32.6	1	2.4	1	NG/G
REFERENCE	ADD-02.2017	7/24/2017	35.7	1	2.1	1	NG/G
REFERENCE	FRB-01_092816_SED_03	9/28/2016	7.53	1	0.071	0	NG/G
REFERENCE	FBJR.2017	9/27/2017	27.4	1	1.6	1	NG/G

Appendix A-38b
UCL Evaluation - Reference Area
Sediment (Mercury and Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.1/13/2018 1:03:37 PM
From File	38_Sediment Reference_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	7.53	Mean	26.13
Maximum	35.7	Median	28.5
SD	9.979	Std. Error of Mean	4.074
Coefficient of Variation	0.382	Skewness	-1.584

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.864	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.246	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	34.33	95% Adjusted-CLT UCL (Chen-1995)	30.01
		95% Modified-t UCL (Johnson-1978)	33.9

Gamma GOF Test

A-D Test Statistic	0.742	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.317	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Appendix A-38b
UCL Evaluation - Reference Area
Sediment (Mercury and Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	4.953	k star (bias corrected MLE)	2.588
Theta hat (MLE)	5.274	Theta star (bias corrected MLE)	10.1
nu hat (MLE)	59.44	nu star (bias corrected)	31.05
MLE Mean (bias corrected)	26.13	MLE Sd (bias corrected)	16.24
		Approximate Chi Square Value (0.05)	19.32
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	16.07

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	41.99	95% Adjusted Gamma UCL (use when n<50)	50.47

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.724	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.345	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.019	Mean of logged Data	3.159
Maximum of Logged Data	3.575	SD of logged Data	0.575

Assuming Lognormal Distribution

95% H-UCL	57.46	90% Chebyshev (MVUE) UCL	45.89
95% Chebyshev (MVUE) UCL	54.46	97.5% Chebyshev (MVUE) UCL	66.37
99% Chebyshev (MVUE) UCL	89.76		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	32.83	95% Jackknife UCL	34.33
95% Standard Bootstrap UCL	32.11	95% Bootstrap-t UCL	32
95% Hall's Bootstrap UCL	30.57	95% Percentile Bootstrap UCL	31.77
95% BCA Bootstrap UCL	30.75		
90% Chebyshev(Mean, Sd) UCL	38.35	95% Chebyshev(Mean, Sd) UCL	43.88
97.5% Chebyshev(Mean, Sd) UCL	51.57	99% Chebyshev(Mean, Sd) UCL	66.66

Suggested UCL to Use

95% Student's-t UCL	34.33

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-38b
UCL Evaluation - Reference Area
Sediment (Mercury and Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Methyl Mercury

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	1
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.693	Minimum Non-Detect	0.071
Maximum Detect	4.417	Maximum Non-Detect	0.071
Variance Detects	1.913	Percent Non-Detects	16.67%
Mean Detects	2.232	SD Detects	1.383
Median Detects	2.1	CV Detects	0.62
Skewness Detects	1.019	Kurtosis Detects	1.772
Mean of Logged Detects	0.635	SD of Logged Detects	0.677

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.939	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.252	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.872	KM Standard Error of Mean	0.633
KM SD	1.387	95% KM (BCA) UCL	2.879
95% KM (t) UCL	3.148	95% KM (Percentile Bootstrap) UCL	2.831
95% KM (z) UCL	2.913	95% KM Bootstrap t UCL	3.156
90% KM Chebyshev UCL	3.771	95% KM Chebyshev UCL	4.631
97.5% KM Chebyshev UCL	5.825	99% KM Chebyshev UCL	8.171

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.208	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.682	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.175	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.359	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-38b
UCL Evaluation - Reference Area
Sediment (Mercury and Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics on Detected Data Only

k hat (MLE)	3.133	k star (bias corrected MLE)	1.386
Theta hat (MLE)	0.712	Theta star (bias corrected MLE)	1.61
nu hat (MLE)	31.33	nu star (bias corrected)	13.86
Mean (detects)	2.232		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.862
Maximum	4.417	Median	1.825
SD	1.534	CV	0.824
k hat (MLE)	0.702	k star (bias corrected MLE)	0.462
Theta hat (MLE)	2.65	Theta star (bias corrected MLE)	4.027
nu hat (MLE)	8.429	nu star (bias corrected)	5.548
Adjusted Level of Significance (β)	0.0122		
Approximate Chi Square Value (5.55, α)	1.413	Adjusted Chi Square Value (5.55, β)	0.794
95% Gamma Approximate UCL (use when n>=50)	7.307	95% Gamma Adjusted UCL (use when n<50)	13.01

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.872	SD (KM)	1.387
Variance (KM)	1.924	SE of Mean (KM)	0.633
k hat (KM)	1.821	k star (KM)	1.022
nu hat (KM)	21.85	nu star (KM)	12.26
theta hat (KM)	1.028	theta star (KM)	1.832
80% gamma percentile (KM)	3.007	90% gamma percentile (KM)	4.287
95% gamma percentile (KM)	5.565	99% gamma percentile (KM)	8.528

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (12.26, α)	5.399	Adjusted Chi Square Value (12.26, β)	3.877
95% Gamma Approximate KM-UCL (use when n>=50)	4.251	95% Gamma Adjusted KM-UCL (use when n<50)	5.919

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.974	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.186	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Appendix A-38b
UCL Evaluation - Reference Area
Sediment (Mercury and Methyl Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.916	Mean in Log Scale	0.349
SD in Original Scale	1.459	SD in Log Scale	0.927
95% t UCL (assumes normality of ROS data)	3.116	95% Percentile Bootstrap UCL	2.881
95% BCA Bootstrap UCL	2.972	95% Bootstrap t UCL	3.538
95% H-UCL (Log ROS)	10.77		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.0882	KM Geo Mean	1.092
KM SD (logged)	1.342	95% Critical H Value (KM-Log)	5.313
KM Standard Error of Mean (logged)	0.612	95% H-UCL (KM -Log)	65.1
KM SD (logged)	1.342	95% Critical H Value (KM-Log)	5.313
KM Standard Error of Mean (logged)	0.612		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.866	Mean in Log Scale	-0.0273
SD in Original Scale	1.528	SD in Log Scale	1.731
95% t UCL (Assumes normality)	3.123	95% H-Stat UCL	791.2

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 3.148

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-39a
Sediment Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	MERCURY	UOM
BO-05.2016	2016	1793	NG/G
BO-05.2017	2017	78.8	NG/G
ES-13.2016	2016	416	NG/G
W-61-High.2016	2016	593	NG/G
EC-40AB.2016	2016	650	NG/G
W-61-Low.2016	2016	926	NG/G
VE-53.2016	2016	994	NG/G
W-61-Intertidal.2016	2016	1163	NG/G
VI-W.2017	2017	92.16	NG/G
W-61-High.2017	2017	166.4	NG/G
SVE-02INT.2017	2017	244.6	NG/G
VE-MU4-GC-1-E.2017	2017	264.3	NG/G
W-61-Intertidal.2017	2017	529	NG/G
ES-13.2017	2017	585.6	NG/G
VE-MU4-GC-1-F.2017	2017	671.6	NG/G
VE-10-01-E.2017	2017	765	NG/G
VE-10-01-C.2017	2017	800.8	NG/G
W-61-Low.2017	2017	844.2	NG/G
ESFP.2017	2017	12.31	NG/G
ES-FP.2017	2017	12.31	NG/G
ES-FP-W.2017	2017	31.04	NG/G
W-65-Low.2016	2016	32.5	NG/G
MM-50.2016	2016	37	NG/G
W-65-Intertidal.2016	2016	41.6	NG/G
W-65-High.2016	2016	84.3	NG/G
MM-66.2016	2016	137	NG/G
W-65-Mid.2016	2016	225	NG/G
W-21-UM-West-A.2016	2016	434	NG/G
MM-64.2016	2016	484	NG/G
W-21-Intertidal.2016	2016	543	NG/G
MMPOLY.2016	2016	554	NG/G
W-21-UM-Central-C.2016	2016	617	NG/G
W-21-Low.2016	2016	704	NG/G
W-21-UM-East-C.2016	2016	751	NG/G
MM-65.2016	2016	821	NG/G
W-21-Mid.2016	2016	869	NG/G
W-21-High.2016	2016	929	NG/G
MM-51.2016	2016	1140	NG/G
MM-T2-C4-B.2017	2017	51.75	NG/G
MM-T3-C1.2017	2017	71.1	NG/G

Appendix A-39a
Sediment Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	MERCURY	UOM
MM-T2-C7-A.2017	2017	76.63	NG/G
MM-T5-C2.2017	2017	82.07	NG/G
W-MM-03.2017	2017	112.8	NG/G
W-MM-TP.2017	2017	151.8	NG/G
MM-MR.2017	2017	154	NG/G
W-65-Mid.2017	2017	161.2	NG/G
MM-T1-C6.2017	2017	163.7	NG/G
W-21-UM-West-A.2017	2017	165.5	NG/G
MM-T1-C3-B.2017	2017	168.3	NG/G
W-65-Intertidal.2017	2017	196.6	NG/G
W-65-High.2017	2017	201	NG/G
MMSW-C_SW.2017	2017	207.4	NG/G
W-MM-10.2017	2017	225.8	NG/G
MM-T3-C7.2017	2017	255.6	NG/G
W-MM-15.2017	2017	257.6	NG/G
W-21-UM-Central-C.2017	2017	265	NG/G
MMSE-1_S1.2017	2017	282.4	NG/G
MM-T2-C5-A.2017	2017	306.2	NG/G
W-MM-13.2017	2017	306.6	NG/G
MMSE-1_S2.2017	2017	320.2	NG/G
MM-T3-C3-B2.2017	2017	327.9	NG/G
MM-T3-C3-C.2017	2017	330	NG/G
MM-T2-C1-B.2017	2017	371.8	NG/G
MMSE-1_N2.2017	2017	398.2	NG/G
W-MM-12.2017	2017	417.6	NG/G
MM-64THRU67.2017	2017	425	NG/G
MM-T3-C6.2017	2017	438	NG/G
W-MM-02.2017	2017	447.6	NG/G
W-MM-04.2017	2017	518.6	NG/G
W-MM-07.2017	2017	560.2	NG/G
MM-T3-C2-C.2017	2017	569.5	NG/G
W-MM-09.2017	2017	575	NG/G
W-MM-06.2017	2017	620	NG/G
W-MM-14.2017	2017	635.2	NG/G
MM-T2-C8-B.2017	2017	643.2	NG/G
W-MM-05.2017	2017	691.2	NG/G
MM-T2-C6-A.2017	2017	734.4	NG/G
MM-T1-C1-A.2017	2017	740.1	NG/G
MM-04-01-C.2017	2017	743	NG/G
MM-04-01-F.2017	2017	756	NG/G

Appendix A-39a
Sediment Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	MERCURY	UOM
MM-T1-C1-B.2017	2017	765	NG/G
W-21-Intertidal.2017	2017	780.2	NG/G
MM-T3-C4-D.2017	2017	790.9	NG/G
W-MM-08.2017	2017	792.6	NG/G
MM-T1-C2-D.2017	2017	792.6	NG/G
W-21-High.2017	2017	801.6	NG/G
MM-T1-C2-B.2017	2017	813.2	NG/G
MM-T3-C2-F.2017	2017	845	NG/G
MM-T3-C4-C.2017	2017	867.2	NG/G
W-21-Low.2017	2017	873.2	NG/G
MM-T1-C5.2017	2017	887.4	NG/G
MMSW-C_N.2017	2017	899.4	NG/G
MM-T3-C5-C.2017	2017	904.6	NG/G
W-21-Mid.2017	2017	927	NG/G
MM-MR-INT.2017	2017	932.2	NG/G
MM-T5-C3.2017	2017	947.9	NG/G
MMSW-C_S.2017	2017	965.4	NG/G
MM-T5-C1.2017	2017	1008	NG/G
W-21-UM-East-C.2017	2017	1008	NG/G
MM-T1-C4.2017	2017	1029	NG/G
W-65-Low.2017	2017	1049	NG/G
W-MM-11.2017	2017	1067	NG/G
MM-T2-C2-A.2017	2017	1246	NG/G
MM-C3-A.2017	2017	1413	NG/G
MM-T2-C3-A.2017	2017	1503	NG/G
W-MM-01.2017	2017	1786	NG/G
MMSE-1_N1.2017	2017	1851	NG/G
W-17-Low.2016	2016	471	NG/G
W-17-Intertidal.2016	2016	518	NG/G
W-17-Mid-2016.2016	2016	1179	NG/G
W-17-Intertidal.2017	2017	590	NG/G
FF-08-02-G.2017	2017	637.4	NG/G
FF-08-01-B.2017	2017	772	NG/G
W-17-Low.2017	2017	998	NG/G
W-17-High.2017	2017	1053	NG/G
FF-08-02-J.2017	2017	1086	NG/G
W-17-Mid.2017	2017	1269	NG/G
W-14-INTA.2017	2017	110.3	NG/G
OB-04.2017	2017	151	NG/G
WP-02-01-D.2017	2017	542.4	NG/G

Appendix A-39a
Sediment Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	MERCURY	UOM
WP-02-01-B.2017	2017	586	NG/G
OB-05.2016	2016	755	NG/G
W-63-Intertidal.2016	2016	1123	NG/G
ON-10-01-B.2017	2017	626.2	NG/G
W-104-INTB.2017	2017	779.8	NG/G
PBR-18-I.2017	2017	785.6	NG/G
W-104-INTA.2017	2017	797.2	NG/G
PBR-18-E.2017	2017	930.8	NG/G
OB-05.2017	2017	981.2	NG/G
W-63-INT.2017	2017	1073	NG/G
ON-10-01-C.2017	2017	1331	NG/G
PBR-19-A.2017	2017	1613	NG/G
EC39ABC_060916_ML_C	2016	896	NG/G
EC39ABC_060916_SED_C	2016	578	NG/G
ES-02_072716_SED_03	2016	961	NG/G
ES-13_072716_SED_03	2016	416.3	NG/G
ES-15_072716_SED_03	2016	151.3	NG/G
GP36ABC_060916_SED_C	2016	883	NG/G
VE-52	2016	96.3	NG/G
VE-58THRU60.2017	2017	675	NG/G
W-108-A.2017	2017	362.6	NG/G
W-109-A.2017	2017	137.2	NG/G
W-110-A.2017	2017	290	NG/G
W-61-HIGH_110816_SED_03	2016	593.7	NG/G
W-61-INT_110816_SED_03	2016	1163	NG/G
W-61-LOW_110816_SED_03	2016	926.7	NG/G
W-61-Mid.2017	2017	712.2	NG/G
W-61-MID_110816_SED_03	2016	1483	NG/G
FRB-01_092816_SED_03	2016	7.53	NG/G
BU-50THRU52.2017	2017	513	NG/G
BU24R_060716_SED_G	2016	82	NG/G
FF-51THRU52.2017	2017	1017	NG/G
FF3H_060616_SED_G	2016	83	NG/G
MM-50THRU56.2017	2017	449.5	NG/G
MM-62	2016	714	NG/G
MM-65	2016	821	NG/G
MM-71	2016	1040	NG/G
MMPOLY_072916_SED_03	2016	554.3	NG/G
W-102-A.2017	2017	2238	NG/G
W-102-B.2017	2017	588.8	NG/G

Appendix A-39a
Sediment Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	MERCURY	UOM
W-102-C.2017	2017	1188	NG/G
W-102-INTA.2017	2017	1250	NG/G
W-17-INTERTIDAL_072616_SED_03	2016	518.3	NG/G
W-17-LOW_072616_SED_03	2016	471	NG/G
W-17-NE.2017	2017	705	NG/G
W-17-NW.2017	2017	403	NG/G
W-21-HIGH_072516_SED_03	2016	929	NG/G
W-21-INTERTIDAL_072516_SED_03	2016	543.3	NG/G
W-21-LOW_072516_SED_03	2016	704.7	NG/G
W-21-MID_072516_SED_03	2016	869	NG/G
W-21-UM-South.2017	2017	418.8	NG/G
W-21UM-CENTRAL-C_072716_SED_03	2016	617.3	NG/G
W-21UM-EAST-C_072516_SED_03	2016	751.7	NG/G
W-21UM-SOUTH_072716_SED_03	2016	267	NG/G
W-21UM-WEST-A_07/27/16_SED_03	2016	434.3	NG/G
W-65-HIGH_072516_SED_03	2016	84.3	NG/G
W-65-INTERTIDAL_072516_SED_03	2016	41.77	NG/G
W-65-LOW_072516_SED_03	2016	32.57	NG/G
W-65-MID_072516_SED_03	2016	225.7	NG/G
W-MM-16.2017	2017	357	NG/G
W-MM-17.2017	2017	190.4	NG/G
W-MM-18.2017	2017	623.2	NG/G
W-MM-19.2017	2017	410	NG/G
W-MM-20.2017	2017	734.4	NG/G
W-MM-21.2017	2017	720.2	NG/G
W-MM-22.2017	2017	455.6	NG/G
W-MM-23.2017	2017	753.8	NG/G
OR-C1-A.2017	2017	803.7	NG/G
VE-09-01-B.2017	2017	744.2	NG/G
VE-09-01-E.2017	2017	731.8	NG/G
VN-03-01-B.2017	2017	716.6	NG/G
VN-03-01-D.2017	2017	722.6	NG/G
BU-01-01-C.2017	2017	873.2	NG/G
BU-08-01-A.2017	2017	641	NG/G
BU-08-01-E.2017	2017	599.2	NG/G
MM-C1-C.2017	2017	773.5	NG/G
MM-C2-C.2017	2017	812.4	NG/G
MM-T4-C1.2017	2017	914.8	NG/G
MM-T4-C2-D.2017	2017	597.5	NG/G
MM-T4-C2-F.2017	2017	632.2	NG/G

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Sediment Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	MERCURY	UOM
MM-T4-C3-C.2017	2017	798.6	NG/G
MM-T4-C4-A.2017	2017	881.9	NG/G
MM-T4-C5.2017	2017	940.7	NG/G
MM-T4-C6.2017	2017	1215	NG/G
MM-T4-C7.2017	2017	538	NG/G
HA-01.2016	2016	438	NG/G
EC-37ABCDE.2016	2016	842	NG/G
EC-39ABC.2016	2016	737	NG/G
VE-50.2016	2016	1670	NG/G
VE-59.2016	2016	1010	NG/G
VE-60.2016	2016	1420	NG/G
VN-56.2016	2016	1340	NG/G
VN-73.2016	2016	876	NG/G
VN-80.2016	2016	1170	NG/G
OR-01-04.2017	2017	915	NG/G
OR-01-05.2017	2017	817.4	NG/G
OR-02-03.2017	2017	781.8	NG/G
OR-T1-C1-B.2017	2017	804.4	NG/G
OR-T1-C1-D.2017	2017	610.6	NG/G
OR-T1-C2-B.2017	2017	754.5	NG/G
OR-T1-C2-C.2017	2017	711.8	NG/G
OR-T1-C3-A.2017	2017	839.6	NG/G
OR-T1-C3-C.2017	2017	760	NG/G
OR-T1-C5-A.2017	2017	745.7	NG/G
OR-T1-C5-C.2017	2017	644.6	NG/G
VN-08-01-B.2017	2017	896.2	NG/G
VN-08-01-E.2017	2017	869.2	NG/G
VN-MU3-GC-1-D.2017	2017	702.2	NG/G
VN-MU3-GC-1-G.2017	2017	789.2	NG/G
CJ-14THRU16.2016	2016	27.2	NG/G
BU-24R.2016	2016	82	NG/G
BU-51.2016	2016	806	NG/G
MM-52.2016	2016	781	NG/G
MM-53.2016	2016	809	NG/G
MM-54.2016	2016	33.6	NG/G
MM-55.2016	2016	750	NG/G
MM-56.2016	2016	33.7	NG/G
MM-62.2016	2016	714	NG/G
MM-67.2016	2016	206	NG/G
MM-68.2016	2016	45.8	NG/G

Appendix A-39a
Sediment Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	MERCURY	UOM
MM-69.2016	2016	711	NG/G
MM-70.2016	2016	74.6	NG/G
MM-71.2016	2016	1040	NG/G
W-17-High-2016.2016	2016	1266	NG/G
W17-N.2016	2016	476	NG/G
W-21-UM-South.2016	2016	267	NG/G
BU-08-02.2017	2017	598	NG/G
W-103-INTA.2017	2017	856.6	NG/G
W-17-HIGH_072116_SED_03	2016	1267	NG/G
W-17-MID_072116_SED_03	2016	1179	NG/G
ADD-01.2017	2017	23.92	NG/G
ADD-01_072116_SED_03	2016	29.63	NG/G
ADD-02.2017	2017	35.7	NG/G
ADD-02_072216_SED_03	2016	32.63	NG/G
W17-N_072116_SED_03	2016	476	NG/G

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Sediment Methyl Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	METHYL_MERCURY	UOM
BO-05.2016	2016	7.86	NG/G
BO-05.2017	2017	2.5	NG/G
ES-13.2016	2016	16.8	NG/G
VE-50.2016	2016	7	NG/G
VE-53.2016	2016	13.6	NG/G
VE-59.2016	2016	9.93	NG/G
VE-60.2016	2016	14.6	NG/G
VN-56.2016	2016	7.81	NG/G
VN-73.2016	2016	8.52	NG/G
VN-80.2016	2016	5.95	NG/G
W-61-High.2016	2016	4.87	NG/G
W-61-Intertidal.2016	2016	5.59	NG/G
W-61-Low.2016	2016	18.8	NG/G
ES-13.2017	2017	7.433	NG/G
OR-01-04.2017	2017	10.1	NG/G
OR-01-05.2017	2017	12.17	NG/G
OR-02-03.2017	2017	4.5	NG/G
SVE-02INT.2017	2017	3.933	NG/G
VE-09-01-E.2017	2017	13.2	NG/G
VE-10-01-E.2017	2017	24.57	NG/G
VE-58THRU60.2017	2017	5.4	NG/G
VI-W.2017	2017	2.267	NG/G
VN-03-01-D.2017	2017	14.63	NG/G
VN-08-01-E.2017	2017	13.47	NG/G
W-108-A.2017	2017	3.067	NG/G
W-61-High.2017	2017	6.5	NG/G
W-61-Intertidal.2017	2017	6.833	NG/G
W-61-Low.2017	2017	17.1	NG/G
CJ-14THRU16.2016	2016	0.244	NG/G
ES-FP.2017	2017	1	NG/G
ES-FP-W.2017	2017	0.9	NG/G
BU-51.2016	2016	5.46	NG/G
MM-50.2016	2016	0.387	NG/G
MM-51.2016	2016	2.3	NG/G
MM-52.2016	2016	1.46	NG/G
MM-53.2016	2016	5.17	NG/G
MM-54.2016	2016	0.433	NG/G
MM-55.2016	2016	6.71	NG/G
MM-56.2016	2016	0.393	NG/G
MM-62.2016	2016	8.69	NG/G

Appendix A-39b
Sediment Methyl Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	METHYL_MERCURY	UOM
MM-64.2016	2016	2.17	NG/G
MM-65.2016	2016	12.5	NG/G
MM-66.2016	2016	0.509	NG/G
MM-67.2016	2016	0.517	NG/G
MM-68.2016	2016	0.203	NG/G
MM-69.2016	2016	4.41	NG/G
MM-70.2016	2016	0.824	NG/G
MM-71.2016	2016	4.52	NG/G
MMPOLY.2016	2016	7.83	NG/G
W-17-High-2016.2016	2016	22.2	NG/G
W-17-Intertidal.2016	2016	2.2	NG/G
W-17-Low.2016	2016	2.85	NG/G
W-17-Mid-2016.2016	2016	3.01	NG/G
W17-N.2016	2016	50.7	NG/G
W-21-High.2016	2016	15.8	NG/G
W-21-Intertidal.2016	2016	2.36	NG/G
W-21-Low.2016	2016	2.68	NG/G
W-21-Mid.2016	2016	2.77	NG/G
W-21-UM-Central-C.2016	2016	7.02	NG/G
W-21-UM-East-C.2016	2016	1.28	NG/G
W-21-UM-South.2016	2016	3.47	NG/G
W-21-UM-West-A.2016	2016	0.713	NG/G
W-65-High.2016	2016	0.116	NG/G
W-65-Intertidal.2016	2016	0.207	NG/G
W-65-Low.2016	2016	0.0335	NG/G
W-65-Mid.2016	2016	5.27	NG/G
BU-08-01-E.2017	2017	14.27	NG/G
BU-50THRU52.2017	2017	5.1	NG/G
FF-08-02-G.2017	2017	13.4	NG/G
MM-04-01-F.2017	2017	10.53	NG/G
MM-50THRU56.2017	2017	1.7	NG/G
MM-64THRU67.2017	2017	3.48	NG/G
MM-MR.2017	2017	1.53	NG/G
MM-MR-INT.2017	2017	3.467	NG/G
MMSE-1_N1.2017	2017	13.1	NG/G
MMSE-1_N2.2017	2017	5.267	NG/G
MMSE-1_S1.2017	2017	13.97	NG/G
MMSE-1_S2.2017	2017	4.633	NG/G
MMSW-C_N.2017	2017	17.13	NG/G
MMSW-C_S.2017	2017	3.9	NG/G

Appendix A-39b
Sediment Methyl Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	METHYL_MERCURY	UOM
MMSW-C_SW.2017	2017	2.867	NG/G
W-17-High.2017	2017	16.3	NG/G
W-17-Intertidal.2017	2017	5.167	NG/G
W-17-Low.2017	2017	9.1	NG/G
W-17-Mid.2017	2017	11.77	NG/G
W-17-NE.2017	2017	37.27	NG/G
W-17-NW.2017	2017	6.667	NG/G
W-21-High.2017	2017	3.267	NG/G
W-21-Intertidal.2017	2017	3.2	NG/G
W-21-Low.2017	2017	4.333	NG/G
W-21-Mid.2017	2017	3.9	NG/G
W-21-UM-Central-C.2017	2017	14.17	NG/G
W-21-UM-East-C.2017	2017	18.93	NG/G
W-21-UM-South.2017	2017	5.4	NG/G
W-21-UM-West-A.2017	2017	3.1	NG/G
W-65-High.2017	2017	17.87	NG/G
W-65-Intertidal.2017	2017	2.767	NG/G
W-65-Low.2017	2017	5.667	NG/G
W-65-Mid.2017	2017	14.27	NG/G
W-MM-01.2017	2017	30.13	NG/G
W-MM-02.2017	2017	19.23	NG/G
W-MM-03.2017	2017	3.733	NG/G
W-MM-04.2017	2017	6.767	NG/G
W-MM-05.2017	2017	14.93	NG/G
W-MM-06.2017	2017	12.83	NG/G
W-MM-07.2017	2017	11.73	NG/G
W-MM-08.2017	2017	17.4	NG/G
W-MM-09.2017	2017	2.433	NG/G
W-MM-10.2017	2017	2.267	NG/G
W-MM-11.2017	2017	15.87	NG/G
W-MM-12.2017	2017	7.733	NG/G
W-MM-13.2017	2017	10.9	NG/G
W-MM-14.2017	2017	18.97	NG/G
W-MM-15.2017	2017	3.4	NG/G
W-MM-16.2017	2017	0.8667	NG/G
W-MM-17.2017	2017	8.467	NG/G
W-MM-18.2017	2017	26.27	NG/G
W-MM-19.2017	2017	16.13	NG/G
W-MM-20.2017	2017	2.633	NG/G
W-MM-21.2017	2017	2	NG/G

Appendix A-39b
Sediment Methyl Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	METHYL_MERCURY	UOM
W-MM-22.2017	2017	20.03	NG/G
W-MM-23.2017	2017	8.29	NG/G
W-MM-TP.2017	2017	1.933	NG/G
OB-05.2016	2016	11.3	NG/G
W-63-Intertidal.2016	2016	11.2	NG/G
OB-04.2017	2017	4.3	NG/G
OB-05.2017	2017	5.767	NG/G
ON-10-01-C.2017	2017	32.9	NG/G
W-103-INTA.2017	2017	10.57	NG/G
W-104-INTA.2017	2017	10.17	NG/G
W-104-INTB.2017	2017	4.767	NG/G
W-14-INTA.2017	2017	3.733	NG/G
W-63-INT.2017	2017	17.53	NG/G
WP-02-01-D.2017	2017	11.93	NG/G
ESFP.2017	2017	1	NG/G
W-65-MID_072516_SED_03	2016	9.019	NG/G
W-21-HIGH_072516_SED_03	2016	27.04	NG/G
W-21-LOW_072516_SED_03	2016	4.587	NG/G
W-21-MID_072516_SED_03	2016	4.741	NG/G
W-21UM-CENTRAL-C_072716_SED_03	2016	12.01	NG/G
W-21UM-EAST-C_072516_SED_03	2016	2.191	NG/G
W-21UM-WEST-A_07/27/16_SED_03	2016	1.22	NG/G
W-17-HIGH_072116_SED_03	2016	37.99	NG/G
W-17-LOW_072616_SED_03	2016	4.878	NG/G
W-17-MID_072116_SED_03	2016	5.151	NG/G
W17-N_072116_SED_03	2016	86.77	NG/G
ES-02_072716_SED_03	2016	37.99	NG/G
ES-13_072716_SED_03	2016	28.75	NG/G
ES-15_072716_SED_03	2016	4.655	NG/G
OL-01_072716_SED_03	2016	11.65	NG/G
SVE-01_072716_SED_03	2016	31.32	NG/G
W-61-HIGH_110816_SED_03	2016	8.335	NG/G
W-61-INT_110816_SED_03	2016	9.567	NG/G
W-61-LOW_110816_SED_03	2016	32.18	NG/G
W-61-MID_110816_SED_03	2016	11.38	NG/G
MMPOLY_072916_SED_03	2016	13.4	NG/G
W-17-INTERTIDAL_072616_SED_03	2016	3.765	NG/G
W-21-INTERTIDAL_072516_SED_03	2016	4.039	NG/G
W-21UM-SOUTH_072716_SED_03	2016	5.939	NG/G
W-65-INTERTIDAL_072516_SED_03	2016	0.3543	NG/G

Appendix A-39b
Sediment Methyl Mercury Data Set for Non-Reference Areas

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

SED_ID	YEAR	METHYL_MERCURY	UOM
W-109-A.2017	2017	0.7167	NG/G
W-110-A.2017	2017	3.178	NG/G
W-61-Mid.2017	2017	20.5	NG/G
FF-51THRU52.2017	2017	6.32	NG/G
W-102-A.2017	2017	17.8	NG/G
W-102-B.2017	2017	5.533	NG/G
W-102-C.2017	2017	11.37	NG/G
W-102-INTA.2017	2017	12.77	NG/G

Appendix A-40a
UCL Evaluation - ProUCL Input for Piscivirous Avian Blood
(Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

ID	DATE	MED_T	MEDIA	AGE	PISC_EA	ANALYSIS_M	PPM_UOM	PISC_EA_AGE	Mercury
0629-451-51_062107_EAG_BL	6/21/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	469.361
0629-451-53_062107_EAG_BL	6/21/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	305.34
0629-459-19_062207_EAG_BL	6/22/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	436.843
0629-459-23_062207_EAG_BL	6/22/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	401.606
0629-522-53_062607_EAG_BL	6/26/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	315.781
0629-522-55_062907_EAG_BL	6/29/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	668.768
0629-523-20_060807_EAG_BL	6/8/2007	Eagle	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	101.011
0629-523-23_061107_EAG_BL	6/11/2007	Eagle	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	230.161
0629-523-24_061107_EAG_BL	6/11/2007	Eagle	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	241.05
0629-523-26_061207_EAG_BL	6/12/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	999.708
0629-523-27_061207_EAG_BL	6/12/2007	Eagle	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	412.787
0629-523-34_061307_EAG_BL	6/13/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	615.648
0629-523-35_061307_EAG_BL	6/13/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	609.273
0629-523-41_061407_EAG_BL	6/14/2007	Eagle	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	338.404
0629-523-42_061407_EAG_BL	6/14/2007	Eagle	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	377.579
0629-523-43_060907_EAG_BL	6/9/2007	Eagle	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	129.442
0629-523-44_061407_EAG_BL	6/14/2007	Eagle	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	250.016
0629-523-45_061807_EAG_BL	6/18/2007	Eagle	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	288.25
0629-523-46_061907_EAG_BL	6/19/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	578.288
0629-523-47_061907_EAG_BL	6/19/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	641.906
0629-523-48_061907_EAG_BL	6/19/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	325.515
0629-523-49_062007_EAG_BL	6/20/2007	Eagle	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	185.523
0629-523-50_062107_EAG_BL	6/21/2007	Eagle	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	490.821
0788-101-01_070307_OSP_BL	7/3/2007	Osprey	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	2211.2
0788-101-07_071207_OSP_BL	7/12/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	131.142
0788-101-08-1_071207_OSP_BL	7/12/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	84.9718
0788-101-08-2_071707_OSP_BL	7/17/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	117.065
0788-101-08-3_072507_OSP_BL	7/25/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	122.684
0788-101-09_071207_OSP_BL	7/12/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	95.2898
0788-101-10-1_071207_OSP_BL	7/12/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	78.3
0788-101-10-2_072507_OSP_BL	7/25/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	83.5394
0788-101-11_071207_OSP_BL	7/12/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	72.9296
0788-101-12_071307_OSP_BL	7/13/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	53.8
0788-101-13_071007_OSP_BL	7/10/2007	Osprey	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1160
0788-101-14_071607_OSP_BL	7/16/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	67.3
0788-101-15_071807_OSP_BL	7/18/2007	Osprey	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	23.2
0788-101-16_071807_OSP_BL	7/18/2007	Osprey	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	33.8
0788-101-17_071807_OSP_BL	7/18/2007	Osprey	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	189
0788-101-26_071907_OSP_BL	7/19/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	54.2
0788-101-27_071907_OSP_BL	7/19/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	45.7
0788-101-28_071907_OSP_BL	7/19/2007	Osprey	BL	ADULT	SB	EPA 1631	NG/G	ADULT_SB	957
0788-101-29_072007_OSP_BL	7/20/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	88.8
0788-101-30_072007_OSP_BL	7/20/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	95.3
0788-101-31_072007_OSP_BL	7/20/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	67.5
0788-101-32_072007_OSP_BL	7/20/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	100
0788-101-33_072007_OSP_BL	7/20/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	74
0788-101-34_072007_OSP_BL	7/20/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	106
0788-101-35_072007_OSP_BL	7/20/2007	Osprey	BL	ADULT	SB	EPA 1631	NG/G	ADULT_SB	985
0788-101-36_072307_OSP_BL	7/23/2007	Osprey	BL	JUVENILE	SB	EPA 1631	NG/G	JUVENILE_SB	126
0788-101-37_072307_OSP_BL	7/23/2007	Osprey	BL	ADULT	SB	EPA 1631	NG/G	ADULT_SB	1330
0788-101-38_072307_OSP_BL	7/23/2007	Osprey	BL	ADULT	SB	EPA 1631	NG/G	ADULT_SB	2430
0788-101-39_072507_OSP_BL	7/25/2007	Osprey	BL	ADULT	SB	EPA 1631	NG/G	ADULT_SB	1430
0788-101-47_073007_OSP_BL	7/30/2007	Osprey	BL	ADULT	SB	EPA 1631	NG/G	ADULT_SB	888
0788-101-51_080207_OSP_BL	8/2/2007	Osprey	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	32.3
0788-101-52_080207_OSP_BL	8/2/2007	Osprey	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	449
0788-101-53_080207_OSP_BL	8/2/2007	Osprey	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	40.3
0788-101-54_080207_OSP_BL	8/2/2007	Osprey	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	29.6
0788-101-55_080207_OSP_BL	8/2/2007	Osprey	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	49.5
0788-101-62_080207_OSP_BL	8/2/2007	Osprey	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	51.3
0848-037-29_072406_DCC_BL	7/24/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	402.809
0848-037-30_072406_DCC_BL	7/24/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	94.3521
0848-037-31_072406_DCC_BL	7/24/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	111.981

Appendix A-40a
UCL Evaluation - ProUCL Input for Piscivirous Avian Blood
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ID	DATE	MED_T	MEDIA	AGE	PISC_EA	ANALYSIS_M	PPM_UOM	PISC_EA_AGE	Mercury
0848-037-32_072406_DCC_BL	7/24/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	123.979
0848-037-33_072406_DCC_BL	7/24/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	132.554
0848-037-34_072406_DCC_BL	7/24/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	143.526
0848-037-35_072406_DCC_BL	7/24/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	215.543
0848-037-36_072406_DCC_BL	7/24/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	165.379
0848-037-37_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	188.033
0848-037-38_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	113.05
0848-037-39_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	154.148
0848-037-40_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	191.534
0848-037-41_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	176.599
0848-037-42_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	113.133
0848-037-43_072506_DCC_BL	7/25/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	134.84
0848-037-44_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	170.404
0848-037-45_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	148.715
0848-037-46_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	223.083
0848-037-47_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	137.948
0848-037-48_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	122.852
0848-037-49_072306_DCC_BL	7/23/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	130.894
0848-037-50_072506_DCC_BL	7/25/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	130.242
0848-037-51_072506_DCC_BL	7/25/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	103.24
0848-037-52_072506_DCC_BL	7/25/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	149.99
0848-037-53_072506_DCC_BL	7/25/2006	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	133.342
0918-133-42_051110_DCC_BL	5/11/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	2338.83
0918-133-43_052710_DCC_BL	5/27/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	801.734
0918-133-44_052710_DCC_BL	5/27/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	639.537
0918-133-45_052710_DCC_BL	5/27/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	718.064
0918-133-46_052710_DCC_BL	5/27/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	831.581
0918-133-47_052710_DCC_BL	5/27/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	738.857
0918-133-48_052710_DCC_BL	5/27/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	1061.88
1058-006-51_052710_DCC_BL	5/27/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	791.572
1058-006-52_052710_DCC_BL	5/27/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	1.00E+03
1058-006-53_052710_DCC_BL	5/27/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	1526.62
1058-006-54_052710_DCC_BL	5/27/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	852.027
1058-006-55_060410_DCC_BL	6/4/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	2073.82
1058-006-56_060410_DCC_BL	6/4/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	1636.74
1058-006-57_060410_DCC_BL	6/4/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	970.386
1058-006-58_060410_DCC_BL	6/4/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	468
1058-006-59_060410_DCC_BL	6/4/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	1137.93
1058-006-60_061110_DCC_BL	6/11/2010	Double-crested Cormorant	BL	NA	D-SB	EPA 1631	NG/G	NoAge_D-SB	564
1058-006-61_061510_DCC_BL	6/15/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	1952.64
1058-006-62_061510_DCC_BL	6/15/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	1349.34
1058-006-63_061510_DCC_BL	6/15/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	1750
1058-006-64_061510_DCC_BL	6/15/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	636.076
1058-006-65_061510_DCC_BL	6/15/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	2078.71
1058-006-66_061510_DCC_BL	6/15/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	838
1058-006-67_061710_DCC_BL	6/17/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	1810
1058-006-68_061710_DCC_BL	6/17/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	1050
1058-006-69_061710_DCC_BL	6/17/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	3040
1058-006-70_061710_DCC_BL	6/17/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	3200
1058-006-71_061710_DCC_BL	6/17/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	1690
1058-006-72_061710_DCC_BL	6/17/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	1950
1058-006-73_062110_DCC_BL	6/21/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	912
1058-006-74_062110_DCC_BL	6/21/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	708
1058-006-75_062110_DCC_BL	6/21/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	1020
1058-006-76_062110_DCC_BL	6/21/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	483
1058-006-77_062110_DCC_BL	6/21/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	2440
1058-006-78_062110_DCC_BL	6/21/2010	Double-crested Cormorant	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	2430
1573-580-10_060807_BEK_BL	6/8/2007	Belted Kingfisher	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	961.88
1573-580-11_062307_BEK_BL	6/23/2007	Belted Kingfisher	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	78.9693
1573-580-12_062407_BEK_BL	6/24/2007	Belted Kingfisher	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	4708.07
1573-580-13_062907_BEK_BL	6/29/2007	Belted Kingfisher	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	1219.29
1573-580-14_070407_BEK_BL	7/4/2007	Belted Kingfisher	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	2419.86

Appendix A-40a
UCL Evaluation - ProUCL Input for Piscivirous Avian Blood
(Mercury)

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ID	DATE	MED_T	MEDIA	AGE	PISC_EA	ANALYSIS_M	PPM_UOM	PISC_EA_AGE	Mercury
1573-580-15_071007_BEK_BL	7/10/2007	Belted Kingfisher	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	907.97
1573-580-16_071207_BEK_BL	7/12/2007	Belted Kingfisher	BL	NA	UP-SB	EPA 1631	NG/G	NoAge_UP-SB	784.744
1593-103-54_070307_BEK_BL	7/3/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	120
1593-103-55_070307_BEK_BL	7/3/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	75.9
1593-103-56_070307_BEK_BL	7/3/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	95.4
1593-103-57_070307_BEK_BL	7/3/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	68.2
1593-103-58_070407_BEK_BL	7/4/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	28.6
1593-103-59_070407_BEK_BL	7/4/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	51.7
1593-103-61_070407_BEK_BL	7/4/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	45.4
1593-103-62_070407_BEK_BL	7/4/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	33.2
1593-103-63_070407_BEK_BL	7/4/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	38.5
1593-103-64_070407_BEK_BL	7/4/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	72
1593-103-65_070407_BEK_BL	7/4/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	24
1593-103-66_070907_BEK_BL	7/9/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	266
1593-103-67_070907_BEK_BL	7/9/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	360
1593-103-68_070907_BEK_BL	7/9/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	295
1593-103-69_070907_BEK_BL	7/9/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	234
1593-103-70_070907_BEK_BL	7/9/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	217
1593-103-71_071007_BEK_BL	7/10/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	148
1593-103-72_071007_BEK_BL	7/10/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	153
1593-103-73_071007_BEK_BL	7/10/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	127
1593-103-74_071007_BEK_BL	7/10/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	145
1593-103-75_071007_BEK_BL	7/10/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	144
1593-103-76_071107_BEK_BL	7/11/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	130
1593-103-77_071607_BEK_BL	7/16/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	130
1593-103-78_071607_BEK_BL	7/16/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	121
1593-103-79_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	309
1593-103-80_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	386
1593-103-81_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	323
1593-103-82_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	322
1593-103-83_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	180
1593-103-84_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	203
1593-103-85_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	116
1593-103-86_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	147
1593-103-87_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	112
1593-103-88_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	189
1593-103-89_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	204
1593-103-90_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	111
1593-103-91_071707_BEK_BL	7/17/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	102
1593-103-92_072507_BEK_BL	7/25/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	82
1593-103-93_072507_BEK_BL	7/25/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	89
1593-103-94_072507_BEK_BL	7/25/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	94
1593-103-95_072507_BEK_BL	7/25/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	97
1593-103-96_072507_BEK_BL	7/25/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	103
1593-103-97_072507_BEK_BL	7/25/2007	Belted Kingfisher	BL	NA	SB	Mercury	NG/G	NoAge_SB	115
1593-933-45_060207_BEK_BL	6/2/2007	Belted Kingfisher	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	359.163
1593-933-46_060807_BEK_BL	6/8/2007	Belted Kingfisher	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	840.724
1593-933-47_062907_BEK_BL	6/29/2007	Belted Kingfisher	BL	NA	SB	EPA 1631	NG/G	NoAge_SB	1143.8
1593-933-48_070307_BEK_BL	7/3/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	78.1
1593-933-49_070307_BEK_BL	7/3/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	111
1593-933-50_070307_BEK_BL	7/3/2007	Belted Kingfisher	BL	NA	UP-SB	Mercury	NG/G	NoAge_UP-SB	94.9
MOUS-2007-01_080707_BLG_BL	8/7/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	344.535
MOUS-2007-02_080707_BLG_BL	8/7/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	338.36
MOUS-2007-03_080707_BLG_BL	8/7/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	290.712
MOUS-2007-06_080707_BLG_BL	8/7/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1306.97
MOUS-2007-07_080707_BLG_BL	8/7/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1397.03
MOUS-2007-08_080807_BLG_BL	8/8/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	241.584
MOUS-2007-09_080807_BLG_BL	8/8/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	216.939
MOUS-2007-10_080807_BLG_BL	8/8/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	893.811
MOUS-2007-11_080807_BLG_BL	8/8/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	248.273
MOUS-2007-12_080907_BLG_BL	8/9/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1584.75
MOUS-2007-13_080907_BLG_BL	8/9/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	272.755

Appendix A-40a
UCL Evaluation - ProUCL Input for Piscivirous Avian Blood
(Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

ID	DATE	MED_T	MEDIA	AGE	PISC_EA	ANALYSIS_M	PPM_UOM	PISC_EA_AGE	Mercury
POND-2007-01_081507_BLG_BL	8/15/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	221.858
POND-2007-02_081507_BLG_BL	8/15/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	253.022
POND-2007-04_081507_BLG_BL	8/15/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	373.043
WEST-2007-01_072707_BLG_BL	7/27/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1798.64
WEST-2007-02_072707_BLG_BL	7/27/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1330.54
WEST-2007-03_072707_BLG_BL	7/27/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1440.31
WEST-2007-04_072707_BLG_BL	7/27/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1125.73
WEST-2007-05_072707_BLG_BL	7/27/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1119.62
WEST-2007-06_072707_BLG_BL	7/27/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1018.27
WEST-2007-07_072707_BLG_BL	7/27/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1221.8
WEST-2007-08_072707_BLG_BL	7/27/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1515.02
WEST-2007-09_072707_BLG_BL	7/27/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1692.74
WEST-2007-10_072707_BLG_BL	7/27/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1279.47
WEST-2007-11_072607_BLG_BL	7/26/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1367.44
WEST-2007-12_072607_BLG_BL	7/26/2007	Black Guillemot	BL	ADULT	D-SB	EPA 1631	NG/G	ADULT_D-SB	1201.51
WEST-2007-13_081507_BLG_BL	8/15/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	184.633
WEST-2007-14_081507_BLG_BL	8/15/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	142.929
WEST-2007-15_081507_BLG_BL	8/15/2007	Black Guillemot	BL	JUVENILE	D-SB	EPA 1631	NG/G	JUVENILE_D-SB	223.606

Appendix A-40b
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Bald Eagle - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.18/2/2018 1:38:44 PM
From File	2018-08-02 Piscivorous Avian BL ProUCL Input - Penobscot.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (noage_d-sb)

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	101	Mean	191.6
Maximum	288.3	Median	185.5
SD	93.77	Std. Error of Mean	54.14
Coefficient of Variation	0.489	Skewness	0.29

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.997	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.192	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	349.7	95% Adjusted-CLT UCL (Chen-1995)	290.3
		95% Modified-t UCL (Johnson-1978)	351.2

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	5.845	k star (bias corrected MLE)	N/A
Theta hat (MLE)	32.78	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	35.07	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.992	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.209	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.615	Mean of logged Data	5.167
Maximum of Logged Data	5.664	SD of logged Data	0.527

Assuming Lognormal Distribution

95% H-UCL	2572	90% Chebyshev (MVUE) UCL	361.4
95% Chebyshev (MVUE) UCL	438.1	97.5% Chebyshev (MVUE) UCL	544.6
99% Chebyshev (MVUE) UCL	753.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	280.6	95% Jackknife UCL	349.7
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	354	95% Chebyshev(Mean, Sd) UCL	427.6
97.5% Chebyshev(Mean, Sd) UCL	529.7	99% Chebyshev(Mean, Sd) UCL	730.2

Appendix A-40b
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Bald Eagle - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL 349.7

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (noage_sb)

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	129.4	Mean	282.8
Maximum	412.8	Median	250
SD	98.39	Std. Error of Mean	37.19
Coefficient of Variation	0.348	Skewness	-0.156

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.95	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.202	Lilliefors GOF Test
5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	355	95% Adjusted-CLT UCL (Chen-1995)	341.6
		95% Modified-t UCL (Johnson-1978)	354.7

Appendix A-40b
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Bald Eagle - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.316	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.709	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.179	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.435	k star (bias corrected MLE)	4.915
Theta hat (MLE)	33.52	Theta star (bias corrected MLE)	57.53
nu hat (MLE)	118.1	nu star (bias corrected)	68.81
MLE Mean (bias corrected)	282.8	MLE Sd (bias corrected)	127.5
		Approximate Chi Square Value (0.05)	50.72
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	46.06

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	383.7	95% Adjusted Gamma UCL (use when n<50)	422.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.914	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.213	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.863	Mean of logged Data	5.584
Maximum of Logged Data	6.023	SD of logged Data	0.393

Assuming Lognormal Distribution

95% H-UCL	414.8	90% Chebyshev (MVUE) UCL	411.4
95% Chebyshev (MVUE) UCL	469	97.5% Chebyshev (MVUE) UCL	548.9
99% Chebyshev (MVUE) UCL	705.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Appendix A-40b
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Bald Eagle - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	343.9	95% Jackknife UCL	355
95% Standard Bootstrap UCL	337.5	95% Bootstrap-t UCL	354.3
95% Hall's Bootstrap UCL	341.2	95% Percentile Bootstrap UCL	342
95% BCA Bootstrap UCL	333		
90% Chebyshev(Mean, Sd) UCL	394.3	95% Chebyshev(Mean, Sd) UCL	444.9
97.5% Chebyshev(Mean, Sd) UCL	515	99% Chebyshev(Mean, Sd) UCL	652.8

Suggested UCL to Use

95% Student's-t UCL 355

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Mercury (noage_up-sb)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	305.3	Mean	527.6
Maximum	999.7	Median	490.8
SD	190.8	Std. Error of Mean	52.92
Coefficient of Variation	0.362	Skewness	1.122

Normal GOF Test

Shapiro Wilk Test Statistic	0.9	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.153	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Appendix A-40b
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Bald Eagle - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	621.9	95% Adjusted-CLT UCL (Chen-1995)	632.2
		95% Modified-t UCL (Johnson-1978)	624.7

Gamma GOF Test

A-D Test Statistic	0.303	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.121	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.046	k star (bias corrected MLE)	7.01
Theta hat (MLE)	58.32	Theta star (bias corrected MLE)	75.27
nu hat (MLE)	235.2	nu star (bias corrected)	182.3
MLE Mean (bias corrected)	527.6	MLE Sd (bias corrected)	199.3
		Approximate Chi Square Value (0.05)	152
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	148.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	632.5	95% Adjusted Gamma UCL (use when n<50)	649.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.127	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.721	Mean of logged Data	6.212
Maximum of Logged Data	6.907	SD of logged Data	0.346

Assuming Lognormal Distribution

95% H-UCL	643.6	90% Chebyshev (MVUE) UCL	680.9
95% Chebyshev (MVUE) UCL	750.6	97.5% Chebyshev (MVUE) UCL	847.3
99% Chebyshev (MVUE) UCL	1037		

Appendix A-40b
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Bald Eagle - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	614.6	95% Jackknife UCL	621.9
95% Standard Bootstrap UCL	609.3	95% Bootstrap-t UCL	643.8
95% Hall's Bootstrap UCL	677.5	95% Percentile Bootstrap UCL	618.9
95% BCA Bootstrap UCL	637.1		
90% Chebyshev(Mean, Sd) UCL	686.4	95% Chebyshev(Mean, Sd) UCL	758.3
97.5% Chebyshev(Mean, Sd) UCL	858.1	99% Chebyshev(Mean, Sd) UCL	1054

Suggested UCL to Use

95% Student's-t UCL	621.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-40c
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Belted Kingfisher - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.18/2/2018 1:39:51 PM
From File	2018-08-02 Piscivorous Avian BL ProUCL Input - Penobscot_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (noage_sb)

General Statistics

Total Number of Observations	26	Number of Distinct Observations	26
		Number of Missing Observations	0
Minimum	24	Mean	363.1
Maximum	2420	Median	118
SD	546.8	Std. Error of Mean	107.2
Coefficient of Variation	1.506	Skewness	2.583

Normal GOF Test

Shapiro Wilk Test Statistic	0.639	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.92	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.31	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.17	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	546.3	95% Adjusted-CLT UCL (Chen-1995)	597.6
		95% Modified-t UCL (Johnson-1978)	555.4

Gamma GOF Test

A-D Test Statistic	1.222	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.785	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.211	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.178	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Appendix A-40c
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Belted Kingfisher - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	0.74	k star (bias corrected MLE)	0.68
Theta hat (MLE)	490.6	Theta star (bias corrected MLE)	533.7
nu hat (MLE)	38.49	nu star (bias corrected)	35.38
MLE Mean (bias corrected)	363.1	MLE Sd (bias corrected)	440.2
		Approximate Chi Square Value (0.05)	22.77
Adjusted Level of Significance	0.0398	Adjusted Chi Square Value	22.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	564.2	95% Adjusted Gamma UCL (use when n<50)	581.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.952	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.145	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.17	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.178	Mean of logged Data	5.084
Maximum of Logged Data	7.791	SD of logged Data	1.262

Assuming Lognormal Distribution

95% H-UCL	738.3	90% Chebyshev (MVUE) UCL	642.5
95% Chebyshev (MVUE) UCL	779.3	97.5% Chebyshev (MVUE) UCL	969.2
99% Chebyshev (MVUE) UCL	1342		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	539.5	95% Jackknife UCL	546.3
95% Standard Bootstrap UCL	535.1	95% Bootstrap-t UCL	677.3
95% Hall's Bootstrap UCL	662.6	95% Percentile Bootstrap UCL	556.6
95% BCA Bootstrap UCL	590		
90% Chebyshev(Mean, Sd) UCL	684.8	95% Chebyshev(Mean, Sd) UCL	830.6
97.5% Chebyshev(Mean, Sd) UCL	1033	99% Chebyshev(Mean, Sd) UCL	1430

Appendix A-40c
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Belted Kingfisher - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% H-UCL 738.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Mercury (noage_up-sb)

General Statistics

Total Number of Observations	30	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	68.2	Mean	355.8
Maximum	4708	Median	144.5
SD	844.2	Std. Error of Mean	154.1
Coefficient of Variation	2.373	Skewness	5.059

Normal GOF Test

Shapiro Wilk Test Statistic	0.328	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.386	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.159	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	617.7	95% Adjusted-CLT UCL (Chen-1995)	761.5
		95% Modified-t UCL (Johnson-1978)	641.4

Appendix A-40c
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Belted Kingfisher - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	4.015	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.783	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.304	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.166	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.856	k star (bias corrected MLE)	0.793
Theta hat (MLE)	415.7	Theta star (bias corrected MLE)	448.9
nu hat (MLE)	51.35	nu star (bias corrected)	47.55
MLE Mean (bias corrected)	355.8	MLE Sd (bias corrected)	399.7
		Approximate Chi Square Value (0.05)	32.73
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	32.02

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	517	95% Adjusted Gamma UCL (use when n<50)	528.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.801	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.208	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.159	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.222	Mean of logged Data	5.187
Maximum of Logged Data	8.457	SD of logged Data	0.885

Assuming Lognormal Distribution

95% H-UCL	388.6	90% Chebyshev (MVUE) UCL	401.5
95% Chebyshev (MVUE) UCL	465.6	97.5% Chebyshev (MVUE) UCL	554.5
99% Chebyshev (MVUE) UCL	729.2		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Appendix A-40c
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Belted Kingfisher - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	609.3	95% Jackknife UCL	617.7
95% Standard Bootstrap UCL	602.3	95% Bootstrap-t UCL	1547
95% Hall's Bootstrap UCL	1388	95% Percentile Bootstrap UCL	642.9
95% BCA Bootstrap UCL	914.9		
90% Chebyshev(Mean, Sd) UCL	818.2	95% Chebyshev(Mean, Sd) UCL	1028
97.5% Chebyshev(Mean, Sd) UCL	1318	99% Chebyshev(Mean, Sd) UCL	1889

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	1028

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-40d
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Black Guillemot - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.18/2/2018 1:40:31 PM
From File	2018-08-02 Piscivorous Avian BL ProUCL Input - Penobscot_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (adult_d-sb)

General Statistics

Total Number of Observations	16	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	893.8	Mean	1331
Maximum	1799	Median	1319
SD	241.3	Std. Error of Mean	60.32
Coefficient of Variation	0.181	Skewness	0.208

Normal GOF Test

Shapiro Wilk Test Statistic	0.991	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0794	Lilliefors GOF Test
5% Lilliefors Critical Value	0.213	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1437	95% Adjusted-CLT UCL (Chen-1995)	1433
		95% Modified-t UCL (Johnson-1978)	1437

Gamma GOF Test

A-D Test Statistic	0.0933	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.736	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0613	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.215	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-40d
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Black Guillemot - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	32.06	k star (bias corrected MLE)	26.09
Theta hat (MLE)	41.51	Theta star (bias corrected MLE)	51.01
nu hat (MLE)	1026	nu star (bias corrected)	834.9
MLE Mean (bias corrected)	1331	MLE Sd (bias corrected)	260.5
		Approximate Chi Square Value (0.05)	768.8
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	761.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1445	95% Adjusted Gamma UCL (use when n<50)	1459

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.99	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0738	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.795	Mean of logged Data	7.178
Maximum of Logged Data	7.495	SD of logged Data	0.184

Assuming Lognormal Distribution

95% H-UCL	1451	90% Chebyshev (MVUE) UCL	1516
95% Chebyshev (MVUE) UCL	1600	97.5% Chebyshev (MVUE) UCL	1716
99% Chebyshev (MVUE) UCL	1944		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1430	95% Jackknife UCL	1437
95% Standard Bootstrap UCL	1426	95% Bootstrap-t UCL	1443
95% Hall's Bootstrap UCL	1439	95% Percentile Bootstrap UCL	1423
95% BCA Bootstrap UCL	1427		
90% Chebyshev(Mean, Sd) UCL	1512	95% Chebyshev(Mean, Sd) UCL	1594
97.5% Chebyshev(Mean, Sd) UCL	1708	99% Chebyshev(Mean, Sd) UCL	1931

Suggested UCL to Use

95% Student's-t UCL	1437

Appendix A-40d
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Black Guillemot - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (juvenile_d-sb)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	142.9	Mean	257.9
Maximum	373	Median	248.3
SD	65.61	Std. Error of Mean	18.2
Coefficient of Variation	0.254	Skewness	0.233

Normal GOF Test

Shapiro Wilk Test Statistic	0.967	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.145	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	290.3	95% Adjusted-CLT UCL (Chen-1995)	289.1
		95% Modified-t UCL (Johnson-1978)	290.5

Gamma GOF Test

A-D Test Statistic	0.222	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.733	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.123	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.236	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-40d
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Black Guillemot - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	16.2	k star (bias corrected MLE)	12.51
Theta hat (MLE)	15.92	Theta star (bias corrected MLE)	20.6
nu hat (MLE)	421.3	nu star (bias corrected)	325.4
MLE Mean (bias corrected)	257.9	MLE Sd (bias corrected)	72.89
		Approximate Chi Square Value (0.05)	284.6
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	279.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	294.8	95% Adjusted Gamma UCL (use when n<50)	300.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.965	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.142	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.962	Mean of logged Data	5.521
Maximum of Logged Data	5.922	SD of logged Data	0.264

Assuming Lognormal Distribution

95% H-UCL	298.7	90% Chebyshev (MVUE) UCL	315.3
95% Chebyshev (MVUE) UCL	341.2	97.5% Chebyshev (MVUE) UCL	377.2
99% Chebyshev (MVUE) UCL	447.8		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	287.8	95% Jackknife UCL	290.3
95% Standard Bootstrap UCL	286.6	95% Bootstrap-t UCL	292.3
95% Hall's Bootstrap UCL	293	95% Percentile Bootstrap UCL	287.4
95% BCA Bootstrap UCL	285.6		
90% Chebyshev(Mean, Sd) UCL	312.5	95% Chebyshev(Mean, Sd) UCL	337.2
97.5% Chebyshev(Mean, Sd) UCL	371.5	99% Chebyshev(Mean, Sd) UCL	438.9

Appendix A-40d
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Black Guillemot - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL	290.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-40e
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Double-crested Cormorant - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.18/2/2018 1:41:03 PM
From File	2018-08-02 Piscivorous Avian BL ProUCL Input - Penobscot_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (noage_d-sb)

General Statistics

Total Number of Observations	42	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	94.35	Mean	525.3
Maximum	2339	Median	189.8
SD	562	Std. Error of Mean	86.72
Coefficient of Variation	1.07	Skewness	1.647

Normal GOF Test

Shapiro Wilk Test Statistic	0.721	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.942	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.276	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.135	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	671.3	95% Adjusted-CLT UCL (Chen-1995)	691.5
		95% Modified-t UCL (Johnson-1978)	674.9

Gamma GOF Test

A-D Test Statistic	2.663	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.775	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.25	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Appendix A-40e
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Double-crested Cormorant - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	1.13	k star (bias corrected MLE)	1.065
Theta hat (MLE)	465	Theta star (bias corrected MLE)	493.3
nu hat (MLE)	94.91	nu star (bias corrected)	89.46
MLE Mean (bias corrected)	525.3	MLE Sd (bias corrected)	509
		Approximate Chi Square Value (0.05)	68.65
Adjusted Level of Significance	0.0443	Adjusted Chi Square Value	68

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	684.5	95% Adjusted Gamma UCL (use when n<50)	691.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.801	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.942	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.217	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.135	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.547	Mean of logged Data	5.76
Maximum of Logged Data	7.757	SD of logged Data	0.998

Assuming Lognormal Distribution

95% H-UCL	753.7	90% Chebyshev (MVUE) UCL	790.1
95% Chebyshev (MVUE) UCL	915.5	97.5% Chebyshev (MVUE) UCL	1090
99% Chebyshev (MVUE) UCL	1431		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	668	95% Jackknife UCL	671.3
95% Standard Bootstrap UCL	669.1	95% Bootstrap-t UCL	706.5
95% Hall's Bootstrap UCL	690.1	95% Percentile Bootstrap UCL	676.7
95% BCA Bootstrap UCL	693.5		
90% Chebyshev(Mean, Sd) UCL	785.5	95% Chebyshev(Mean, Sd) UCL	903.3
97.5% Chebyshev(Mean, Sd) UCL	1067	99% Chebyshev(Mean, Sd) UCL	1388

Appendix A-40e
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Double-crested Cormorant - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	903.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (noage_sb)

General Statistics

Total Number of Observations	18	Number of Distinct Observations	18
		Number of Missing Observations	0
Minimum	483	Mean	1630
Maximum	3200	Median	1720
SD	815	Std. Error of Mean	192.1
Coefficient of Variation	0.5	Skewness	0.403

Normal GOF Test

Shapiro Wilk Test Statistic	0.947	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1964	95% Adjusted-CLT UCL (Chen-1995)	1965
		95% Modified-t UCL (Johnson-1978)	1967

Gamma GOF Test

A-D Test Statistic	0.319	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.151	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.205	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix A-40e
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Double-crested Cormorant - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	3.881	k star (bias corrected MLE)	3.271
Theta hat (MLE)	420	Theta star (bias corrected MLE)	498.2
nu hat (MLE)	139.7	nu star (bias corrected)	117.8
MLE Mean (bias corrected)	1630	MLE Sd (bias corrected)	901.1
		Approximate Chi Square Value (0.05)	93.71
Adjusted Level of Significance	0.0357	Adjusted Chi Square Value	91.65

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2048	95% Adjusted Gamma UCL (use when n<50)	2094

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.952	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.176	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.202	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.18	Mean of logged Data	7.262
Maximum of Logged Data	8.071	SD of logged Data	0.557

Assuming Lognormal Distribution

95% H-UCL	2203	90% Chebyshev (MVUE) UCL	2324
95% Chebyshev (MVUE) UCL	2630	97.5% Chebyshev (MVUE) UCL	3055
99% Chebyshev (MVUE) UCL	3890		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1946	95% Jackknife UCL	1964
95% Standard Bootstrap UCL	1933	95% Bootstrap-t UCL	1976
95% Hall's Bootstrap UCL	1957	95% Percentile Bootstrap UCL	1949
95% BCA Bootstrap UCL	1939		
90% Chebyshev(Mean, Sd) UCL	2206	95% Chebyshev(Mean, Sd) UCL	2467
97.5% Chebyshev(Mean, Sd) UCL	2829	99% Chebyshev(Mean, Sd) UCL	3541

Appendix A-40e
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Double-crested Cormorant - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Suggested UCL to Use

95% Student's-t UCL 1964

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-40f
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Osprey - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.18/2/2018 1:41:33 PM
From File	2018-08-02 Piscivorous Avian BL ProUCL Input - Penobscot_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Mercury (adult_d-sb)

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	189	Mean	1002
Maximum	2211	Median	804.5
SD	904.4	Std. Error of Mean	452.2
Coefficient of Variation	0.902	Skewness	0.958

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.928	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.23	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2067	95% Adjusted-CLT UCL (Chen-1995)	1978
		95% Modified-t UCL (Johnson-1978)	2103

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UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Osprey - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.221	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.663	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.212	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.4	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.448	k star (bias corrected MLE)	0.529
Theta hat (MLE)	692.3	Theta star (bias corrected MLE)	1896
nu hat (MLE)	11.58	nu star (bias corrected)	4.229
MLE Mean (bias corrected)	1002	MLE Sd (bias corrected)	1379
		Approximate Chi Square Value (0.05)	0.814
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5206	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.188	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.242	Mean of logged Data	6.527
Maximum of Logged Data	7.701	SD of logged Data	1.078

Assuming Lognormal Distribution

95% H-UCL	105644	90% Chebyshev (MVUE) UCL	2540
95% Chebyshev (MVUE) UCL	3227	97.5% Chebyshev (MVUE) UCL	4181
99% Chebyshev (MVUE) UCL	6055		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

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UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Osprey - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCLs

95% CLT UCL	1746	95% Jackknife UCL	2067
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	2359	95% Chebyshev(Mean, Sd) UCL	2973
97.5% Chebyshev(Mean, Sd) UCL	3826	99% Chebyshev(Mean, Sd) UCL	5502

Suggested UCL to Use

95% Student's-t UCL	2067

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (adult_sb)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	888	Mean	1337
Maximum	2430	Median	1158
SD	578.5	Std. Error of Mean	236.2
Coefficient of Variation	0.433	Skewness	1.734

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.797	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.269	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

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UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Osprey - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1813	95% Adjusted-CLT UCL (Chen-1995)	1904
		95% Modified-t UCL (Johnson-1978)	1840

Gamma GOF Test

A-D Test Statistic	0.499	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.256	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.891	k star (bias corrected MLE)	4.057
Theta hat (MLE)	169.4	Theta star (bias corrected MLE)	329.5
nu hat (MLE)	94.7	nu star (bias corrected)	48.68
MLE Mean (bias corrected)	1337	MLE Sd (bias corrected)	663.6
		Approximate Chi Square Value (0.05)	33.67
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	29.23

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1933	95% Adjusted Gamma UCL (use when n<50)	2226

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.872	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.239	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.789	Mean of logged Data	7.133
Maximum of Logged Data	7.796	SD of logged Data	0.377

Assuming Lognormal Distribution

95% H-UCL	2004	90% Chebyshev (MVUE) UCL	1941
95% Chebyshev (MVUE) UCL	2218	97.5% Chebyshev (MVUE) UCL	2603
99% Chebyshev (MVUE) UCL	3359		

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UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Osprey - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1725	95% Jackknife UCL	1813
95% Standard Bootstrap UCL	1688	95% Bootstrap-t UCL	2260
95% Hall's Bootstrap UCL	3168	95% Percentile Bootstrap UCL	1730
95% BCA Bootstrap UCL	1835		
90% Chebyshev(Mean, Sd) UCL	2045	95% Chebyshev(Mean, Sd) UCL	2366
97.5% Chebyshev(Mean, Sd) UCL	2812	99% Chebyshev(Mean, Sd) UCL	3687

Suggested UCL to Use

95% Student's-t UCL 1813

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (juvenile_d-sb)

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	23.2	Mean	37.14
Maximum	51.3	Median	33.8
SD	10.4	Std. Error of Mean	3.931
Coefficient of Variation	0.28	Skewness	0.304

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Appendix A-40f
UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Osprey - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.938	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.197	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	44.78	95% Adjusted-CLT UCL (Chen-1995)	44.09
		95% Modified-t UCL (Johnson-1978)	44.86

Gamma GOF Test

A-D Test Statistic	0.254	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.179	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	14.75	k star (bias corrected MLE)	8.525
Theta hat (MLE)	2.518	Theta star (bias corrected MLE)	4.357
nu hat (MLE)	206.5	nu star (bias corrected)	119.4
MLE Mean (bias corrected)	37.14	MLE Sd (bias corrected)	12.72
		Approximate Chi Square Value (0.05)	95.13
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	88.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	46.6	95% Adjusted Gamma UCL (use when n<50)	50.03

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.156	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.144	Mean of logged Data	3.58
Maximum of Logged Data	3.938	SD of logged Data	0.285

Assuming Lognormal Distribution

95% H-UCL	48.12	90% Chebyshev (MVUE) UCL	49.18
95% Chebyshev (MVUE) UCL	54.62	97.5% Chebyshev (MVUE) UCL	62.18
99% Chebyshev (MVUE) UCL	77.03		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	43.61	95% Jackknife UCL	44.78
95% Standard Bootstrap UCL	43.13	95% Bootstrap-t UCL	47.17
95% Hall's Bootstrap UCL	45.81	95% Percentile Bootstrap UCL	43.4
95% BCA Bootstrap UCL	43.61		
90% Chebyshev(Mean, Sd) UCL	48.94	95% Chebyshev(Mean, Sd) UCL	54.28
97.5% Chebyshev(Mean, Sd) UCL	61.69	99% Chebyshev(Mean, Sd) UCL	76.26

Suggested UCL to Use

95% Student's-t UCL	44.78

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury (juvenile_sb)

General Statistics

Total Number of Observations	19	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	45.7	Mean	87.61
Maximum	131.1	Median	84.97
SD	25.19	Std. Error of Mean	5.779
Coefficient of Variation	0.288	Skewness	0.172

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UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Osprey - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Normal GOF Test

Shapiro Wilk Test Statistic	0.968	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0894	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	97.63	95% Adjusted-CLT UCL (Chen-1995)	97.36
		95% Modified-t UCL (Johnson-1978)	97.67

Gamma GOF Test

A-D Test Statistic	0.184	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0872	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.198	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	12.23	k star (bias corrected MLE)	10.33
Theta hat (MLE)	7.163	Theta star (bias corrected MLE)	8.477
nu hat (MLE)	464.8	nu star (bias corrected)	392.7
MLE Mean (bias corrected)	87.61	MLE Sd (bias corrected)	27.25
		Approximate Chi Square Value (0.05)	347.8
Adjusted Level of Significance	0.0369	Adjusted Chi Square Value	344.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	98.92	95% Adjusted Gamma UCL (use when n<50)	99.99

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.966	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.901	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0852	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.197	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

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UCL Evaluation - ProUCL Output for Piscivirous Avian Blood
(Osprey - Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal Statistics

Minimum of Logged Data	3.822	Mean of logged Data	4.431
Maximum of Logged Data	4.876	SD of logged Data	0.301

Assuming Lognormal Distribution

95% H-UCL	100.3	90% Chebyshev (MVUE) UCL	106.2
95% Chebyshev (MVUE) UCL	114.5	97.5% Chebyshev (MVUE) UCL	126.1
99% Chebyshev (MVUE) UCL	148.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	97.11	95% Jackknife UCL	97.63
95% Standard Bootstrap UCL	96.92	95% Bootstrap-t UCL	97.7
95% Hall's Bootstrap UCL	97.09	95% Percentile Bootstrap UCL	96.76
95% BCA Bootstrap UCL	96.62		
90% Chebyshev(Mean, Sd) UCL	104.9	95% Chebyshev(Mean, Sd) UCL	112.8
97.5% Chebyshev(Mean, Sd) UCL	123.7	99% Chebyshev(Mean, Sd) UCL	145.1

Suggested UCL to Use

95% Student's-t UCL	97.63

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix A-41
Piscivirous Avian Egg Data Set
(Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

ID	DATE	MED_T	MEDIA	PISC_EA	ANALYSIS_M	PPM_UOM	Mercury	Methyl mercury
CAS-11-06_081606_DCC_EG	8/16/2006	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	508.724
CAS-11-06_081606_DCC_EG	8/16/2006	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	488.901	NA
CAST-2007-01_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	213.629	NA
CAST-2007-02_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	199.017	NA
CAST-2007-03_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	173.165	NA
CAST-2007-04_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	260.429
CAST-2007-04_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	Metals	NG/G	264.475	NA
CAST-2007-05_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	470.88	NA
CAST-2007-06_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	418.265	NA
CAST-2007-07_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	192.203	NA
CAST-2007-08_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	166.054	NA
CAST-2007-09_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	212.909	NA
CAST-2007-10_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	308.811	NA
CAST-2007-11_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	354.609	NA
CAST-2007-12_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	323.842	NA
CAST-2007-13_060707_DCC_EG	6/7/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	411.621	NA
COMP-2007-01_070707_BLG_EG	7/7/2007	Black Guillemot	EGG	D-SB	EPA 7473	NG/G	495.224	NA
COMP-2007-02_070707_BLG_EG	7/7/2007	Black Guillemot	EGG	D-SB	EPA 7473	NG/G	1058.52	NA
EAGO-2007-01_010107_BLG_EG	1/1/2007	Black Guillemot	EGG	D-SB	EPA 7473	NG/G	911.985	NA
EAGO-2007-02_010107_BLG_EG	1/1/2007	Black Guillemot	EGG	D-SB	EPA 7473	NG/G	648.568	NA
EGOR-2007-01_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	138.657
EGOR-2007-01_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	Metals	NG/G	160.613	NA
EGOR-2007-02_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	364.465	NA
EGOR-2007-03_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	457.026	NA
EGOR-2007-04_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	677.082	NA
EGOR-2007-05_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	230.554	NA
EGOR-2007-06_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	394.043
EGOR-2007-06_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	418.539	NA
EGOR-2007-07_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	392.069	NA
EGOR-2007-08_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	295.342	NA
EGOR-2007-09_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	218.977	NA
EGOR-2007-10_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	322.246	NA
EGOR-2007-11_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	196.04	NA
EGOR-2007-12_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	334.924	NA
EGR-12-06_072306_DCC_EG	7/23/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	370.069	NA
EGR-13-06_072306_DCC_EG	7/23/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	371.633	NA
EGR-14-06_072306_DCC_EG	7/23/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	350.683	NA
EGR-15-06_072306_DCC_EG	7/23/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	331.168	NA
EGR-16-06_072306_DCC_EG	7/23/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	388.372	NA
EGR-17-06_072306_DCC_EG	7/23/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	298.318	NA
EGR-18-06_072306_DCC_EG	7/23/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	296.891	NA
EGR-19-06_072306_DCC_EG	7/23/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	319.44	NA
EGR-30-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	358.214	NA
EGR-31-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	385.105
EGR-31-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	386.606	NA
EGR-32-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	434.465	NA
EGR-33-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	300.69	NA
EGR-34-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	294.008	NA
EGR-35-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	441.874	NA
EGR-36-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	332.726	NA
EGR-37-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	350.497	NA
EGR-38-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	178.755	NA
FLAT-2007-01_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	205.729	NA

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ID	DATE	MED_T	MEDIA	PISC_EA	ANALYSIS_M	PPM_UOM	Mercury	Methyl mercury
FLAT-2007-02_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	280.297	NA
FLAT-2007-03_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	249.043	NA
FLAT-2007-04_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	277.088	NA
FLAT-2007-05_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	290.428	NA
FLAT-2007-06_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	317.133	NA
FLAT-2007-07_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	293.437
FLAT-2007-07_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	Metals	NG/G	283.726	NA
FLAT-2007-08_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	185.761
FLAT-2007-08_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	Metals	NG/G	187.786	NA
FLAT-2007-09_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	482.531	NA
FLAT-2007-10_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	339.478	NA
FLAT-2007-11_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	320.245	NA
FLAT-2007-12_061307_DCC_EG	6/13/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	230.124	NA
FORT-2007-01_061507_DCC_EG	6/15/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	598.978	NA
FPO-39-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	887.397	NA
FPO-40-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	954.919
FPO-40-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	890.808	NA
FPO-40-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	SB	Metals	NG/G	891	NA
GREE-2007-01_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	136.96	NA
GREE-2007-02_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	283.188	NA
GREE-2007-03_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	434.628	NA
GREE-2007-04_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	250.84	NA
GREE-2007-05_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	298.668	NA
GREE-2007-06_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	203.076	NA
GREE-2007-07_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	236.32	NA
GREE-2007-08_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	141.965	NA
GREE-2007-09_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	309.699	NA
GREE-2007-10_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	198.868	NA
GREE-2007-11_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	409.143	NA
GREE-2007-12_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	280.478	NA
GREE-2007-13_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	267.84	NA
GREE-2007-14_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	229.012	NA
GREE-2007-15_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	142.248	NA
GREE-2007-16_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	337.046	NA
GREE-2007-17_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	205.595	NA
GREE-2007-18_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	179.268	NA
KIDD-2007-01_062707_DCC_EG	6/27/2007	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	276.336
KIDD-2007-01_062707_DCC_EG	6/27/2007	Double-crested Cormorant	EGG	SB	Metals	NG/G	293.862	NA
KIDD-2007-02_062707_DCC_EG	6/27/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	394.407	NA
LUCE-2007-01_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	645.547	NA
LUCE-2007-02_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	650.413	NA
LUCE-2007-03_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	626.341	NA
LUCE-2007-04_061507_DCC_EG	6/15/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	789.741	NA
OS-051-2_071307_OSP_EG	7/13/2007	Osprey	EGG	SB	Mercury	NG/G	170.45	NA
OS-09_071307_OSP_EG	7/13/2007	Osprey	EGG	D-SB	EPA 1631	NG/G	NA	141.283
OS-09_071307_OSP_EG	7/13/2007	Osprey	EGG	D-SB	Metals	NG/G	135.838	NA
OS-128_071207_OSP_EG	7/12/2007	Osprey	EGG	SB	Mercury	NG/G	413.8	NA
OS-142_061807_OSP_EG	6/18/2007	Osprey	EGG	D-SB	Mercury	NG/G	77.56	NA
OS-49_070507_OSP_EG	7/5/2007	Osprey	EGG	SB	EPA 7473	NG/G	115.478	NA
OS-51_062707_OSP_EG	6/27/2007	Osprey	EGG	SB	EPA 7473	NG/G	121.898	NA
PBCA-09-01_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	145.024
PBCA-09-01_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	144.217	NA
PBCA-09-02_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	307.194	NA

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ID	DATE	MED_T	MEDIA	PISC_EA	ANALYSIS_M	PPM_UOM	Mercury	Methyl mercury
PBCA-09-03_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	272.706	NA
PBCA-09-04_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	192.508
PBCA-09-04_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	201.129	NA
PBCA-09-05_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	125.093	NA
PBCA-09-06_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	216.125
PBCA-09-06_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	229.133	NA
PBCA-09-07_060409_DCC_EG	6/4/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	210.742	NA
PBCA-09-08_060409_DCC_EG	6/4/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	300.062	NA
PBCA-09-09_060409_DCC_EG	6/4/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	229.642
PBCA-09-09_060409_DCC_EG	6/4/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	249.263	NA
PBCA-09-10_060409_DCC_EG	6/4/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	138.122	NA
PBCA-09-11_060409_DCC_EG	6/4/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	278.983
PBCA-09-11_060409_DCC_EG	6/4/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	302.784	NA
PBCA-09-12_060409_DCC_EG	6/4/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	145.575	NA
PBFI-09-01_052109_DCC_EG	5/21/2009	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	376.35
PBFI-09-01_052109_DCC_EG	5/21/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	414.733	NA
PBFI-09-02_052109_DCC_EG	5/21/2009	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	101.137
PBFI-09-02_052109_DCC_EG	5/21/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	114.081	NA
PBLC-10-01_061510_DCC_EG	6/15/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	668.202	NA
PBLC-10-02_061510_DCC_EG	6/15/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	640.844	NA
PBLC-10-03_061510_DCC_EG	6/15/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	641.65	NA
PBSH-09-01_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	271.888
PBSH-09-01_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	285.721	NA
PBSH-09-02_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	273.723	NA
PBSH-09-03_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	309.704
PBSH-09-03_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	314.297	NA
PBSH-09-04_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	305.582	NA
PBSH-09-05_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	169.39
PBSH-09-05_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	179.251	NA
PBSH-09-06_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	344.572	NA
PBSH-09-07_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	182.722
PBSH-09-07_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	196.694	NA
PBSH-09-08_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	312.183	NA
PBSH-09-09_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	113.496	NA
PBSH-09-10_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	215.061
PBSH-09-10_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	255.046	NA
PBSH-09-11_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	195.632	NA
PBSH-09-12_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	109.028	NA
PBSP-09-01_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	300.932
PBSP-09-01_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	309.916	NA
PBSP-09-02_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	298.326	NA
PBSP-09-03_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	217.995	NA
PBSP-09-04_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	501.485
PBSP-09-04_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	555.722	NA
PBSP-09-05_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	229.122	NA
PBSP-09-06_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	363.01
PBSP-09-06_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	429.977	NA
PBSP-09-07_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	192.647	NA
PBSP-09-08_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	184.693	NA
PBSP-09-09_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	404.545	NA
PBSP-09-10_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	318.888
PBSP-09-10_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	333.346	NA
PBSP-09-11_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	136.929

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ID	DATE	MED_T	MEDIA	PISC_EA	ANALYSIS_M	PPM_UOM	Mercury	Methyl mercury
PBSP-09-11_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	167.887	NA
PBSP-09-12_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	298.094	NA
PBSP-09-13_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	190.59
PBSP-09-13_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	222.267	NA
PBSP-09-14_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	165.539	NA
PBSP-09-15_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	307.099
PBSP-09-15_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	347.252	NA
PBSP-09-16_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	424.426	NA
PBSP-09-17_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	375.299	NA
PBSP-09-18_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	281.132	NA
PBSP-09-19_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	246.805	NA
PBSP-09-20_051209_DCC_EG	5/12/2009	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	198.29	NA
PBSP-10-01-A_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	263.406	NA
PBSP-10-01-B_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	361.412	NA
PBSP-10-01-C_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	269.769	NA
PBSP-10-01-D_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	554.618	NA
PBSP-10-01-E_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	589.816	NA
PBSP-10-02-A_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	179.756	NA
PBSP-10-02-B_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	305.267	NA
PBSP-10-02-C_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	278.543	NA
PBSP-10-02-D_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	520.095	NA
PBSP-10-03-A_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	186.792	NA
PBSP-10-03-B_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	327.851	NA
PBSP-10-03-C_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	265.616	NA
PBSP-10-03-D_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	517.174	NA
PBSP-10-04-A_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	173.62	NA
PBSP-10-04-B_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	430.488	NA
PBSP-10-04-C_050510_DCC_EG	5/5/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	295.622	NA
PBSP-10-05-A_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	291.527	NA
PBSP-10-05-B_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	438.468	NA
PBSP-10-05-C_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	519.879	NA
PBSP-10-06-A_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	300.365	NA
PBSP-10-06-B_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	431.206	NA
PBSP-10-06-C_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	513.59	NA
PBSP-10-07-A_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	307.133	NA
PBSP-10-07-C_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	538.208	NA
PBSP-10-08-A_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	311.921	NA
PBSP-10-08-C_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	509.877	NA
PBSP-10-09-A_061510_DCC_EG	6/15/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	370.292	NA
PBSP-10-09-C_061510_DCC_EG	6/15/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	421.503	NA
PBSP-10-10-A_061510_DCC_EG	6/15/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	363.829	NA
PBSP-10-10-C_061510_DCC_EG	6/15/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	557.389	NA
PBSP-10-11-A_061510_DCC_EG	6/15/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	344.514	NA
PBSP-10-11-C_061510_DCC_EG	6/15/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	549.563	NA
PBSP-10-33_061510_DCC_EG	6/15/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	574.553	NA
PBSP-10-34_061510_DCC_EG	6/15/2010	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	527.299	NA
PBTC-09-01_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	177.914
PBTC-09-01_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	168.879	NA
PBTC-09-02_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	172.536	NA
PBTC-09-03_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	186.094	NA
PBTC-09-04_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	219.356
PBTC-09-04_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	250.962	NA
PBTC-09-05_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	191.995	NA

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ID	DATE	MED_T	MEDIA	PISC_EA	ANALYSIS_M	PPM_UOM	Mercury	Methyl mercury
PBTC-09-06_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	267.094	NA
PBTC-09-07_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	153.208	NA
PBTC-09-08_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	256.92	NA
PBTC-09-09_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	189.693	NA
PBTC-09-10_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	116.575
PBTC-09-10_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	128.749	NA
PBTC-09-11_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	231.632	NA
PBTC-09-12_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	212.616
PBTC-09-12_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	238.796	NA
PBTC-09-13_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	199.063	NA
PBTC-09-14_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	174.635	NA
PBTC-09-15_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	218.535	NA
PBTC-09-16_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	301.246	NA
PBTC-09-17_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	221.775	NA
PBTC-09-18_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	175.727
PBTC-09-18_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	213.656	NA
PBTC-09-19_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	160.924	NA
PBTC-09-20_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	82.9815
PBTC-09-20_060309_DCC_EG	6/3/2009	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	98.1125	NA
PBTC-10-01_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	223.617	NA
PBTC-10-02_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	225.832	NA
PBTC-10-03_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	201.951	NA
PBTC-10-04_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	37.9275	NA
PBTC-10-05_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	243.955	NA
PBTC-10-06_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	286.952	NA
PBTC-10-07_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	270.578	NA
PBTC-10-08_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	255.415	NA
PBTC-10-09_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	193.334	NA
PBTC-10-10_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	196.928	NA
PBTC-10-11_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	370.934	NA
PBTC-10-12_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	210.819	NA
PBTC-10-13_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	217.511	NA
PBTC-10-14_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	211.112	NA
PBTC-10-15_052710_DCC_EG	5/27/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	216.685	NA
PBTC-10-16_060410_DCC_EG	6/4/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	84.4146	NA
PBTC-10-17_060410_DCC_EG	6/4/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	184.821	NA
PBTC-10-18_060410_DCC_EG	6/4/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	273.362	NA
PBTC-10-19_060410_DCC_EG	6/4/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	259.376	NA
PBTC-10-20_060410_DCC_EG	6/4/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	177.988	NA
PBTC-10-21_060410_DCC_EG	6/4/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	200.85	NA
PBTC-10-22_060410_DCC_EG	6/4/2010	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	400.866	NA
PENBFI-08-01_060608_DCC_EG	6/6/2008	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	180.578	NA
PENBSH-08-01_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	290.198	NA
PENBSH-08-02_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	309.275	NA
PENBSH-08-03_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	252.904	NA
PENBSH-08-04_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	251.012	NA
PENBSH-08-05_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	285.925	NA
PENBSH-08-06_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	342.652	NA
PENBSH-08-07_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	463.568	NA
PENBSH-08-08_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	490.839
PENBSH-08-08_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	484.954	NA
PENBSH-08-09_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	281.409	NA
PENBSH-08-10_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	269.525	NA

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ID	DATE	MED_T	MEDIA	PISC_EA	ANALYSIS_M	PPM_UOM	Mercury	Methyl mercury
PENBSH-08-11_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	292.558	NA
PENBSH-08-12_060208_DCC_EG	6/2/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	305.269	NA
PENBSP-08-01_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	308.384
PENBSP-08-01_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	292.858	NA
PENBSP-08-02_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	305.382	NA
PENBSP-08-03_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	798.619	NA
PENBSP-08-04_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	311.032	NA
PENBSP-08-05_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	298.263	NA
PENBSP-08-06_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	295.791	NA
PENBSP-08-07_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	342.588	NA
PENBSP-08-08_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	386.5	NA
PENBSP-08-09_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	439.17	NA
PENBSP-08-10_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	438.134
PENBSP-08-10_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	414.083	NA
PENBSP-08-11_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	298.939	NA
PENBSP-08-12_060908_DCC_EG	6/9/2008	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	272.92	NA
POND-2007-01_010107_BLG_EG	1/1/2007	Black Guillemot	EGG	D-SB	EPA 7473	NG/G	1182.11	NA
RAMI-2007-01_061507_BLG_EG	6/15/2007	Black Guillemot	EGG	D-SB	EPA 7473	NG/G	482.237	NA
ROB-01-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	119.696
ROB-01-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	118.341	NA
ROB-02-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	107.526	NA
ROB-03-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	141.666	NA
ROB-04-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	135.582	NA
ROB-05-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	123.096	NA
ROB-06-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	133.775	NA
ROB-07-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	278.544	NA
ROB-08-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	365.213	NA
ROB-09-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	265.446	NA
ROB-10-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	246.413	NA
ROBB-2007-01_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	230.761
ROBB-2007-01_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	Metals	NG/G	277.753	NA
ROBB-2007-02_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	192.678	NA
ROBB-2007-03_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	329.322	NA
ROBB-2007-04_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	490.713	NA
ROBB-2007-05_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	309.925	NA
ROBB-2007-06_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	365.631	NA
ROBB-2007-07_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	419.617	NA
ROBB-2007-08_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	207.131	NA
ROBB-2007-09_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	683.782	NA
ROBB-2007-10_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	181.613
ROBB-2007-10_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	Metals	NG/G	199.33	NA
ROBB-2007-11_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	245.257
ROBB-2007-11_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	Metals	NG/G	240.507	NA
ROBB-2007-12_061807_DCC_EG	6/18/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	461.295	NA
ROBR-2007-01_061907_BLG_EG	6/19/2007	Black Guillemot	EGG	D-SB	EPA 7473	NG/G	863.588	NA
ROBR-2007-02_061807_BLG_EG	6/18/2007	Black Guillemot	EGG	D-SB	EPA 7473	NG/G	962.712	NA
Sandy Point_061812_DCC_01_EG	6/18/2012	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	139	NA
Sandy Point_061812_DCC_02_EG	6/18/2012	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	444.61215	NA
Sandy Point_061812_DCC_03_EG	6/18/2012	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	509.73757	NA
Sandy Point_061812_DCC_04_EG	6/18/2012	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	305.53846	NA
Sandy Point_061812_DCC_05_EG	6/18/2012	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	257.97686	NA
Sandy Point_061812_DCC_06_EG	6/18/2012	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	986.29352	NA
Sandy Point_061812_DCC_07_EG	6/18/2012	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	295.65382	NA

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ID	DATE	MED_T	MEDIA	PISC_EA	ANALYSIS_M	PPM_UOM	Mercury	Methyl mercury
SPOO-2007-01_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	270.617	NA
SPOO-2007-02_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	322.997	NA
SPOO-2007-03_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	184.677
SPOO-2007-03_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	Metals	NG/G	233.678	NA
SPOO-2007-04_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	349.27	NA
SPOO-2007-05_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	339.374	NA
SPOO-2007-06_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	229.936
SPOO-2007-06_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	Metals	NG/G	229.678	NA
SPOO-2007-07_070107_DCC_EG	7/1/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	254.063	NA
STOC-2007-01_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	341.522	NA
STOC-2007-02_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	277.676	NA
STOC-2007-03_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	491.386	NA
STOC-2007-04_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	261.648	NA
STOC-2007-05_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	294.885	NA
STOC-2007-06_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	663.612	NA
STOC-2007-07_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	269.644	NA
STOC-2007-08_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	225.053	NA
STOC-2007-09_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 1631	NG/G	NA	183.11
STOC-2007-09_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	Metals	NG/G	231.988	NA
STOC-2007-10_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	527.014	NA
STOC-2007-11_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	335.411	NA
STOC-2007-12_060107_DCC_EG	6/1/2007	Double-crested Cormorant	EGG	SB	EPA 7473	NG/G	255.539	NA
THI-20-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	484.168	NA
THI-21-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	259.156
THI-21-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	269.474	NA
THI-22-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	135.882	NA
THI-23-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	278.468	NA
THI-24-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	474.63	NA
THI-25-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	381.193	NA
THI-26-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	376.693	NA
THI-27-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	374.092	NA
THI-28-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	510.463	NA
THI-29-06_071306_DCC_EG	7/13/2006	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	343.828	NA
THRU-2007-01_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	376.097	NA
THRU-2007-02_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	470.577	NA
THRU-2007-03_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	222.838	NA
THRU-2007-04_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	327.662	NA
THRU-2007-05_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	385.727	NA
THRU-2007-06_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	370.641	NA
THRU-2007-07_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	288.55	NA
THRU-2007-08_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	367.331	NA
THRU-2007-09_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	289.874
THRU-2007-09_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	302.785	NA
THRU-2007-09_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	Metals	NG/G	302.785	NA
THRU-2007-10_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 1631	NG/G	NA	221.105
THRU-2007-10_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	235.236	NA
THRU-2007-11_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	405.101	NA
THRU-2007-12_061907_DCC_EG	6/19/2007	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	292.421	NA
Thrumcap Island_061812_DCC_01_EG	6/18/2012	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	153	NA
Thrumcap Island_061812_DCC_02_EG	6/18/2012	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	296.66164	NA
Thrumcap Island_061812_DCC_03_EG	6/18/2012	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	355.73635	NA
Thrumcap Island_061812_DCC_04_EG	6/18/2012	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	223.06334	NA
Thrumcap Island_061812_DCC_06_EG	6/18/2012	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	259.73266	NA

Appendix A-41
Piscivirous Avian Egg Data Set
(Mercury)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

ID	DATE	MED_T	MEDIA	PISC_EA	ANALYSIS_M	PPM_UOM	Mercury	Methyl mercury
Thrumcap Island_061812_DCC_07_EG	6/18/2012	Double-crested Cormorant	EGG	D-SB	EPA 7473	NG/G	321.38938	NA
WEST-2007-01_081507_BLG_EG	8/15/2007	Black Guillemot	EGG	D-SB	EPA 7473	NG/G	663.38	NA
WEST-2007-02_081507_BLG_EG	8/15/2007	Black Guillemot	EGG	D-SB	EPA 7473	NG/G	807.954	NA

APPENDIX B

Background Threshold Value Calculation

Appendix B - BTV Calculations

Appendix B-1a
Background Evaluation - ProUCL Input
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	LOC_GRP	MED_T	ID	DATE	PARAM_NAME	FINAL_RESU	ESULT_UOM
FBJR_17LT024	REFERENCE	Lobster	FBJR_17LT024_091417_LOB_01_TA	9/14/2017	Mercury	38.9	NG/G
FBJR_17LT024	REFERENCE	Lobster	FBJR_17LT024_091417_LOB_02_TA	9/14/2017	Mercury	28.8	NG/G
FBJR_17LT024	REFERENCE	Lobster	FBJR_17LT024_091417_LOB_03_TA	9/14/2017	Mercury	40.6	NG/G
FBJR_17LT024	REFERENCE	Lobster	FBJR_17LT024_091417_LOB_04_TA	9/14/2017	Mercury	45.4	NG/G
FBJR_17LT025	REFERENCE	Lobster	FBJR_17LT025_091417_LOB_05_TA	9/14/2017	Mercury	37.5	NG/G
FBJR_17LT025	REFERENCE	Lobster	FBJR_17LT025_091417_LOB_06_TA	9/14/2017	Mercury	35.2	NG/G
FBJR_17LT026	REFERENCE	Lobster	FBJR_17LT026_091417_LOB_07_TA	9/14/2017	Mercury	57.5	NG/G
FBJR_17LT026	REFERENCE	Lobster	FBJR_17LT026_091417_LOB_08_TA	9/14/2017	Mercury	46.2	NG/G
FBJR_17LT026	REFERENCE	Lobster	FBJR_17LT026_091417_LOB_09_TA	9/14/2017	Mercury	26.8	NG/G
FBJR_17LT026	REFERENCE	Lobster	FBJR_17LT026_091417_LOB_10_TA	9/14/2017	Mercury	34.1	NG/G
FBJR_17LT027	REFERENCE	Lobster	FBJR_17LT027_091417_LOB_11_TA	9/14/2017	Mercury	46.9	NG/G
FBJR_17LT027	REFERENCE	Lobster	FBJR_17LT027_091417_LOB_12_TA	9/14/2017	Mercury	38.4	NG/G
FBJR_17LT027	REFERENCE	Lobster	FBJR_17LT027_091417_LOB_13_TA	9/14/2017	Mercury	35.5	NG/G
FBJR_17LT027	REFERENCE	Lobster	FBJR_17LT027_091417_LOB_14_TA	9/14/2017	Mercury	64.8	NG/G
FBJR_17LT027	REFERENCE	Lobster	FBJR_17LT027_091417_LOB_15_TA	9/14/2017	Mercury	38.1	NG/G
FBJR_17LT027	REFERENCE	Lobster	FBJR_17LT027_091417_LOB_16_TA	9/14/2017	Mercury	35.4	NG/G
FBJR_17LT027	REFERENCE	Lobster	FBJR_17LT027_091417_LOB_17_TA	9/14/2017	Mercury	39.2	NG/G
FBJR_17LT028	REFERENCE	Lobster	FBJR_17LT028_091417_LOB_18_TA	9/14/2017	Mercury	43.3	NG/G
FBJR_17LT028	REFERENCE	Lobster	FBJR_17LT028_091417_LOB_19_TA	9/14/2017	Mercury	43.8	NG/G
FBJR_17LT028	REFERENCE	Lobster	FBJR_17LT028_091417_LOB_20_TA	9/14/2017	Mercury	36	NG/G

Appendix B-1b
Background Evaluation - Outlier Test
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation	ProUCL 5.11/4/2018 10:13:50 AM
From File	WorkSheet.xls
Full Precision	OFF

Dixon's Outlier Test for Lobster

Number of Observations = 20
10% critical value: 0.401
5% critical value: 0.45
1% critical value: 0.535

1. Observation Value 64.8 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.583

For 10% significance level, 64.8 is an outlier.
For 5% significance level, 64.8 is an outlier.
For 1% significance level, 64.8 is an outlier.

2. Observation Value 26.8 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.363

For 10% significance level, 26.8 is not an outlier.
For 5% significance level, 26.8 is not an outlier.
For 1% significance level, 26.8 is not an outlier.

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation	ProUCL 5.11/4/2018 10:14:41 AM
From File	WorkSheet.xls
Full Precision	OFF

Dixon's Outlier Test for Lobster

Number of Observations = 19
10% critical value: 0.412
5% critical value: 0.462
1% critical value: 0.547

1. Observation Value 57.5 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.483

For 10% significance level, 57.5 is an outlier.
For 5% significance level, 57.5 is an outlier.
For 1% significance level, 57.5 is not an outlier.

2. Observation Value 26.8 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.376

For 10% significance level, 26.8 is not an outlier.
For 5% significance level, 26.8 is not an outlier.
For 1% significance level, 26.8 is not an outlier.

Appendix B-1c
Background Evaluation - Goodness of Fit
American Lobster

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/15/2017 11:18:31 AM
From File	WorkSheet_f.xls
Full Precision	OFF
Confidence Coefficient	0.95

Lobster

Raw Statistics	
Number of Valid Observations	19
Number of Missing Observations	1
Number of Distinct Observations	19
Minimum	26.8
Maximum	57.5
Mean of Raw Data	39.35
Standard Deviation of Raw Data	6.945
Khat	34.69
Theta hat	1.134
Kstar	29.25
Theta star	1.345
Mean of Log Transformed Data	3.658
Standard Deviation of Log Transformed Data	0.175

Normal GOF Test Results

Correlation Coefficient R	0.968
Shapiro Wilk Test Statistic	0.951
Shapiro Wilk Critical (0.05) Value	0.901
Approximate Shapiro Wilk P Value	0.384
Lilliefors Test Statistic	0.14
Lilliefors Critical (0.05) Value	0.197

Data appear Normal at (0.05) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.977
A-D Test Statistic	0.319
A-D Critical (0.05) Value	0.74
K-S Test Statistic	0.121
K-S Critical(0.05) Value	0.198

Data appear Gamma Distributed at (0.05) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.978
Shapiro Wilk Test Statistic	0.967
Shapiro Wilk Critical (0.05) Value	0.901
Approximate Shapiro Wilk P Value	0.676
Lilliefors Test Statistic	0.132
Lilliefors Critical (0.05) Value	0.197

Data appear Lognormal at (0.05) Significance Level

Appendix B-2a
Background Evaluation - ProUCL Input
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	LOC_GRP	MED_T	ID	DATE	PARAM_NAME	FINAL_RESU	RESULT_UOM
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	5.52	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	6.18	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	11.7	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	8.51	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	7.09	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	5.46	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	11.9	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	13	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	7.19	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	7.74	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	9.2	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	7.44	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	10.5	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	6.45	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	10.3	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	7.17	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	8.36	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	6.85	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	7.68	NG/G
FRB-REF	REFERENCE	Blue Mussel	C001_091317_	9/13/2017	Mercury	7.02	NG/G

Appendix B-2b
Background Evaluation - Outlier Test
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation	ProUCL 5.11/15/2017 11:45:20 AM
From File	WorkSheet.xls
Full Precision	OFF

Dixon's Outlier Test for Blue Mussel Ref

Number of Observations = 20
10% critical value: 0.401
5% critical value: 0.45
1% critical value: 0.535

1. Observation Value 13 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.191

For 10% significance level, 13 is not an outlier.
For 5% significance level, 13 is not an outlier.
For 1% significance level, 13 is not an outlier.

2. Observation Value 5.46 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.115

For 10% significance level, 5.46 is not an outlier.
For 5% significance level, 5.46 is not an outlier.
For 1% significance level, 5.46 is not an outlier.

Appendix B-2c
Background Evaluation - Goodness of Fit
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/15/2017 11:45:27 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	0.95

Blue Mussel Ref

Raw Statistics	
Number of Valid Observations	20
Number of Distinct Observations	20
Minimum	5.46
Maximum	13
Mean of Raw Data	8.263
Standard Deviation of Raw Data	2.166
Khat	16.56
Theta hat	0.499
Kstar	14.11
Theta star	0.586
Mean of Log Transformed Data	2.081
Standard Deviation of Log Transformed Data	0.25

Normal GOF Test Results

Correlation Coefficient R	0.958
Shapiro Wilk Test Statistic	0.91
Shapiro Wilk Critical (0.05) Value	0.905
Approximate Shapiro Wilk P Value	0.0694
Lilliefors Test Statistic	0.195
Lilliefors Critical (0.05) Value	0.192

Data appear Approximate Normal at (0.05) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.976
A-D Test Statistic	0.532
A-D Critical (0.05) Value	0.741
K-S Test Statistic	0.172
K-S Critical(0.05) Value	0.194

Data appear Gamma Distributed at (0.05) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.979
Shapiro Wilk Test Statistic	0.949
Shapiro Wilk Critical (0.05) Value	0.905
Approximate Shapiro Wilk P Value	0.387
Lilliefors Test Statistic	0.156
Lilliefors Critical (0.05) Value	0.192

Data appear Lognormal at (0.05) Significance Level

Appendix B-2d
Background Evaluation - BTV Calculation
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation	ProUCL 5.111/15/2017 11:45:34 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
New or Future K Observations	1
Number of Bootstrap Operations	2000

Blue Mussel Ref

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
Minimum	5.46	First Quartile	6.978
Second Largest	11.9	Median	7.56
Maximum	13	Third Quartile	9.475
Mean	8.263	SD	2.166
Coefficient of Variation	0.262	Skewness	0.852
Mean of logged Data	2.081	SD of logged Data	0.25

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.396	d2max (for USL)	2.557

Normal GOF Test

Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.195	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	13.45	90% Percentile (z)	11.04
95% UPL (t)	12.1	95% Percentile (z)	11.83
95% USL	13.8	99% Percentile (z)	13.3

Gamma GOF Test

A-D Test Statistic	0.532	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.172	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	16.56	k star (bias corrected MLE)	14.11
Theta hat (MLE)	0.499	Theta star (bias corrected MLE)	0.586
nu hat (MLE)	662.5	nu star (bias corrected)	564.5
MLE Mean (bias corrected)	8.263	MLE Sd (bias corrected)	2.2

Appendix B-2d
Background Evaluation - BTV Calculation
Blue Mussel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	12.31	90% Percentile	11.18
95% Hawkins Wixley (HW) Approx. Gamma UPL	12.35	95% Percentile	12.18
95% WH Approx. Gamma UTL with 95% Coverage	14.09	99% Percentile	14.22
95% HW Approx. Gamma UTL with 95% Coverage	14.2		
95% WH USL	14.57	95% HW USL	14.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.156	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	14.58	90% Percentile (z)	11.04
95% UPL (t)	12.48	95% Percentile (z)	12.09
95% USL	15.18	99% Percentile (z)	14.33

Nonparametric Distribution Free Background Statistics

Data appear Approximate Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	20	95% UTL with 95% Coverage	13
Approx, f used to compute achieved CC	1.053	Approximate Actual Confidence Coefficient achieved by UTL	0.642
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	13	95% BCA Bootstrap UTL with 95% Coverage	13
95% UPL	12.95	90% Percentile	11.72
90% Chebyshev UPL	14.92	95% Percentile	11.96
95% Chebyshev UPL	17.94	99% Percentile	12.79
95% USL	13		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Appendix B-3a
Background Evaluation - ProUCL Input
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	LOC_GRP	MED_T	ID	DATE	PARAM_NAME	FINAL_RESU	RESULT_UOM
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_01_WB	9/12/2017	Mercury	18.1	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_02_WB	9/12/2017	Mercury	14.6	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_03_WB	9/12/2017	Mercury	6.88	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_04_WB	9/12/2017	Mercury	22.2	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_05_WB	9/12/2017	Mercury	10.8	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_06_WB	9/12/2017	Mercury	14.5	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_07_WB	9/12/2017	Mercury	26.2	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_08_WB	9/12/2017	Mercury	24.6	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_09_WB	9/12/2017	Mercury	8.2	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_10_WB	9/12/2017	Mercury	10.6	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_11_WB	9/12/2017	Mercury	10.9	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_12_WB	9/12/2017	Mercury	6.57	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_13_WB	9/12/2017	Mercury	9.38	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_14_WB	9/12/2017	Mercury	19	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_15_WB	9/12/2017	Mercury	7.29	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_16_WB	9/12/2017	Mercury	15.7	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_17_WB	9/12/2017	Mercury	12.2	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_18_WB	9/12/2017	Mercury	7.36	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_19_WB	9/12/2017	Mercury	7.98	NG/G
FRB-01_17SN001	REFERENCE	Rainbow Smelt	FRB-01_17SN001_091217_RAS_20_WB	9/12/2017	Mercury	11.8	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_01_WB	9/28/2016	Mercury	5.46	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_02_WB	9/28/2016	Mercury	5.96	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_03_WB	9/28/2016	Mercury	7.27	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_04_WB	9/28/2016	Mercury	6.37	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_05_WB	9/28/2016	Mercury	6.5	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_06_WB	9/28/2016	Mercury	7.62	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_07_WB	9/28/2016	Mercury	5.07	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_08_WB	9/28/2016	Mercury	8	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_09_WB	9/28/2016	Mercury	7.03	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_10_WB	9/28/2016	Mercury	6.89	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_11_WB	9/28/2016	Mercury	6.46	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_12_WB	9/28/2016	Mercury	6.6	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_13_WB	9/28/2016	Mercury	6.79	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_14_WB	9/28/2016	Mercury	6.67	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_15_WB	9/28/2016	Mercury	8.37	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_16_WB	9/28/2016	Mercury	6.19	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_17_WB	9/28/2016	Mercury	5.72	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_18_WB	9/28/2016	Mercury	8.26	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_19_WB	9/28/2016	Mercury	7.35	NG/G
FRB-01d	REFERENCE	Rainbow Smelt	FRB-01_092816_RAS_20_WB	9/28/2016	Mercury	6.52	NG/G

Appendix B-3b
Background Evaluation - Outlier Test
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation	ProUCL 5.111/15/2017 11:04:14 AM
From File	WorkSheet_e.xls
Full Precision	OFF

Rosner's Outlier Test for Smelt Reference

Mean	**9.999**
Standard Deviation	**5.368**
Number of data	**40**
Number of suspected outliers	**1**

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	9.999	5.3	26.2	7	3.057	3.04	3.38

For 5% Significance Level, there is 1 Potential Outlier
Potential outliers is: 26.2

For 1% Significance Level, there is no Potential Outlier

Appendix B-3c
Background Evaluation - Goodness of Fit
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.111/15/2017 11:07:14 AM
From File	WorkSheet_e.xls
Full Precision	OFF
Confidence Coefficient	0.95

Smelt Reference

Raw Statistics

Number of Valid Observations	40
Number of Distinct Observations	40
Minimum	5.07
Maximum	26.2
Mean of Raw Data	9.999
Standard Deviation of Raw Data	5.368
Khat	4.891
Theta hat	2.044
Kstar	4.541
Theta star	2.202
Mean of Log Transformed Data	2.197
Standard Deviation of Log Transformed Data	0.436

Normal GOF Test Results

Correlation Coefficient R	0.87
Shapiro Wilk Test Statistic	0.755
Shapiro Wilk Critical (0.05) Value	0.94
Approximate Shapiro Wilk P Value	3.4237E-8
Lilliefors Test Statistic	0.269
Lilliefors Critical (0.05) Value	0.139

Data not Normal at (0.05) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.943
A-D Test Statistic	2.601
A-D Critical (0.05) Value	0.752
K-S Test Statistic	0.24
K-S Critical(0.05) Value	0.14

Data not Gamma Distributed at (0.05) Significance Level

Appendix B-3c
Background Evaluation - Goodness of Fit
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal GOF Test Results

Correlation Coefficient R	0.936
Shapiro Wilk Test Statistic	0.865
Shapiro Wilk Critical (0.05) Value	0.94
Approximate Shapiro Wilk P Value	9.1665E-5
Lilliefors Test Statistic	0.216
Lilliefors Critical (0.05) Value	0.139

Data not Lognormal at (0.05) Significance Level

Non-parametric GOF Test Results

Data do not follow a discernible distribution at (0.05) Level of Significance

Appendix B-3d
Background Evaluation - BTV Calculation
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation	ProUCL 5.111/15/2017 11:04:24 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
New or Future K Observations	1
Number of Bootstrap Operations	2000

Smelt Reference

General Statistics

Total Number of Observations	40	Number of Distinct Observations	40
Minimum	5.07	First Quartile	6.593
Second Largest	24.6	Median	7.49
Maximum	26.2	Third Quartile	11.13
Mean	9.999	SD	5.368
Coefficient of Variation	0.537	Skewness	1.725
Mean of logged Data	2.197	SD of logged Data	0.436

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.117	d2max (for USL)	2.868

Normal GOF Test

Shapiro Wilk Test Statistic	0.755	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.269	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	21.36	90% Percentile (z)	16.88
95% UPL (t)	19.16	95% Percentile (z)	18.83
95% USL	25.39	99% Percentile (z)	22.49

Gamma GOF Test

A-D Test Statistic	2.601	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.24	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Appendix B-3d
Background Evaluation - BTV Calculation
Rainbow Smelt

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	4.891	k star (bias corrected MLE)	4.541
Theta hat (MLE)	2.044	Theta star (bias corrected MLE)	2.202
nu hat (MLE)	391.3	nu star (bias corrected)	363.3
MLE Mean (bias corrected)	9.999	MLE Sd (bias corrected)	4.692

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	18.89	90% Percentile	16.28
95% Hawkins Wixley (HW) Approx. Gamma UPL	18.88	95% Percentile	18.75
95% WH Approx. Gamma UTL with 95% Coverage	21.91	99% Percentile	23.99
95% HW Approx. Gamma UTL with 95% Coverage	22.05		
95% WH USL	28.23	95% HW USL	28.85

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.865	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.216	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.139	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	22.63	90% Percentile (z)	15.72
95% UPL (t)	18.91	95% Percentile (z)	18.42
95% USL	31.37	99% Percentile (z)	24.78

Nonparametric Distribution Free Background Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	40	95% UTL with 95% Coverage	26.2
Approx, f used to compute achieved CC	2.105	Approximate Actual Confidence Coefficient achieved by UTL	0.871
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	26.2	95% BCA Bootstrap UTL with 95% Coverage	26.2
95% UPL	24.48	90% Percentile	18.19
90% Chebyshev UPL	26.3	95% Percentile	22.32
95% Chebyshev UPL	33.69	99% Percentile	25.58
95% USL	26.2		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Appendix B-4a
Background Evaluation - ProUCL Input
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	LOC_GRP	MED_T	ID	DATE	ARAM_NAM	FINAL_RESU	RESULT_UOM
OV-04_17ET015	REFERENCE	Eel	OV-04_17ET015_060917_EEL_01_WB	6/9/2017	Mercury	306	NG/G
OV-04_17ET628	REFERENCE	Eel	OV-04_17ET628_072817_EEL_02_WB	7/28/2017	Mercury	320	NG/G
OV-04_17ET628	REFERENCE	Eel	OV-04_17ET628_072817_EEL_03_WB	7/28/2017	Mercury	176	NG/G
OV-04_17ET628	REFERENCE	Eel	OV-04_17ET628_072817_EEL_04_WB	7/28/2017	Mercury	161	NG/G
OV-04_17ET628	REFERENCE	Eel	OV-04_17ET628_072817_EEL_05_WB	7/28/2017	Mercury	153	NG/G
OV-04_17ET628	REFERENCE	Eel	OV-04_17ET628_072817_EEL_06_WB	7/28/2017	Mercury	142	NG/G

Appendix B-4b
Background Evaluation - Outlier Test
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Outlier Tests for Selected Uncensored Variables

User Selected Options	
Date/Time of Computation	ProUCL 5.110/13/2017 1:34:44 PM
From File	WorkSheet.xls
Full Precision	OFF

Dixon's Outlier Test for Eel

Number of Observations = 6
10% critical value: 0.482
5% critical value: 0.56
1% critical value: 0.698

1. Observation Value 320 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.079

For 10% significance level, 320 is not an outlier.
For 5% significance level, 320 is not an outlier.
For 1% significance level, 320 is not an outlier.

2. Observation Value 142 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.062

For 10% significance level, 142 is not an outlier.
For 5% significance level, 142 is not an outlier.
For 1% significance level, 142 is not an outlier.

Appendix B-4c
Background Evaluation - Goodness of Fit
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.19/21/2017 1:41:08 PM
From File	HH_eel-reference UPL.xls
Full Precision	OFF
Confidence Coefficient	0.95

FINAL_RESU (ov-04)

Raw Statistics	
Number of Valid Observations	6
Number of Distinct Observations	6
Minimum	142
Maximum	320
Mean of Raw Data	209.7
Standard Deviation of Raw Data	80.93
Khat	8.908
Theta hat	23.54
Kstar	4.565
Theta star	45.93
Mean of Log Transformed Data	5.288
Standard Deviation of Log Transformed Data	0.362

Normal GOF Test Results	
Correlation Coefficient R	0.889
Shapiro Wilk Test Statistic	0.769
Shapiro Wilk Critical (0.05) Value	0.788
Approximate Shapiro Wilk P Value	N/A
Lilliefors Test Statistic	0.328
Lilliefors Critical (0.05) Value	0.325

Data not Normal at (0.05) Significance Level

Gamma GOF Test Results	
Correlation Coefficient R	0.915
A-D Test Statistic	0.727
A-D Critical (0.05) Value	0.698
K-S Test Statistic	0.32
K-S Critical(0.05) Value	0.333

Data follow Appr. Gamma Distribution at (0.05) Significance Level

Lognormal GOF Test Results	
Correlation Coefficient R	0.909
Shapiro Wilk Test Statistic	0.804
Shapiro Wilk Critical (0.05) Value	0.788
Approximate Shapiro Wilk P Value	N/A
Lilliefors Test Statistic	0.294
Lilliefors Critical (0.05) Value	0.325

Data appear Lognormal at (0.05) Significance Level

Appendix B-4d
Background Evaluation - BTV Calculation
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation	ProUCL 5.19/21/2017 1:28:46 PM
From File	C:\Users\leslie.ouy\Desktop\2017_09_06 Penobscot BERA Support\2.0 Analytical Data\UCL calcs\HH-EPCs UCLs\HH_
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
New or Future K Observations	1
Number of Bootstrap Operations	2000

FINAL_RESU (ov-04)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
Minimum	142	First Quartile	155
Second Largest	306	Median	168.5
Maximum	320	Third Quartile	273.5
Mean	209.7	SD	80.93
Coefficient of Variation	0.386	Skewness	0.901
Mean of logged Data	5.288	SD of logged Data	0.362

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	3.708	d2max (for USL)	1.822

Normal GOF Test

Shapiro Wilk Test Statistic	0.769	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.328	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	509.7	90% Percentile (z)	313.4
95% UPL (t)	385.8	95% Percentile (z)	342.8
95% USL	357.1	99% Percentile (z)	397.9

Gamma GOF Test

A-D Test Statistic	0.727	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.32	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Appendix B-4d
Background Evaluation - BTV Calculation
American Eel

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	8.908	k star (bias corrected MLE)	4.565
Theta hat (MLE)	23.54	Theta star (bias corrected MLE)	45.93
nu hat (MLE)	106.9	nu star (bias corrected)	54.78
MLE Mean (bias corrected)	209.7	MLE Sd (bias corrected)	98.13

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	413.3	90% Percentile	341.1
95% Hawkins Wixley (HW) Approx. Gamma UPL	418	95% Percentile	392.7
95% WH Approx. Gamma UTL with 95% Coverage	628	99% Percentile	502.2
95% HW Approx. Gamma UTL with 95% Coverage	652.8		
95% WH USL	371.8	95% HW USL	374.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.804	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.294	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	756.7	90% Percentile (z)	314.7
95% UPL (t)	435	95% Percentile (z)	358.9
95% USL	382.7	99% Percentile (z)	459.2

Nonparametric Distribution Free Background Statistics

Data appear Approximate Gamma Distribution at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	6	95% UTL with 95% Coverage	320
Approx, f used to compute achieved CC	0.316	Approximate Actual Confidence Coefficient achieved by UTL	0.265
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	320	95% BCA Bootstrap UTL with 95% Coverage	320
95% UPL	320	90% Percentile	313
90% Chebyshev UPL	471.9	95% Percentile	316.5
95% Chebyshev UPL	590.7	99% Percentile	319.3
95% USL	320		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Appendix B-5a
Background Evaluation - ProUCL Input
American Black Duck - Tissue

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	LOC_GRP	MED_T	ID	DATE	PARAM_NAME	FINAL_RESU	RESULT_UOM
FRB-01	REFERENCE	American Black Duck	FRB-01_012417_ABD_06_MU	1/25/2017	Mercury	10.1	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_012417_ABD_07_MU	1/25/2017	Mercury	46.5	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_012417_ABD_08_MU	1/25/2017	Mercury	44.8	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_012417_ABD_09_MU	1/26/2017	Mercury	47.6	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_012417_ABD_10_MU	1/26/2017	Mercury	41.7	NG/G
ABDU-012714-01	REFERENCE	American Black Duck	ABDU-012714_ABD_MU	1/27/2014	Mercury	85.3	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_18WT001_013018_ABD_01_BL	1/30/2018	Mercury	70.0	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_18WT001_013018_ABD_02_BL	1/30/2018	Mercury	69.4	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_18WT001_013018_ABD_03_BL	1/30/2018	Mercury	75.9	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_18WT001_013018_ABD_04_BL	1/30/2018	Mercury	43.3	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_18WT001_013018_ABD_05_BL	1/30/2018	Mercury	42.0	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-OCN_18WT001_013018_ABD_06_BL	1/30/2018	Mercury	66.4	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-OCN_18WT001_013018_ABD_07_BL	1/30/2018	Mercury	93.6	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-OCN_18WT001_013018_ABD_08_BL	1/30/2018	Mercury	81.0	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-OCN_18WT001_013018_ABD_09_BL	1/30/2018	Mercury	89.0	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-OCN_18WT001_013018_ABD_10_BL	1/30/2018	Mercury	67.0	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-OCN_18WT001_013018_ABD_11_BL	1/30/2018	Mercury	74.4	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-OCN_18WT001_013018_ABD_12_BL	1/30/2018	Mercury	64.0	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_18WT001_013118_ABD_13_BL	1/31/2018	Mercury	52.0	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_18WT001_013118_ABD_14_BL	1/31/2018	Mercury	74.9	NG/G
FRB-01	REFERENCE	American Black Duck	FRB-01_18WT001_013118_ABD_15_BL	1/31/2018	Mercury	68.5	NG/G

Appendix B-5b
Background Evaluation - Outlier Test
American Black Duck - Tissue

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation	ProUCL 5.14/13/2018 4:16:03 PM
From File	WorkSheet.xls
Full Precision	OFF

Dixon's Outlier Test for ABD TISSUE Hg

Number of Observations = 21

10% critical value: 0.391

5% critical value: 0.44

1% critical value: 0.524

1. Observation Value 93.6 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.161

For 10% significance level, 93.6 is not an outlier.

For 5% significance level, 93.6 is not an outlier.

For 1% significance level, 93.6 is not an outlier.

2. Observation Value 10.1 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.424

For 10% significance level, 10.1 is an outlier.

For 5% significance level, 10.1 is not an outlier.

For 1% significance level, 10.1 is not an outlier.

Appendix B-5c
Background Evaluation - Goodness of Fit
American Black Duck - Tissue

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.14/13/2018 4:17:09 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	0.95

ABD TISSUE Hg

Raw Statistics

Number of Valid Observations	21
Number of Distinct Observations	21
Minimum	10.1
Maximum	93.6
Mean of Raw Data	62.26
Standard Deviation of Raw Data	20.06
Khat	6.509
Theta hat	9.565
Kstar	5.611
Theta star	11.1
Mean of Log Transformed Data	4.052
Standard Deviation of Log Transformed Data	0.476

Normal GOF Test Results

Correlation Coefficient R	0.968
Shapiro Wilk Test Statistic	0.942
Shapiro Wilk Critical (0.05) Value	0.908
Approximate Shapiro Wilk P Value	0.232
Lilliefors Test Statistic	0.154
Lilliefors Critical (0.05) Value	0.188

Data appear Normal at (0.05) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.931
A-D Test Statistic	0.984
A-D Critical (0.05) Value	0.745
K-S Test Statistic	0.199
K-S Critical(0.05) Value	0.19

Data not Gamma Distributed at (0.05) Significance Level

Appendix B-5c
Background Evaluation - Goodness of Fit
American Black Duck - Tissue

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal GOF Test Results

Correlation Coefficient R	0.845
Shapiro Wilk Test Statistic	0.736
Shapiro Wilk Critical (0.05) Value	0.908
Approximate Shapiro Wilk P Value	3.4086E-5
Lilliefors Test Statistic	0.207
Lilliefors Critical (0.05) Value	0.188

Data not Lognormal at (0.05) Significance Level

Appendix B-5d
BackgroundEvaluation - BTV Calculation
America Black Duck - Tissue

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation	ProUCL 5.14/13/2018 4:17:31 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
New or Future K Observations	1
Number of Bootstrap Operations	2000

ABD TISSUE Hg

General Statistics

Total Number of Observations	21	Number of Distinct Observations	21
Minimum	10.1	First Quartile	46.5
Second Largest	89	Median	67
Maximum	93.6	Third Quartile	74.9
Mean	62.26	SD	20.06
Coefficient of Variation	0.322	Skewness	-0.703
Mean of logged Data	4.052	SD of logged Data	0.476

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.371	d2max (for USL)	2.58

Normal GOF Test

Shapiro Wilk Test Statistic	0.942	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.154	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.188	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	109.8	90% Percentile (z)	87.97
95% UPL (t)	97.68	95% Percentile (z)	95.26
95% USL	114	99% Percentile (z)	108.9

Appendix B-5d
BackgroundEvaluation - BTV Calculation
America Black Duck - Tissue

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test

A-D Test Statistic	0.984	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.199	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.19	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.509	k star (bias corrected MLE)	5.611
Theta hat (MLE)	9.565	Theta star (bias corrected MLE)	11.1
nu hat (MLE)	273.4	nu star (bias corrected)	235.7
MLE Mean (bias corrected)	62.26	MLE Sd (bias corrected)	26.28

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	112.6	90% Percentile	97.41
95% Hawkins Wixley (HW) Approx. Gamma UPL	116.3	95% Percentile	110.8
95% WH Approx. Gamma UTL with 95% Coverage	136.3	99% Percentile	139
95% HW Approx. Gamma UTL with 95% Coverage	143.3		
95% WH USL	145.3	95% HW USL	153.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.736	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.908	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.207	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.188	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	178	90% Percentile (z)	105.9
95% UPL (t)	133.4	95% Percentile (z)	125.9
95% USL	196.6	99% Percentile (z)	174.2

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Appendix B-5d
BackgroundEvaluation - BTV Calculation
America Black Duck - Tissue

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	21	95% UTL with 95% Coverage	93.6
Approx, f used to compute achieved CC	1.105	Approximate Actual Confidence Coefficient achieved by UTL	0.659
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	93.6	95% BCA Bootstrap UTL with 95% Coverage	93.6
95% UPL	93.14	90% Percentile	85.3
90% Chebyshev UPL	123.9	95% Percentile	89
95% Chebyshev UPL	151.8	99% Percentile	92.68
95% USL	93.6		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Appendix B-6a
Background Evaluation - ProUCL Input
American Black Duck - Blood

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	LOC_GRP	MED_T	ID	DATE	PARAM_NAME	FINAL_RESU	RESULT_UOM
FRB	Reference	American Black Duck	1917-294-05_021214_ABD_BL	2/12/2014	Mercury	54.76002	NG/G
FRB	Reference	American Black Duck	1917-294-12_021214_ABD_BL	2/12/2014	Mercury	31.1792	NG/G
FRB	Reference	American Black Duck	1917-294-14_021214_ABD_BL	2/12/2014	Mercury	32.04738	NG/G
FRB	Reference	American Black Duck	2047-308-73_012714_ABD_BL	1/27/2014	Mercury	123.73942	NG/G
FRB	Reference	American Black Duck	2047-308-74_012714_ABD_BL	1/27/2014	Mercury	202.90248	NG/G
FRB	Reference	American Black Duck	2047-308-75_012714_ABD_BL	1/27/2014	Mercury	15.91397	NG/G
FRB	Reference	American Black Duck	2047-308-78_012714_ABD_BL	1/27/2014	Mercury	370.2637	NG/G
FRB	Reference	American Black Duck	2047-308-81_012714_ABD_BL	1/27/2014	Mercury	51.09566	NG/G
FRB	Reference	American Black Duck	2047-308-83_012714_ABD_BL	1/27/2014	Mercury	51.8	NG/G
FRB	Reference	American Black Duck	2047-308-87_012714_ABD_BL	1/27/2014	Mercury	75.57064	NG/G
FRB	Reference	American Black Duck	2047-309-09_012814_ABD_BL	1/28/2014	Mercury	90.56599	NG/G
FRB	Reference	American Black Duck	2047-309-10_012814_ABD_BL	1/28/2014	Mercury	67.21228	NG/G
FRB	Reference	American Black Duck	2047-309-11_012814_ABD_BL	1/28/2014	Mercury	40.79906	NG/G
FRB	Reference	American Black Duck	2047-309-12_012814_ABD_BL	1/28/2014	Mercury	84.17478	NG/G
FRB	Reference	American Black Duck	2047-309-13_012814_ABD_BL	1/28/2014	Mercury	40.47535	NG/G
FRB	Reference	American Black Duck	2047-309-14_012814_ABD_BL	1/28/2014	Mercury	57.62941	NG/G
FRB	Reference	American Black Duck	2047-309-15_012814_ABD_BL	1/28/2014	Mercury	44.76686	NG/G
FRB	Reference	American Black Duck	2047-309-16_012814_ABD_BL	1/28/2014	Mercury	88.71786	NG/G
FRB	Reference	American Black Duck	2047-309-17_012814_ABD_BL	1/28/2014	Mercury	100.57506	NG/G
FRB	Reference	American Black Duck	2047-309-18_012814_ABD_BL	1/28/2014	Mercury	96.78397	NG/G
FRB	Reference	American Black Duck	2047-309-19_012814_ABD_BL	1/28/2014	Mercury	62.65778	NG/G
FRB	Reference	American Black Duck	ABDU-012714_ABD_BL	1/27/2014	Mercury	69.4	NG/G
FRB	Reference	American Black Duck	FRB-01_012417_ABD_01_BL	1/24/2017	Mercury	43.5	NG/G
FRB	Reference	American Black Duck	FRB-01_012417_ABD_02_BL	1/24/2017	Mercury	35.5	NG/G
FRB	Reference	American Black Duck	FRB-01_012417_ABD_03_BL	1/24/2017	Mercury	31.2	NG/G
FRB	Reference	American Black Duck	FRB-01_012417_ABD_04_BL	1/24/2017	Mercury	109	NG/G
FRB	Reference	American Black Duck	FRB-01_012417_ABD_05_BL	1/24/2017	Mercury	70.6	NG/G
FRB	Reference	American Black Duck	FRB-01_012417_ABD_06_BL	1/24/2017	Mercury	11.3	NG/G
FRB	Reference	American Black Duck	FRB-01_012417_ABD_07_BL	1/24/2017	Mercury	53.8	NG/G
FRB	Reference	American Black Duck	FRB-01_012417_ABD_08_BL	1/24/2017	Mercury	53.1	NG/G
FRB	Reference	American Black Duck	FRB-01_012417_ABD_09_BL	1/24/2017	Mercury	43.3	NG/G
FRB	Reference	American Black Duck	FRB-01_012417_ABD_10_BL	1/24/2017	Mercury	69	NG/G
FRB	Reference	American Black Duck	FRB-01_020217_ABD_11_BL	2/2/2017	Mercury	83.9	NG/G
FRB	Reference	American Black Duck	FRB-01_020217_ABD_12_BL	2/2/2017	Mercury	41.5	NG/G
FRB	Reference	American Black Duck	FRB-01_020217_ABD_13_BL	2/2/2017	Mercury	31.5	NG/G
FRB	Reference	American Black Duck	FRB-01_020217_ABD_14_BL	2/2/2017	Mercury	89.3	NG/G
FRB	Reference	American Black Duck	FRB-01_020217_ABD_15_BL	2/2/2017	Mercury	32.6	NG/G
FRB	Reference	American Black Duck	FRB-01_18WT001_013018_ABD_01_BL	1/30/2018	Mercury	56.5	NG/G
FRB	Reference	American Black Duck	FRB-01_18WT001_013018_ABD_02_BL	1/30/2018	Mercury	55.8	NG/G
FRB	Reference	American Black Duck	FRB-01_18WT001_013018_ABD_03_BL	1/30/2018	Mercury	63.9	NG/G
FRB	Reference	American Black Duck	FRB-01_18WT001_013018_ABD_04_BL	1/30/2018	Mercury	22.9	NG/G
FRB	Reference	American Black Duck	FRB-01_18WT001_013018_ABD_05_BL	1/30/2018	Mercury	21.3	NG/G
FRB	Reference	American Black Duck	FRB-OCN_18WT001_013018_ABD_06_BL	1/30/2018	Mercury	52	NG/G
FRB	Reference	American Black Duck	FRB-OCN_18WT001_013018_ABD_07_BL	1/30/2018	Mercury	86.1	NG/G
FRB	Reference	American Black Duck	FRB-OCN_18WT001_013018_ABD_08_BL	1/30/2018	Mercury	70.3	NG/G
FRB	Reference	American Black Duck	FRB-OCN_18WT001_013018_ABD_09_BL	1/30/2018	Mercury	80.4	NG/G
FRB	Reference	American Black Duck	FRB-OCN_18WT001_013018_ABD_10_BL	1/30/2018	Mercury	52.7	NG/G
FRB	Reference	American Black Duck	FRB-OCN_18WT001_013018_ABD_11_BL	1/30/2018	Mercury	62	NG/G
FRB	Reference	American Black Duck	FRB-OCN_18WT001_013018_ABD_12_BL	1/30/2018	Mercury	49	NG/G
FRB	Reference	American Black Duck	FRB-01_18WT001_013118_ABD_13_BL	1/31/2018	Mercury	33.9	NG/G
FRB	Reference	American Black Duck	FRB-01_18WT001_013118_ABD_14_BL	1/31/2018	Mercury	62.7	NG/G
FRB	Reference	American Black Duck	FRB-01_18WT001_013118_ABD_15_BL	1/31/2018	Mercury	54.6	NG/G

Appendix B-6b
Background Evaluation - Outlier Test
American Black Duck - Blood

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation	ProUCL 5.14/13/2018 1:04:43 PM
From File	B-6 Duck Blood Background BTV 041318 INPUT.xls
Full Precision	OFF

Rosner's Outlier Test for FINAL_RESU

Mean	66.85
Standard Deviation	53.18
Number of data	52
Number of suspected outliers	3

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	66.85	52.66	370.3	7	5.762	3.144	3.496
2	60.9	31.73	202.9	5	4.475	3.134	3.486
3	58.06	24.65	123.7	4	2.664	3.126	3.478

For 5% significance level, there are 2 Potential Outliers

Potential outliers are:

370.3, 202.9

For 1% Significance Level, there are 2 Potential Outliers

Potential outliers are:

370.3, 202.9

Appendix B-6c
Background Evaluation - Goodness of Fit
American Black Duck - Blood

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.14/13/2018 1:05:40 PM
From File	B-6 Duck Blood Background BTV 041318 INPUT.xls
Full Precision	OFF
Confidence Coefficient	0.95

FINAL_RESU

Raw Statistics

Number of Valid Observations	50
Number of Missing Observations	2
Number of Distinct Observations	50
Minimum	11.3
Maximum	123.7
Mean of Raw Data	58.06
Standard Deviation of Raw Data	24.65
Khat	5.041
Theta hat	11.52
Kstar	4.752
Theta star	12.22
Mean of Log Transformed Data	3.959
Standard Deviation of Log Transformed Data	0.488

Normal GOF Test Results

Correlation Coefficient R	0.991
Shapiro Wilk Test Statistic	0.976
Shapiro Wilk Critical (0.05) Value	0.947
Approximate Shapiro Wilk P Value	0.59
Lilliefors Test Statistic	0.087
Lilliefors Critical (0.05) Value	0.125

Data appear Normal at (0.05) Significance Level

Appendix B-6c
Background Evaluation - Goodness of Fit
American Black Duck - Blood

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma GOF Test Results

Correlation Coefficient R	0.993
A-D Test Statistic	0.251
A-D Critical (0.05) Value	0.754
K-S Test Statistic	0.0882
K-S Critical(0.05) Value	0.126

Data appear Gamma Distributed at (0.05) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.975
Shapiro Wilk Test Statistic	0.952
Shapiro Wilk Critical (0.05) Value	0.947
Approximate Shapiro Wilk P Value	0.0728
Lilliefors Test Statistic	0.119
Lilliefors Critical (0.05) Value	0.125

Data appear Lognormal at (0.05) Significance Level

Appendix B-6d
Background Evaluation - BTV Calculation
American Black Duck - Blood

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation	ProUCL 5.14/13/2018 1:06:41 PM
From File	B-6 Duck Blood Background BTV 041318 INPUT.xlsx
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
New or Future K Observations	1
Number of Bootstrap Operations	2000

FINAL_RESU

General Statistics

Total Number of Observations	50	Number of Distinct Observations	50
		Number of Missing Observations	2
Minimum	11.3	First Quartile	40.97
Second Largest	109	Median	54.68
Maximum	123.7	Third Quartile	70.53
Mean	58.06	SD	24.65
Coefficient of Variation	0.425	Skewness	0.443
Mean of logged Data	3.959	SD of logged Data	0.488

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.058	d2max (for USL)	2.957

Normal GOF Test

Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.947	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.087	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.125	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	108.8	90% Percentile (z)	89.65
95% UPL (t)	99.8	95% Percentile (z)	98.61
95% USL	131	99% Percentile (z)	115.4

Gamma GOF Test

A-D Test Statistic	0.251	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0882	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.126	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix B-6d
Background Evaluation - BTV Calculation
American Black Duck - Blood

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	5.041	k star (bias corrected MLE)	4.752
Theta hat (MLE)	11.52	Theta star (bias corrected MLE)	12.22
nu hat (MLE)	504.1	nu star (bias corrected)	475.2
MLE Mean (bias corrected)	58.06	MLE Sd (bias corrected)	26.64

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	108.5	90% Percentile	93.73
95% Hawkins Wixley (HW) Approx. Gamma UPL	110.6	95% Percentile	107.7
95% WH Approx. Gamma UTL with 95% Coverage	123.6	99% Percentile	137.1
95% HW Approx. Gamma UTL with 95% Coverage	127.2		
95% WH USL	166.6	95% HW USL	175.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.952	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.947	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.119	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.125	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	143	90% Percentile (z)	97.91
95% UPL (t)	119.7	95% Percentile (z)	116.9
95% USL	221.7	99% Percentile (z)	163

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	49	95% UTL with 95% Coverage	109
Approx, f used to compute achieved CC	1.289	Approximate Actual Confidence Coefficient achieved by UTL	0.721
		Approximate Sample Size needed to achieve specified CC	93
95% Percentile Bootstrap UTL with 95% Coverage	113.3	95% BCA Bootstrap UTL with 95% Coverage	109
95% UPL	104.4	90% Percentile	89.43
90% Chebyshev UPL	132.7	95% Percentile	98.87
95% Chebyshev UPL	166.6	99% Percentile	116.5
95% USL	123.7		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Appendix B-7a
Background Evaluation - ProUCL Input
Nelson's Sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	LOC_GRP	MED_T	ID	DATE	PARAM_NAME	FINAL_RESU	RESULT_UOM
ADD-01	ADD-01j	Nelson's sharp-tailed sparrow	ADD-01_072116_NSS_01_BL	7/21/2016	Mercury	740	NG/G
ADD-01	ADD-01h	Nelson's sharp-tailed sparrow	ADD-01_072116_NSS_02_BL	7/21/2016	Mercury	566	NG/G
ADD-01	ADD-01g	Nelson's sharp-tailed sparrow	ADD-01_072216_NSS_03_BL	7/22/2016	Mercury	317	NG/G
ADD-01	ADD-01e	Nelson's sharp-tailed sparrow	ADD-01_072216_NSS_04_BL	7/22/2016	Mercury	558	NG/G
ADD-01	ADD-01g	Nelson's sharp-tailed sparrow	ADD-01_072216_NSS_05_BL	7/22/2016	Mercury	382	NG/G
ADD-01	ADD-01a	Nelson's sharp-tailed sparrow	ADD-01_072516_NSS_06_BL	7/25/2016	Mercury	290	NG/G
ADD-01	ADD-01a	Nelson's sharp-tailed sparrow	ADD-01_072516_NSS_07_BL	7/25/2016	Mercury	637	NG/G
ADD-01	ADD-01i	Nelson's sharp-tailed sparrow	ADD-01_072616_NSS_08_BL	7/25/2016	Mercury	434	NG/G
ADD-01	ADD-01d	Nelson's sharp-tailed sparrow	ADD-01_072616_NSS_09_BL	7/25/2016	Mercury	296	NG/G
ADD-01	ADD-01f	Nelson's sharp-tailed sparrow	ADD-01_072616_NSS_10_BL	7/25/2016	Mercury	467	NG/G
ADD-01	ADD-01i	Nelson's sharp-tailed sparrow	ADD-01_072616_NSS_11_BL	7/25/2016	Mercury	469	NG/G
ADD-01	ADD-01_17MN001	Nelson's sharp-tailed sparrow	ADD-01_17MN001_062117_NSS_01_BL	6/21/2017	Mercury	508	NG/G
ADD-01	ADD-01_17MN001	Nelson's sharp-tailed sparrow	ADD-01_17MN001_062117_NSS_02_BL	6/21/2017	Mercury	520	NG/G
ADD-01	ADD-01_17MN001	Nelson's sharp-tailed sparrow	ADD-01_17MN001_062117_NSS_03_BL	6/21/2017	Mercury	342	NG/G
ADD-01	ADD-01_17MN001	Nelson's sharp-tailed sparrow	ADD-01_17MN001_062217_NSS_09_BL	6/22/2017	Mercury	343	NG/G
ADD-01	ADD-01_17MN002	Nelson's sharp-tailed sparrow	ADD-01_17MN002_062217_NSS_11_BL	6/22/2017	Mercury	378	NG/G
ADD-01	ADD-01_17MN002	Nelson's sharp-tailed sparrow	ADD-01_17MN002_062217_NSS_12_BL	6/22/2017	Mercury	373	NG/G
ADD-01	ADD-01_17MN003	Nelson's sharp-tailed sparrow	ADD-01_17MN003_062117_NSS_08_BL	6/21/2017	Mercury	343	NG/G
ADD-01	ADD-01_17MN004	Nelson's sharp-tailed sparrow	ADD-01_17MN004_062117_NSS_06_BL	6/21/2017	Mercury	375	NG/G
ADD-01	ADD-01_17MN006	Nelson's sharp-tailed sparrow	ADD-01_17MN006_062117_NSS_05_BL	6/21/2017	Mercury	465	NG/G
ADD-01	ADD-01_17MN006	Nelson's sharp-tailed sparrow	ADD-01_17MN006_062117_NSS_07_BL	6/21/2017	Mercury	339	NG/G
ADD-01	ADD-01_17MN007	Nelson's sharp-tailed sparrow	ADD-01_17MN007_062217_NSS_10_BL	6/22/2017	Mercury	219	NG/G
ADD-01	ADD-01_17MN009	Nelson's sharp-tailed sparrow	ADD-01_17MN009_062117_NSS_04_BL	6/21/2017	Mercury	280	NG/G
ADD-01	ADD-01_17MN011	Nelson's sharp-tailed sparrow	ADD-01_17MN011_062217_NSS_13_BL	6/22/2017	Mercury	264	NG/G
ADD-01	ADD-01_17MN050	Nelson's sharp-tailed sparrow	ADD-01_17MN050_062717_NSS_14_BL	6/27/2017	Mercury	460	NG/G
ADD-01	ADD-01_17MN051	Nelson's sharp-tailed sparrow	ADD-01_17MN051_062717_NSS_15_BL	6/27/2017	Mercury	618	NG/G

Appendix B-7b
Background Evaluation - Outlier Test
Nelson's Sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation	ProUCL 5.11/4/2018 12:31:38 PM
From File	WorkSheet.xls
Full Precision	OFF

Rosner's Outlier Test for Sparrow

Mean	**422.4**
Standard Deviation	**128.7**
Number of data	**26**
Number of suspected outliers	**1**

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	422.4	126.2	740	1	2.516	2.84	3.16

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Appendix B-7c
Background Evaluation - Goodness of Fit
Nelson's Sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.11/4/2018 12:31:56 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	0.95

Sparrow

Raw Statistics

Number of Valid Observations	26
Number of Distinct Observations	25
Minimum	219
Maximum	740
Mean of Raw Data	422.4
Standard Deviation of Raw Data	128.7
Khat	11.65
Theta hat	36.26
Kstar	10.33
Theta star	40.88
Mean of Log Transformed Data	6.002
Standard Deviation of Log Transformed Data	0.301

Normal GOF Test Results

Correlation Coefficient R	0.978
Shapiro Wilk Test Statistic	0.955
Shapiro Wilk Critical (0.05) Value	0.92
Approximate Shapiro Wilk P Value	0.322
Lilliefors Test Statistic	0.162
Lilliefors Critical (0.05) Value	0.17

Data appear Normal at (0.05) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.993
A-D Test Statistic	0.259
A-D Critical (0.05) Value	0.744
K-S Test Statistic	0.133
K-S Critical(0.05) Value	0.171

Data appear Gamma Distributed at (0.05) Significance Level

Appendix B-7c
Background Evaluation - Goodness of Fit
Nelson's Sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Lognormal GOF Test Results

Correlation Coefficient R	0.994
Shapiro Wilk Test Statistic	0.985
Shapiro Wilk Critical (0.05) Value	0.92
Approximate Shapiro Wilk P Value	0.952
Lilliefors Test Statistic	0.114
Lilliefors Critical (0.05) Value	0.17

Data appear Lognormal at (0.05) Significance Level

Appendix B-7d
Background Evaluation - BTV Calculation
Nelson's Sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation	ProUCL 5.11/4/2018 12:32:14 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
New or Future K Observations	1
Number of Bootstrap Operations	2000

Sparrow

General Statistics

Total Number of Observations	26	Number of Distinct Observations	25
Minimum	219	First Quartile	339.8
Second Largest	637	Median	380
Maximum	740	Third Quartile	498.3
Mean	422.4	SD	128.7
Coefficient of Variation	0.305	Skewness	0.679
Mean of logged Data	6.002	SD of logged Data	0.301

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.275	d2max (for USL)	2.681

Normal GOF Test

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.92	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.17	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	715.3	90% Percentile (z)	587.4
95% UPL (t)	646.5	95% Percentile (z)	634.2
95% USL	767.5	99% Percentile (z)	721.9

Gamma GOF Test

A-D Test Statistic	0.259	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.133	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.171	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Appendix B-7d
Background Evaluation - BTV Calculation
Nelson's Sparrow

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Gamma Statistics

k hat (MLE)	11.65	k star (bias corrected MLE)	10.33
Theta hat (MLE)	36.26	Theta star (bias corrected MLE)	40.88
nu hat (MLE)	605.9	nu star (bias corrected)	537.3
MLE Mean (bias corrected)	422.4	MLE Sd (bias corrected)	131.4

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	665.9	90% Percentile	597.2
95% Hawkins Wixley (HW) Approx. Gamma UPL	669.5	95% Percentile	659.2
95% WH Approx. Gamma UTL with 95% Coverage	761.5	99% Percentile	786.5
95% HW Approx. Gamma UTL with 95% Coverage	770		
95% WH USL	839.9	95% HW USL	853.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.985	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.17	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	801.6	90% Percentile (z)	594.6
95% UPL (t)	682.6	95% Percentile (z)	663.2
95% USL	905.7	99% Percentile (z)	814.1

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	26	95% UTL with 95% Coverage	740
Approx, f used to compute achieved CC	1.368	Approximate Actual Confidence Coefficient achieved by UTL	0.736
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	740	95% BCA Bootstrap UTL with 95% Coverage	740
95% UPL	704	90% Percentile	592
90% Chebyshev UPL	815.9	95% Percentile	632.3
95% Chebyshev UPL	994.2	99% Percentile	714.3
95% USL	740		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Appendix B-8a
Background Evaluation - ProUCL Input
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	LOC_GRP	MED_T	ID	DATE	PARAM_NAME	FINAL_RESU	RESULT_UOM
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_01_WB	9/12/2017	Mercury	5.17	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_02_WB	9/12/2017	Mercury	8.36	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_03_WB	9/12/2017	Mercury	5.05	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_04_WB	9/12/2017	Mercury	7.11	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_05_WB	9/12/2017	Mercury	7.57	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_06_WB	9/12/2017	Mercury	6.46	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_07_WB	9/12/2017	Mercury	7.7	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_08_WB	9/12/2017	Mercury	7.6	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_09_WB	9/12/2017	Mercury	6.16	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_10_WB	9/12/2017	Mercury	6.74	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_11_WB	9/12/2017	Mercury	6.7	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_12_WB	9/12/2017	Mercury	4.81	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_13_WB	9/12/2017	Mercury	5.65	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_14_WB	9/12/2017	Mercury	6.1	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_15_WB	9/12/2017	Mercury	5.08	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_16_WB	9/12/2017	Mercury	6.6	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_17_WB	9/12/2017	Mercury	5.85	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_18_WB	9/12/2017	Mercury	7.84	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_19_WB	9/12/2017	Mercury	6.53	NG/G
FRB-01_17SN001	REFERENCE	Mummichog	FRB-01_17SN001_091217_MUM_20_WB	9/12/2017	Mercury	4.44	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_01_WB	9/28/2016	Mercury	6.49	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_02_WB	9/28/2016	Mercury	9.83	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_03_WB	9/28/2016	Mercury	6.77	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_04_WB	9/28/2016	Mercury	5.16	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_05_WB	9/28/2016	Mercury	6.9	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_06_WB	9/28/2016	Mercury	7.83	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_07_WB	9/28/2016	Mercury	9.29	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_08_WB	9/28/2016	Mercury	5.76	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_09_WB	9/28/2016	Mercury	7.05	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_10_WB	9/28/2016	Mercury	8.37	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_11_WB	9/28/2016	Mercury	13.5	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_12_WB	9/28/2016	Mercury	7.67	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_13_WB	9/28/2016	Mercury	9.38	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_14_WB	9/28/2016	Mercury	7.9	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_15_WB	9/28/2016	Mercury	8.19	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_16_WB	9/28/2016	Mercury	8.01	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_17_WB	9/28/2016	Mercury	8.58	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_18_WB	9/28/2016	Mercury	11.1	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_19_WB	9/28/2016	Mercury	4.94	NG/G
FRB-01b	REFERENCE	Mummichog	FRB-01_092816_MUM_20_WB	9/28/2016	Mercury	8.43	NG/G

Appendix B-8b
Background Evaluation - Outlier Test
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation	ProUCL 5.11/4/2018 12:08:00 PM
From File	WorkSheet.xls
Full Precision	OFF

Rosner's Outlier Test for Mummichog

Mean	**7.217**
Standard Deviation	**1.81**
Number of data	**40**
Number of suspected outliers	**1**

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	7.217	1.788	13.5	31	3.515	3.04	3.38

For 5% Significance Level, there is 1 Potential Outlier
Potential outliers is: 13.5

For 1% Significance Level, there is 1 Potential Outlier
Potential outliers is: 13.5

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation	ProUCL 5.11/4/2018 12:09:01 PM
From File	WorkSheet.xls
Full Precision	OFF

Rosner's Outlier Test for Mummichog

Mean	**7.056**
Standard Deviation	**1.516**
Number of data	**39**
Number of suspected outliers	**1**

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	7.056	1.496	11.1	37	2.703	3.03	3.37

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Appendix B-8c
Background Evaluation - Goodness of Fit
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Goodness-of-Fit Test Statistics for Uncensored Full Data Sets without Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.11/4/2018 12:09:31 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	0.95

Mummichog

Raw Statistics

Number of Valid Observations	39
Number of Missing Observations	1
Number of Distinct Observations	39
Minimum	4.44
Maximum	11.1
Mean of Raw Data	7.056
Standard Deviation of Raw Data	1.516
Khat	22.31
Theta hat	0.316
Kstar	20.61
Theta star	0.342
Mean of Log Transformed Data	1.931
Standard Deviation of Log Transformed Data	0.216

Normal GOF Test Results

Correlation Coefficient R	0.988
Shapiro Wilk Test Statistic	0.973
Shapiro Wilk Critical (0.05) Value	0.939
Approximate Shapiro Wilk P Value	0.569
Lilliefors Test Statistic	0.0727
Lilliefors Critical (0.05) Value	0.14

Data appear Normal at (0.05) Significance Level

Gamma GOF Test Results

Correlation Coefficient R	0.994
A-D Test Statistic	0.258
A-D Critical (0.05) Value	0.747
K-S Test Statistic	0.0937
K-S Critical(0.05) Value	0.141

Data appear Gamma Distributed at (0.05) Significance Level

Lognormal GOF Test Results

Correlation Coefficient R	0.992
Shapiro Wilk Test Statistic	0.977
Shapiro Wilk Critical (0.05) Value	0.939
Approximate Shapiro Wilk P Value	0.707
Lilliefors Test Statistic	0.102
Lilliefors Critical (0.05) Value	0.14

Data appear Lognormal at (0.05) Significance Level

Appendix B-8d
Background Evaluation - BTV Calculation
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation	ProUCL 5.11/4/2018 12:10:04 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
New or Future K Observations	1
Number of Bootstrap Operations	2000

Mummichog

General Statistics

Total Number of Observations	39	Number of Distinct Observations	39
		Number of Missing Observations	1
Minimum	4.44	First Quartile	5.975
Second Largest	9.83	Median	6.9
Maximum	11.1	Third Quartile	7.955
Mean	7.056	SD	1.516
Coefficient of Variation	0.215	Skewness	0.394
Mean of logged Data	1.931	SD of logged Data	0.216

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.124	d2max (for USL)	2.857

Normal GOF Test

Shapiro Wilk Test Statistic	0.973	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.939	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0727	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.14	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	10.28	90% Percentile (z)	8.998
95% UPL (t)	9.644	95% Percentile (z)	9.549
95% USL	11.39	99% Percentile (z)	10.58

Gamma GOF Test

A-D Test Statistic	0.258	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0937	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.141	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	22.31	k star (bias corrected MLE)	20.61
Theta hat (MLE)	0.316	Theta star (bias corrected MLE)	0.342
nu hat (MLE)	1740	nu star (bias corrected)	1607
MLE Mean (bias corrected)	7.056	MLE Sd (bias corrected)	1.554

Appendix B-8d
Background Evaluation - BTV Calculation
Mummichog

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	9.836	90% Percentile	9.106
95% Hawkins Wixley (HW) Approx. Gamma UPL	9.869	95% Percentile	9.792
95% WH Approx. Gamma UTL with 95% Coverage	10.65	99% Percentile	11.17
95% HW Approx. Gamma UTL with 95% Coverage	10.71		
95% WH USL	12.17	95% HW USL	12.31

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.939	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.102	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.14	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	10.92	90% Percentile (z)	9.102
95% UPL (t)	9.98	95% Percentile (z)	9.846
95% USL	12.8	99% Percentile (z)	11.41

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	39	95% UTL with 95% Coverage	11.1
Approx, f used to compute achieved CC	2.053	Approximate Actual Confidence Coefficient achieved by UTL	0.865
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	11.1	95% BCA Bootstrap UTL with 95% Coverage	11.1
95% UPL	9.83	90% Percentile	8.722
90% Chebyshev UPL	11.66	95% Percentile	9.425
95% Chebyshev UPL	13.75	99% Percentile	10.62
95% USL	11.1		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Appendix B-9a
Mercury Background Evaluation - Data
Sediment

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Year	Work Order	River Reach	Marsh/Intertidal	Chembox Code	Location ID	Latitude	Longitude	Sample ID	Sample Date	Depth Units	Top Depth	Parameter	Mercury (Method 1631)		
												Method	EPA 1631e		
												Units	ng/g		
												Bottom Depth	Result	Qual	Detection Limit
2006/2007	(-)	(-)	(-)	(-)	EB-1	45.64917	-68.55359	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	23.2		
					EB-2	45.66003	-68.5602	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	20		
					EB-3	45.65209	-68.55207	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	27.8		
					EB-4	45.62107	-68.5375	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	71		
					EB-5	45.6652	-68.56596	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	36.7		
					OV-1	44.8564	-68.67973	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	24.3		
					OV-2	44.83901	-68.70116	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	65.9		
					OV-3	44.8484	-68.69355	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	51.2		
					OV-4	44.8776	-68.6728	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	252.1		
					OV-5	44.84783	-68.69498	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	55.9		
2007	(-)	(-)	(-)	(-)	D-01 55-60	44.48233	68.8087	(-)	August 20, 2007	cm	0.0	3.0	19.1		
					D-01 60-65	44.48233	68.8087	(-)	August 20, 2007	cm	0.0	3.0	18.7		
					D-01 65-70	44.48233	68.8087	(-)	August 20, 2007	cm	0.0	3.0	18.3		
					D-01 70-75	44.48233	68.8087	(-)	August 20, 2007	cm	0.0	3.0	19.4		
					E05-01	44.11487	69.05456	(-)	August 22, 2007	cm	0.0	3.0	61.8		
					E05-02	44.11474	69.02993	(-)	August 22, 2007	cm	0.0	3.0	60.3		
					E05-03	44.11441	68.99982	(-)	August 22, 2007	cm	0.0	3.0	89.5		
					E05-04	44.11593	68.97286	(-)	August 22, 2007	cm	0.0	3.0	50.6		
					E05-05	44.11391	68.92167	(-)	August 22, 2007	cm	0.0	3.0	68.4		
					E05-06	44.11424	68.77984	(-)	August 22, 2007	cm	0.0	3.0	63.7		
					E05-07	44.11404	68.75247	(-)	August 22, 2007	cm	0.0	3.0	45.9		
					E05-08	44.11494	68.7243	(-)	August 22, 2007	cm	0.0	3.0	14.2		
					E05-10	44.11748	68.67036	(-)	August 22, 2007	cm	0.0	3.0	45.1		
					E05-11	44.1146	68.63982	(-)	August 22, 2007	cm	0.0	3.0	40.6		
					E05-12	44.11406	68.6141	(-)	August 22, 2007	cm	0.0	3.0	23.8		
					E05-13	44.11327	68.58661	(-)	August 22, 2007	cm	0.0	3.0	35.5		
					E08-01	43.94913	69.28264	(-)	August 27, 2007	cm	0.0	3.0	49.3		
					E08-02	43.9736	69.26436	(-)	August 27, 2007	cm	0.0	3.0	52.9		
					E08-03	44.00802	69.22604	(-)	August 27, 2007	cm	0.0	3.0	53.9		
					E08-04	44.03767	69.19842	(-)	August 27, 2007	cm	0.0	3.0	55.3		
					E08-05	44.06709	69.18121	(-)	August 27, 2007	cm	0.0	3.0	45.9		
2009	(-)	Sheepscot	Subtidal Sediment	(-)	SC1-Subtidal	43 58 42.6	69 39 44.7	(-)	October 14, 2009	cm	0.0	3.0	141		
					SC2-Subtidal	44 55 35.9	69 40 37.2	(-)	October 14, 2009	cm	0.0	3.0	158		
					SC3-Subtidal	43 59 07.6	69 39 10.7	(-)	October 14, 2009	cm	0.0	3.0	137		
		St. George	Subtidal Sediment	(-)	SG1-Subtidal	43 56 57	69 16 52	(-)	October 13, 2009	cm	0.0	3.0	27.7		
					SG2-Subtidal	44 02 01	69 12 08	(-)	October 13, 2009	cm	0.0	3.0	34		
					SG3-Subtidal	44 01 14	69 12 48	(-)	October 13, 2009	cm	0.0	3.0	52.5		
		Narraguagus	Subtidal Sediment	(-)	NG1-Subtidal	44 32 14	67 52 20	(-)	October 1, 2009	cm	0.0	3.0	29.7		
					NG2-Subtidal	44 32 04	67 52 21	(-)	October 1, 2009	cm	0.0	3.0	25.2		
					NG3-Subtidal	44 31 15	67 51 28	(-)	October 1, 2009	cm	0.0	3.0	27.6		
		Sheepscot	Intertidal Sediment	(-)	SC1-Intertidal	43 55 36.2	69 40 40.0	(-)	October 14, 2009	cm	0.0	3.0	35.9		
					SC2-Intertidal	43 56 39.3	69 40 13,9	(-)	October 14, 2009	cm	0.0	3.0	93.3		
					SC3-Intertidal	43 58 15.5	69 79 41.0	(-)	October 14, 2009	cm	0.0	3.0	104		
		St. George	Intertidal Sediment	(-)	SG1- Intertidal	44 01 24.6	69 12 48.5	(-)	October 13, 2009	cm	0.0	3.0	6.8		
					SG2- Intertidal	44 01 45.6	69 12 33.1	(-)	October 13, 2009	cm	0.0	3.0	45.4		
					SG3- Intertidal	44 02 55.5	69 11 45.8	(-)	October 13, 2009	cm	0.0	3.0	41.1		
		Narraguagus	Intertidal Sediment	(-)	NG1- Intertidal	44 32 10.8	67 52 09.6	(-)	October 1, 2009	cm	0.0	3.0	29.5		
					NG2- Intertidal	44 31 56	67 52 17.4	(-)	October 1, 2009	cm	0.0	3.0	32.6		
					NG3- Intertidal	44 31 42	67 51 34.5	(-)	October 1, 2009	cm	0.0	3.0	21.5		
2016	(-)	Addison River	Intertidal Sediment	(-)	ADD-02	44.6431	-67.7201	ADD-02_072216_SED_03	07/22/16	ft	0.0	0.3	28.9		N/A
		Veazie	Intertidal Sediment	(-)	OV-04	44.8765	-68.6739	OV-04_072216_SED_03	07/22/16	ft	0.0	0.3	31.1		
		Veazie	Intertidal Sediment	(-)	OV-01	44.8564	-68.6797	OV-01_072216_SED_03	07/22/16	ft	0.0	0.3	29.3		
		Veazie	Intertidal Sediment	(-)	OV-02	44.8375	-68.7015	OV-02_072216_SED_03	07/22/16	ft	0.0	0.3	46.5		
2017	40	Addison River	Intertidal Sediment	Non-cohesive	ADD-02	44.643074	-67.719641	ADD-02_072417_SED_00-01	7/24/2017	ft	0.0	0.1	35		2.02
								ADD-02_072417_SED_01-03	7/24/2017	ft	0.1	0.3	36		1.89
								ADD-02_072517_SED_03-05	7/25/2017	ft	0.3	0.5	36	J	8.49
								ADD-02_072517_SED_05-10	7/25/2017	ft	0.5	1.0	33		7.09
		Veazie	Intertidal Sediment	Grab	OV-01	44.85644708	-68.6797088	OV-01_072617_SED_00-03	7/26/2017	ft	0.0	0.3	16		0.99
				Grab	OV-02	44.8375615	-68.7014977	OV-02_072617_SED_00-03	7/26/2017	ft	0.0	0.3	11		1.00
				Non-cohesive	OV-04	44.87588715	-68.6736751	OV-04_081517_SED_00-01	8/15/2017	ft	0.0	0.1	82		11.10
								OV-04_081517_SED_01-03	8/15/2017	ft	0.1	0.3	109		11.70
								OV-04_081717_SED_03-05	8/17/2017	ft	0.3	0.5	91		10.90
	50	Background	Marsh Platform Sediment	Marsh Soil	ADD-01	44.643851	-67.720005	ADD-01_071817_SED_00-01	07/18/17	ft	0.0	0.1	16	J	4.50
								ADD-01_071817_SED_01-03	07/18/17	ft	0.1	0.3	32		4.00
								ADD-01_071917_SED_03-05	07/19/17	ft	0.3	0.5	19		2.95
								ADD-01_071917_SED_05-10	07/19/17	ft	0.5	1.0	13		2.68
			Subtidal Sediment	Non-cohesive	FBJR	(-)	(-)	FB-JR_091417_SED_00-03	09/14/17	ft	0.0	0.3	29		2.57
								FB-JR_092717_SED_00-01	09/27/17	ft	0.3	1.0	27		1.41
								FB-JR_092717_SED_01-03	09/27/17	ft	1.0	3.0	30		1.56
								FB-JR_092817_SED_03-05	09/28/17	ft	3.0	5.0	39		1.44
				Grab	HB-01	(-)	(-)	HB-01_091317_SED_00-03	09/13/17	ft	0.0	0.5	57		1.26
				Cohesive	OV-04A	44.86959064	-68.6724139	OV-04A_081517_SED_00-01	08/15/17	ft	0.0	0.1	22		1.06
								OV-04A_081517_SED_01-03	08/15/17	ft	0.1	0.3	25		4.83
								OV-04A_081717_SED_03-05	08/17/17	ft	0.3	0.5	14	J	4.70
								OV-04A_081717_SED_05-10	08/17/17	ft	0.5	1.0	15	z	0.96

Appendix B-9b
Mercury Background Evaluation - ProUCL Input
Sediment

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	DATE	Top Depth (cm)	Bottom Depth (cm)	Mercury Concentration (ng/g)	Detect Flag
EB-1	I II III IV V VI 2006-2007	0	3	23.2	1
EB-2	I II III IV V VI 2006-2007	0	3	20	1
EB-3	I II III IV V VI 2006-2007	0	3	27.8	1
EB-4	I II III IV V VI 2006-2007	0	3	71	1
EB-5	I II III IV V VI 2006-2007	0	3	36.7	1
OV-1	I II III IV V VI 2006-2007	0	3	24.3	1
OV-2	I II III IV V VI 2006-2007	0	3	65.9	1
OV-3	I II III IV V VI 2006-2007	0	3	51.2	1
OV-4	I II III IV V VI 2006-2007	0	3		
OV-5	I II III IV V VI 2006-2007	0	3	55.9	1
D-01 55-60	August 20, 2007	0	3	19.1	1
D-01 60-65	August 20, 2007	0	3	18.7	1
D-01 65-70	August 20, 2007	0	3	18.3	1
D-01 70-75	August 20, 2007	0	3	19.4	1
E05-01	August 22, 2007	0	3	61.8	1
E05-02	August 22, 2007	0	3	60.3	1
E05-03	August 22, 2007	0	3	89.5	1
E05-04	August 22, 2007	0	3	50.6	1
E05-05	August 22, 2007	0	3	68.4	1
E05-06	August 22, 2007	0	3	63.7	1
E05-07	August 22, 2007	0	3	45.9	1
E05-08	August 22, 2007	0	3	14.2	1

Appendix B-9b
Mercury Background Evaluation - ProUCL Input
Sediment

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	DATE	Top Depth (cm)	Bottom Depth (cm)	Mercury Concentration (ng/g)	Detect Flag
E05-10	August 22, 2007	0	3	45.1	1
E05-11	August 22, 2007	0	3	40.6	1
E05-12	August 22, 2007	0	3	23.8	1
E05-13	August 22, 2007	0	3	35.5	1
E08-01	August 27, 2007	0	3	49.3	1
E08-02	August 27, 2007	0	3	52.9	1
E08-03	August 27, 2007	0	3	53.9	1
E08-04	August 27, 2007	0	3	55.3	1
E08-05	August 27, 2007	0	3	45.9	1
SC1-Subtidal	October 14, 2009	0	3	141	1
SC2-Subtidal	October 14, 2009	0	3	158	1
SC3-Subtidal	October 14, 2009	0	3	137	1
SG1-Subtidal	October 13, 2009	0	3	27.7	1
SG2-Subtidal	October 13, 2009	0	3	34	1
SG3-Subtidal	October 13, 2009	0	3	52.5	1
NG1-Subtidal	October 1, 2009	0	3	29.7	1
NG2-Subtidal	October 1, 2009	0	3	25.2	1
NG3-Subtidal	October 1, 2009	0	3	27.6	1
SC1-Intertidal	October 14, 2009	0	3	35.9	1
SC2-Intertidal	October 14, 2009	0	3	93.3	1
SC3-Intertidal	October 14, 2009	0	3	104	1
SG1- Intertidal	October 13, 2009	0	3	6.8	1
SG2- Intertidal	October 13, 2009	0	3	45.4	1
SG3- Intertidal	October 13, 2009	0	3	41.1	1
NG1- Intertidal	October 1, 2009	0	3	29.5	1
NG2- Intertidal	October 1, 2009	0	3	32.6	1
NG3- Intertidal	October 1, 2009	0	3	21.5	1

Appendix B-9b
Mercury Background Evaluation - ProUCL Input
Sediment

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

LOC_NAME	DATE	Top Depth (cm)	Bottom Depth (cm)	Mercury Concentration (ng/g)	Detect Flag
ADD-02	42573	0	9.144	28.9	1
OV-04	42573	0	9.144	31.1	1
OV-01	42573	0	9.144	29.3	1
OV-02	42573	0	9.144	46.5	1
ADD-02	42940.697	0	3.048	35.1	1
ADD-02	42940.698	3.048	9.144	35.8	1
ADD-02	42941.604	9.144	15.24	35.9	1
ADD-02	42941.606	15.24	30.48	33	1
OV-01	42942.34	0	9.144	16.1	1
OV-02	42942.361	0	9.144	11.4	1
OV-04	42962.752	0	3.048	81.6	1
OV-04	42962.753	3.048	9.144	109	1
OV-04	42964.79	9.144	15.24	90.5	1
ADD-01	42934	0	3.048	16.4	1
ADD-01	42934	3.048	9.144	32.4	1
ADD-01	42935	9.144	15.24	19.2	1
ADD-01	42935	15.24	30.48	12.7	1
FBJR	42992	0	9.144	29.2	1
FBJR	43005	9.144	30.48	27.4	1
HB-01	42991	0	15.24	56.8	1
OV-04A	42962	0	3.048	22.1	1
OV-04A	42962	3.048	9.144	24.8	1
OV-04A	42964	9.144	15.24	13.9	1
OV-04A	42964	15.24	30.48	15.1	1

Appendix B-9c
Mercury Background Evaluation - BTV Calculation
Sediment

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation	ProUCL 5.11/17/2018 1:07:23 PM
From File	P:\ENV\3616166052_USD_Penobscot\Hg Sediment Background\Sediment Input.xlsx
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
New or Future K Observations	1
Number of Bootstrap Operations	2000

Sediment Mercury Data (0-1 ft)

General Statistics

Total Number of Observations	72	Number of Distinct Observations	70
		Number of Missing Observations	1
Minimum	6.8	First Quartile	24.18
Second Largest	141	Median	35.3
Maximum	158	Third Quartile	54.25
Mean	44.52	SD	30.95
Coefficient of Variation	0.695	Skewness	1.753
Mean of logged Data	3.596	SD of logged Data	0.633

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.98	d2max (for USL)	3.094

Normal GOF Test

Shapiro Wilk Test Statistic	0.829	**Normal GOF Test**
5% Shapiro Wilk P Value	2.166E-11	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.169	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.104	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	105.8	90% Percentile (z)	84.18
95% UPL (t)	96.45	95% Percentile (z)	95.42
95% USL	140.3	99% Percentile (z)	116.5

Gamma GOF Test

A-D Test Statistic	0.73	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.76	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.107	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.106	Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.651	k star (bias corrected MLE)	2.549
Theta hat (MLE)	16.8	Theta star (bias corrected MLE)	17.46
nu hat (MLE)	381.7	nu star (bias corrected)	367.1
MLE Mean (bias corrected)	44.52	MLE Sd (bias corrected)	27.88

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	98.15	90% Percentile	81.87
95% Hawkins Wixley (HW) Approx. Gamma UPL	99.32	95% Percentile	97.99
95% WH Approx. Gamma UTL with 95% Coverage	112.9	99% Percentile	133.2
95% HW Approx. Gamma UTL with 95% Coverage	115.4		
95% WH USL	179.9	95% HW USL	191.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.988	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.924	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0649	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.104	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	127.7	90% Percentile (z)	82.04
95% UPL (t)	105.5	95% Percentile (z)	103.3
95% USL	258.6	99% Percentile (z)	159

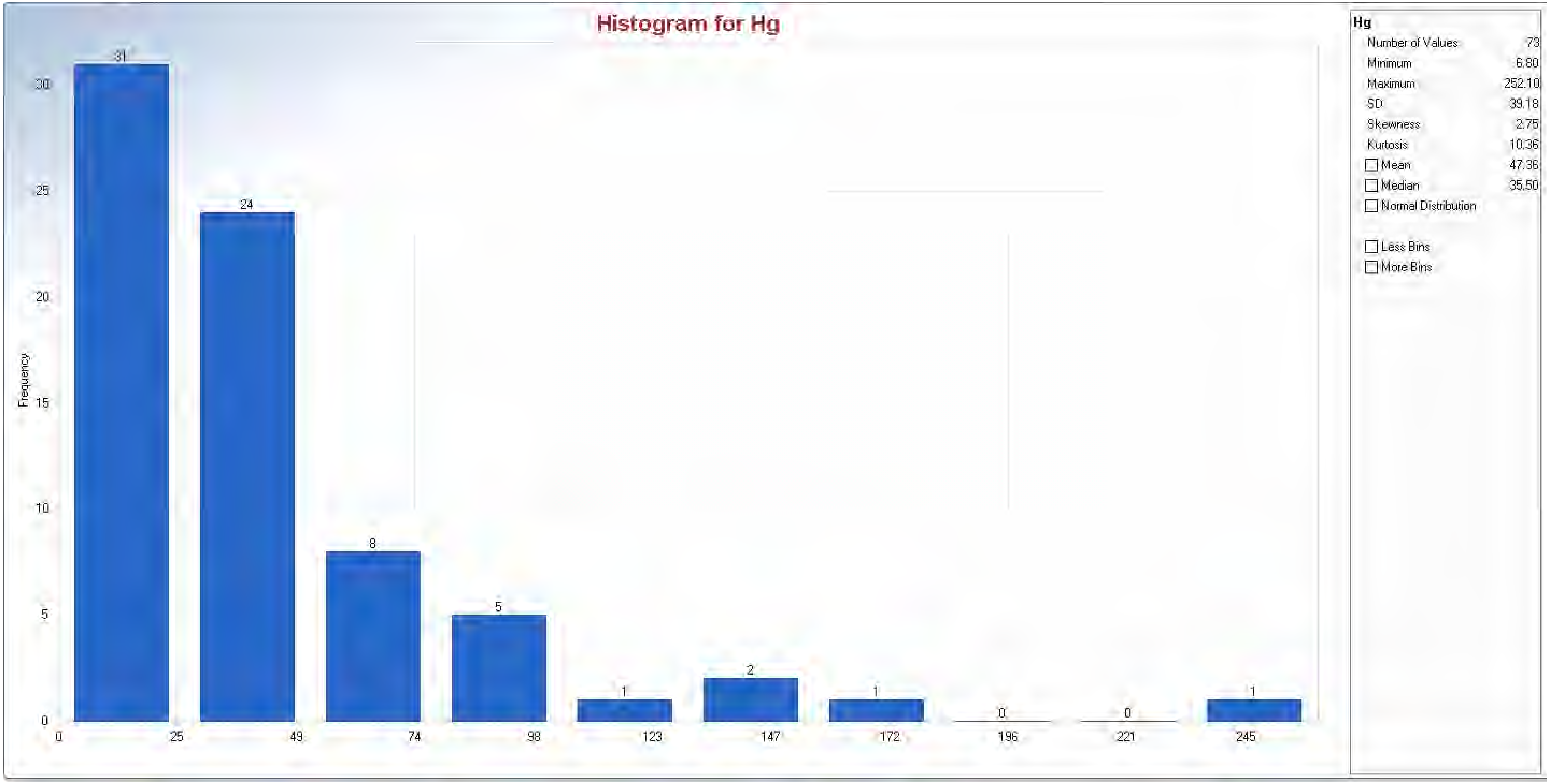
Nonparametric Distribution Free Background Statistics

Data appear Approximate Gamma Distribution at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	71	95% UTL with 95% Coverage	141
Approx, f used to compute achieved CC	1.868	Approximate Actual Confidence Coefficient achieved by UTL	0.881
		Approximate Sample Size needed to achieve specified CC	93
95% Percentile Bootstrap UTL with 95% Coverage	141	95% BCA Bootstrap UTL with 95% Coverage	138.8
95% UPL	118.8	90% Percentile	88.71
90% Chebyshev UPL	138	95% Percentile	106.3
95% Chebyshev UPL	180.4	99% Percentile	145.9
95% USL	158		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.



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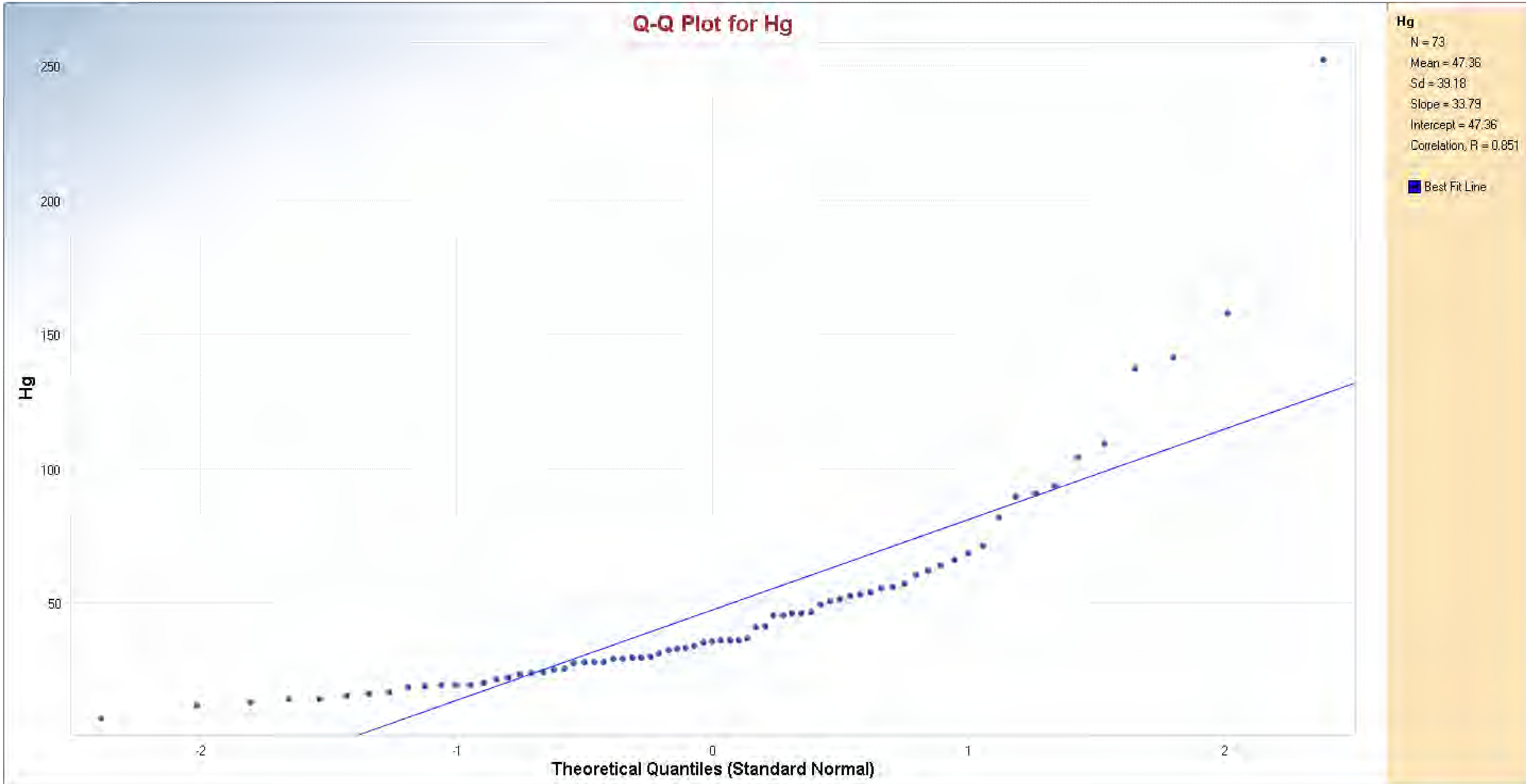
Appendix B-9d
Penobscot Background Sediment Histrogram

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052	Prepared/Date: JRM 2/5/2018	Checked/Date: LSV 2/5/2018



Document:G:\Penobscot River\mxds\Report_Figures_2017\RA_and_Preliminary_Remediation_Development\Background_Sediment_Q-Q_Plot_landscape.mxd 2/5/2018 4:01:40 PM cody.simpson

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Appendix B-9e
Penobscot Background Sediment Q-Q Plot

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052	Prepared/Date: JRM 2/5/2018	Checked/Date: LSV 2/5/2018

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Year	Work Order	River Reach	Marsh/Intertidal	Chembox Code	Location ID	Latitude	Longitude	Sample ID	Sample Date	Depth Units	Top Depth	Parameter	Methyl Mercury (Method 1630)		
												Method	EPA 1630		
												Units	ng/g		
												Bottom Depth	Result	Qual	Detection Limit
2006/2007	(-)	(-)	(-)	(-)	EB-1	45.64917	-68.55359	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	0.47		
					EB-2	45.66003	-68.5602	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	0.89		
					EB-3	45.65209	-68.55207	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	0.75		
					EB-4	45.62107	-68.5375	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	1.33		
					EB-5	45.6652	-68.56596	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	1.22		
					OV-1	44.8564	-68.67973	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	0.89		
					OV-2	44.83901	-68.70116	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	1.41		
					OV-3	44.8484	-68.69355	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	1.72		
					OV-4	44.8776	-68.6728	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	4.1		
					OV-5	44.84783	-68.69498	(-)	I II III IV V VI 2006-2007	cm	0.0	3.0	0.85		
2007	(-)	(-)	(-)	(-)	D-01 55-60	44.48233	68.8087	(-)	August 20, 2007	cm	0.0	3.0	n.d.		
					D-01 60-65	44.48233	68.8087	(-)	August 20, 2007	cm	0.0	3.0	n.d.		
					D-01 65-70	44.48233	68.8087	(-)	August 20, 2007	cm	0.0	3.0	n.d.		
					D-01 70-75	44.48233	68.8087	(-)	August 20, 2007	cm	0.0	3.0	n.d.		
					E05-01	44.11487	69.05456	(-)	August 22, 2007	cm	0.0	3.0	0.15		
					E05-02	44.11474	69.02993	(-)	August 22, 2007	cm	0.0	3.0	0.17		
					E05-03	44.11441	68.99982	(-)	August 22, 2007	cm	0.0	3.0	0.17		
					E05-04	44.11593	68.97286	(-)	August 22, 2007	cm	0.0	3.0	0.09		
					E05-05	44.11391	68.92167	(-)	August 22, 2007	cm	0.0	3.0	0.1		
					E05-06	44.11424	68.77984	(-)	August 22, 2007	cm	0.0	3.0	0.1		
					E05-07	44.11404	68.75247	(-)	August 22, 2007	cm	0.0	3.0	0.12		
					E05-08	44.11494	68.7243	(-)	August 22, 2007	cm	0.0	3.0	0.06		
					E05-10	44.11748	68.67036	(-)	August 22, 2007	cm	0.0	3.0	0.11		
					E05-11	44.1146	68.63982	(-)	August 22, 2007	cm	0.0	3.0	0.16		
					E05-12	44.11406	68.6141	(-)	August 22, 2007	cm	0.0	3.0	0.09		
					E05-13	44.11327	68.58661	(-)	August 22, 2007	cm	0.0	3.0	0.1		
					E08-01	43.94913	69.28264	(-)	August 27, 2007	cm	0.0	3.0	0.21		
					E08-02	43.9736	69.26436	(-)	August 27, 2007	cm	0.0	3.0	0.16		
					E08-03	44.00802	69.22604	(-)	August 27, 2007	cm	0.0	3.0	0.14		
					E08-04	44.03767	69.19842	(-)	August 27, 2007	cm	0.0	3.0	0.16		
					E08-05	44.06709	69.18121	(-)	August 27, 2007	cm	0.0	3.0	0.22		
2009	(-)	Sheepscot	Subtidal Sediment	(-)	SC1-Subtidal	43 58 42.6	69 39 44.7	(-)	October 14, 2009	cm	0.0	3.0	1.43		
					SC2-Subtidal	44 55 35.9	69 40 37.2	(-)	October 14, 2009	cm	0.0	3.0	1.87		
					SC3-Subtidal	43 59 07.6	69 39 10.7	(-)	October 14, 2009	cm	0.0	3.0	1.18		
		St. George	Subtidal Sediment	(-)	SG1-Subtidal	43 56 57	69 16 52	(-)	October 13, 2009	cm	0.0	3.0	0.36		
					SG2-Subtidal	44 02 01	69 12 08	(-)	October 13, 2009	cm	0.0	3.0	0.18		
					SG3-Subtidal	44 01 14	69 12 48	(-)	October 13, 2009	cm	0.0	3.0	0.19		
		Narraguagus	Subtidal Sediment	(-)	NG1-Subtidal	44 32 14	67 52 20	(-)	October 1, 2009	cm	0.0	3.0	0.23		
					NG2-Subtidal	44 32 04	67 52 21	(-)	October 1, 2009	cm	0.0	3.0	0.16		
					NG3-Subtidal	44 31 15	67 51 28	(-)	October 1, 2009	cm	0.0	3.0	0.23		
		Sheepscot	Intertidal Sediment	(-)	SC1-Intertidal	43 55 36.2	69 40 40.0	(-)	October 14, 2009	cm	0.0	3.0	0.37		
					SC2-Intertidal	43 56 39.3	69 40 13,9	(-)	October 14, 2009	cm	0.0	3.0	1.7		
					SC3-Intertidal	43 58 15.5	69 79 41.0	(-)	October 14, 2009	cm	0.0	3.0	1.27		
		St. George	Intertidal Sediment	(-)	SG1- Intertidal	44 01 24.6	69 12 48.5	(-)	October 13, 2009	cm	0.0	3.0	0.21		
					SG2- Intertidal	44 01 45.6	69 12 33.1	(-)	October 13, 2009	cm	0.0	3.0	0.29		
					SG3- Intertidal	44 02 55.5	69 11 45.8	(-)	October 13, 2009	cm	0.0	3.0	0.33		
		Narraguagus	Intertidal Sediment	(-)	NG1- Intertidal	44 32 10.8	67 52 09.6	(-)	October 1, 2009	cm	0.0	3.0	0.28		
					NG2- Intertidal	44 31 56	67 52 17.4	(-)	October 1, 2009	cm	0.0	3.0	0.23		
					NG3- Intertidal	44 31 42	67 51 34.5	(-)	October 1, 2009	cm	0.0	3.0	0.46		
2016	(-)	Addison River	Intertidal Sediment	(-)	ADD-02	44.6431	-67.7201	ADD-02_072216_SED_03	07/22/16	ft	0.0	0.3	2.4		N/A
		Veazie	Intertidal Sediment	(-)	OV-04	44.8765	-68.6739	OV-04_072216_SED_03	07/22/16	ft	0.0	0.3	0.009	U	
		Veazie	Intertidal Sediment	(-)	OV-01	44.8564	-68.6797	OV-01_072216_SED_03	07/22/16	ft	0.0	0.3	0.02	J	
		Veazie	Intertidal Sediment	(-)	OV-02	44.8375	-68.7015	OV-02_072216_SED_03	07/22/16	ft	0.0	0.3	3.68		
2017	40	Addison River	Intertidal Sediment	Non-cohesive	ADD-02	44.643074	-67.719641	ADD-02_072417_SED_00-01	7/24/2017	ft	0.0	0.1	4	U	2.02
								ADD-02_072417_SED_01-03	7/24/2017	ft	0.1	0.3	4.3	U	1.89
								ADD-02_072517_SED_03-05	7/25/2017	ft	0.3	0.5	(-)	(-)	8.49
								ADD-02_072517_SED_05-10	7/25/2017	ft	0.5	1.0	(-)	(-)	7.09
		Veazie	Intertidal Sediment	Grab	OV-01	44.85644708	-68.67970877	OV-01_072617_SED_00-03	7/26/2017	ft	0.0	0.3	2.1	U	0.99
				Grab	OV-02	44.8375615	-68.70149771	OV-02_072617_SED_00-03	7/26/2017	ft	0.0	0.3	2	U	1.00
				Non-cohesive	OV-04	44.87588715	-68.67367512	OV-04_081517_SED_00-01	8/15/2017	ft	0.0	0.1	0.6	J	11.10
								OV-04_081517_SED_01-03	8/15/2017	ft	0.1	0.3	0.4	U	11.70
								OV-04_081717_SED_03-05	8/17/2017	ft	0.3	0.5	(-)	(-)	10.90
	50	Background	Marsh Platform Sediment	Marsh Soil	ADD-01	44.643851	-67.720005	ADD-01_071817_SED_00-01	07/18/17	ft	0.0	0.1	9.9	U	4.50
								ADD-01_071817_SED_01-03	07/18/17	ft	0.1	0.3	8.3	U	4.00
								ADD-01_071917_SED_03-05	07/19/17	ft	0.3	0.5	(-)	(-)	2.95
								ADD-01_071917_SED_05-10	07/19/17	ft	0.5	1.0	(-)	(-)	2.68
			Subtidal Sediment	Non-cohesive	FBJR	(-)	(-)	FB-JR_091417_SED_00-03	09/14/17	ft	0.0	0.3	5.2	U	2.57
								FB-JR_092717_SED_00-01	09/27/17	ft	0.3	1.0	3.1	U	1.41
								FB-JR_092717_SED_01-03	09/27/17	ft	1.0	3.0	3.2	U	1.56
								FB-JR_092817_SED_03-05	09/28/17	ft	3.0	5.0	(-)	(-)	1.44
				Grab	HB-01	(-)	(-)	HB-01_091317_SED_00-03	09/13/17	ft	0.0	0.5	3.1	U	1.26
				Cohesive	OV-04A	44.86959064	-68.6724139	OV-04A_081517_SED_00-01	08/15/17	ft	0.0	0.1		U	1.06
								OV-04A_081517_SED_01-03	08/15/17	ft	0.1	0.3		U	4.83
								OV-04A_081717_SED_03-05	08/17/17	ft	0.3	0.5	(-)	(-)	4.70
								OV-04A_081717_SED_05-10	08/17/17	ft	0.5	1.0	(-)	(-)	0.96

Appendix B-10b
Methyl Mercury Background Evaluation - ProUCL Input
Sediment

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

MeHg Bkg	D_MeHg Bkg	MeHg Bkg 2	D_MeHg Bkg 2	MeHg Bkg 3	D_MeHg Bkg 3
0.47	1	0.47	1	0.47	1
0.89	1	0.89	1	0.89	1
0.75	1	0.75	1	0.75	1
1.33	1	1.33	1	1.33	1
1.22	1	1.22	1	1.22	1
0.89	1	0.89	1	0.89	1
1.41	1	1.41	1	1.41	1
1.72	1	1.72	1	1.72	1
4.1	1	4.1	1	4.1	1
0.85	1	0.85	1	0.85	1
0.15	1	0.15	1	0.15	1
0.17	1	0.17	1	0.17	1
0.17	1	0.17	1	0.17	1
0.09	1	0.09	1	0.09	1
0.1	1	0.1	1	0.1	1
0.1	1	0.1	1	0.1	1
0.12	1	0.12	1	0.12	1
0.06	1	0.06	1	0.06	1
0.11	1	0.11	1	0.11	1
0.16	1	0.16	1	0.16	1
0.09	1	0.09	1	0.09	1
0.1	1	0.1	1	0.1	1
0.21	1	0.21	1	0.21	1
0.16	1	0.16	1	0.16	1
0.14	1	0.14	1	0.14	1
0.16	1	0.16	1	0.16	1
0.22	1	0.22	1	0.22	1
1.43	1	1.43	1	1.43	1
1.87	1	1.87	1	1.87	1
1.18	1	1.18	1	1.18	1
0.36	1	0.36	1	0.36	1
0.18	1	0.18	1	0.18	1
0.19	1	0.19	1	0.19	1
0.23	1	0.23	1	0.23	1
0.16	1	0.16	1	0.16	1
0.23	1	0.23	1	0.23	1
0.37	1	0.37	1	0.37	1
1.7	1	1.7	1	1.7	1
1.27	1	1.27	1	1.27	1
0.21	1	0.21	1	0.21	1
0.29	1	0.29	1	0.29	1
0.33	1	0.33	1	0.33	1
0.28	1	0.28	1	0.28	1
0.23	1	0.23	1	0.23	1
0.46	1	0.46	1	0.46	1
2.4	1	2.4	1	2.4	1
0.009	0	0.009	0	0.02	1
0.02	1	0.02	1	0.6	1
3.68	0	3.68	0		
1	0	4	0		
1.1	0	4.3	0		
0.5	0	2.1	0		
0.5	0	2	0		
0.6	1	0.6	1		
0.4	0	0.4	0		

Appendix B-10b
Methyl Mercury Background Evaluation - ProUCL Input
Sediment

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

MeHg Bkg	D_MeHg Bkg	MeHg Bkg 2	D_MeHg Bkg 2	MeHg Bkg 3	D_MeHg Bkg 3
2.5	0	9.9	0		
2.1	0	8.3	0		
1.3	0	5.2	0		
0.8	0	3.1	0		
0.8	0	3.1	0		
0.4	0				
0.5	0				

Appendix B-10c
Methyl Mercury Background Evaluation - BTV Calculation
Sediment

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation	ProUCL 5.11/29/2018 2:20:02 PM
From File	P:\ENV\3616166052_USD_Penobscot\Hg Sediment Background\Methyl Mercury BTVs.xlsx
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
New or Future K Observations	1
Number of Bootstrap Operations	2000

MeHg Bkg 3

General Statistics

Total Number of Observations	48	Number of Distinct Observations	37
Minimum	0.02	First Quartile	0.16
Second Largest	2.4	Median	0.23
Maximum	4.1	Third Quartile	0.89
Mean	0.624	SD	0.777
Coefficient of Variation	1.246	Skewness	2.425
Mean of logged Data	-1.098	SD of logged Data	1.138

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.069	d2max (for USL)	2.941

Normal GOF Test

Shapiro Wilk Test Statistic	0.713	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.947	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.253	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.127	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	2.231	90% Percentile (z)	1.62
95% UPL (t)	1.941	95% Percentile (z)	1.902
95% USL	2.909	99% Percentile (z)	2.432

Gamma GOF Test

A-D Test Statistic	1.809	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.782	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.197	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.132	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.93	k star (bias corrected MLE)	0.886
Theta hat (MLE)	0.67	Theta star (bias corrected MLE)	0.704
nu hat (MLE)	89.29	nu star (bias corrected)	85.04
MLE Mean (bias corrected)	0.624	MLE Sd (bias corrected)	0.662

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	1.921	90% Percentile	1.479
95% Hawkins Wixley (HW) Approx. Gamma UPL	1.965	95% Percentile	1.95
95% WH Approx. Gamma UTL with 95% Coverage	2.475	99% Percentile	3.054
95% HW Approx. Gamma UTL with 95% Coverage	2.605		
95% WH USL	4.166	95% HW USL	4.703

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.947	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.149	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.127	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	3.51	90% Percentile (z)	1.433
95% UPL (t)	2.295	95% Percentile (z)	2.167
95% USL	9.473	99% Percentile (z)	4.707

Nonparametric Distribution Free Background Statistics

Data appear Approximate Lognormal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	47	95% UTL with 95% Coverage	2.4
Approx, f used to compute achieved CC	1.237	Approximate Actual Confidence Coefficient achieved by UTL	0.699
		Approximate Sample Size needed to achieve specified CC	93

Appendix B-10c
Methyl Mercury Background Evaluation - BTV Calculation
Sediment

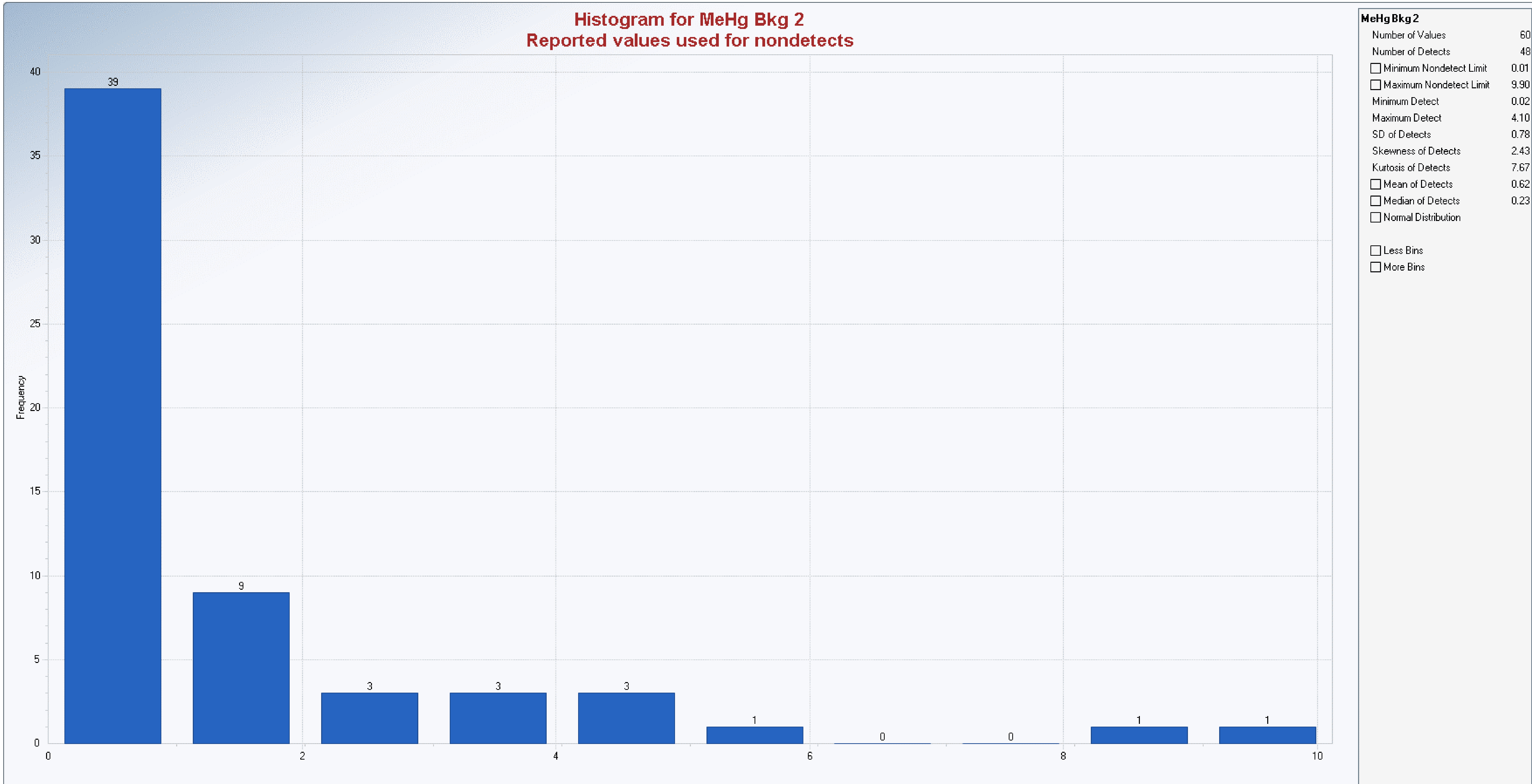
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Background Statistics for Uncensored Full Data Sets

User Selected Options

95% Percentile Bootstrap UTL with 95% Coverage	3.505		95% BCA Bootstrap UTL with 95% Coverage	3.32
95% UPL	2.162		90% Percentile	1.511
90% Chebyshev UPL	2.979		95% Percentile	1.818
95% Chebyshev UPL	4.046		99% Percentile	3.301
95% USL	4.1			

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.



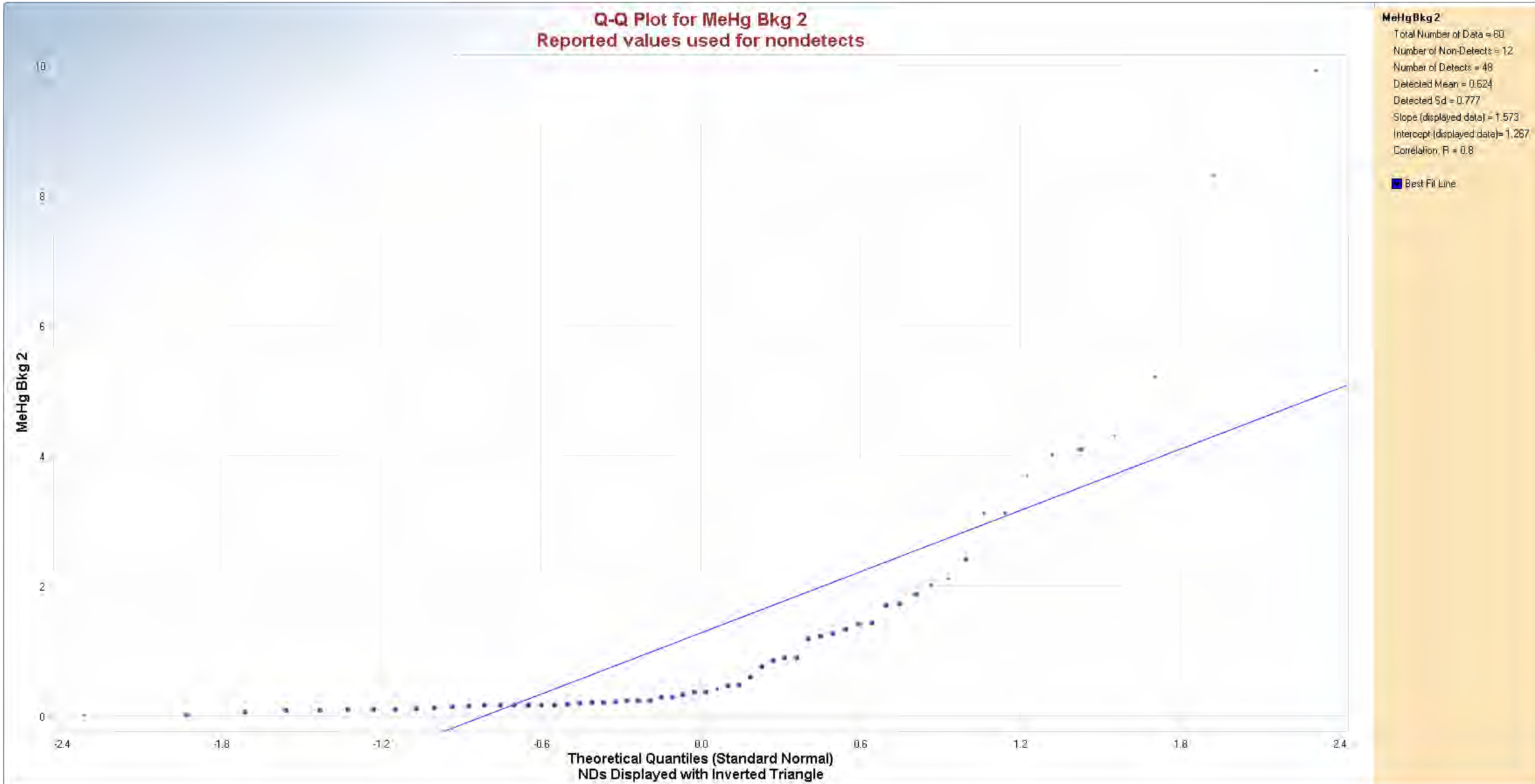
Appendix B-10d
Penobscot Background Sediment Histrogram

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

amec foster wheeler

Project: 3616166052	Prepared/Date: RD 2/5/2018	Checked/Date: LSV 2/5/2018

Document: G:\Penobscot River\mxds\Report_Figures_2017\RA_and_Preliminary_Remediation_Development\Background_Sediment_Histogram_landscape_MeHg.mxd 2/5/2018 4:02:32 PM cody.simpson



Appendix B-10e
Penobscot Background Sediment Q-Q Plot

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

amec foster wheeler

Project: 3616166052 | Prepared/Date: RD 2/6/2018 | Checked/Date: LSV 2/6/2018

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APPENDIX C

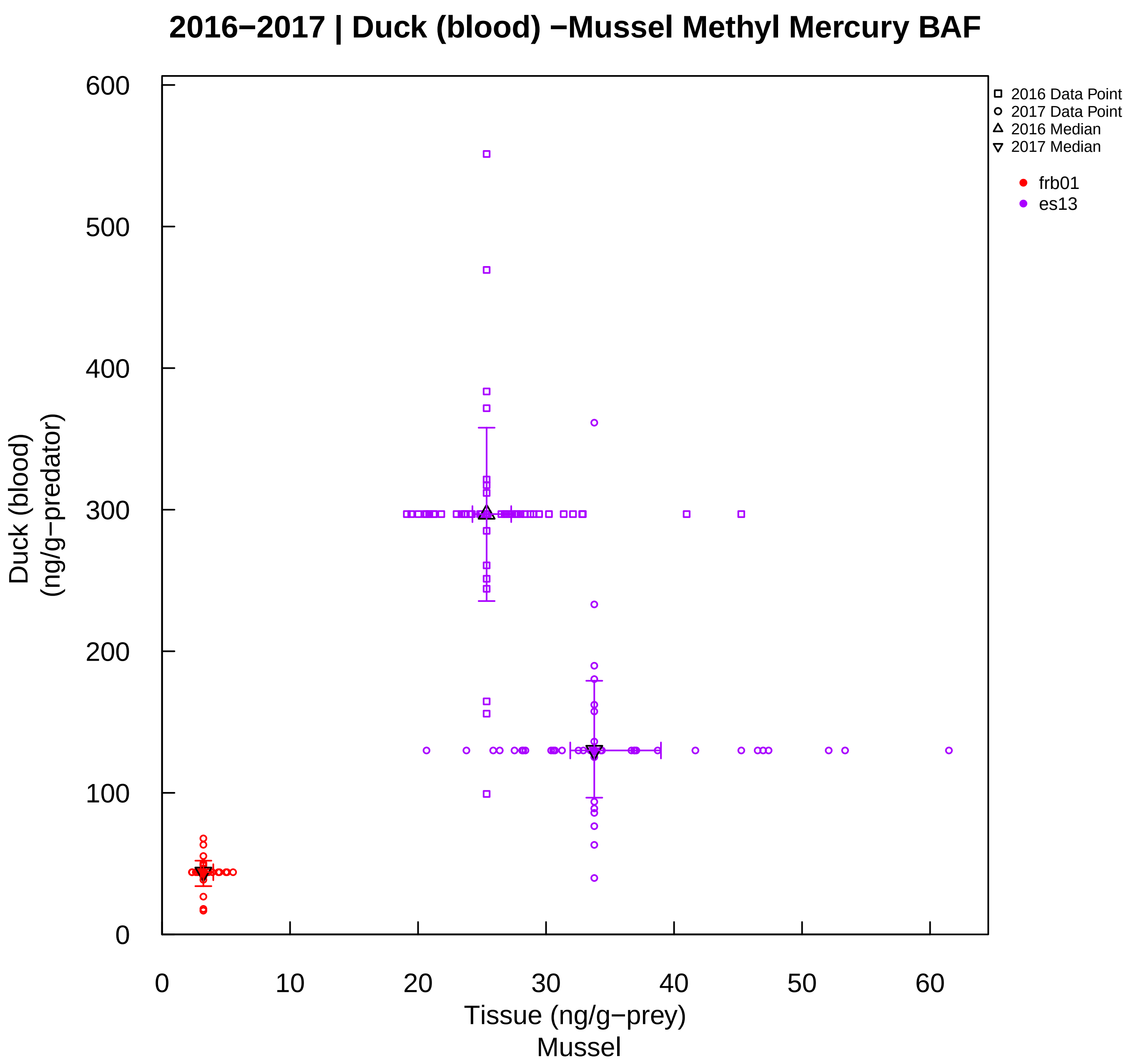
BASF and BAF Development

2016-2017 BAF REGRESSION MODELS & PLOTS

Set	Description
C-1	BAF and BSAF Regression Plots & Summary
C-2	BAF and BSAF Regression Plots & Summary with Extreme Values Present
C-3	Outlier Testing
C-4	BAF and BSAF Regression Plots & Summary with Extreme Values Excluded
C-5	BSAF Figures (2016-2017)
C-6	BAF Tables (2016-2017)
C-7	R Code

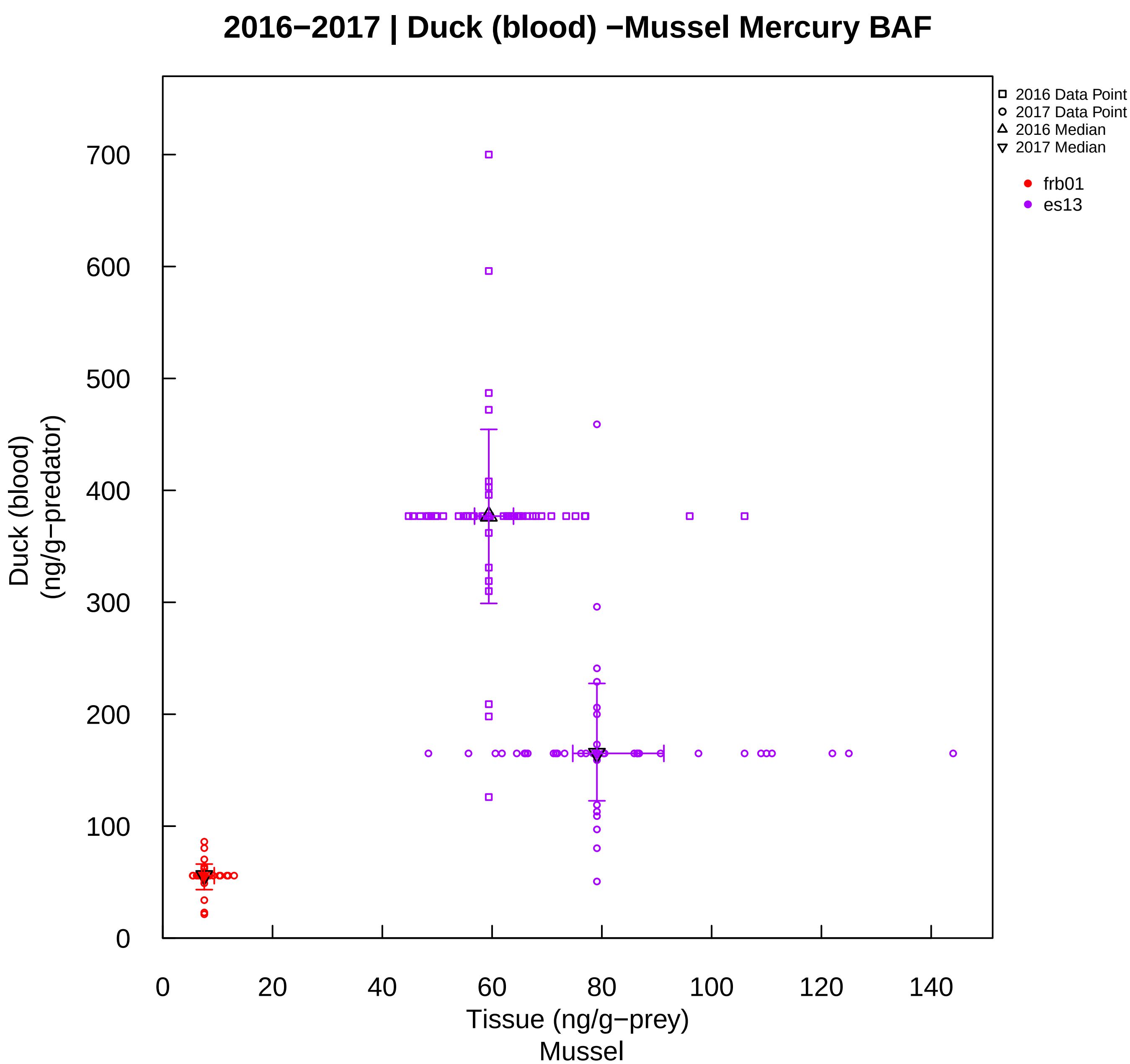
C-1

BAF and BSAF Regression Plots & Summary



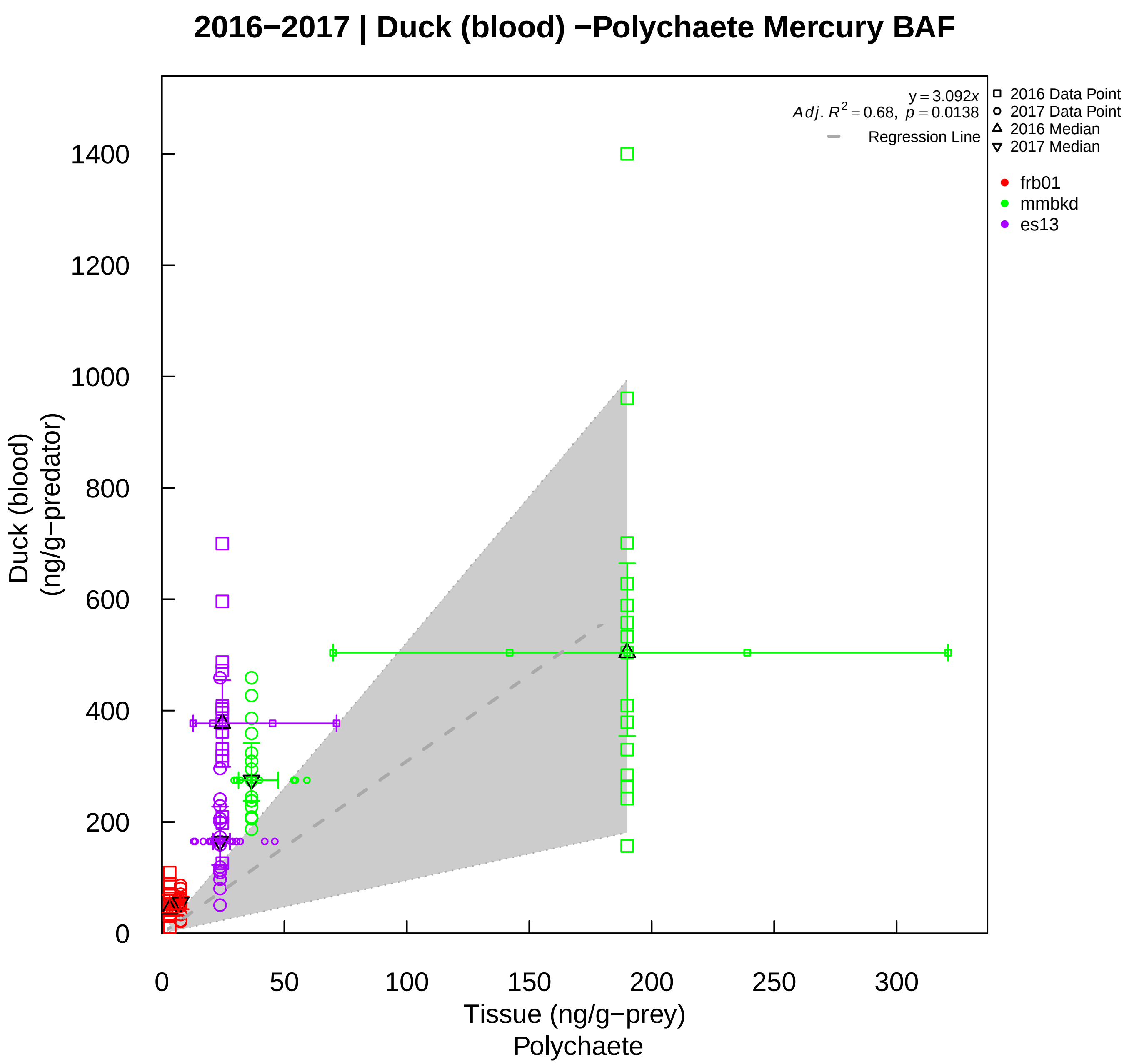
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



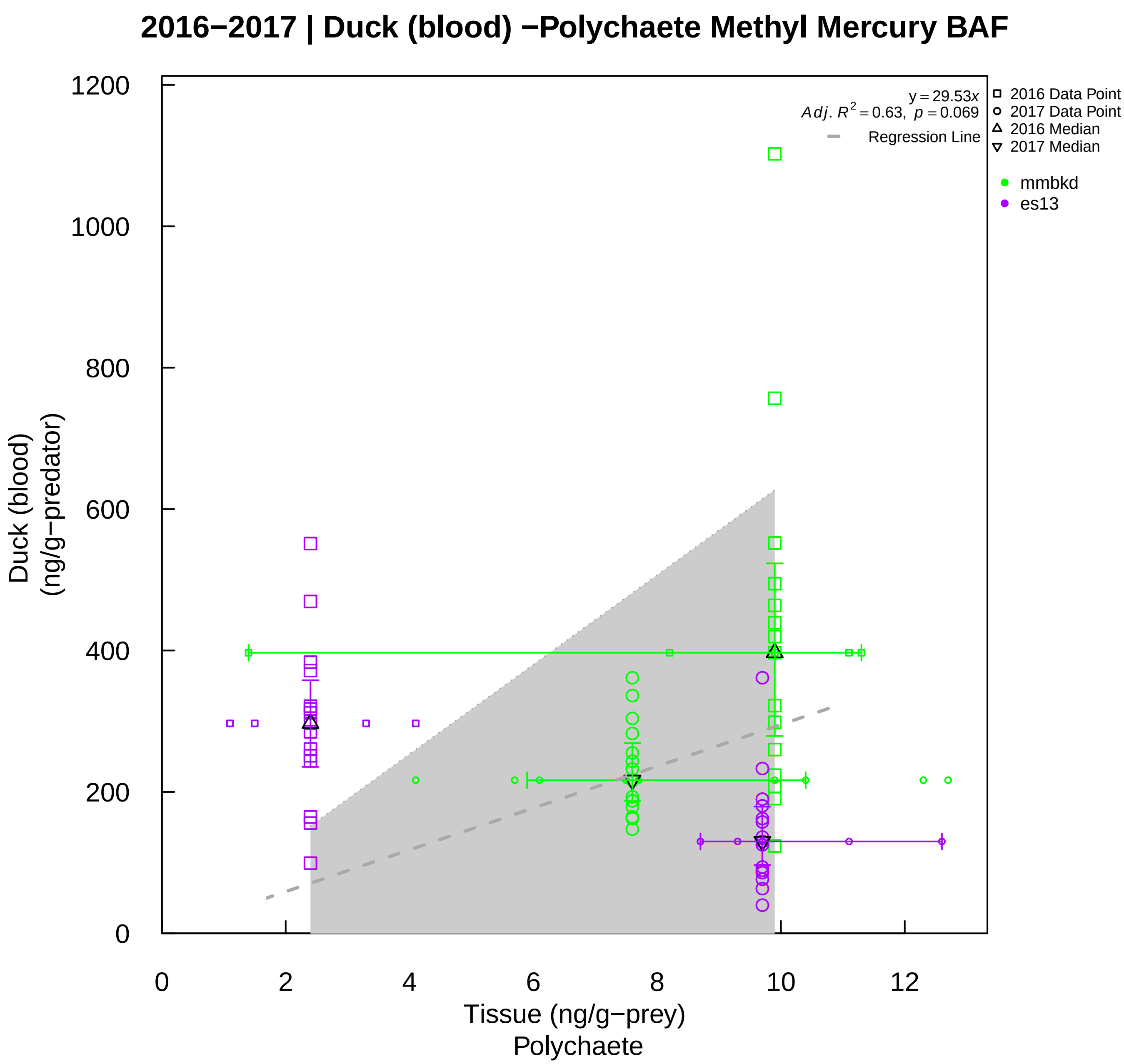
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



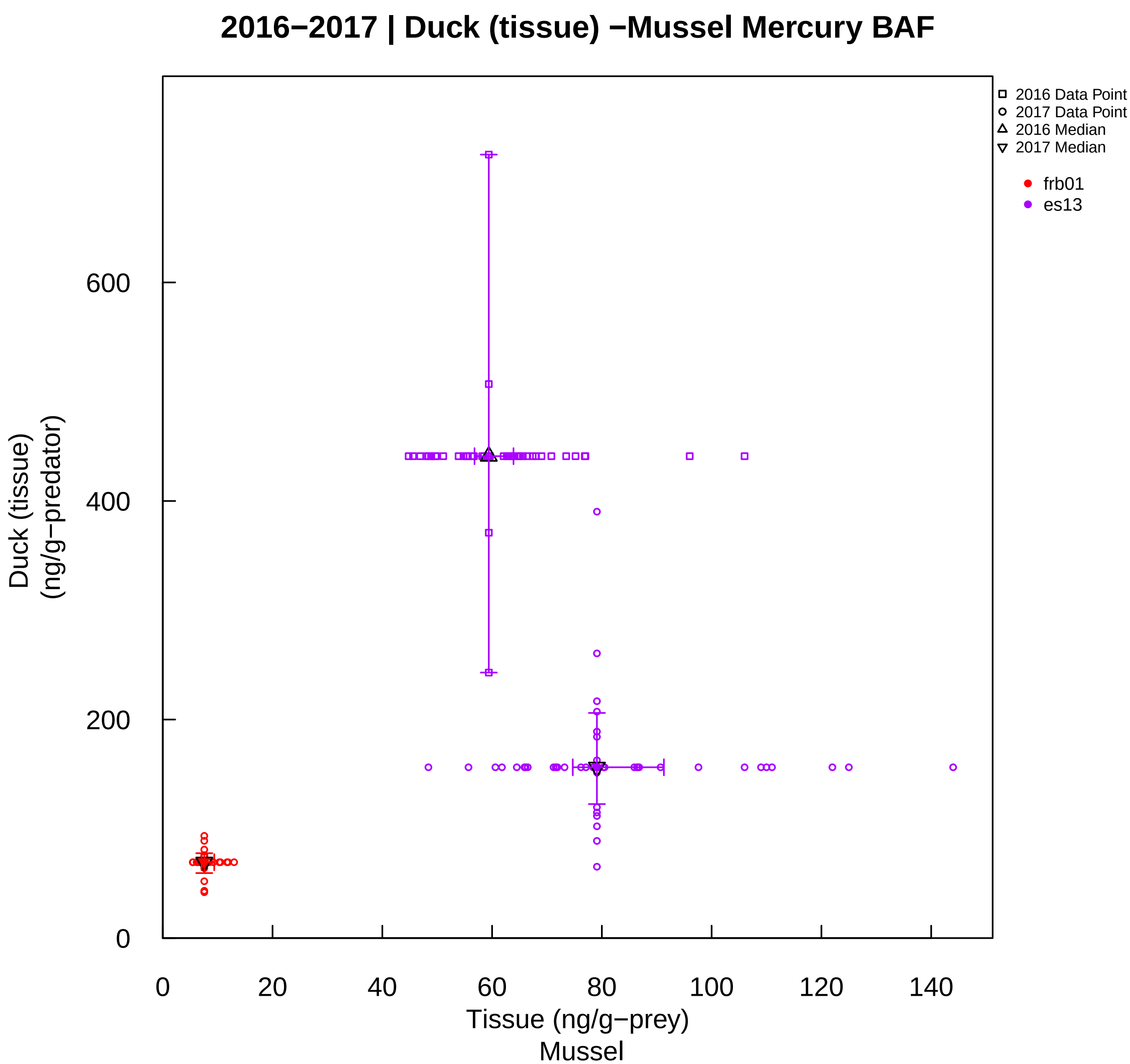
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



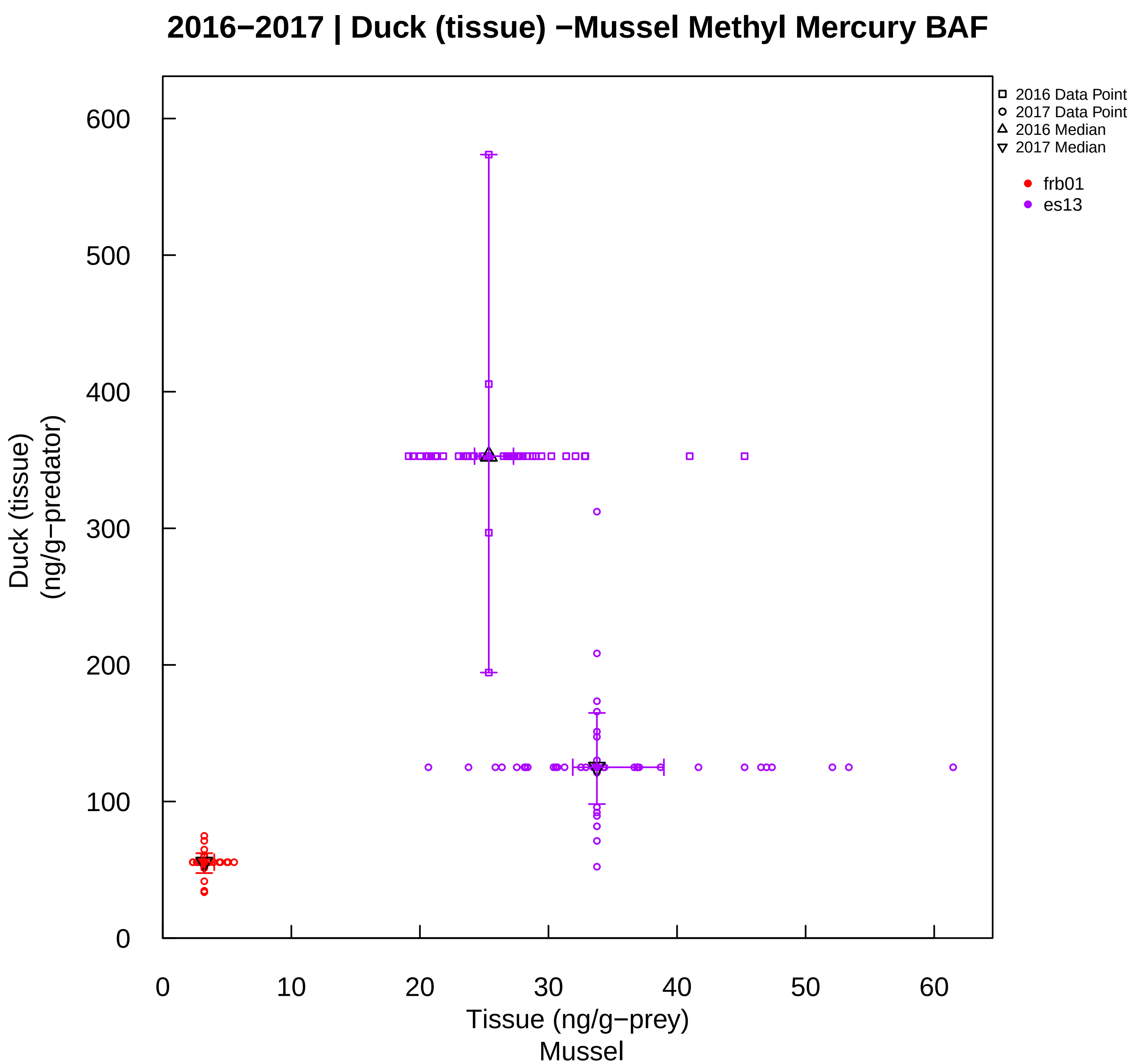
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



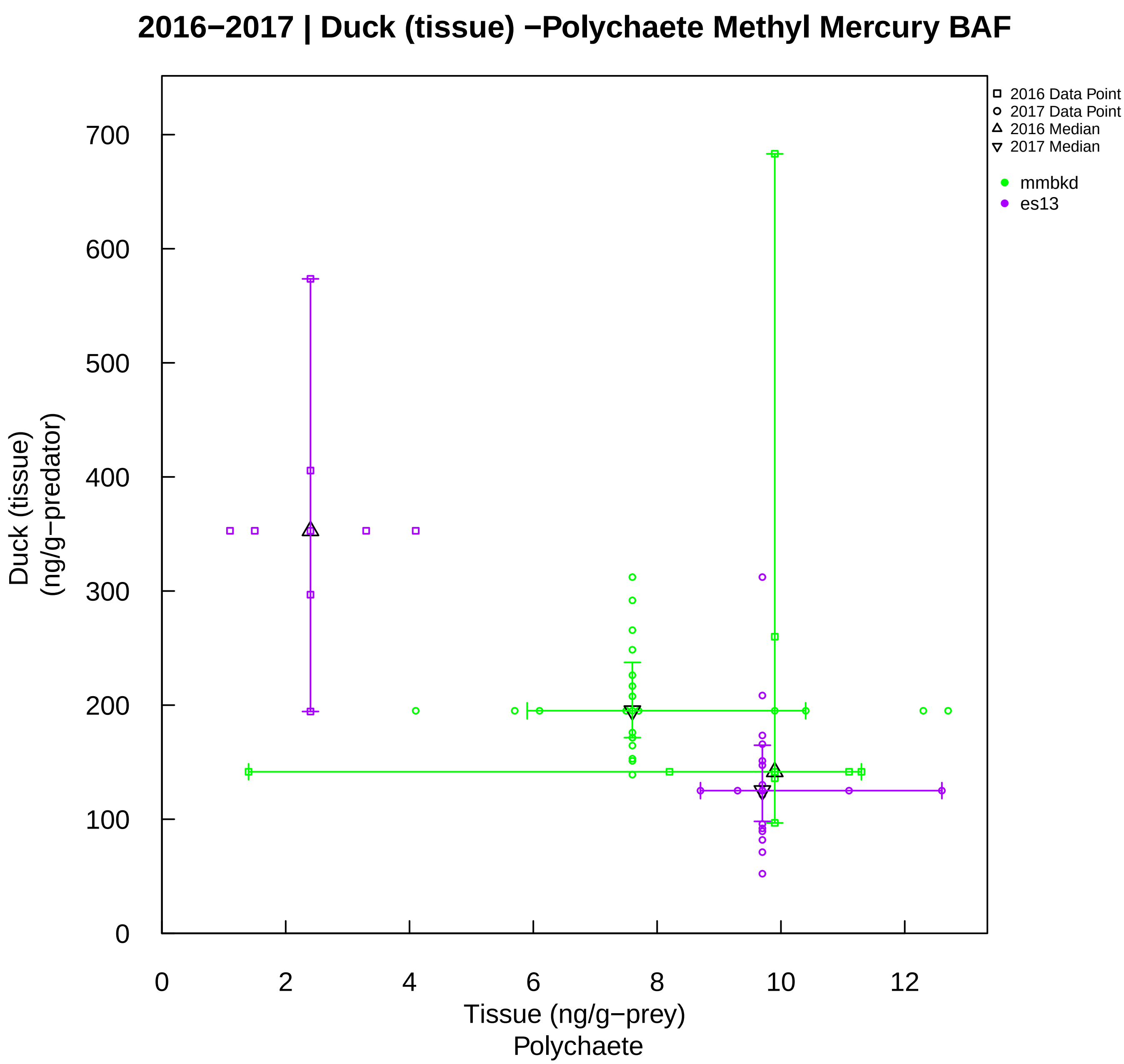
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



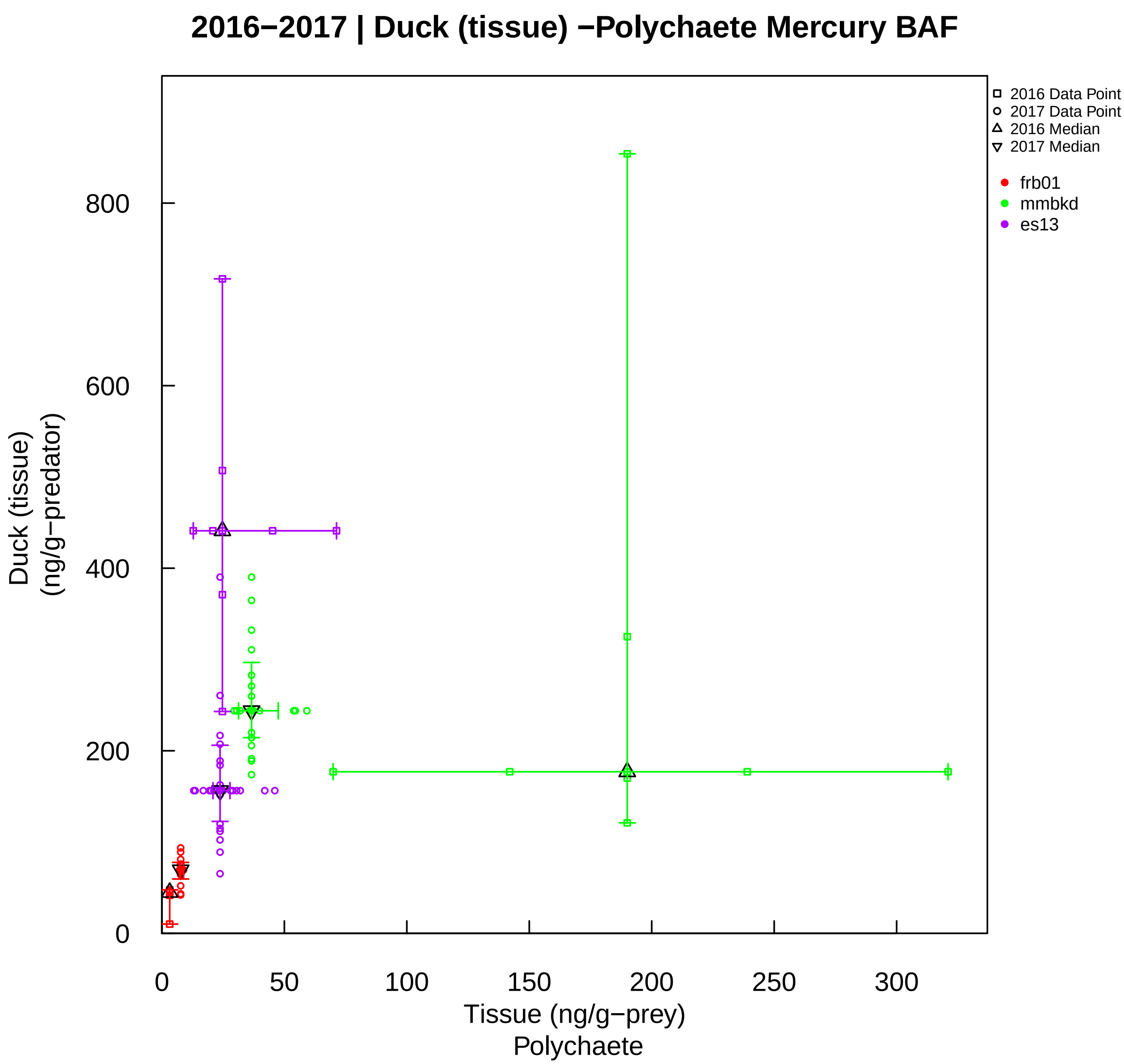
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



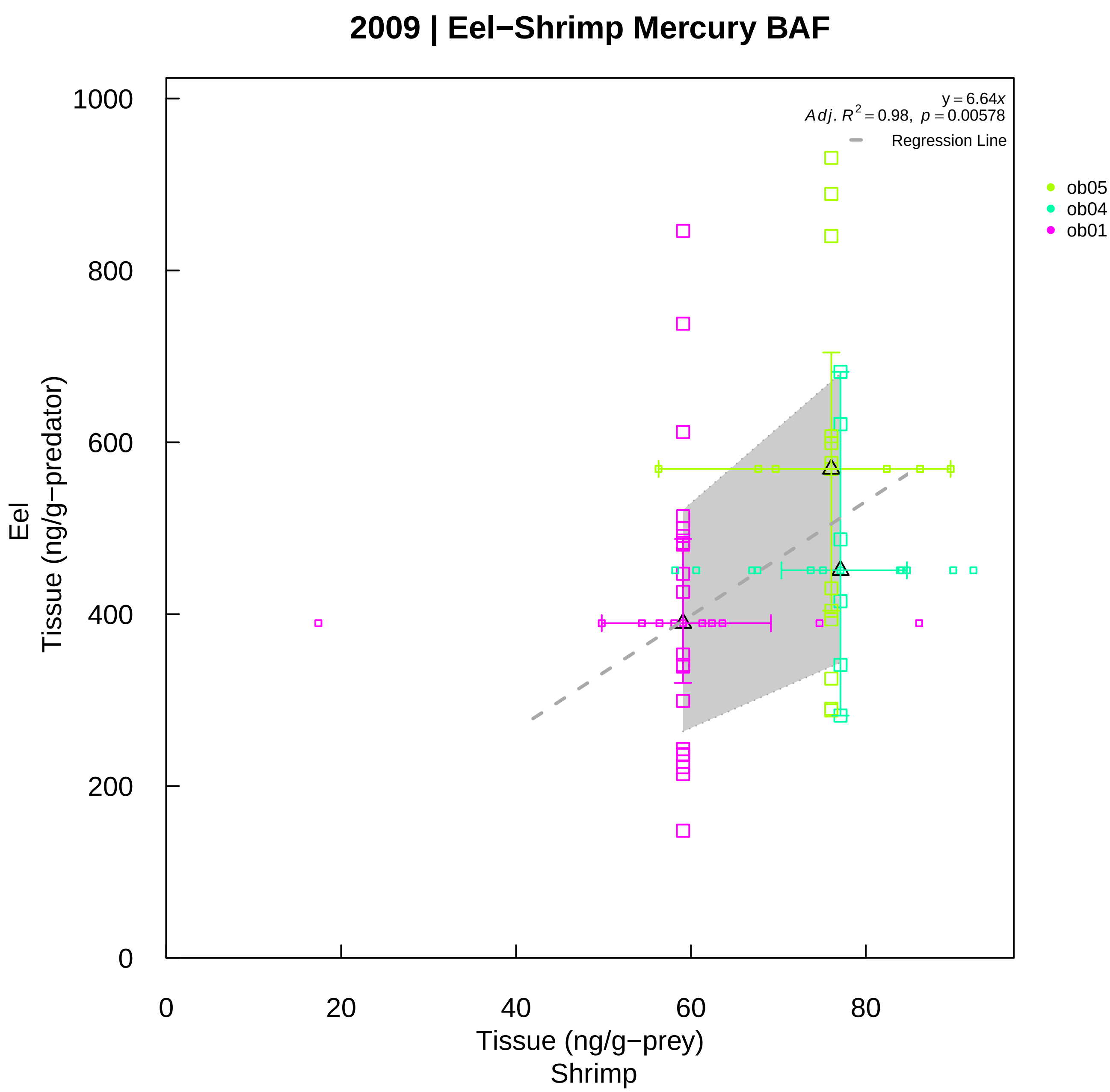
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



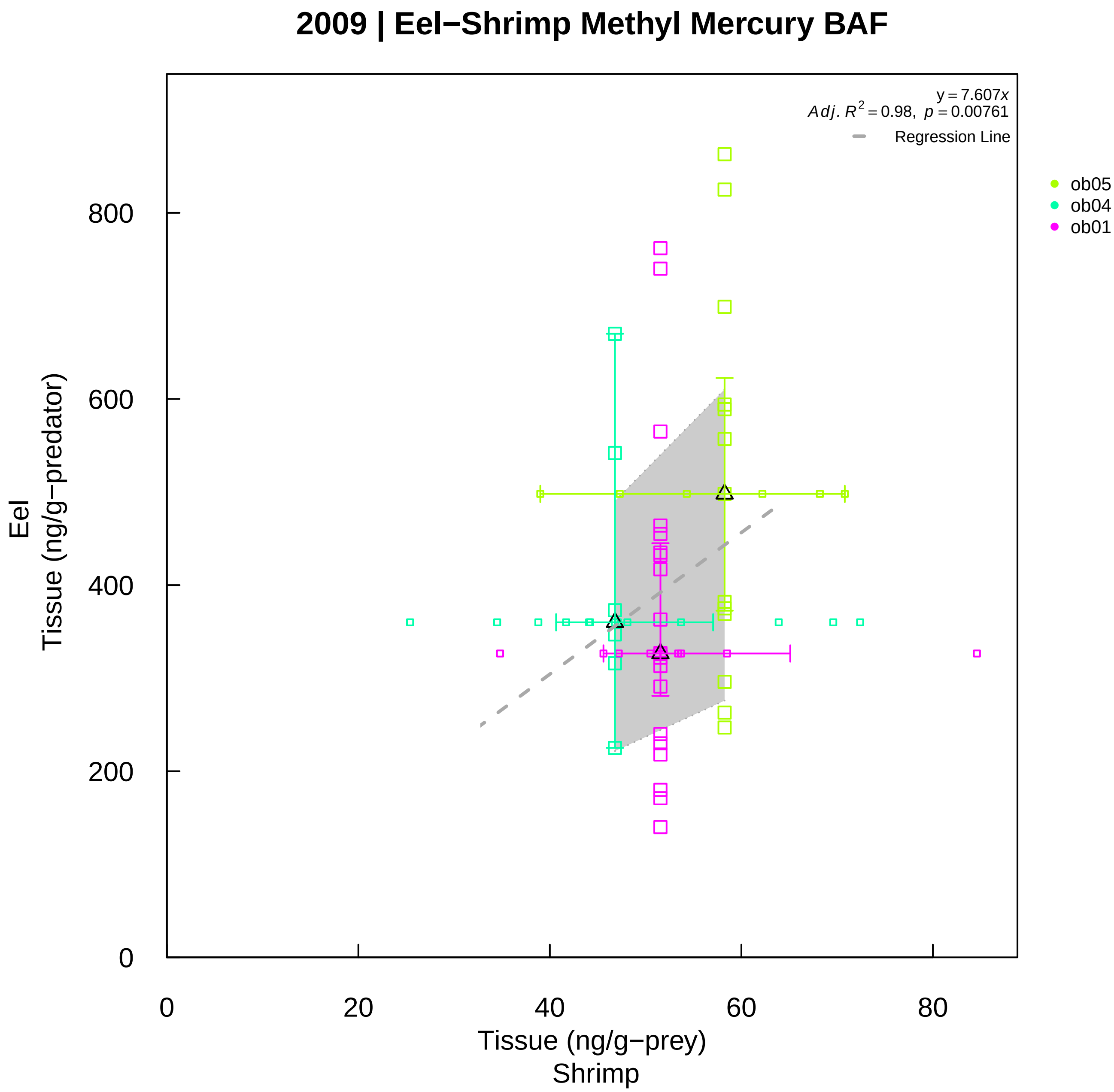
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



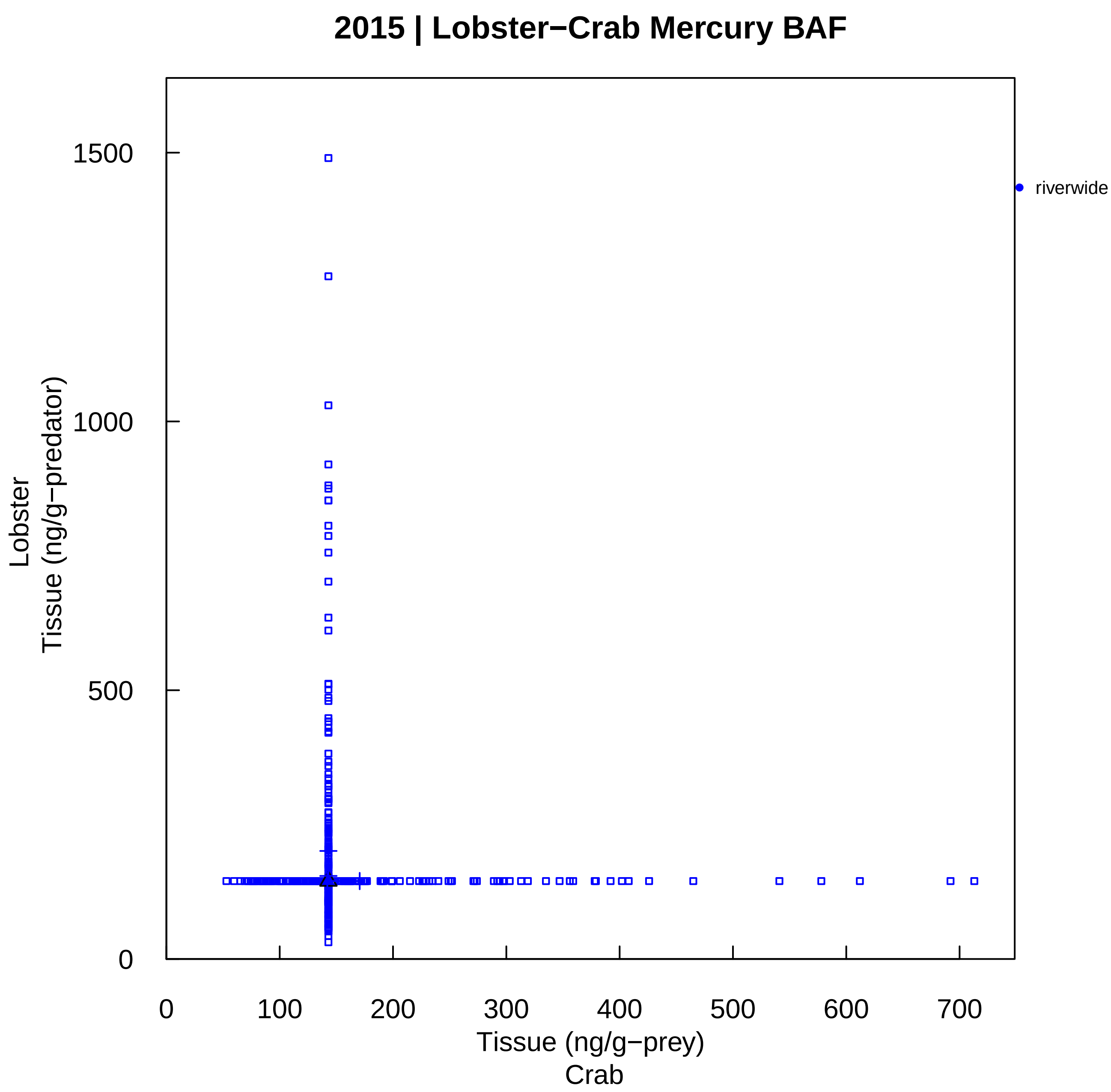
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



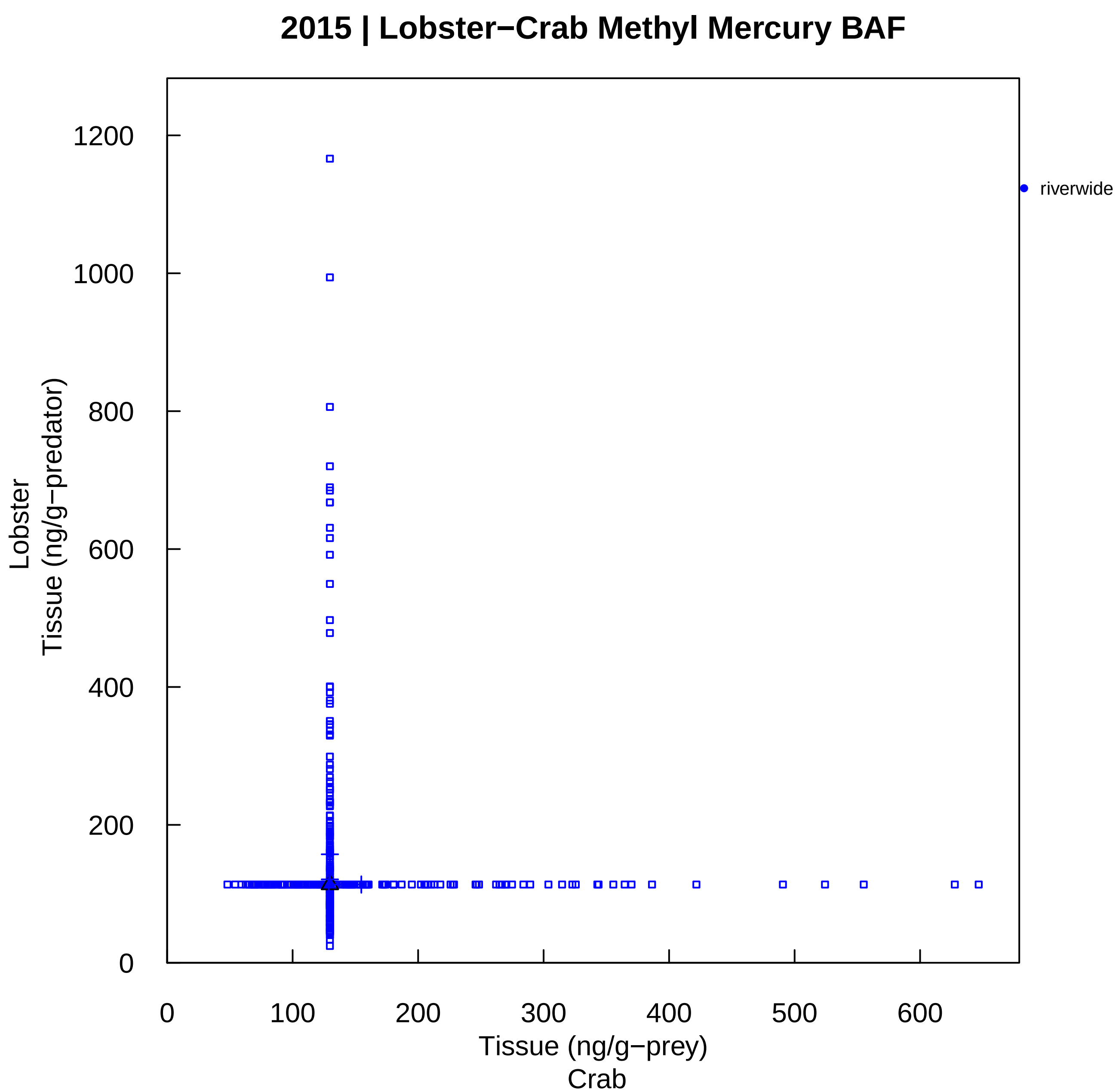
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

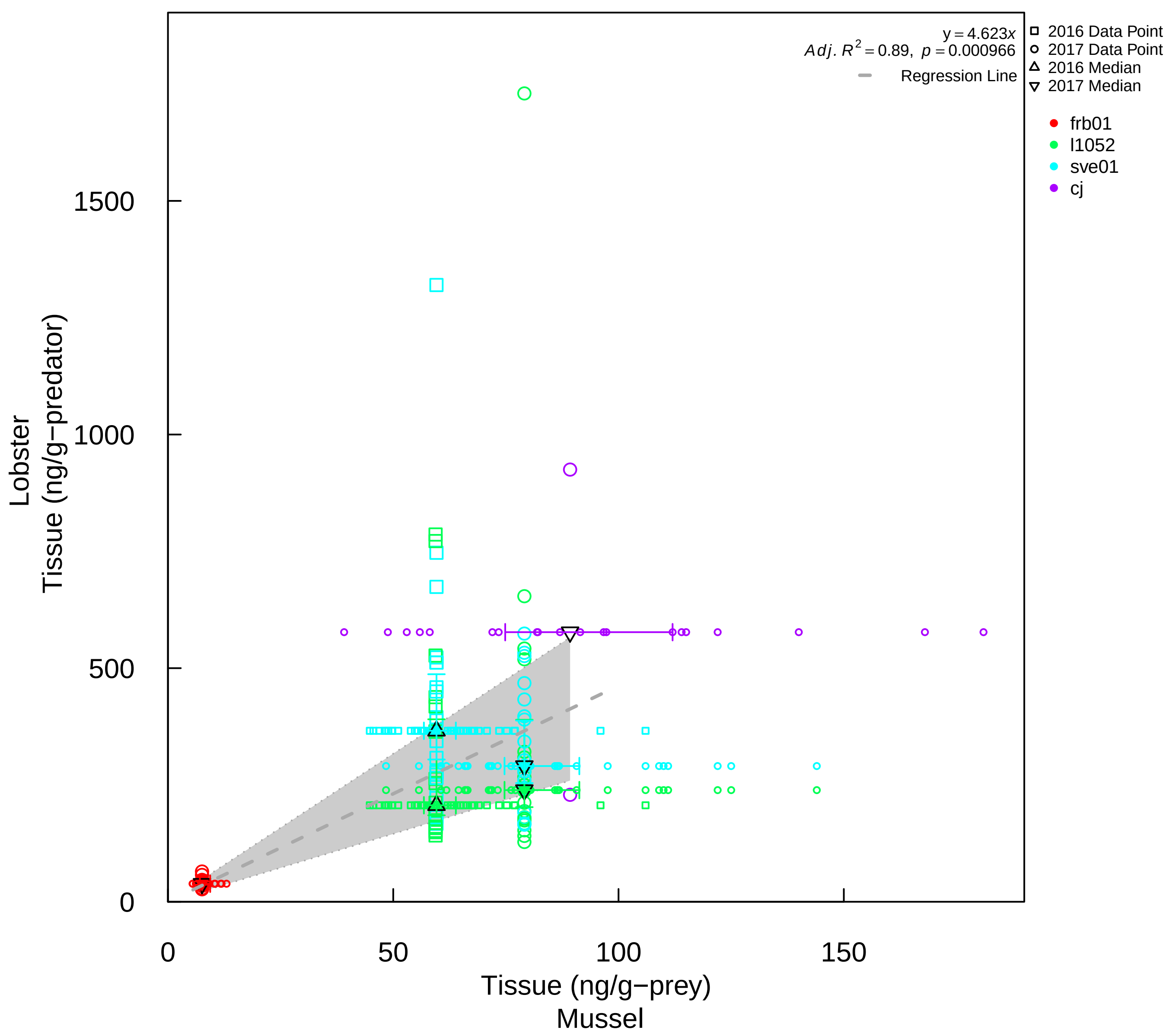
*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

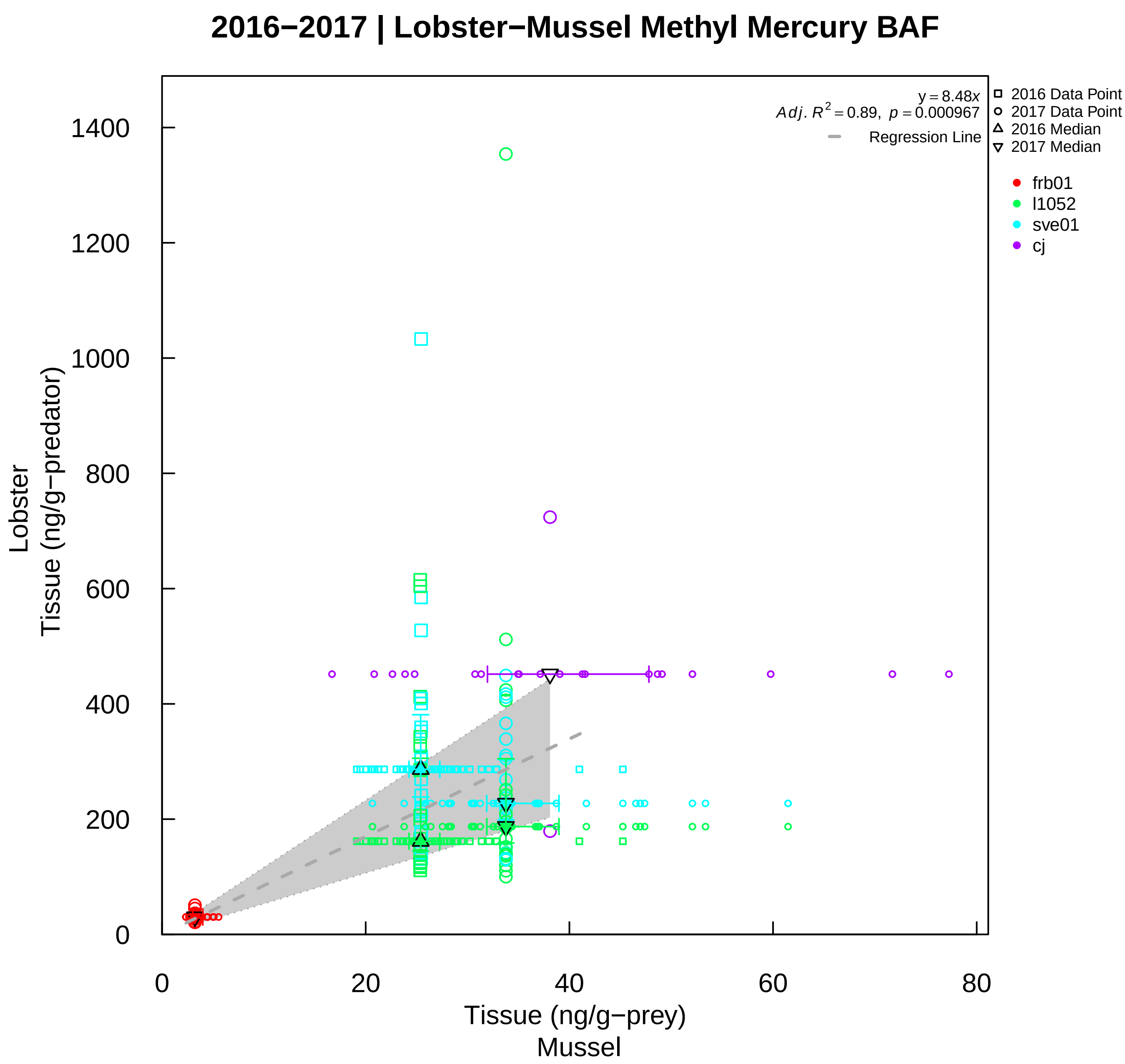
*-Indicates regression on outlier-free data.

2016−2017 | Lobster−Mussel Mercury BAF



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



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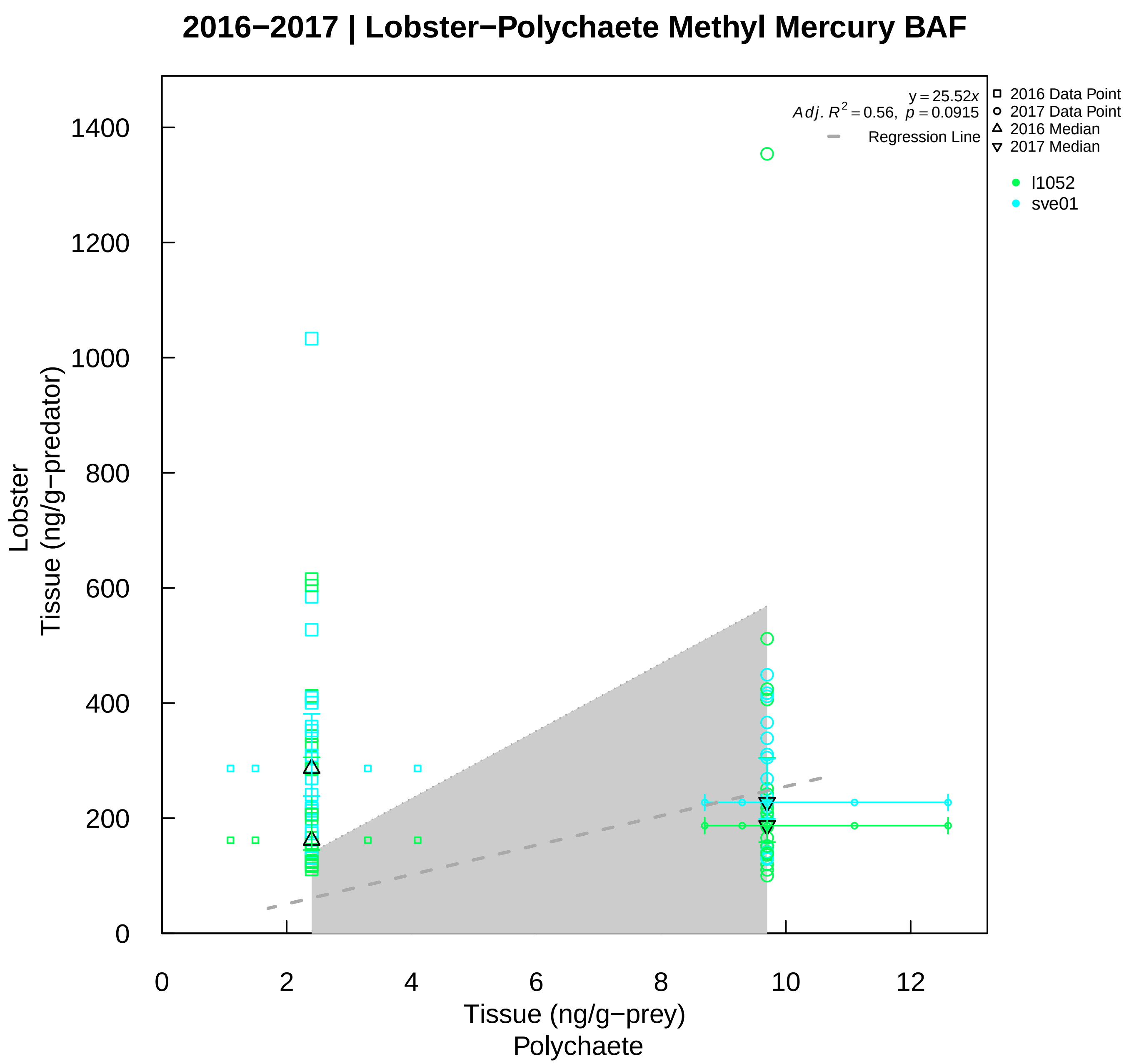
*-Indicates regression on outlier-free data.



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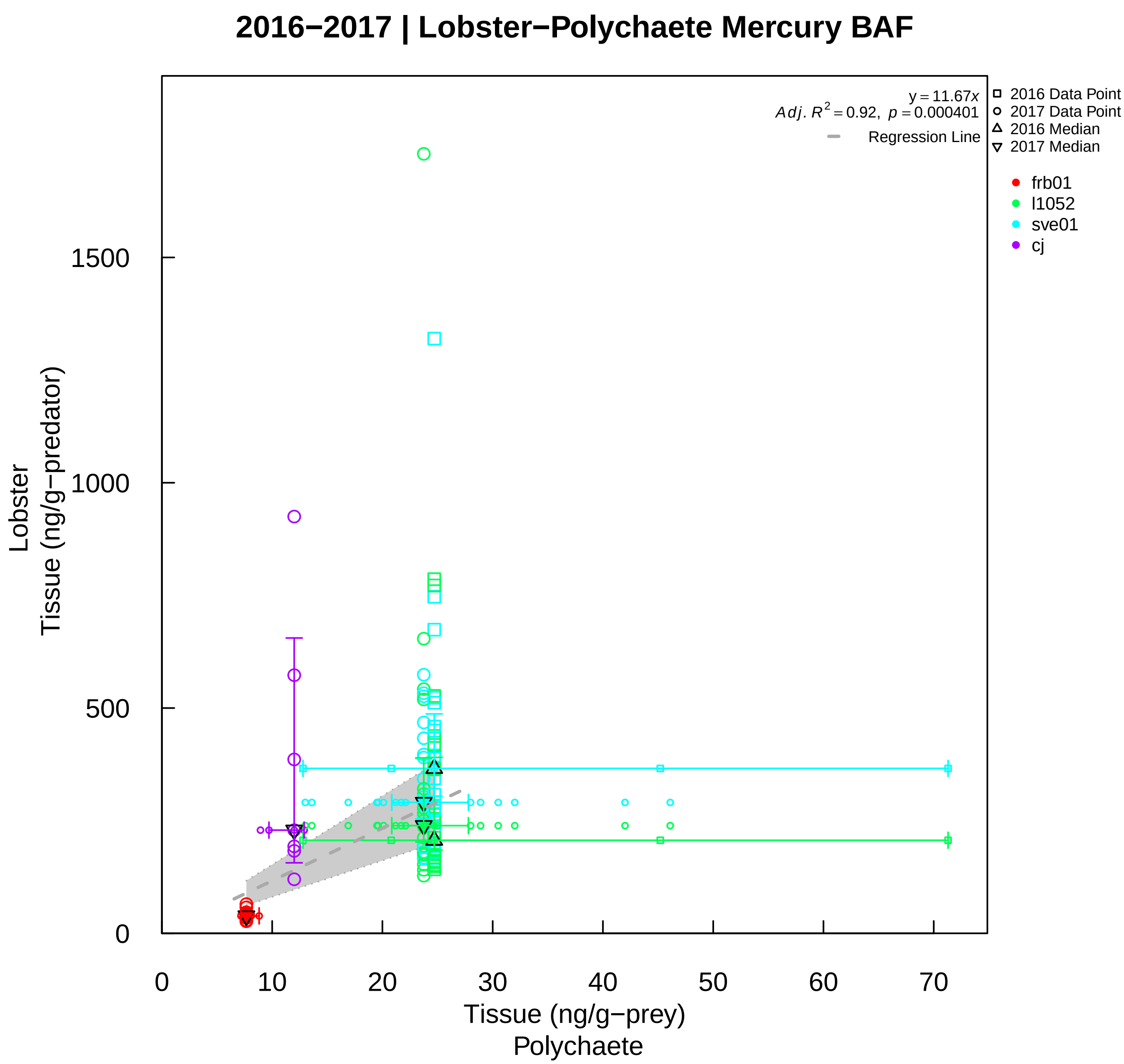
*-Indicates regression on outlier-free data.



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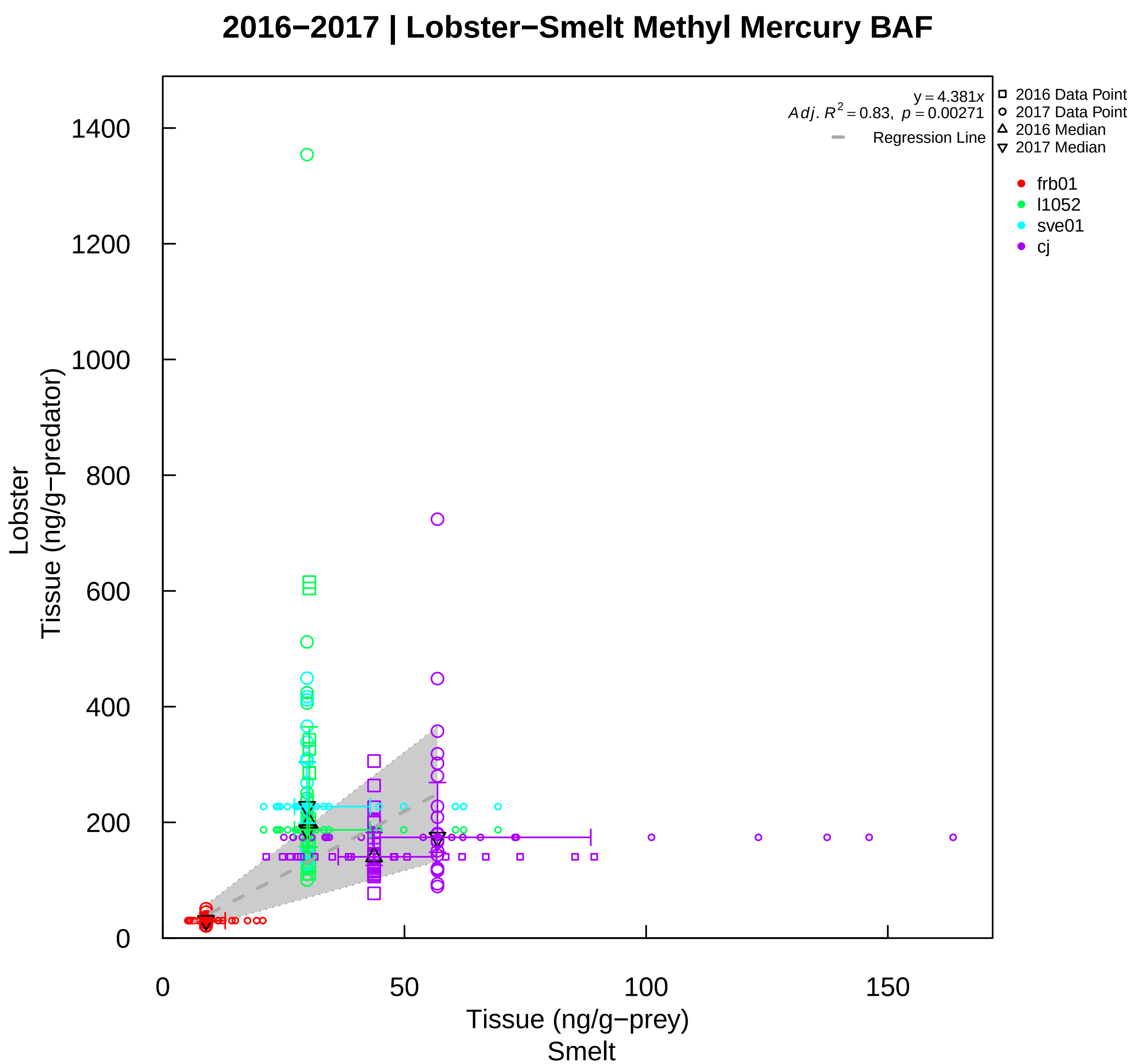
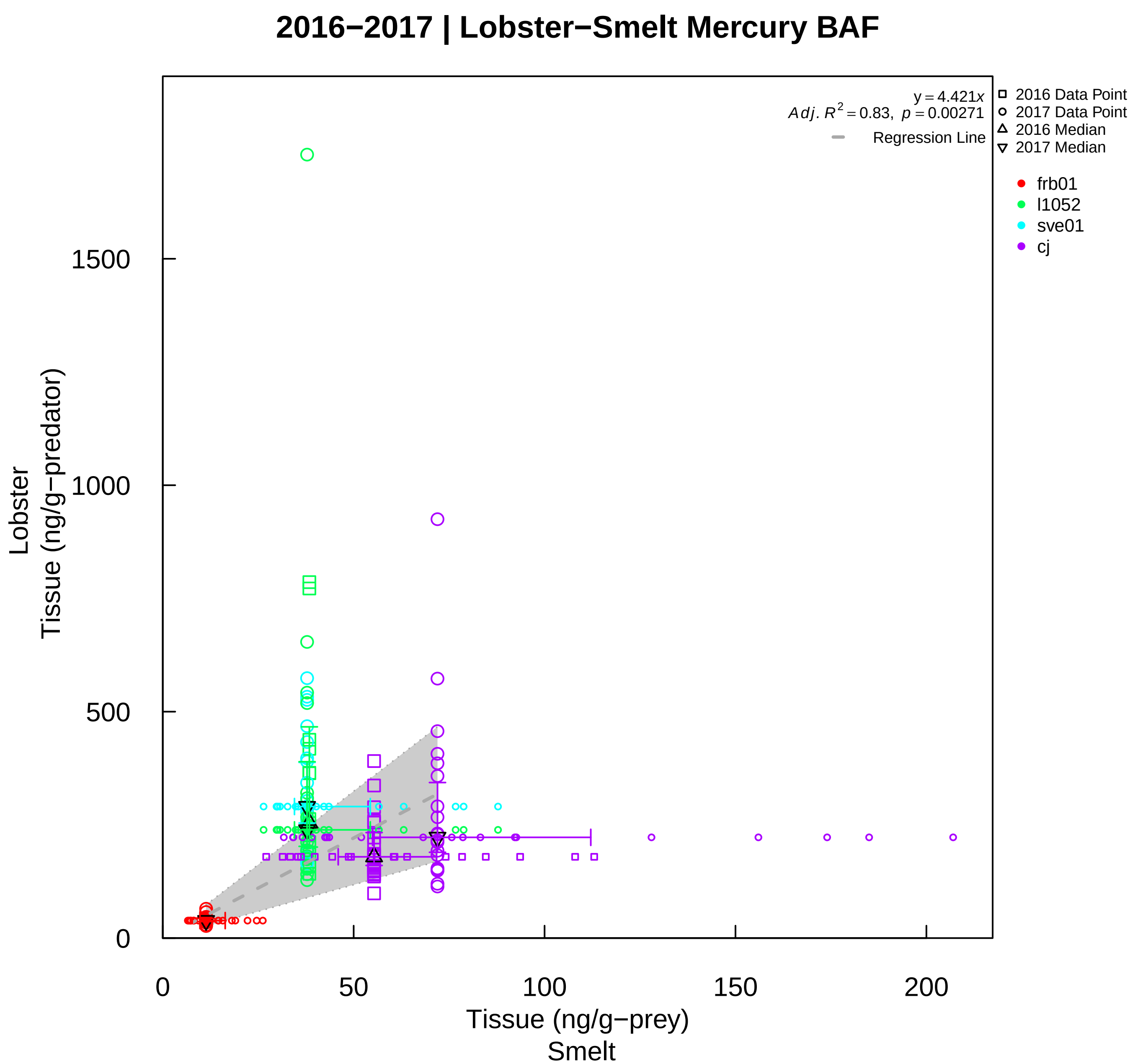
*-Indicates regression on outlier-free data.



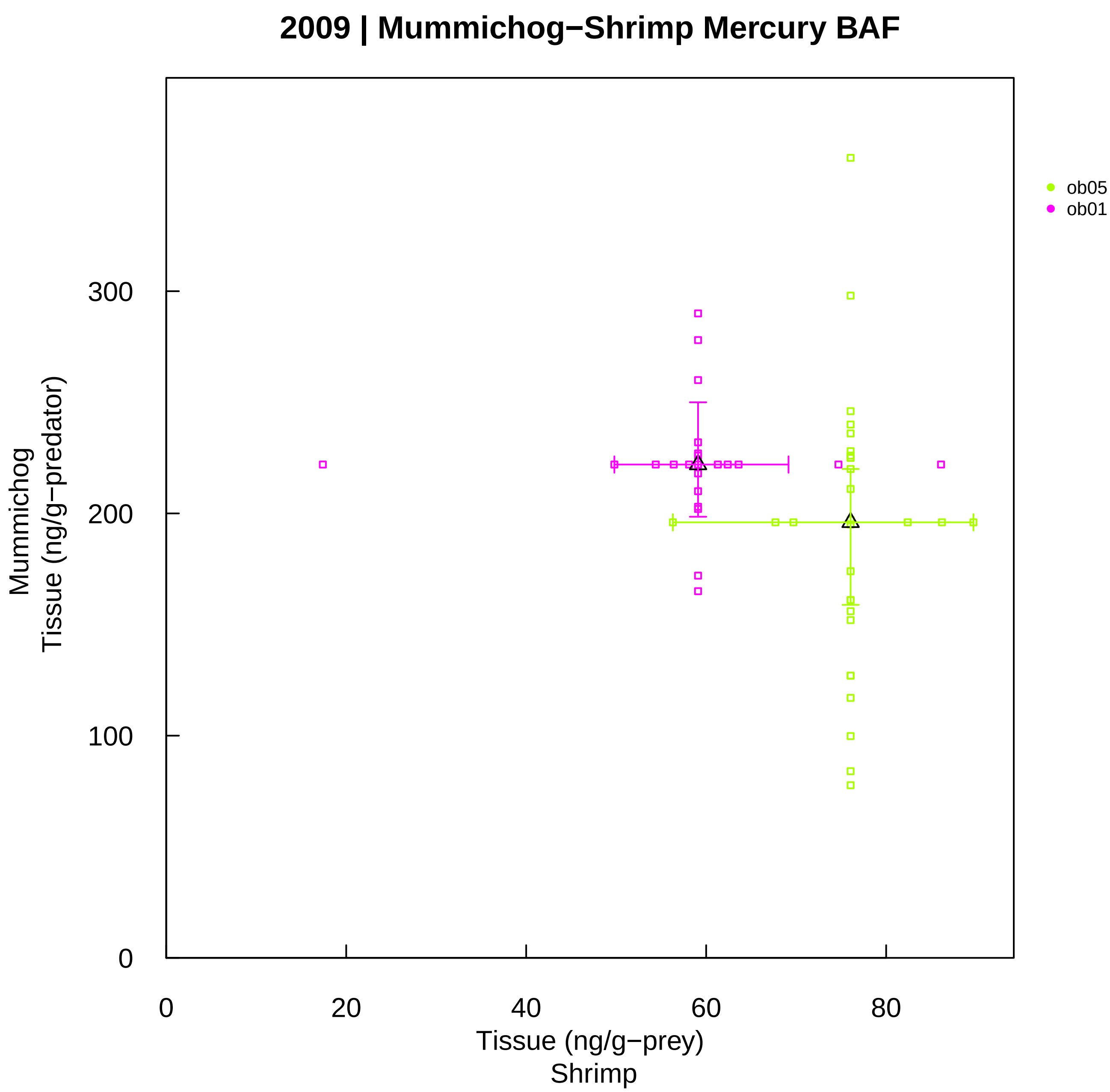
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



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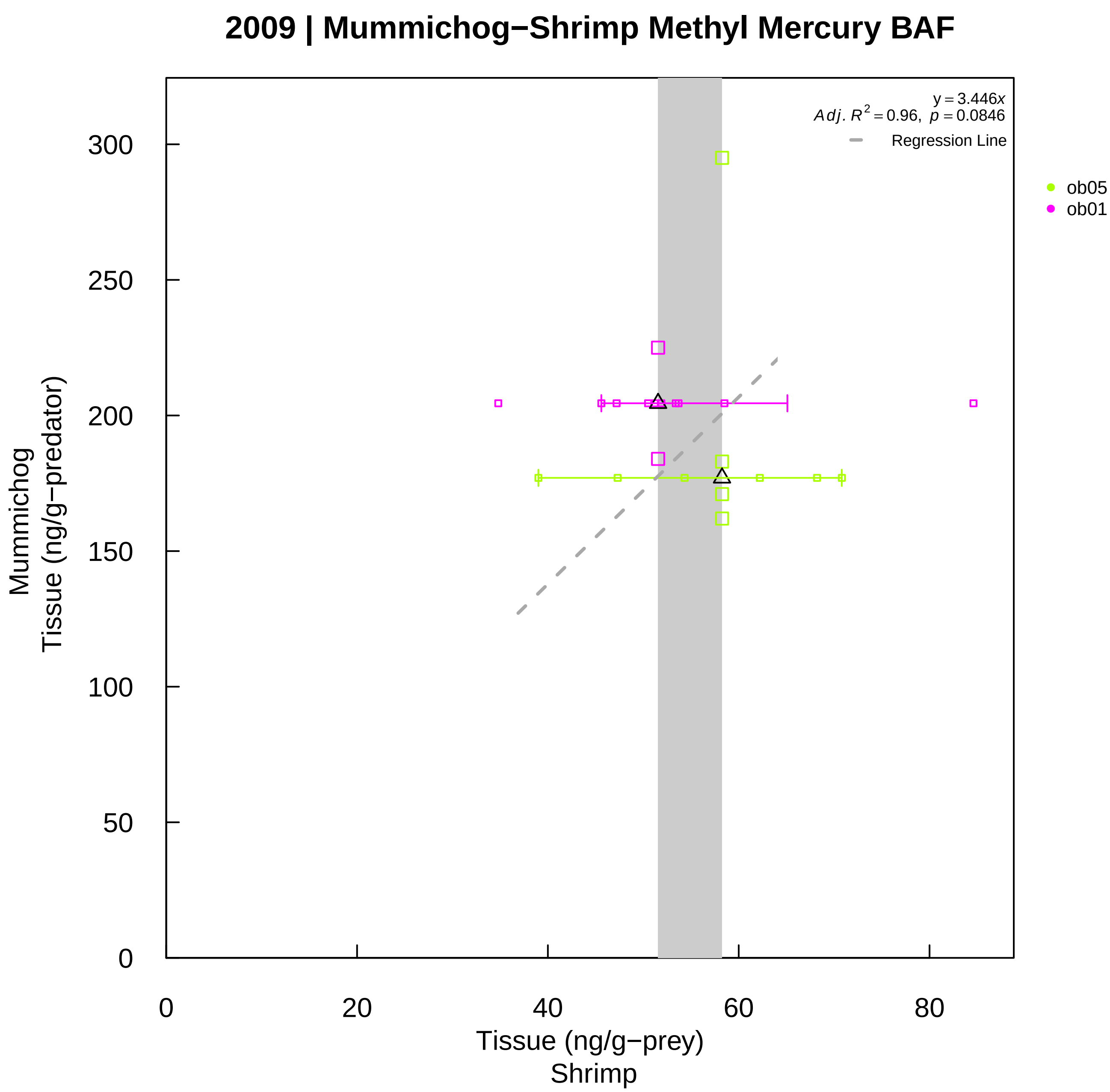
*-Indicates regression on outlier-free data.



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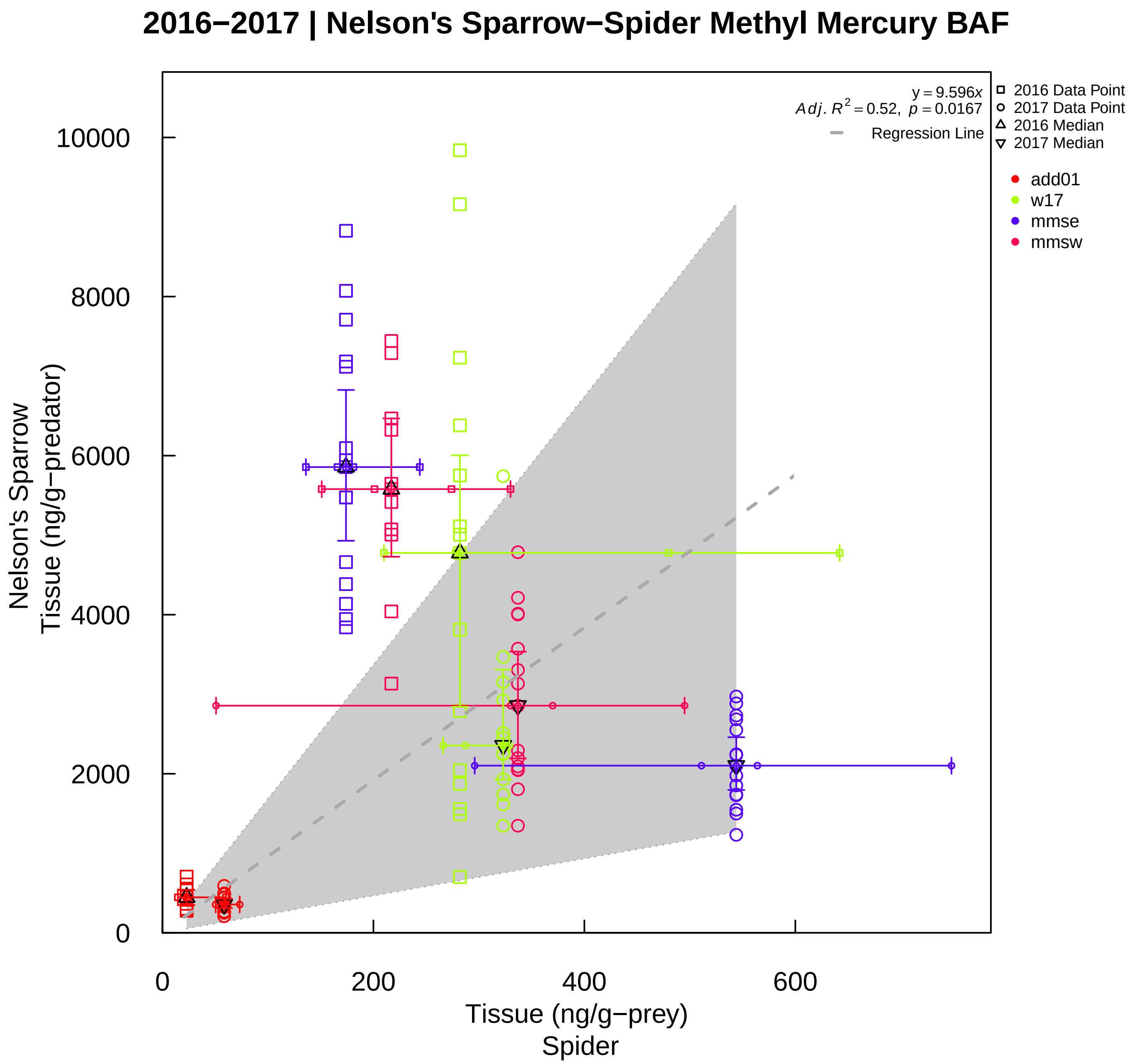
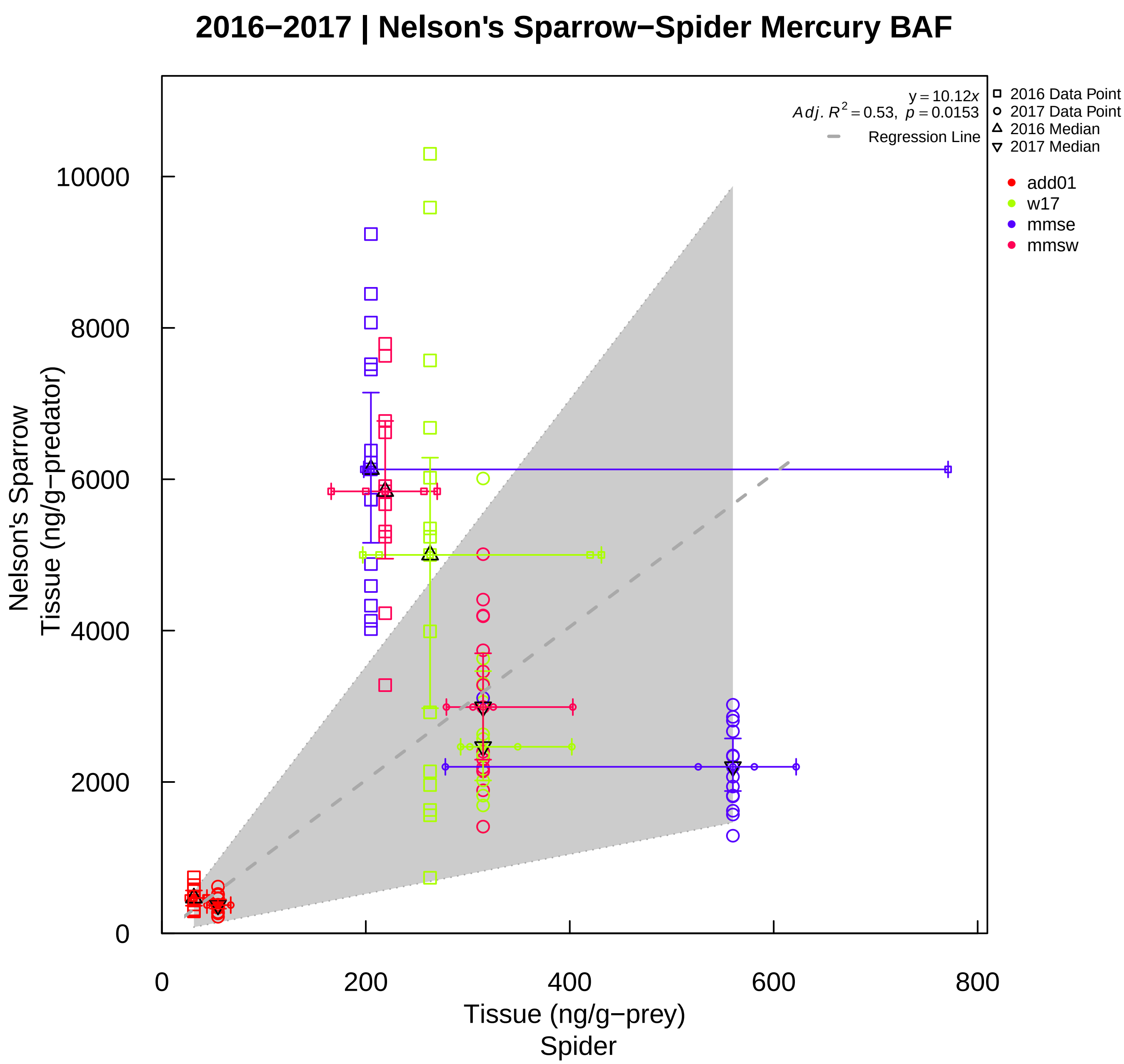
*-Indicates regression on outlier-free data.



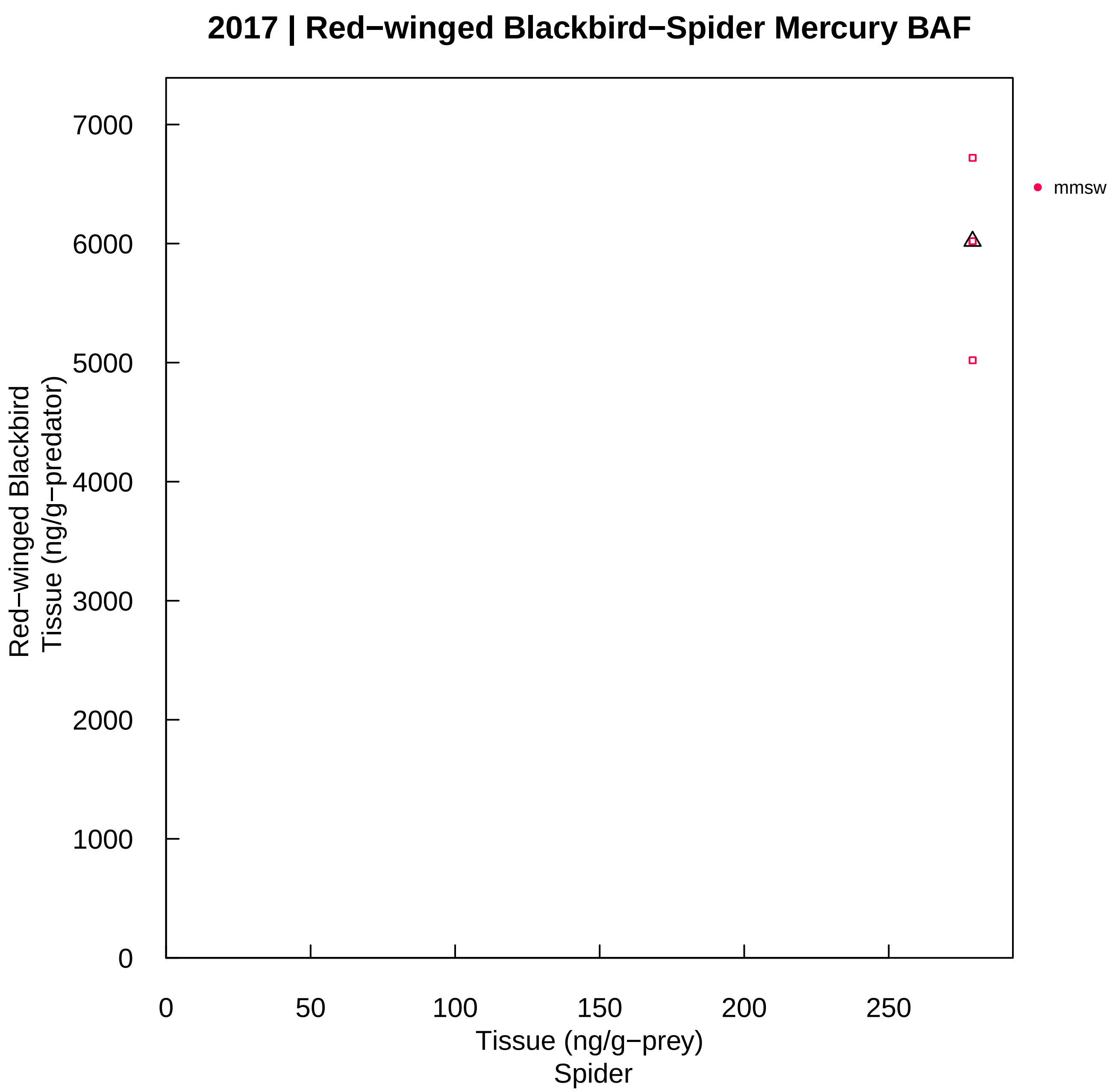
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



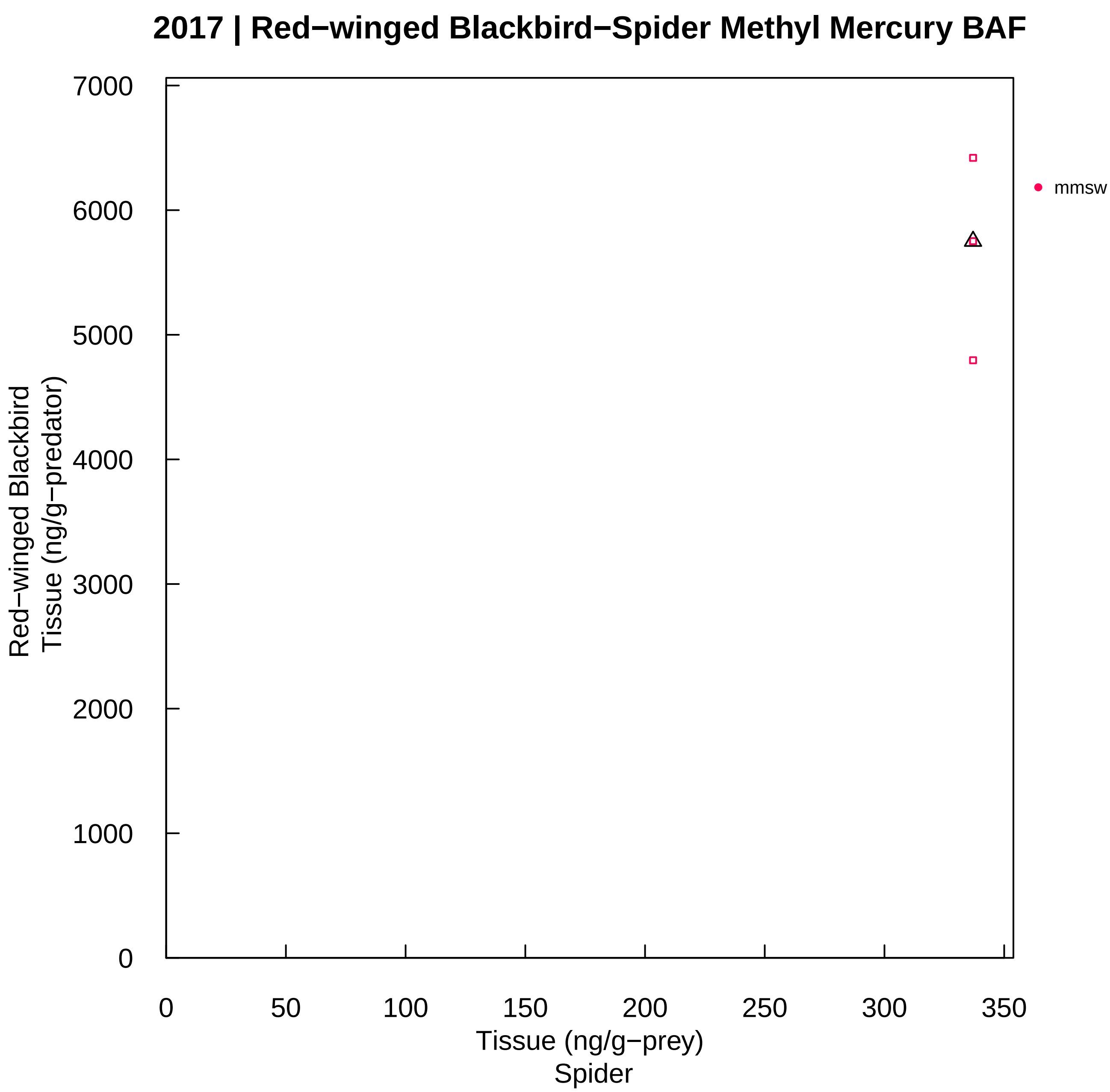
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



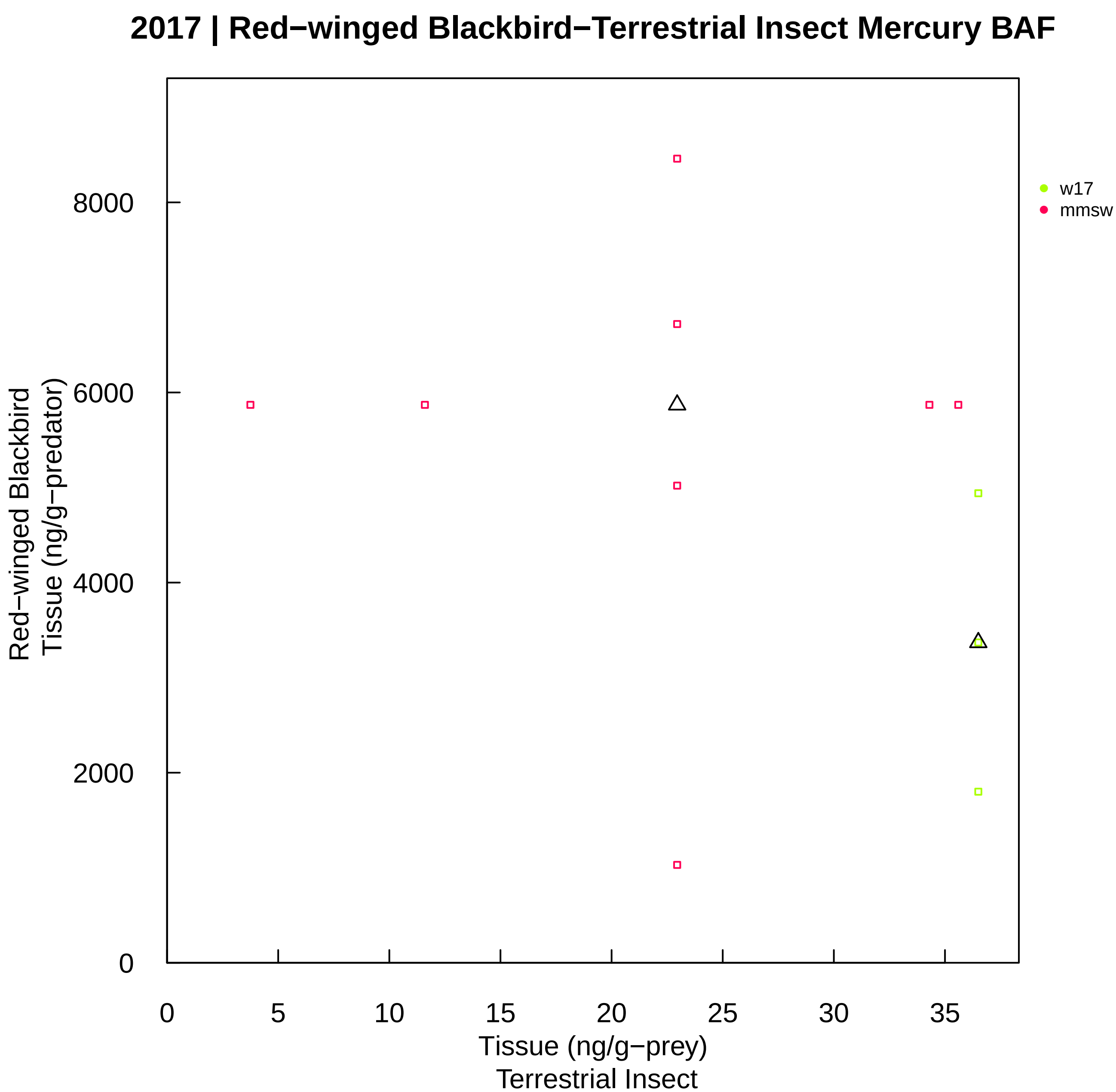
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



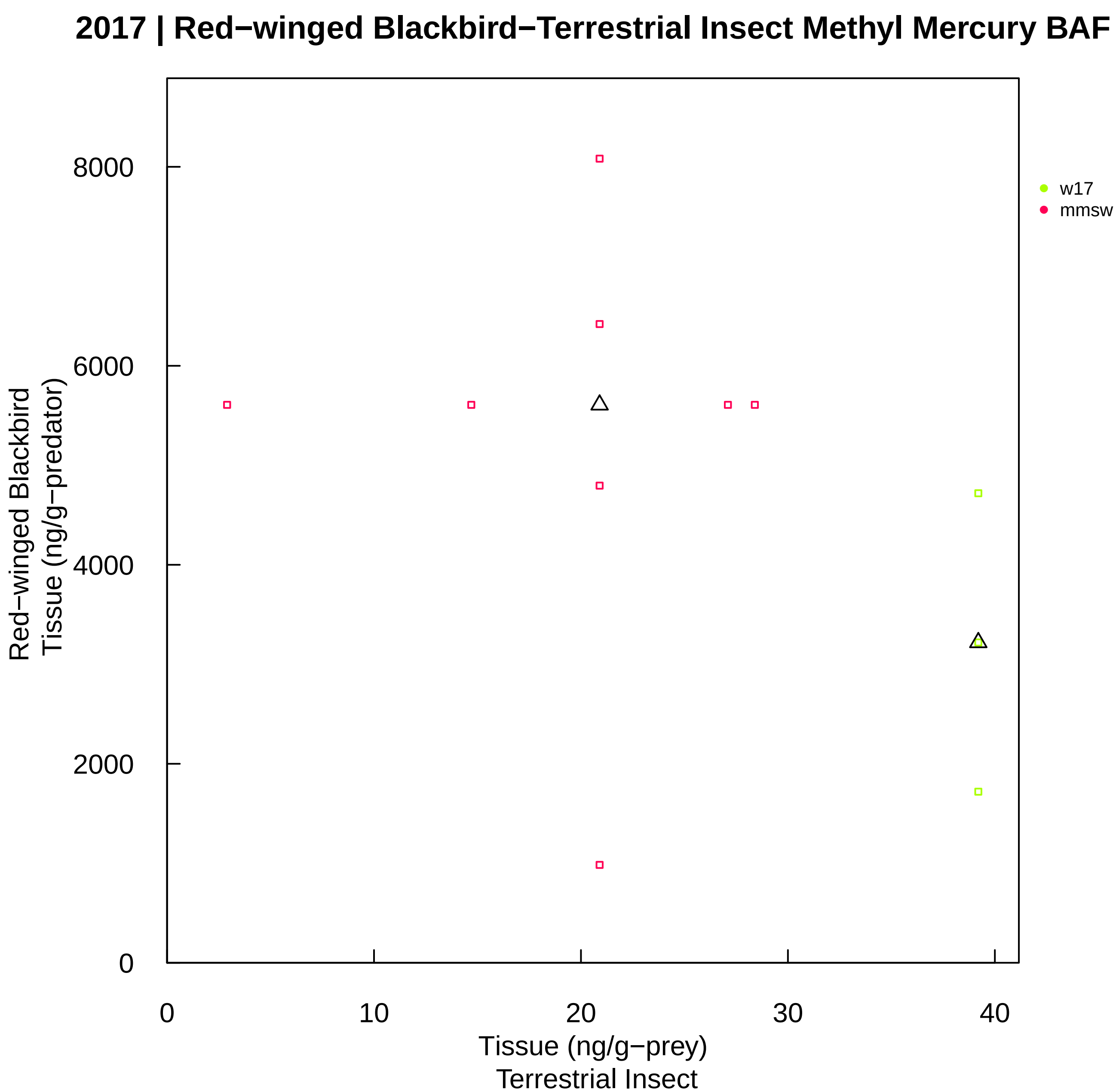
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



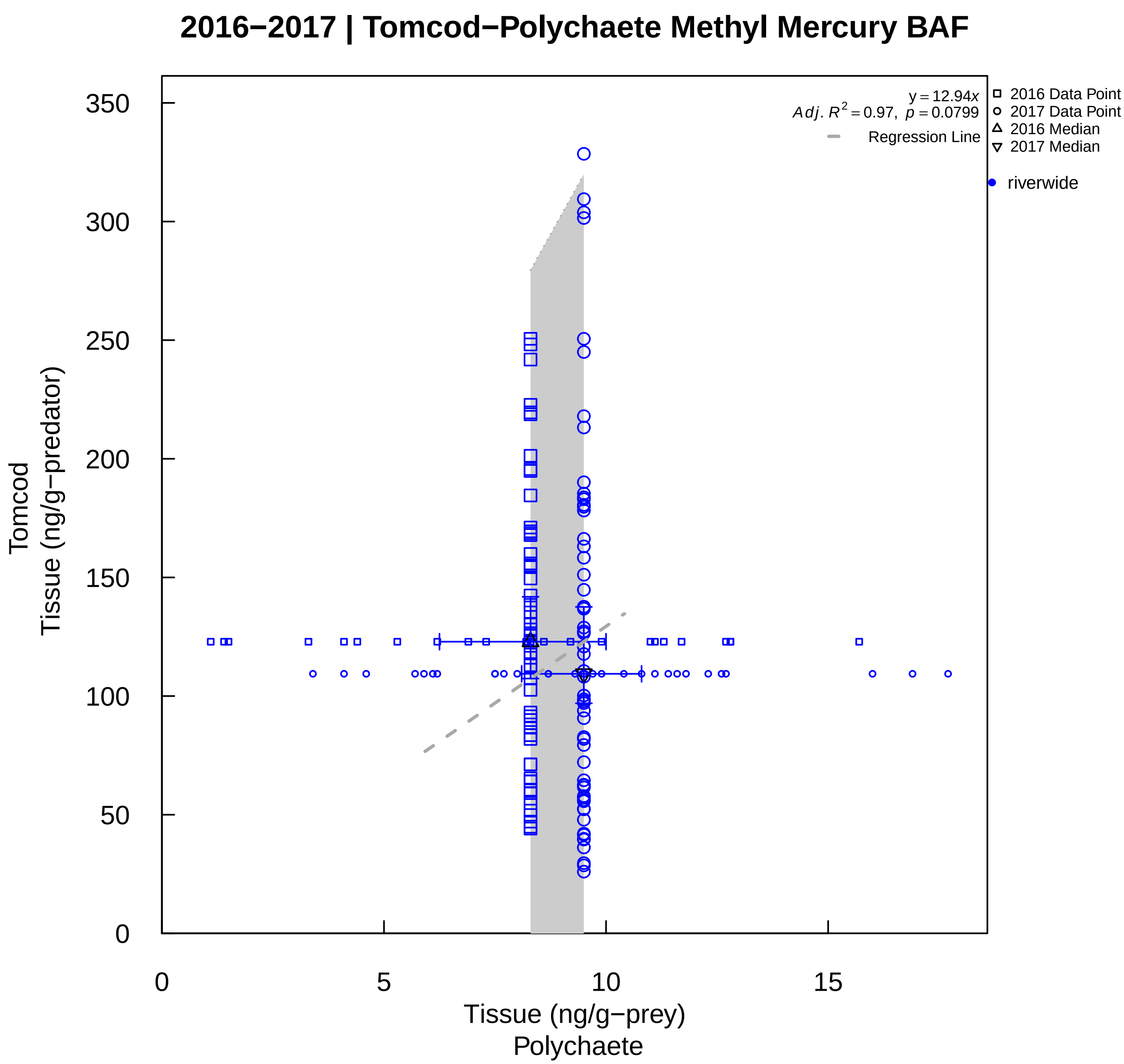
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

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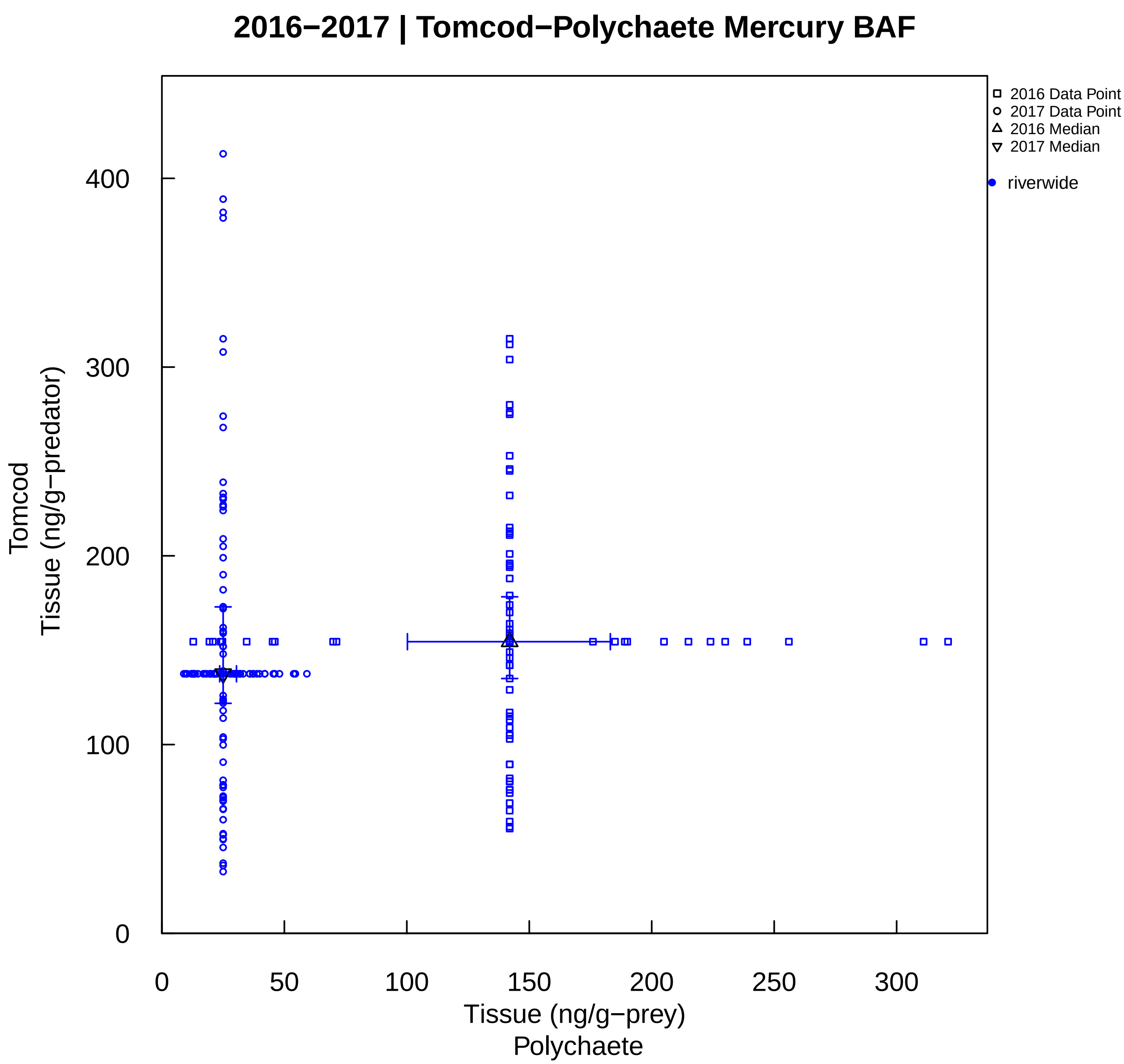
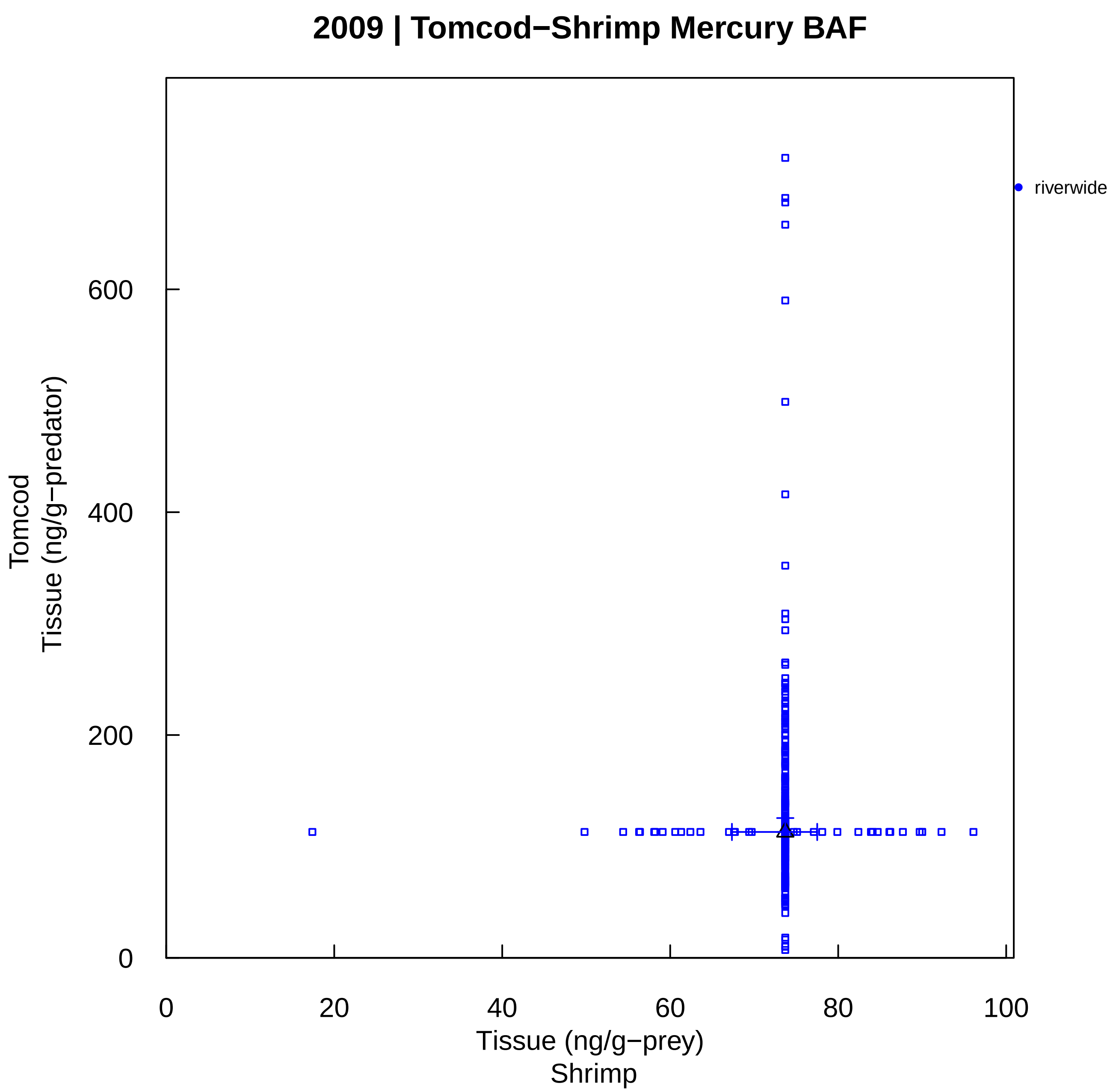


Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

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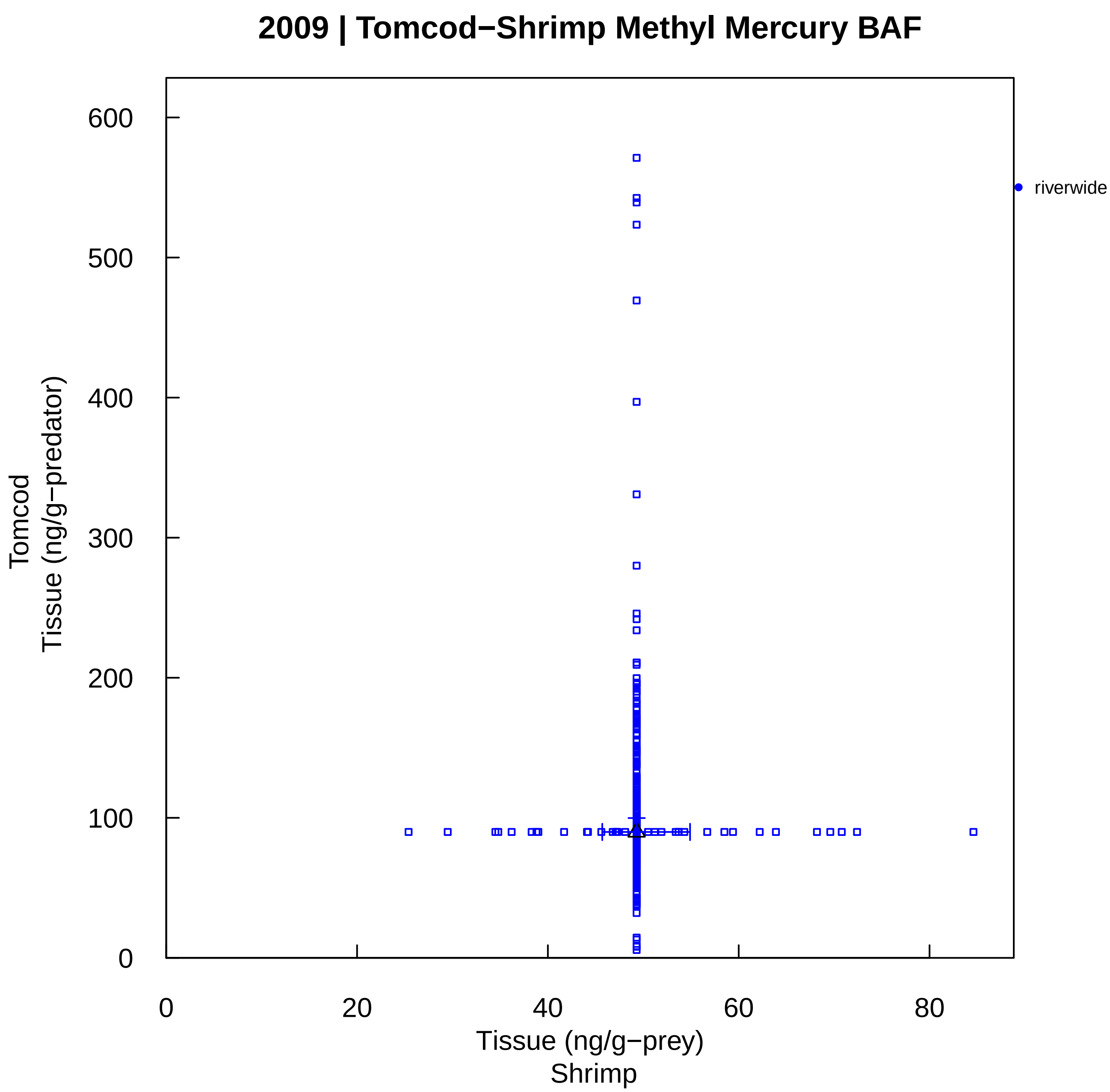


Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.

SUMMARY OF BAF LINEAR REGRESSION MODEL RESULTS

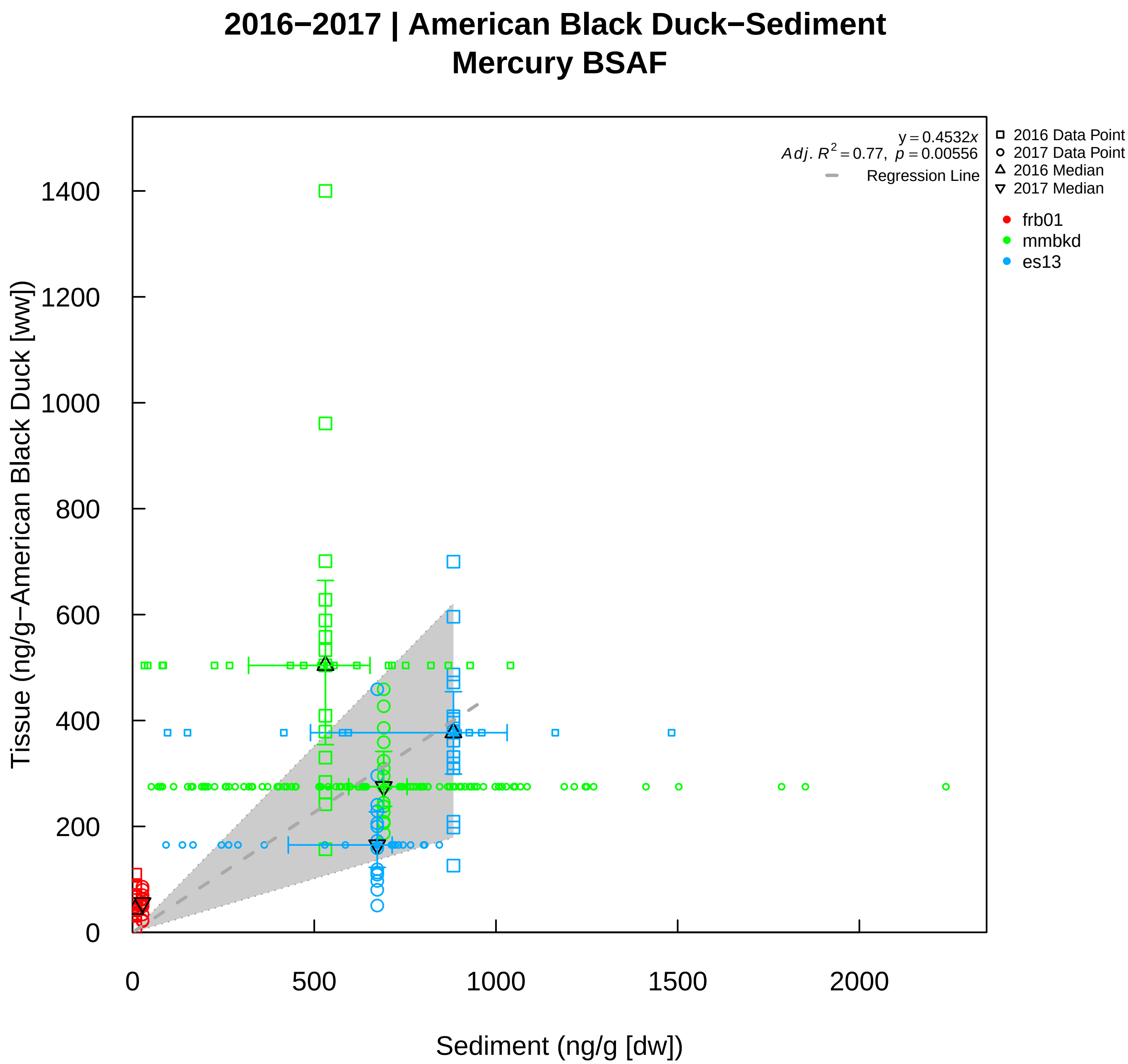
		Linear Regression Model Summary			
BAF Pair [1] (Predator-Prey)	Parameter	estimate	std.error	p.value	adj.r.squared
DuckB -Mussel [7]	Mercury	3.6	1.5	0.13	0.64
DuckB -Mussel [7]	Methyl Mercury	6.7	2.7	0.13	0.64
DuckB -Polychaete [7]	Mercury	3.1	0.83	0.014	0.68
DuckB -Polychaete [7]	Methyl Mercury	30	11	0.069	0.63
DuckT -Mussel [7]	Mercury	4	1.9	0.17	0.54
DuckT -Mussel [7]	Methyl Mercury	7.4	3.5	0.17	0.54
DuckT -Polychaete [7]	Mercury	1.5	1.1	0.23	0.13
DuckT -Polychaete [7]	Methyl Mercury	19	12	0.19	0.31
Eel-Shrimp [2]	Mercury	6.6	0.51	0.0058	0.98
Eel-Shrimp [2]	Methyl Mercury	7.6	0.67	0.0076	0.98
Lobster-Crab [3]	Mercury	1	--	--	--
Lobster-Crab [3]	Methyl Mercury	0.88	--	--	--
Lobster-Mussel	Mercury	4.6	0.67	0.00097	0.89
Lobster-Mussel	Methyl Mercury	8.5	1.2	0.00097	0.89
Lobster-Polychaete	Mercury	12	1.4	0.0004	0.92
Lobster-Polychaete	Methyl Mercury	26	10	0.092	0.56
Lobster-Smelt	Mercury	4.4	0.8	0.0027	0.83
Lobster-Smelt	Methyl Mercury	4.4	0.8	0.0027	0.83
Mummichog-Shrimp	Mercury	3	0.57	0.12	0.93
Mummichog-Shrimp	Methyl Mercury	3.4	0.46	0.085	0.96
Nelson's Sparrow-Spider	Mercury	10	3.2	0.015	0.53
Nelson's Sparrow-Spider	Methyl Mercury	9.6	3.1	0.017	0.52
Red-winged Blackbird-Spider [4]	Mercury	22	--	--	--
Red-winged Blackbird-Spider [4]	Methyl Mercury	17	--	--	--
Red-winged Blackbird-Terrestrial Insect [4]	Mercury	140	74	0.31	0.56
Red-winged Blackbird-Terrestrial Insect [4]	Methyl Mercury	120	77	0.36	0.44
Tomcod-Polychaete	Mercury	1.2	0.75	0.35	0.45
Tomcod-Polychaete	Methyl Mercury	13	1.6	0.080	0.97
Tomcod-Shrimp [2]	Mercury	1.5	--	--	--
Tomcod-Shrimp [2]	Methyl Mercury	1.8	--	--	--

Notes:

1 Paired biota samples (Predator-Prey) collected 2016 - 2017, unless indicated otherwise.
2 Paired biota samples (Predator-Prey) collected in 2009.
3 Paired biota samples (Predator-Prey) collected in 2015.
4 Paired biota samples (Predator-Prey) collected in 2017.
5 -- indicates regression model not applicable (sample size < 2).
6 Highlighted cells indicate:

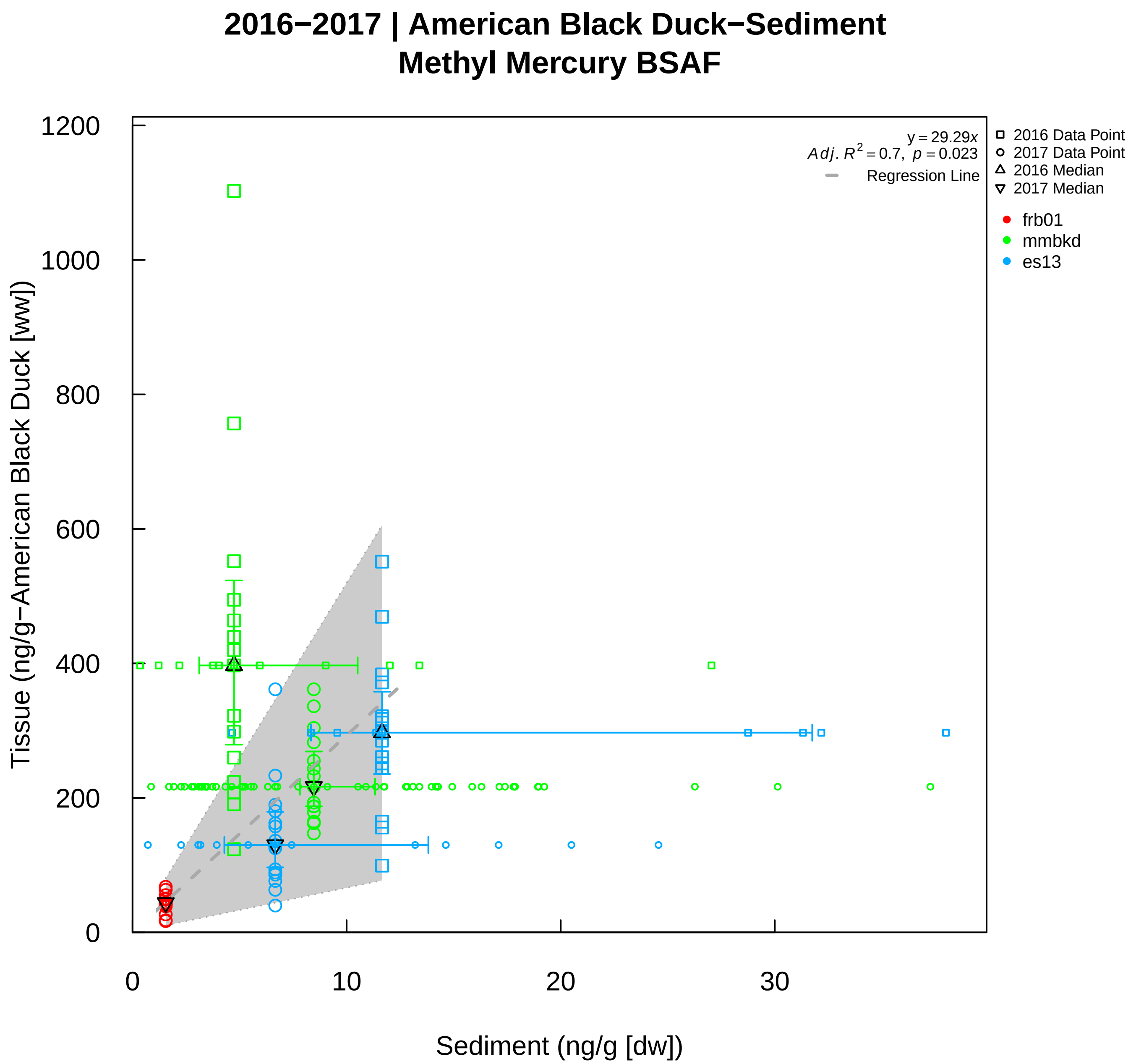
p-value < 0.05; statistically significant	0.049
0.10 > p-value ≥ 0.05; approaching significance	0.08
p-value > 0.10; not statistically different from zero	0.35

7 Duck (predator) samples collected 2017-2018, paired with prey collected 2016-2017.



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



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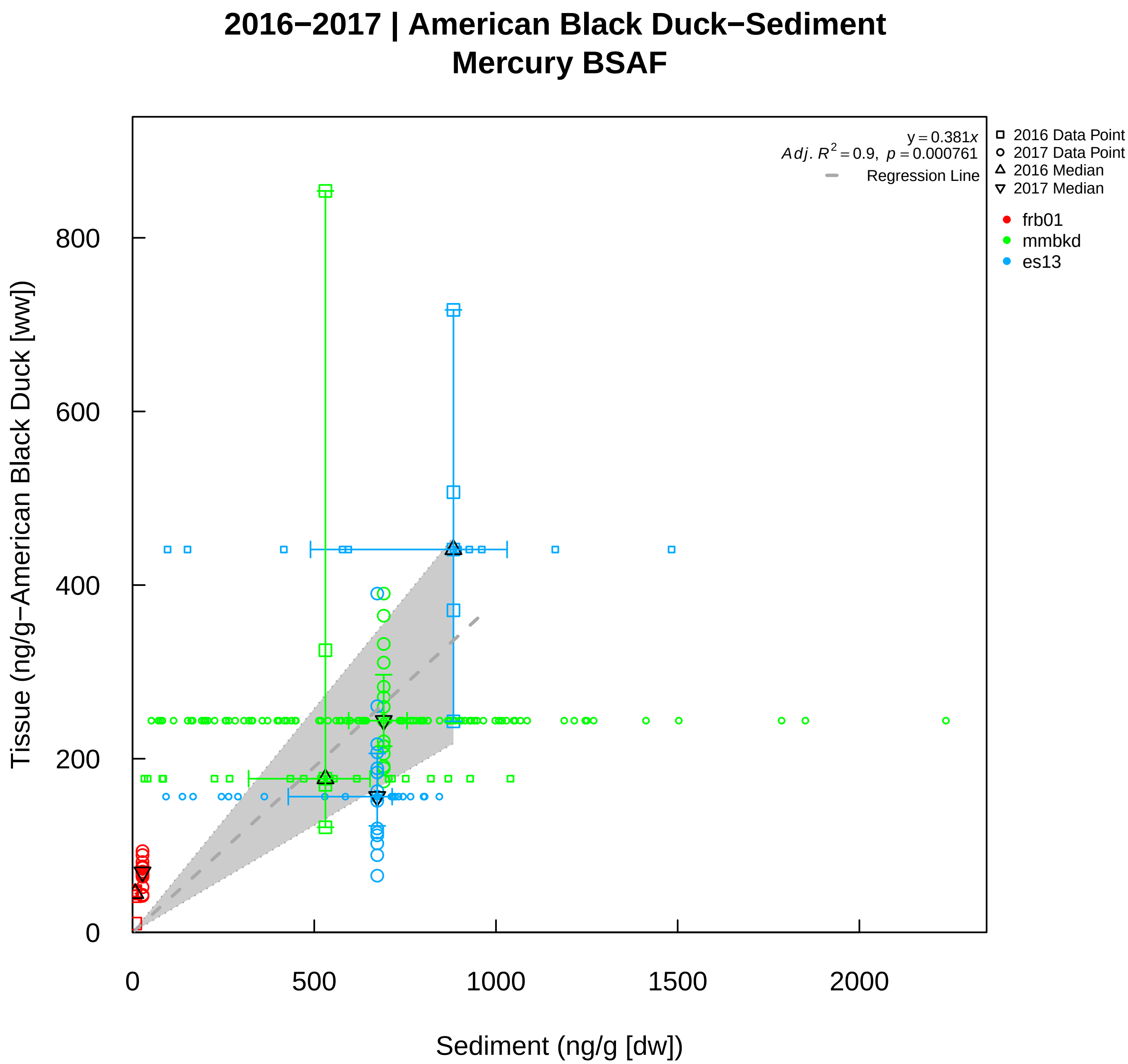
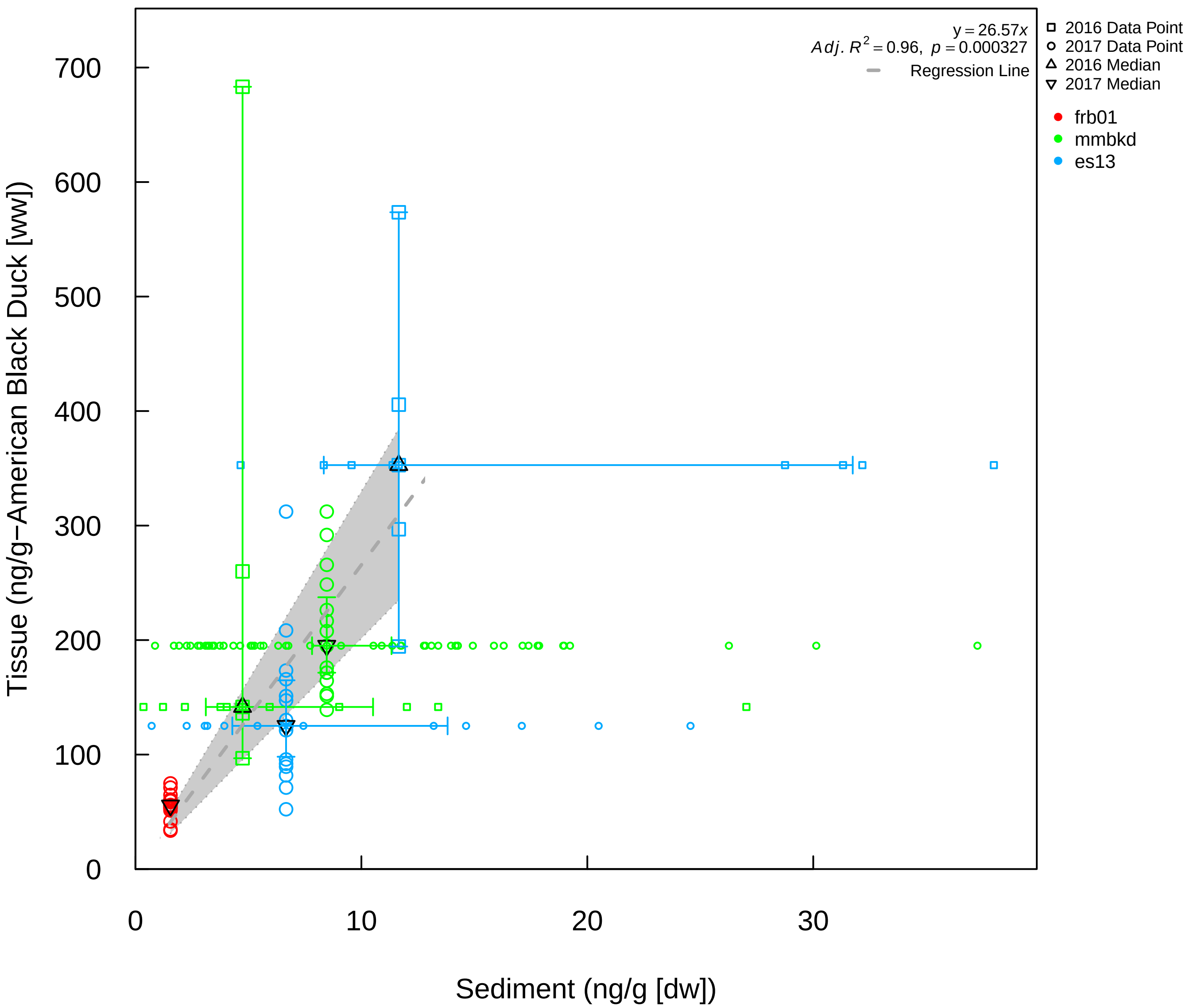


Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.

2016−2017 | American Black Duck−Sediment Methyl Mercury BSAF



Grey shaded region represents the regression 95% confidence interval.

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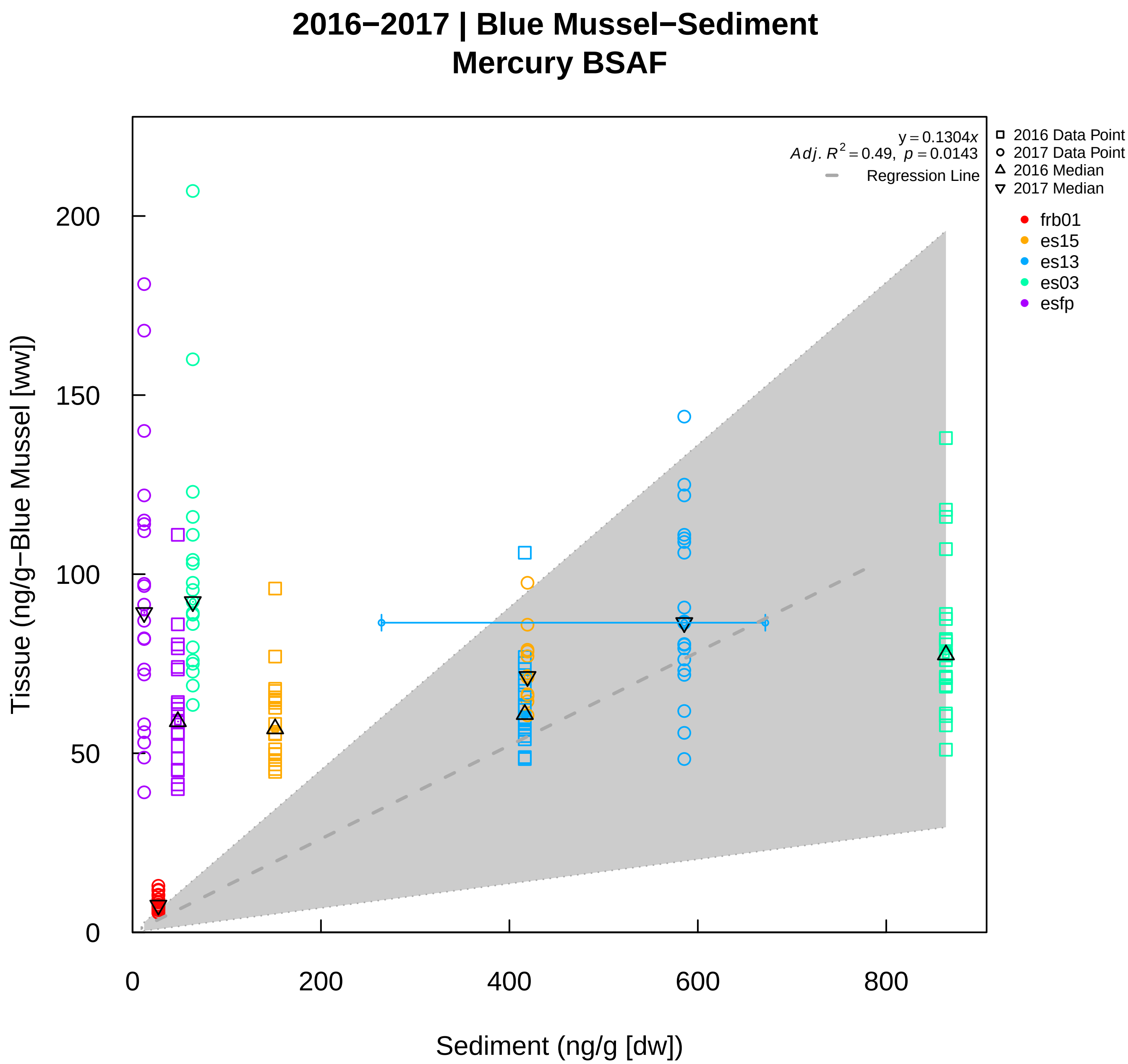
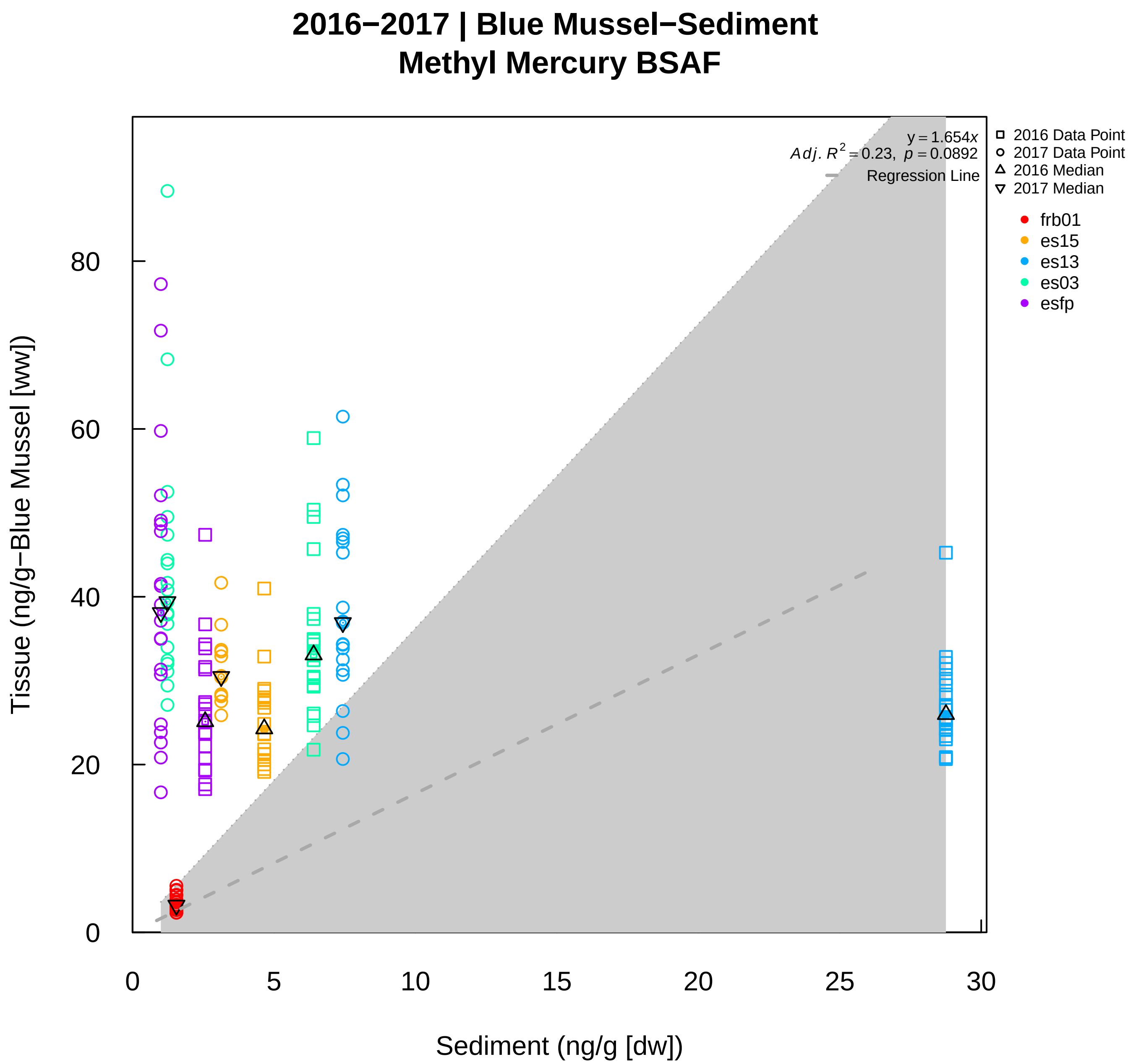


Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



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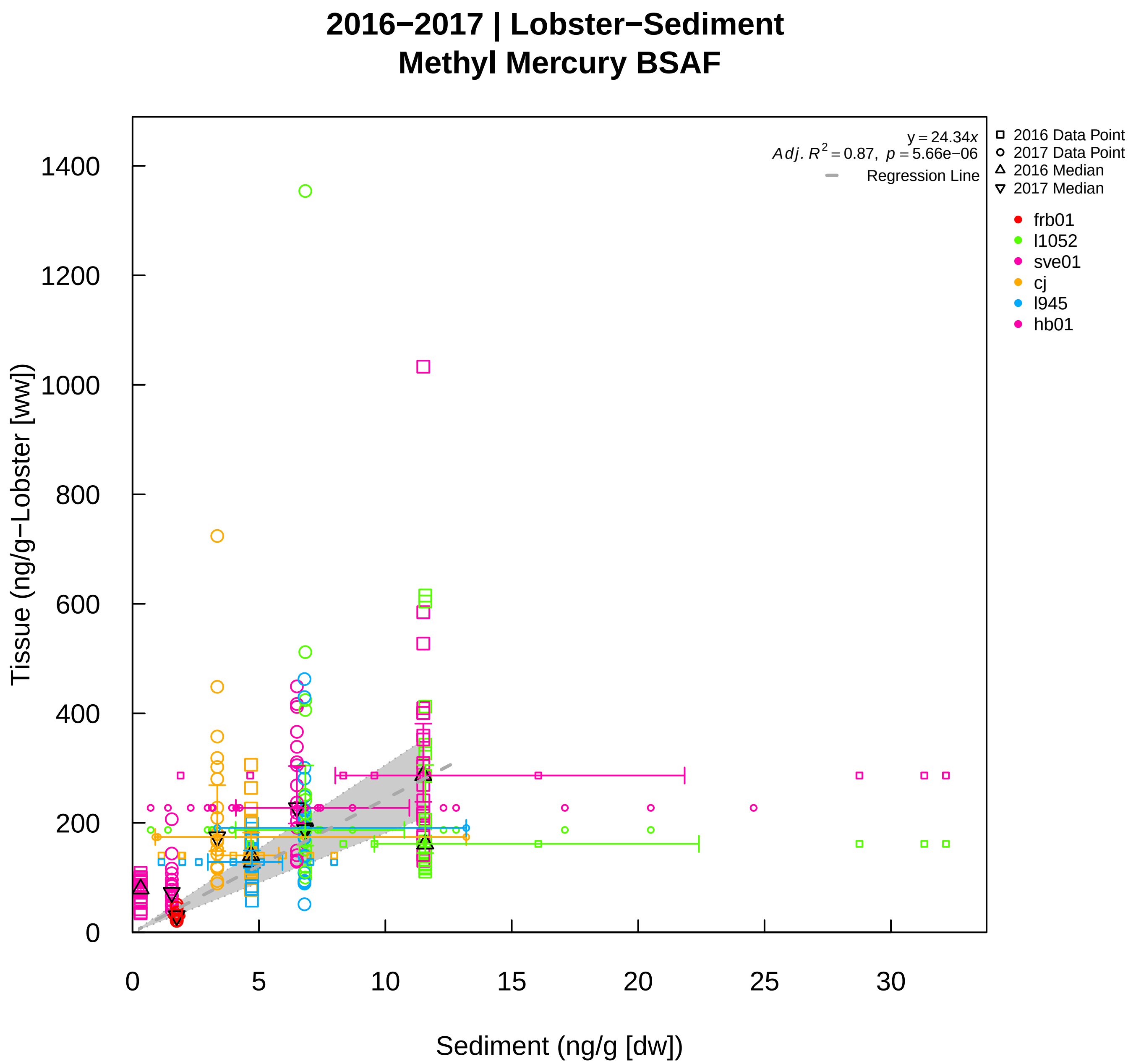
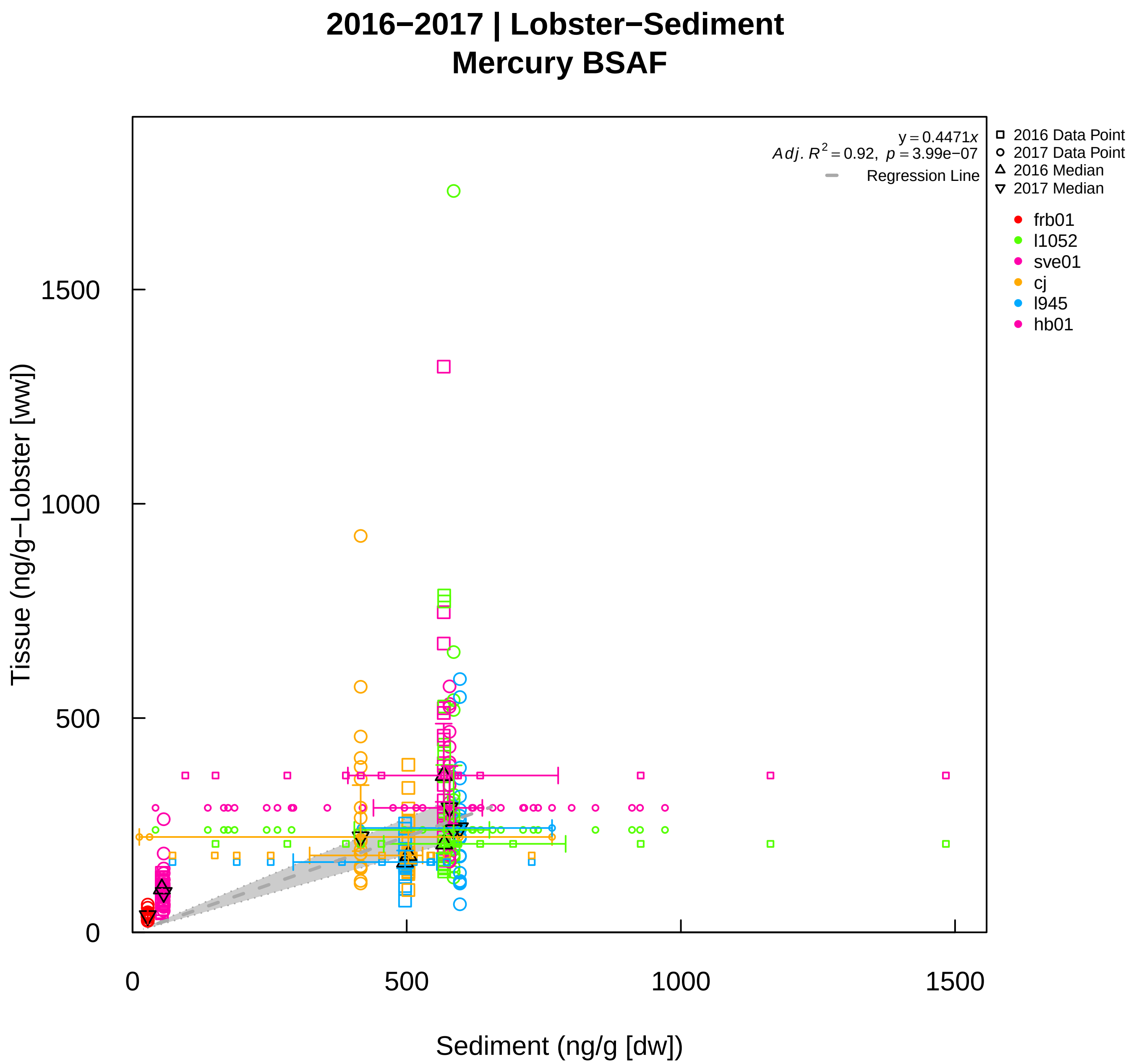


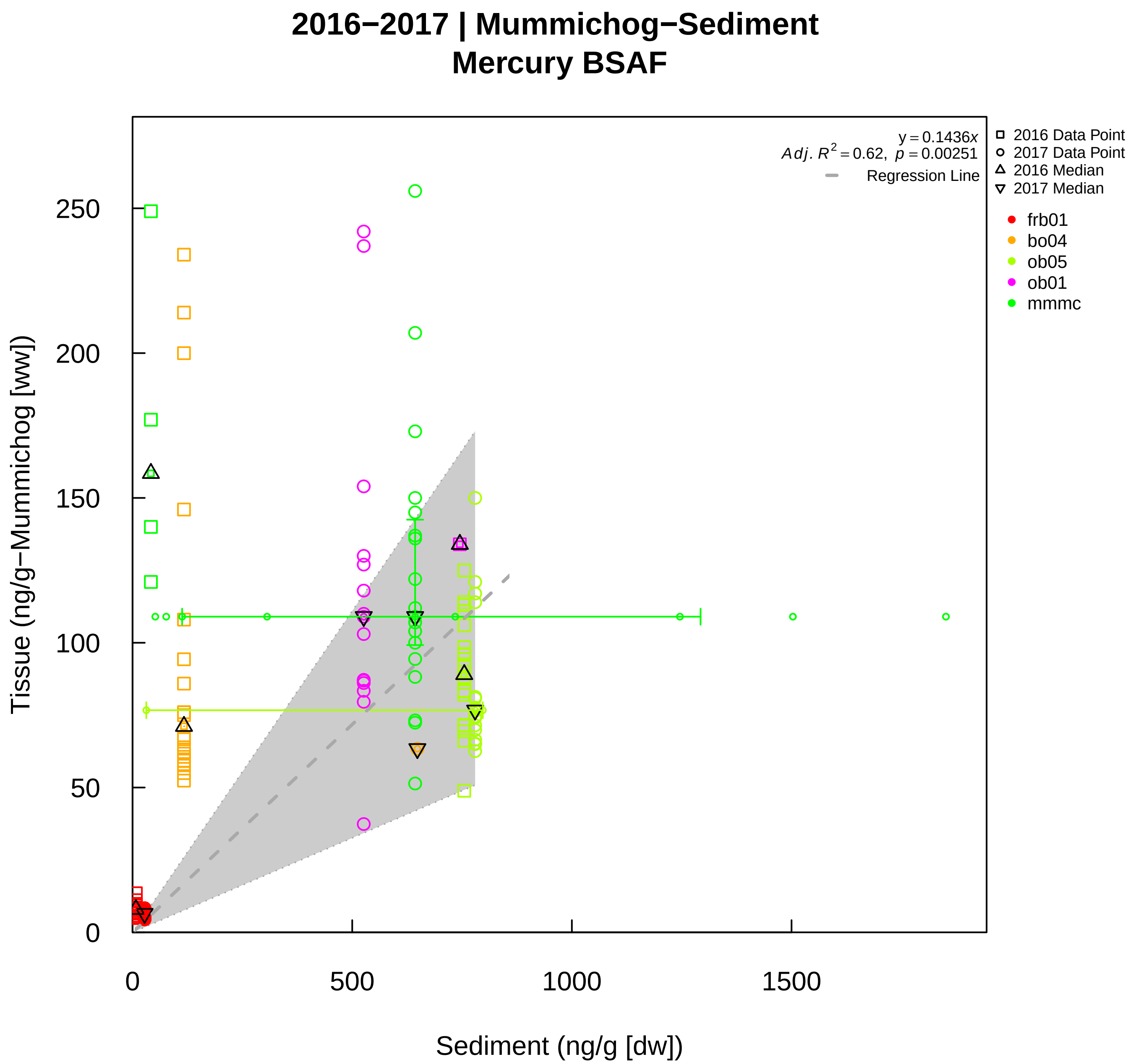
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



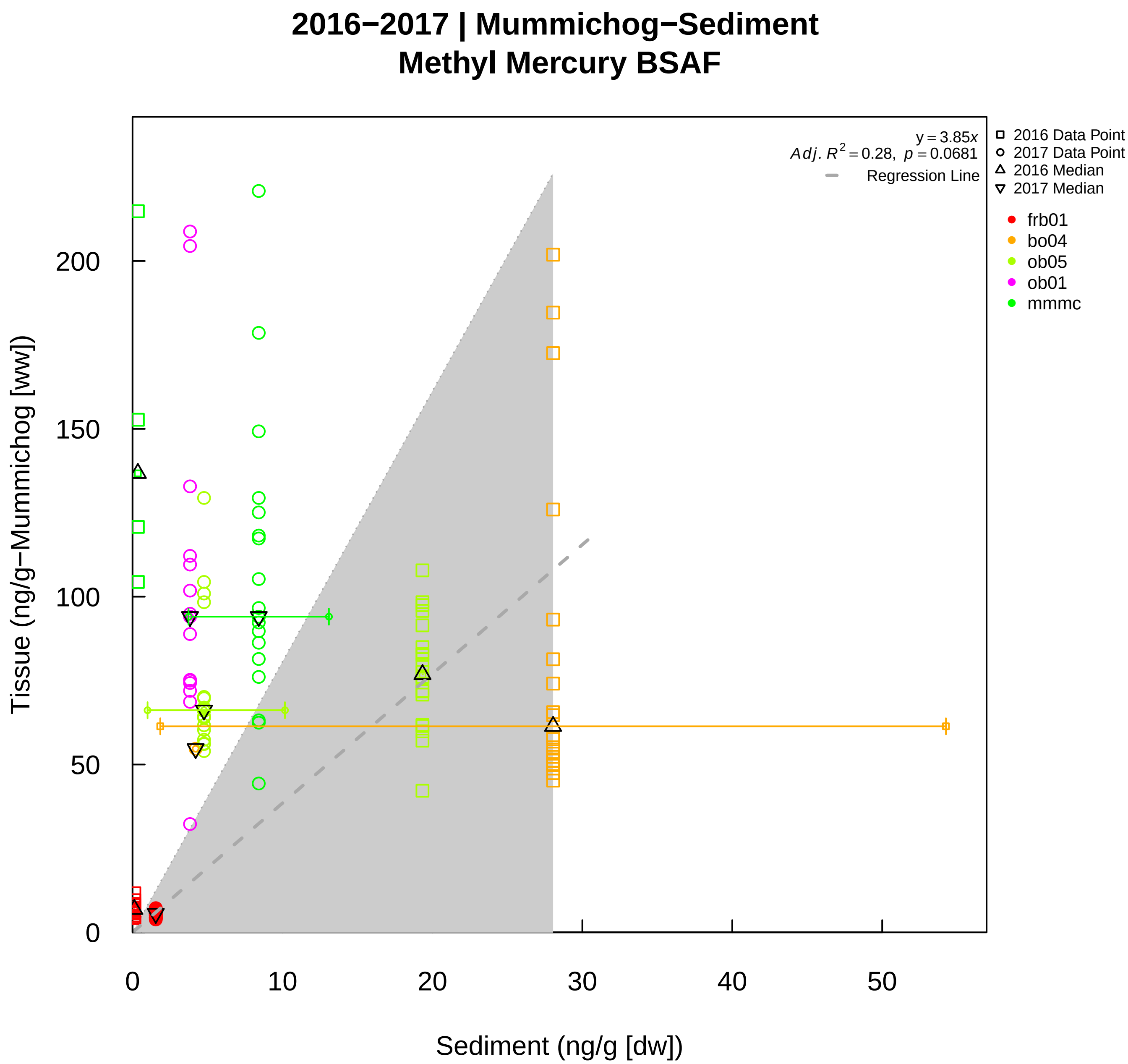
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



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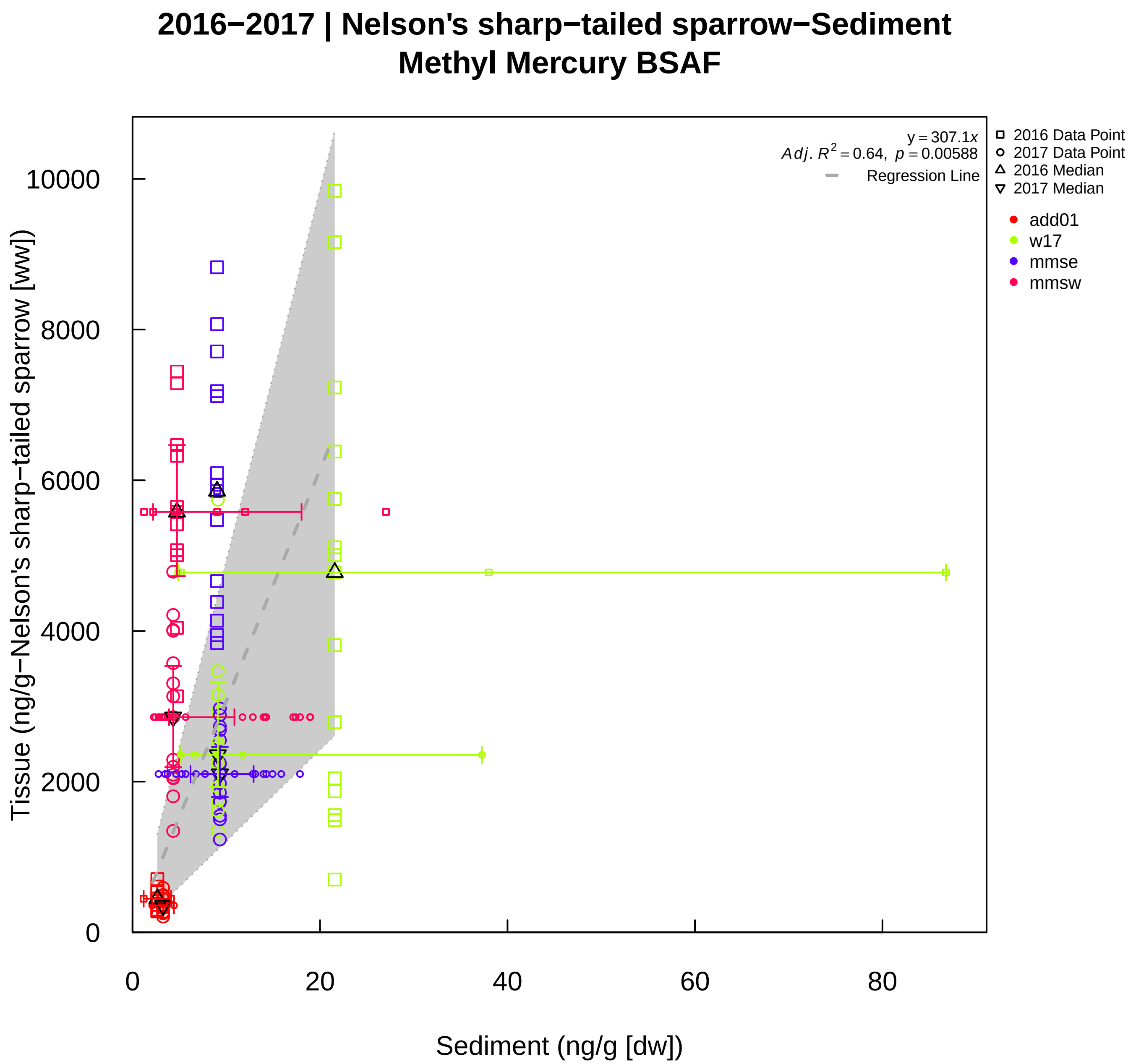

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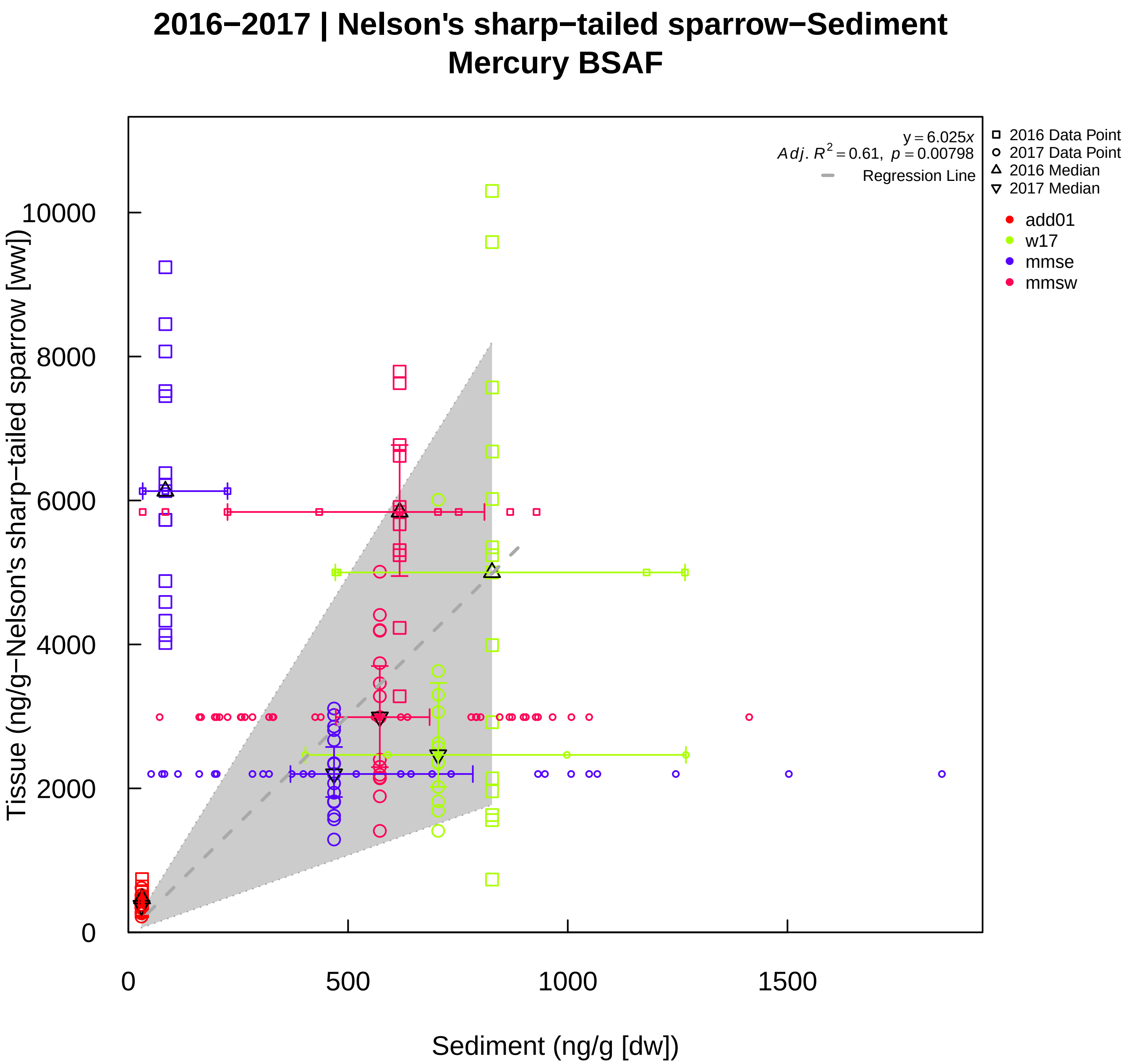

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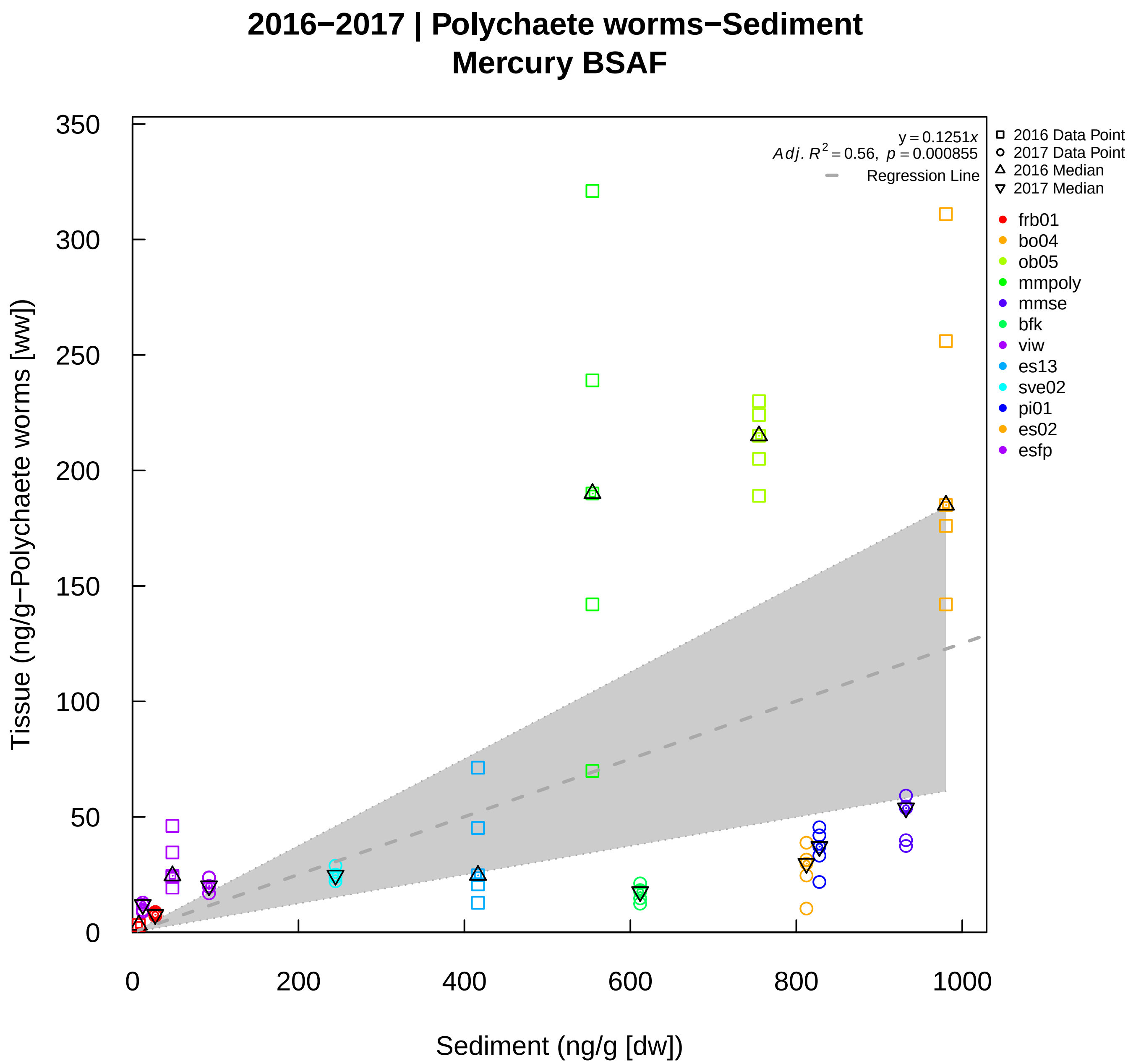

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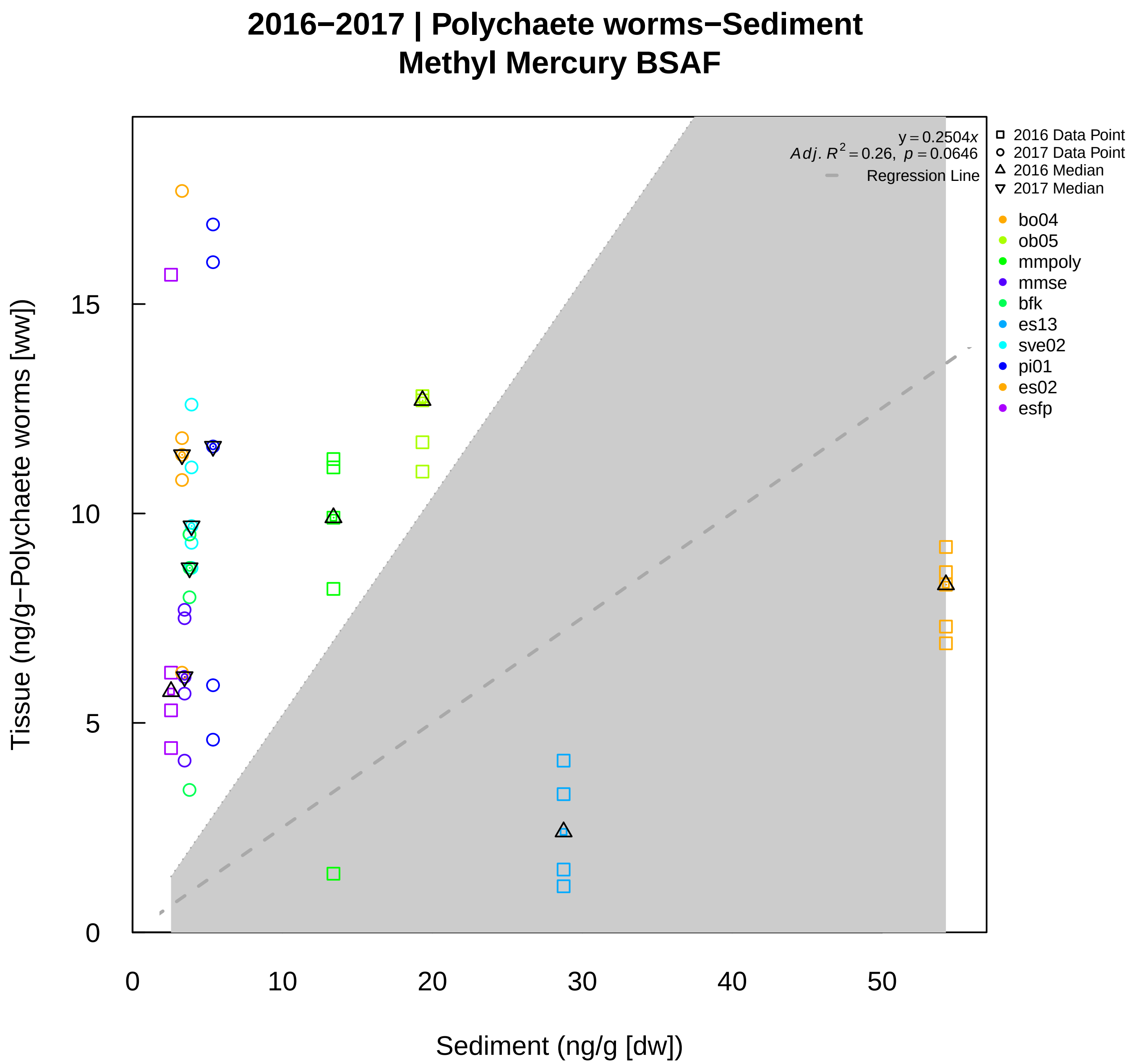

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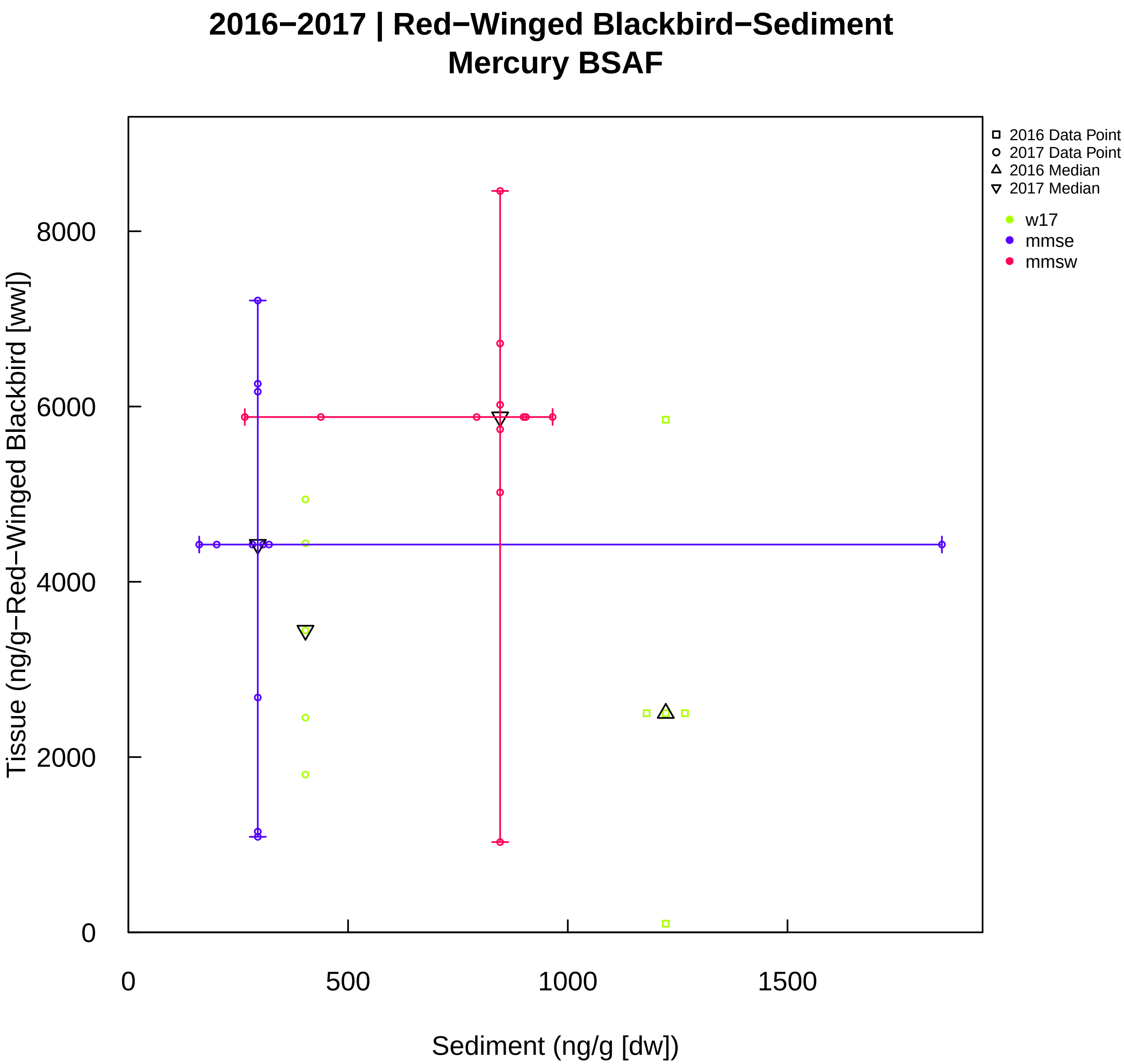

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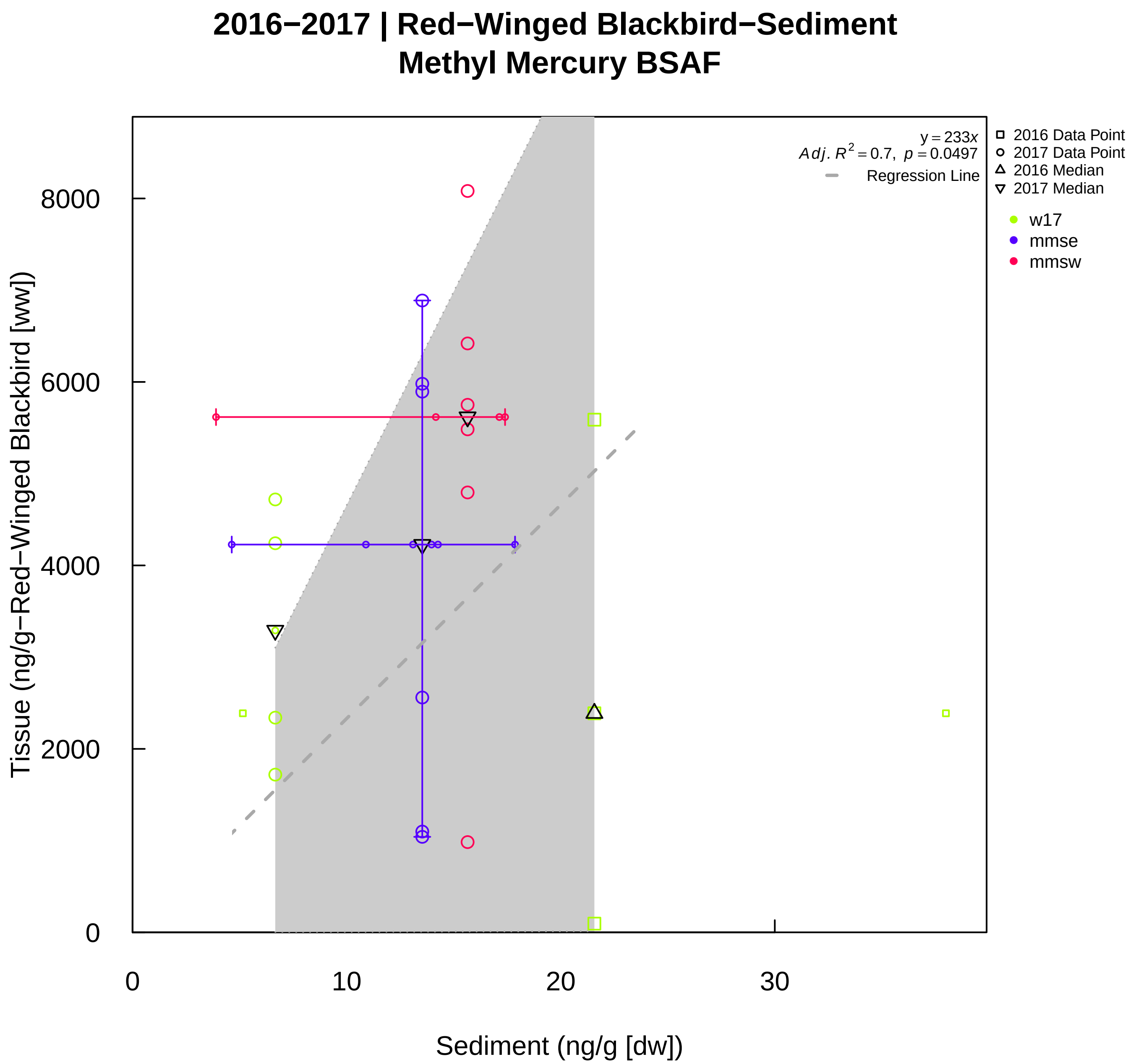

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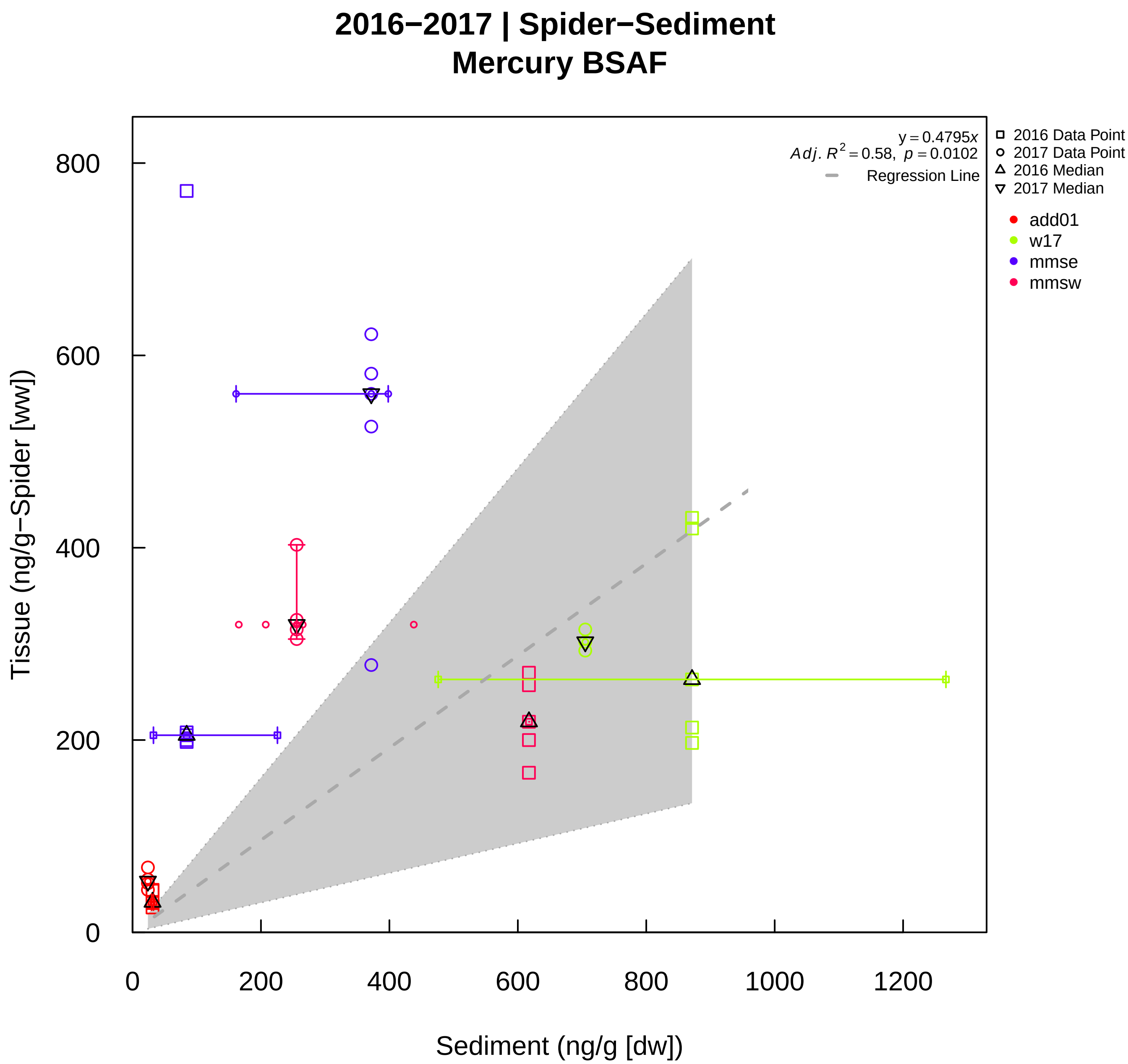

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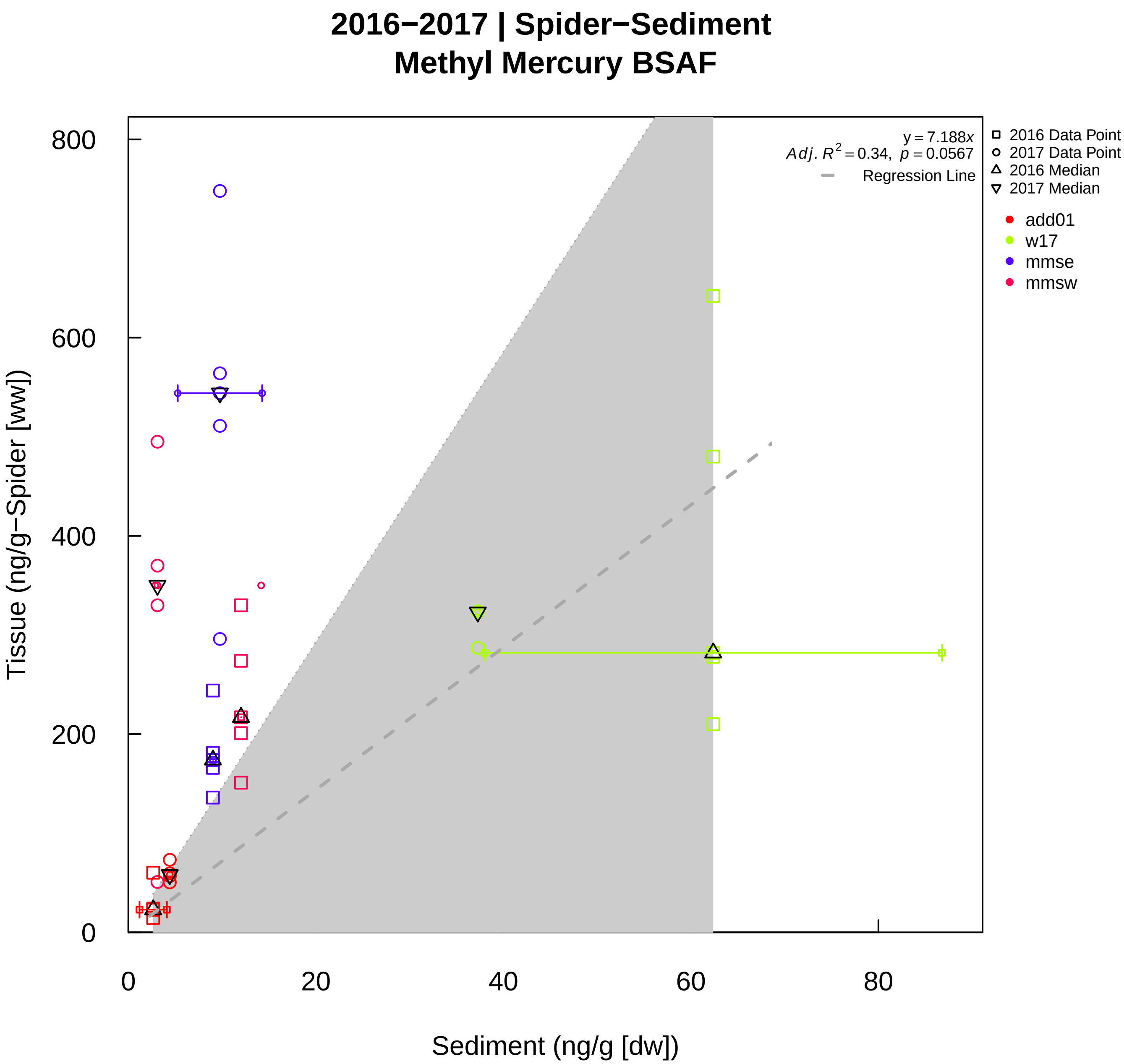

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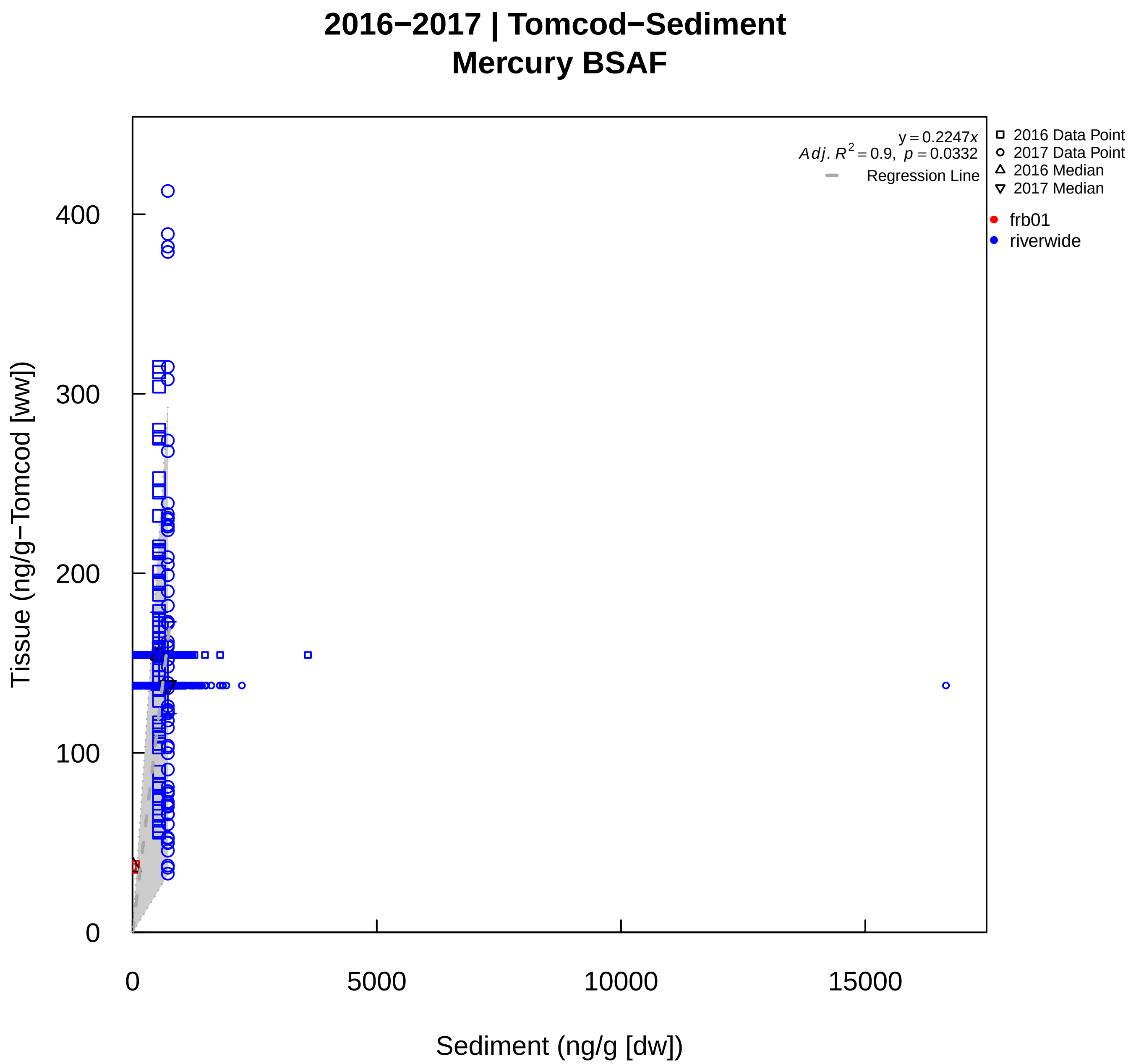

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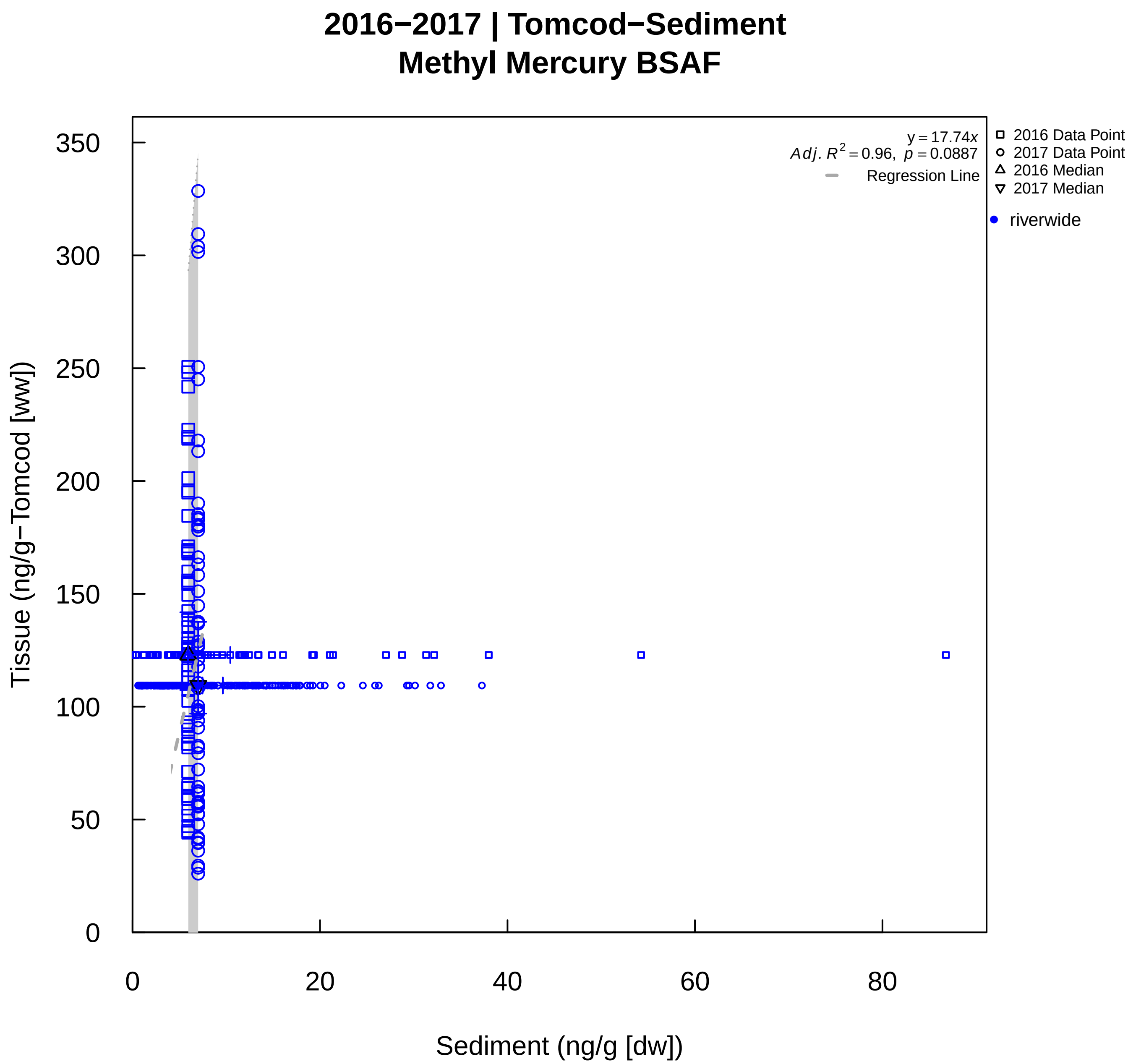


Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.

SUMMARY OF BSAF LINEAR REGRESSION MODEL RESULTS

		BSAF Linear Regression Model Summary			
Biota [1]	**Parameter**	**estimate**	**std.error**	**p.value**	**adj.r.squared**
Eel	Mercury	0.66	0.11	0.002	0.85
Eel	Methyl Mercury	52	19	0.068	0.63
Spider	Mercury	0.48	0.14	0.01	0.58
Spider	Methyl Mercury	7.2	3.2	0.057	0.34
Terrestrial Insects	Mercury	0.041	0.051	0.44	-0.044
Terrestrial Insects	Methyl Mercury	1.7	0.72	0.051	0.36
Polychaete	Methyl Mercury	0.25	0.12	0.07	0.26
Polychaete	Mercury	0.13	0.029	0.00085	0.56
Rock Crab [2]	Mercury	0.30	--	--	--
Rock Crab [2]	Methyl Mercury	19	--	--	--
Blue Mussel	Methyl Mercury	1.7	0.86	0.089	0.23
Blue Mussel	Mercury	0.13	0.042	0.014	0.49
Lobster	Mercury	0.45	0.039	0.0000004	0.92
Lobster	Methyl Mercury	24	2.8	0.0000057	0.87
Mummichog	Mercury	0.14	0.035	0.0025	0.62
Mummichog	Methyl Mercury	3.8	1.8	0.068	0.28
Nelson's sparrow	Mercury	6.0	1.6	0.008	0.61
Nelson's sparrow	Methyl Mercury	310	79	0.0059	0.64
Red-winged Blackbird	Mercury	4.4	1.9	0.10	0.53
Red-winged Blackbird	Methyl Mercury	230	73	0.050	0.70
Smelt	Methyl Mercury	9.1	1.7	0.0005	0.73
Smelt	Mercury	0.12	0.026	0.0012	0.63
Tomcod	Mercury	0.22	0.042	0.033	0.9
Tomcod	Methyl Mercury	18	2.5	0.089	1.0
Black Duck (blood) [3]	Mercury	0.45	0.097	0.0056	0.77
Black Duck (blood) [3]	Methyl Mercury	29	8.2	0.023	0.7
Black Duck (tissue) [3]	Mercury	0.38	0.052	0.00076	0.9
Black Duck (tissue) [3]	Methyl Mercury	27	2.30	0.00033	1.0

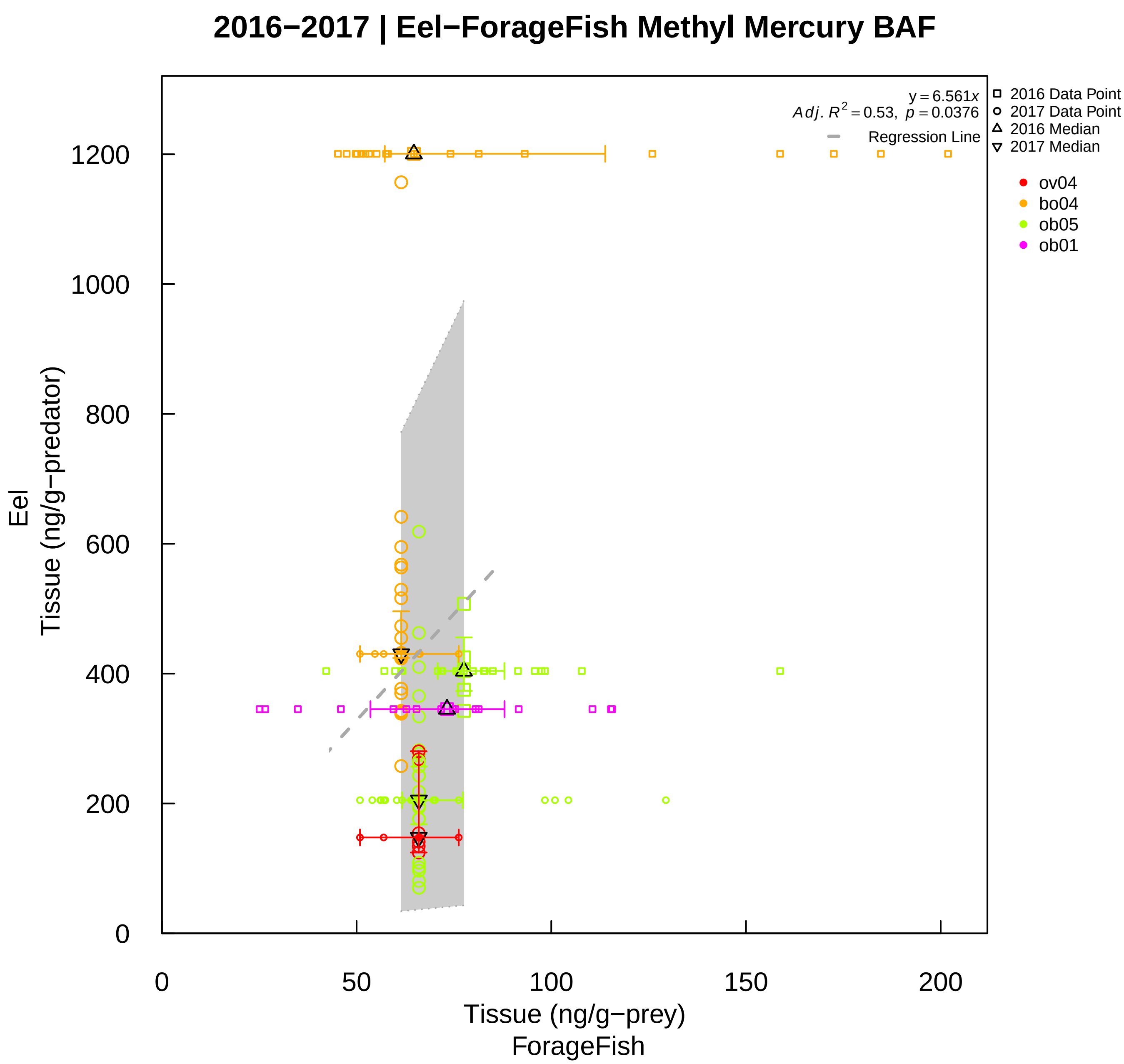
Notes:

1 Paired biota and sediment samples collected 2016 - 2017, unless indicated otherwise.
2 Paired biota and sediment samples collected in 2015.
3 Paired biota and sediment samples collected in 2017 & 2016 and 2018 & 2017, respectively.
4 -- indicates regression model not applicable (sample size < 2).
5 Highlighted cells indicate:

p-value < 0.05; statistically significant	0.04
0.10 > p-value ≥ 0.05; approaching significance	0.076
p-value ≥ 0.10; not statistically different from zero	0.34

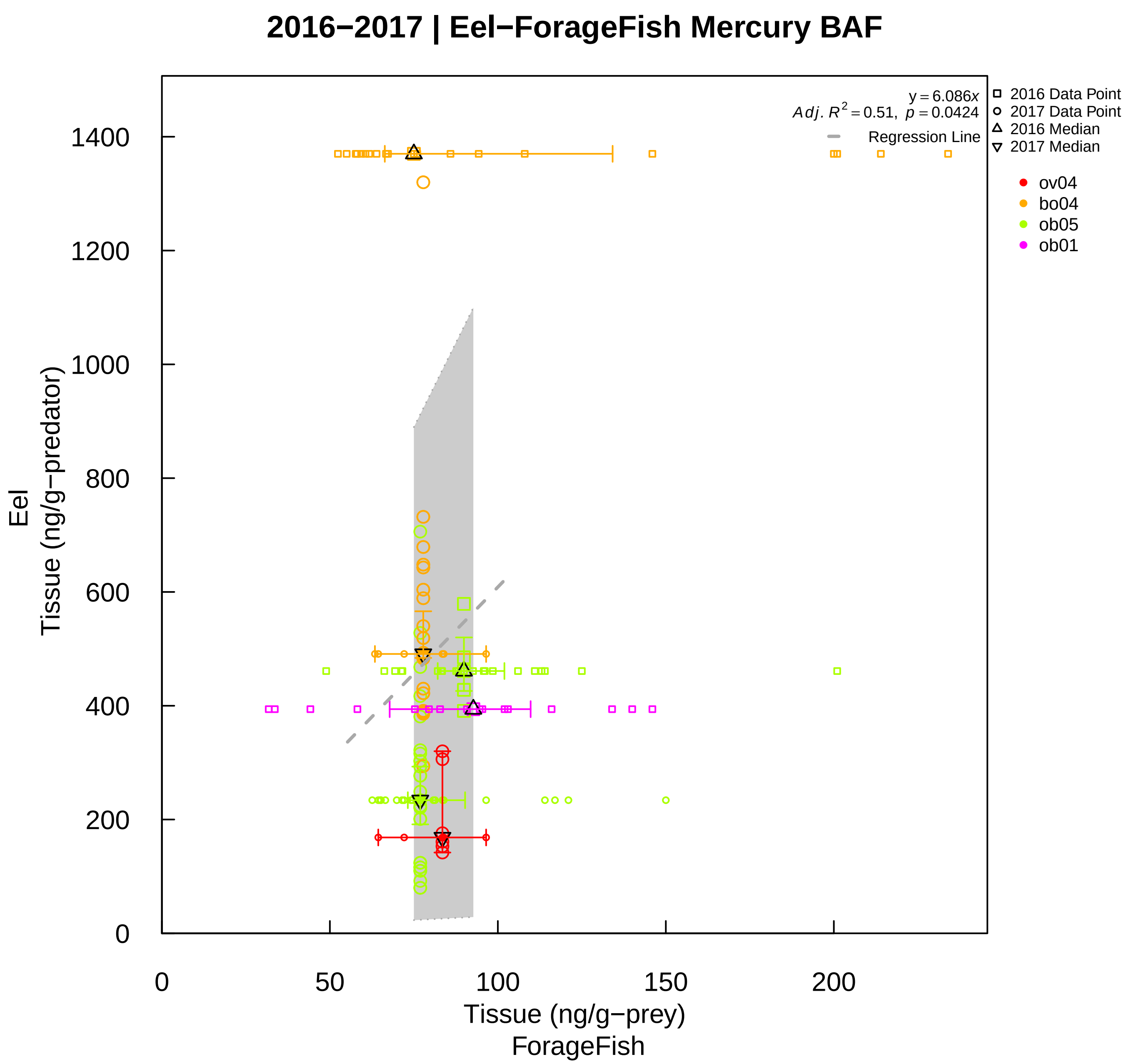
C-2

BAF and BSAF Regression Plots & Summary with Extreme Values Present



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



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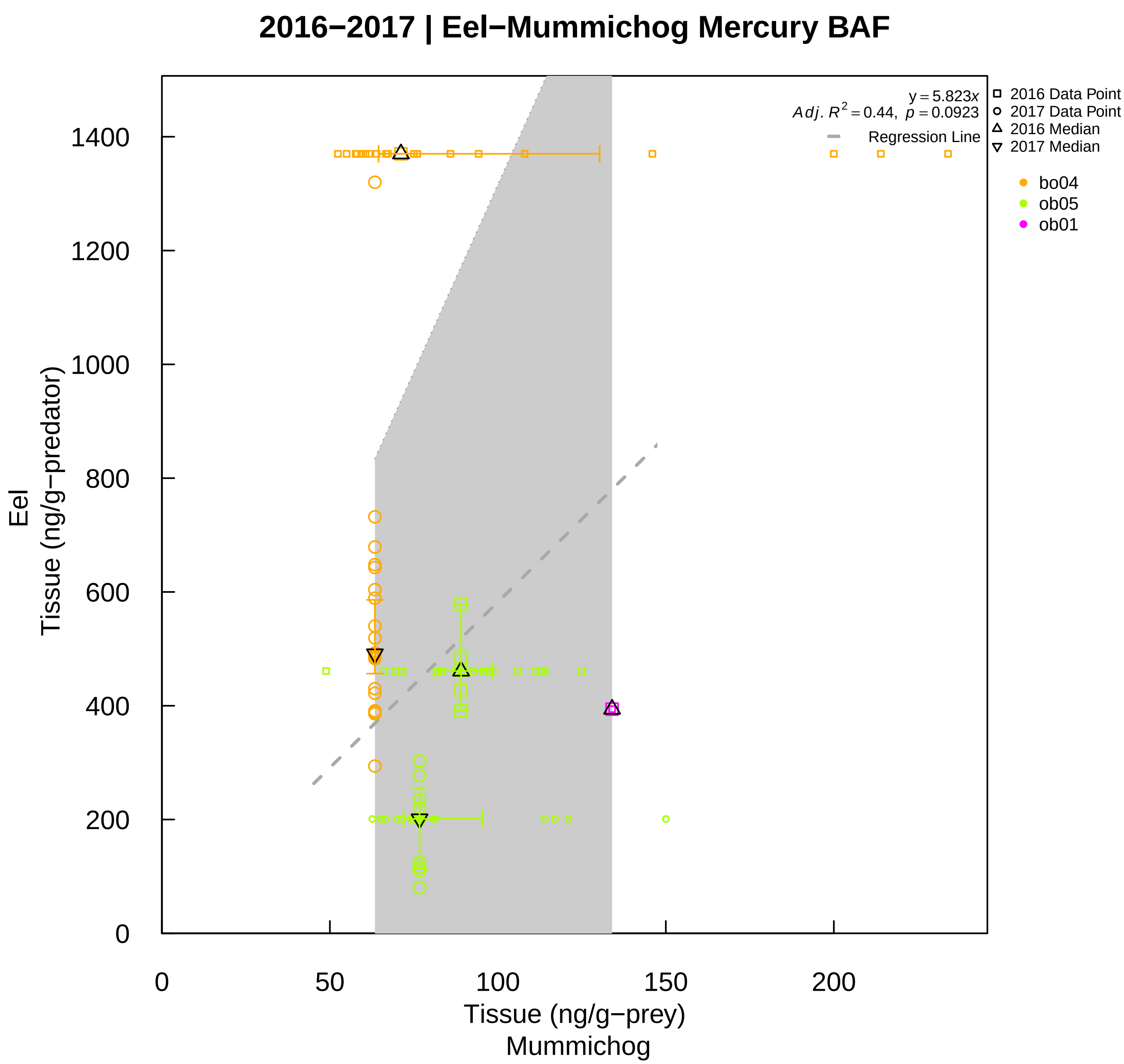

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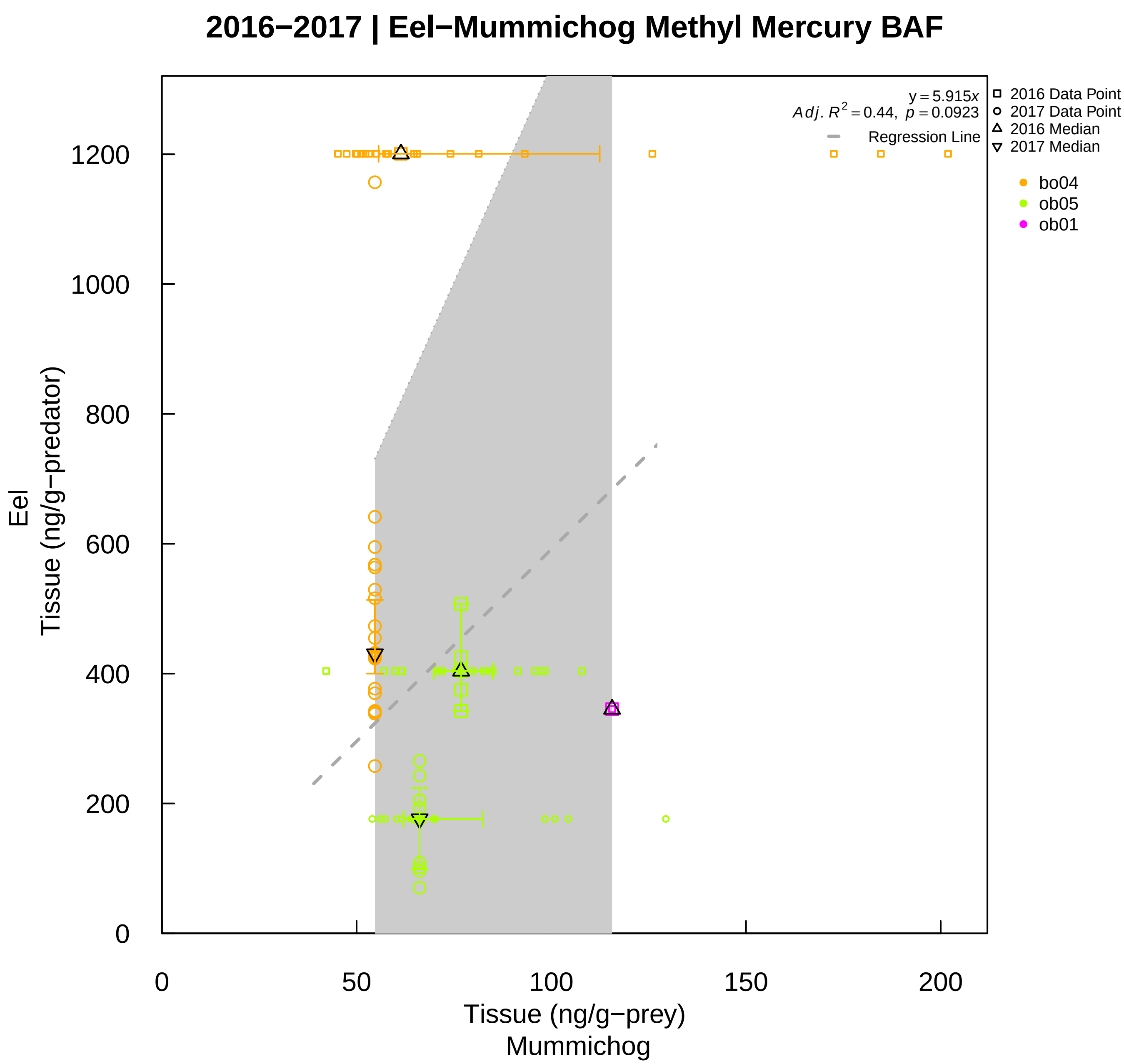

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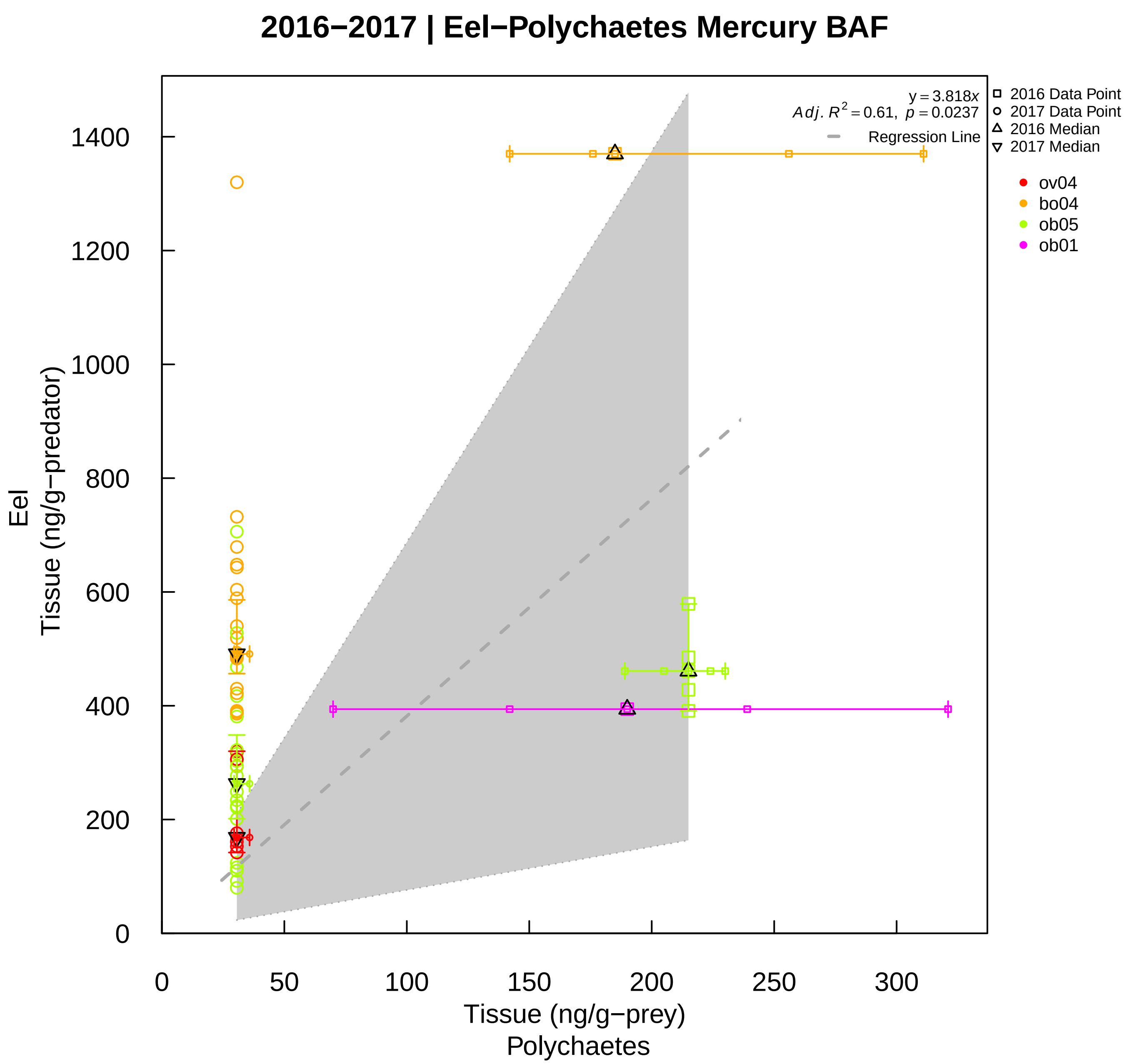

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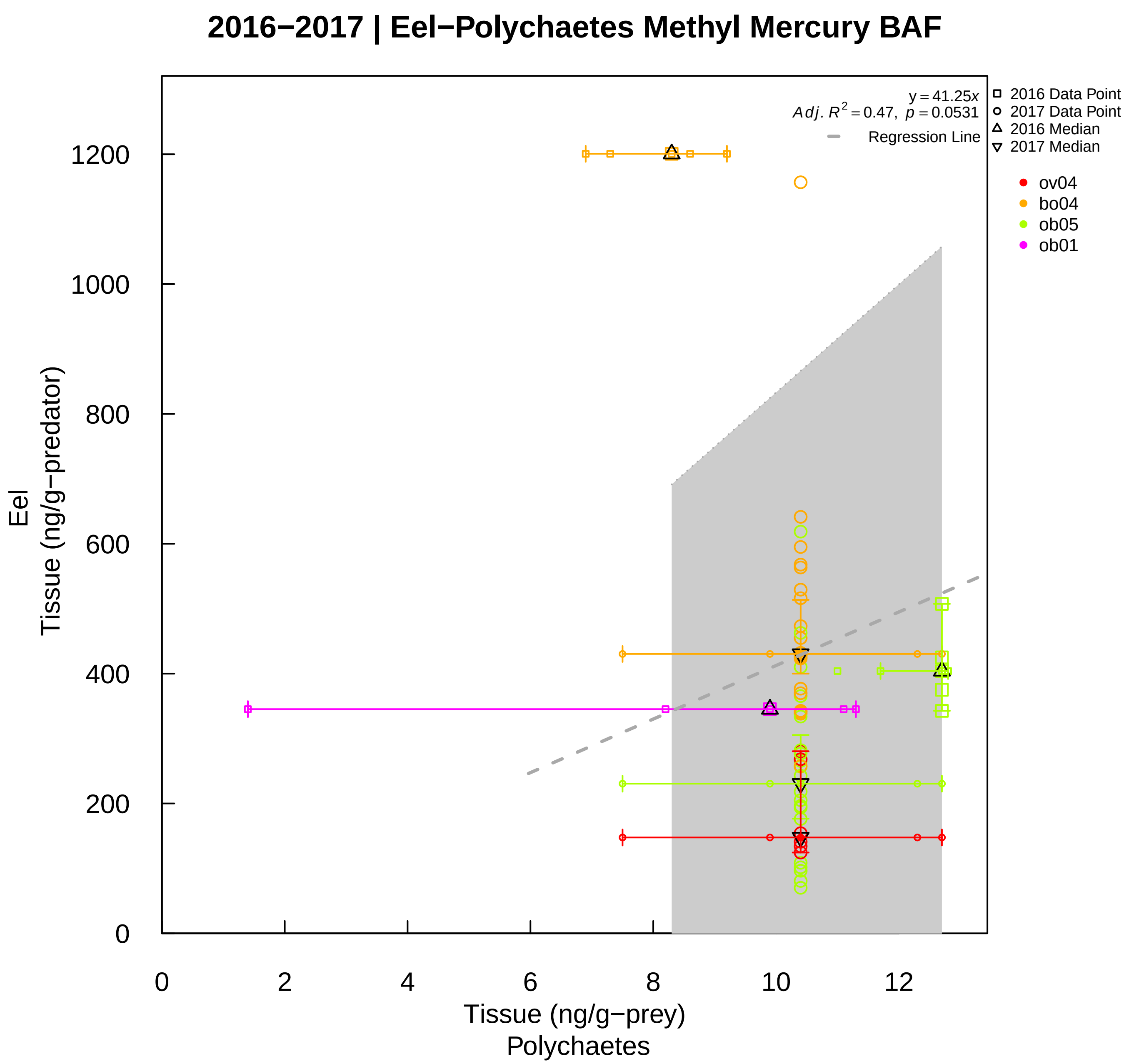

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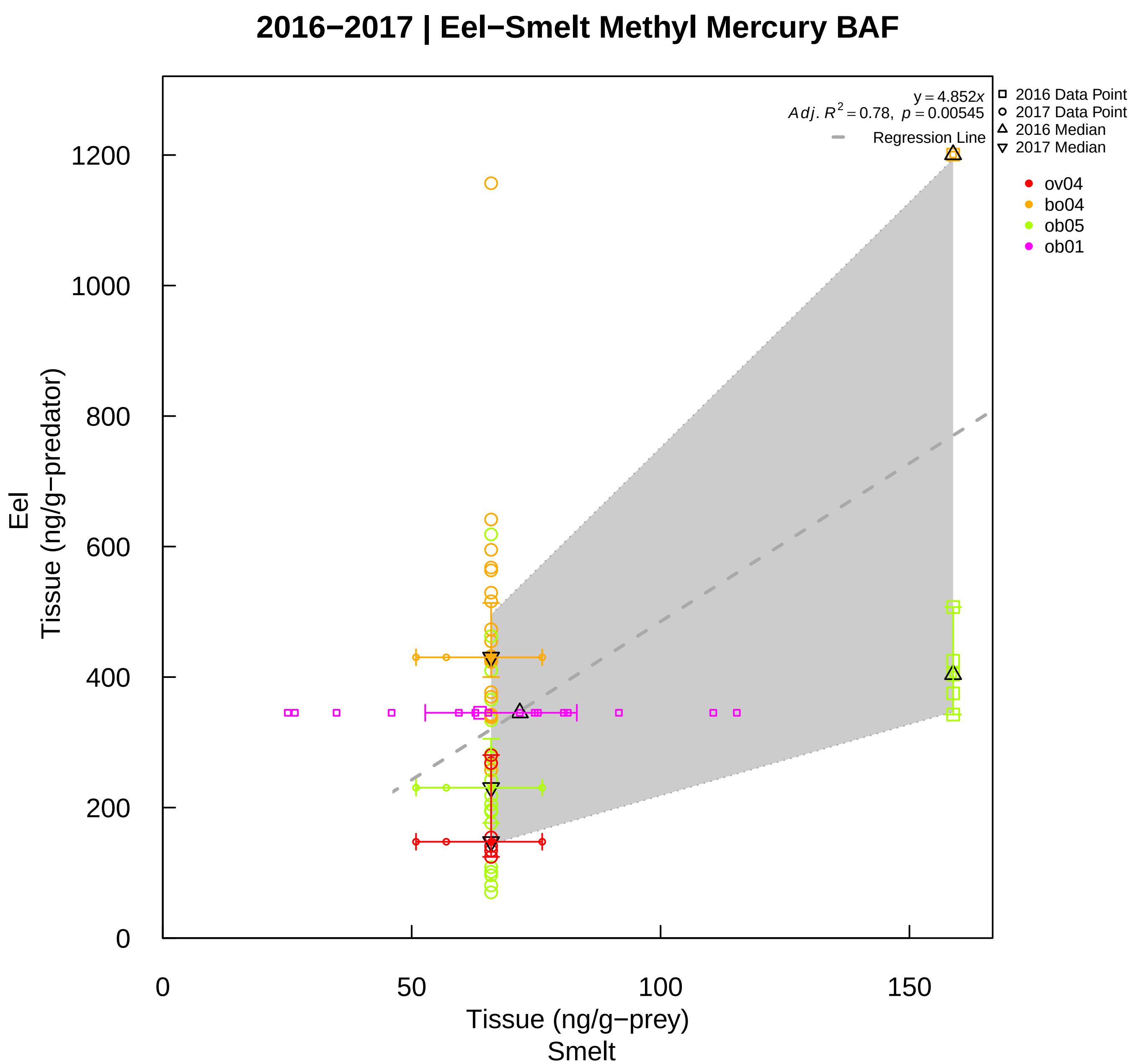

Grey shaded region represents the regression 95% confidence interval.

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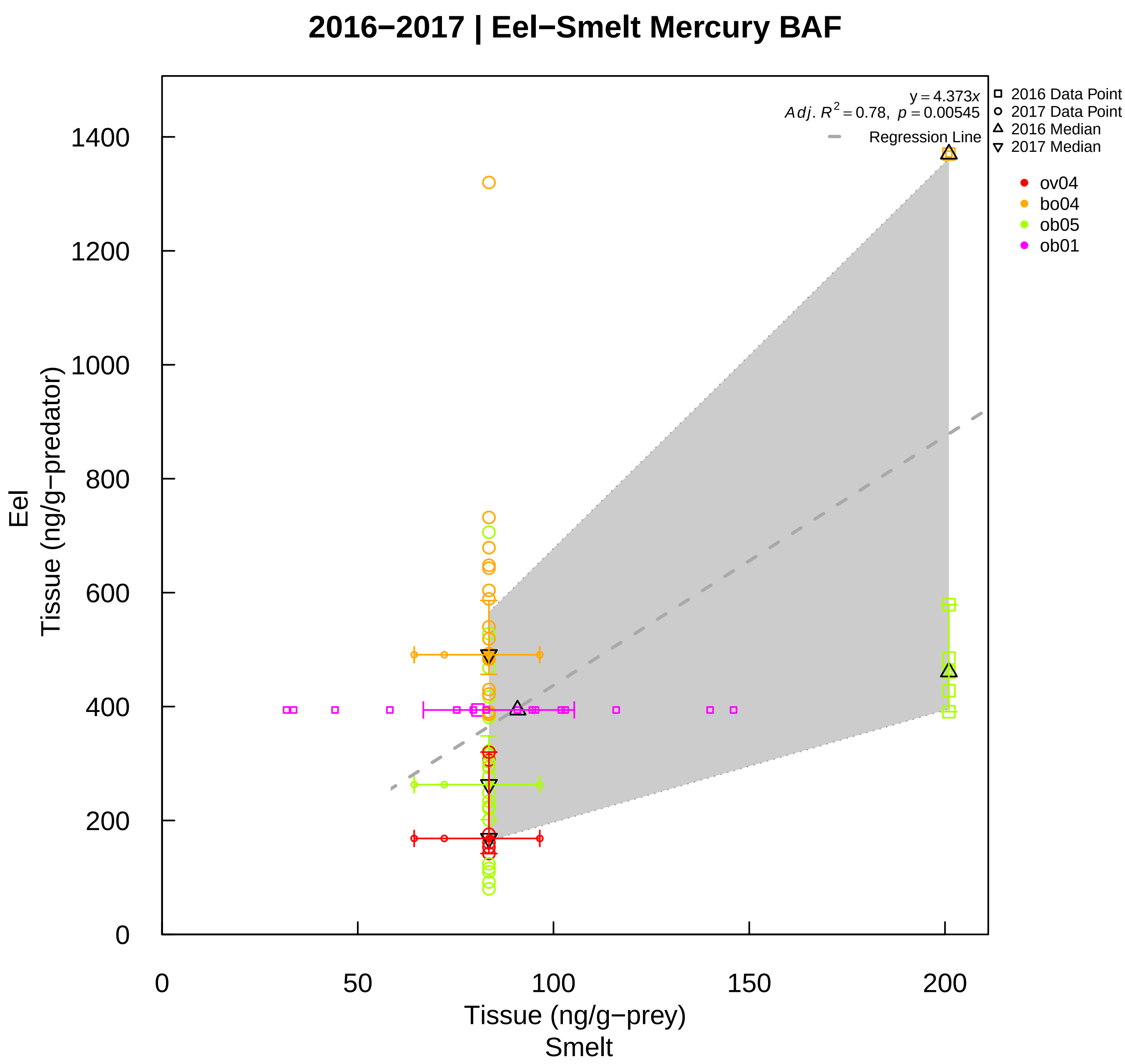

Grey shaded region represents the regression 95% confidence interval.

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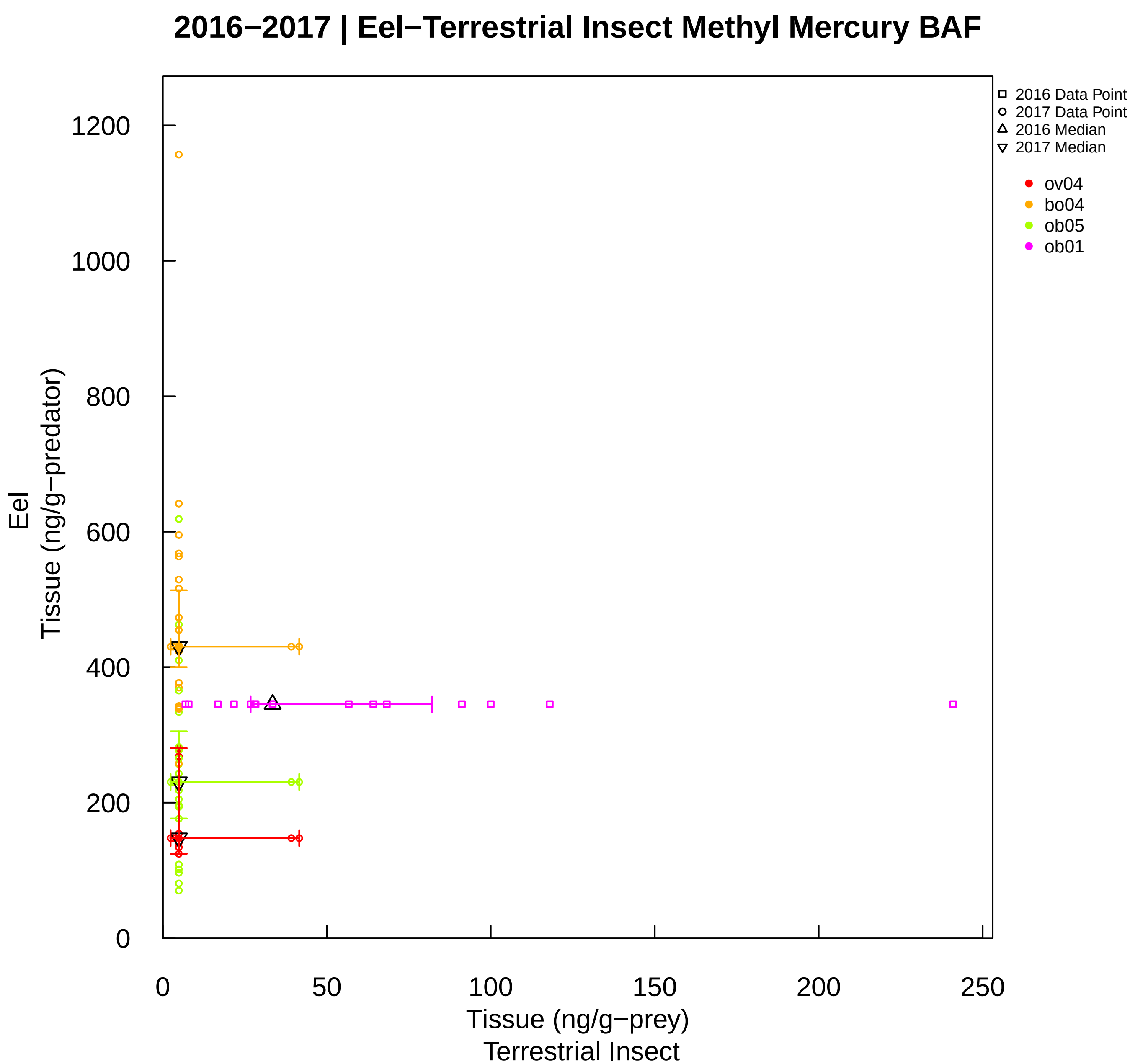

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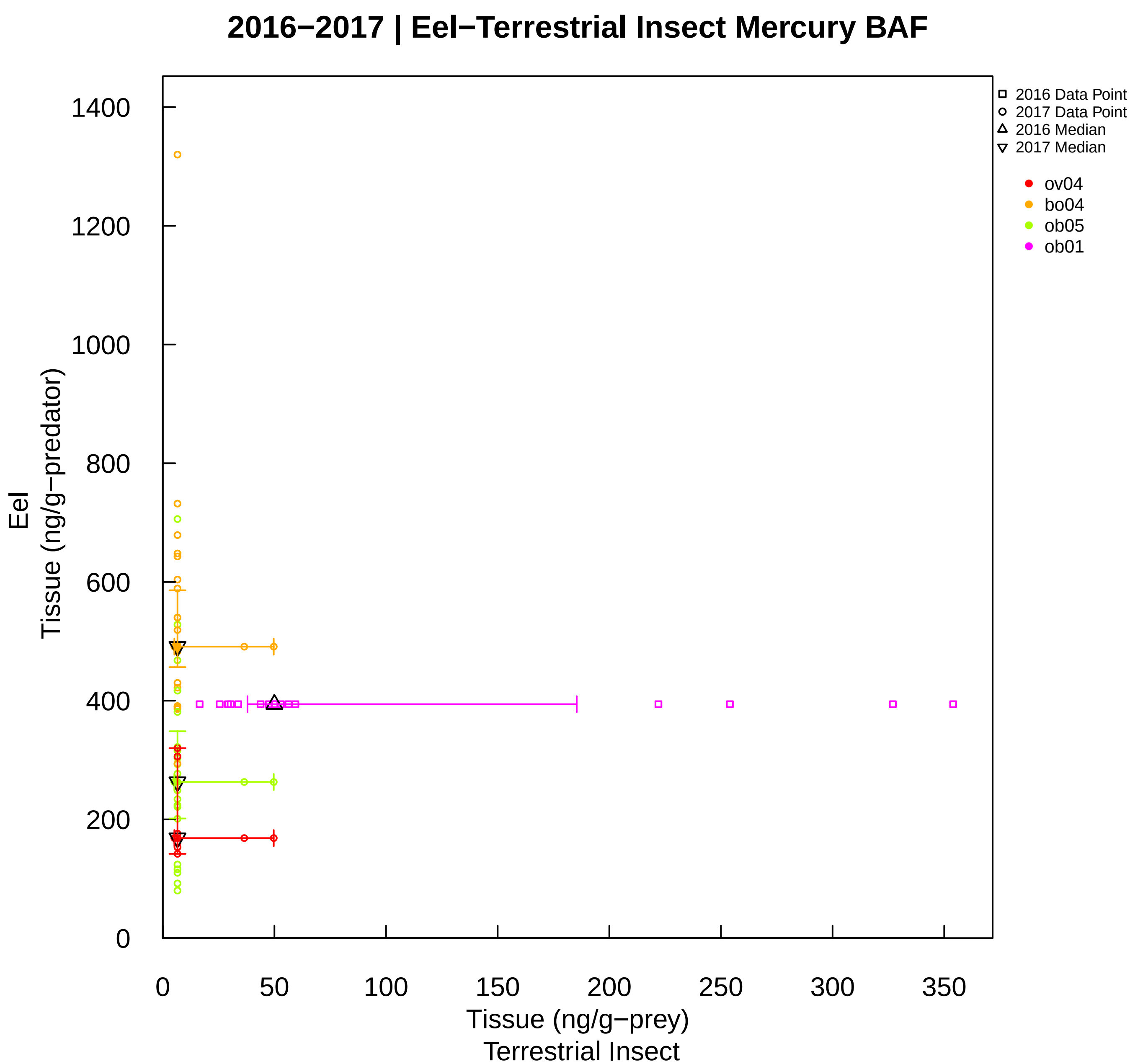

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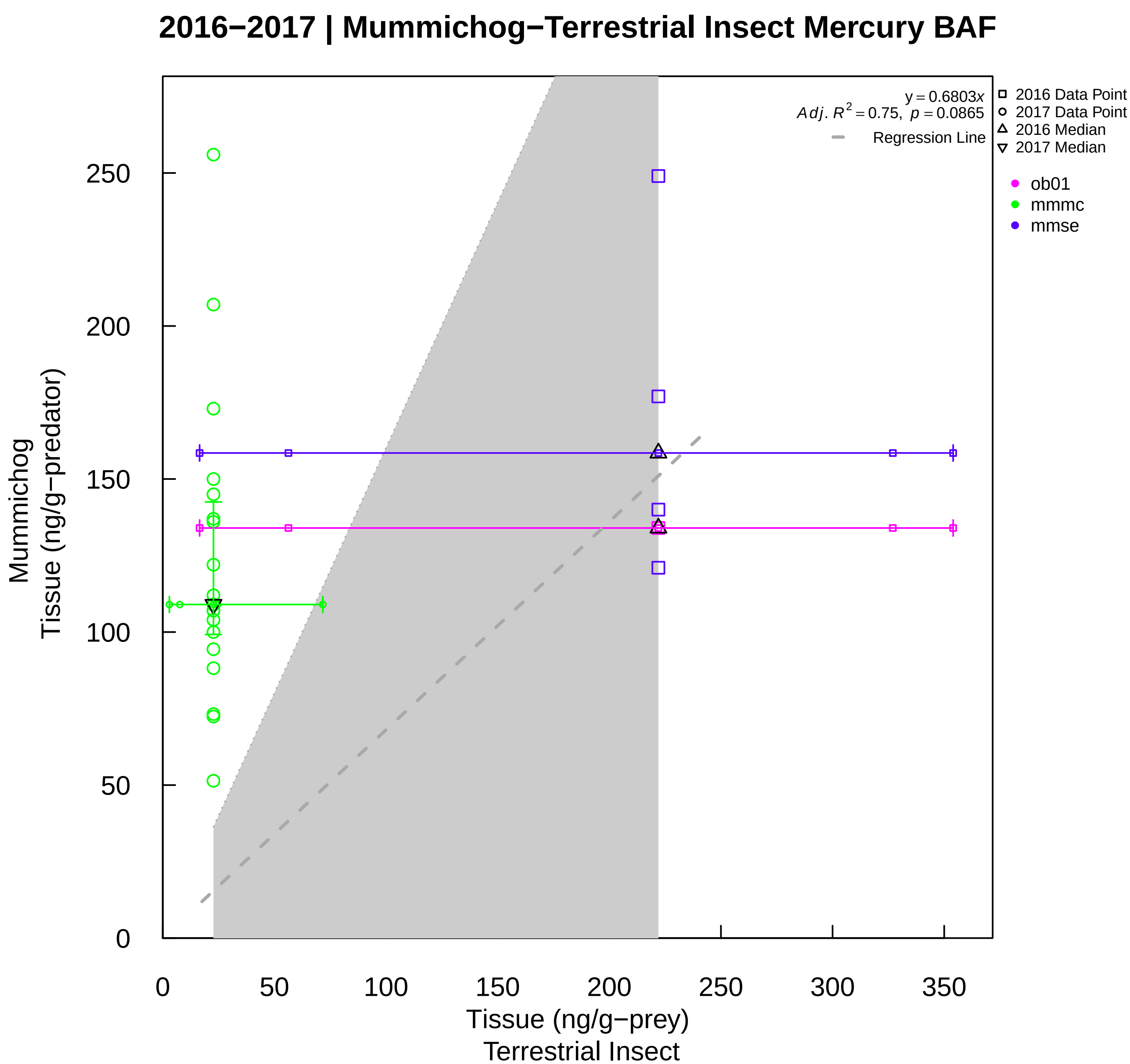

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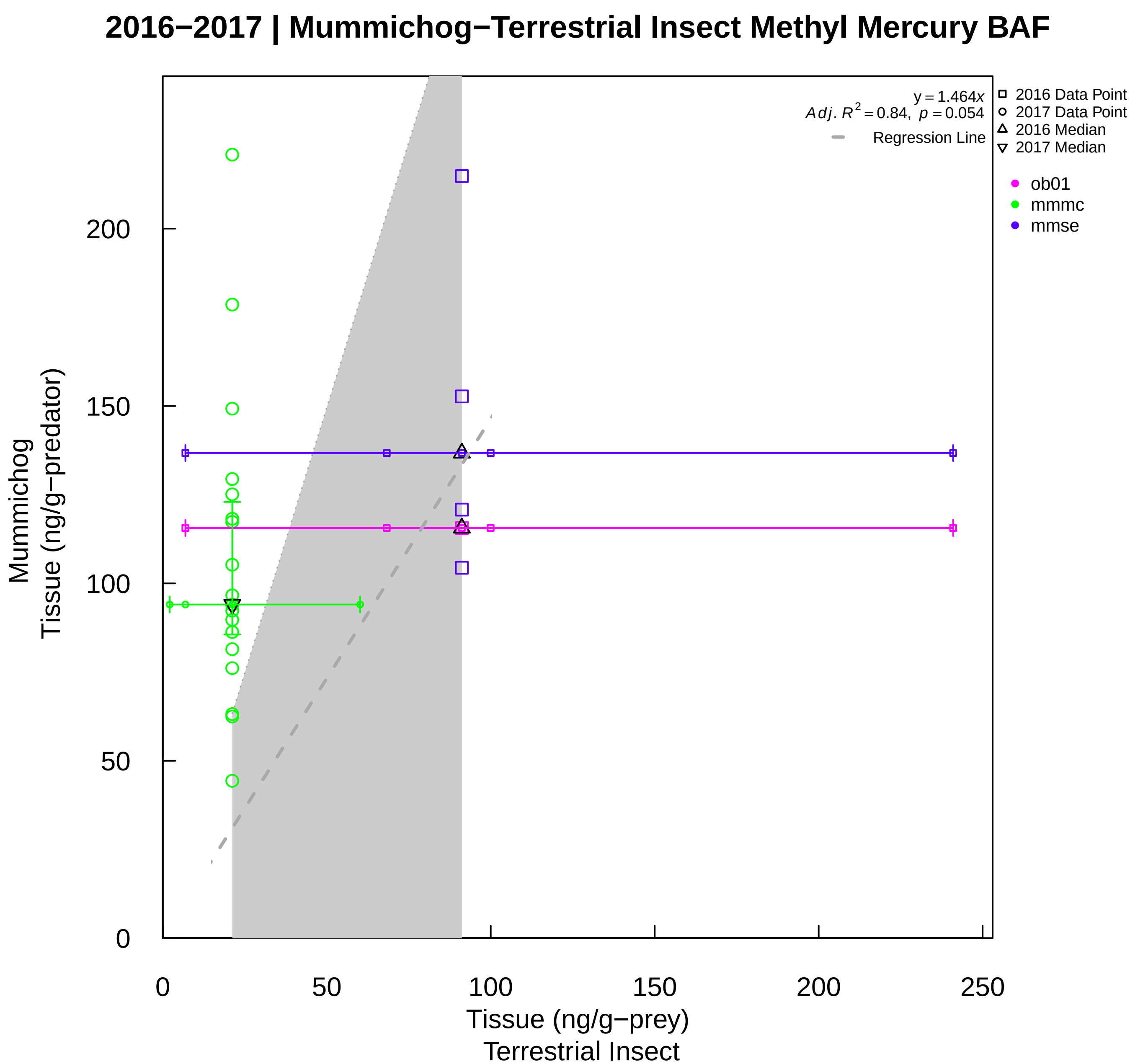

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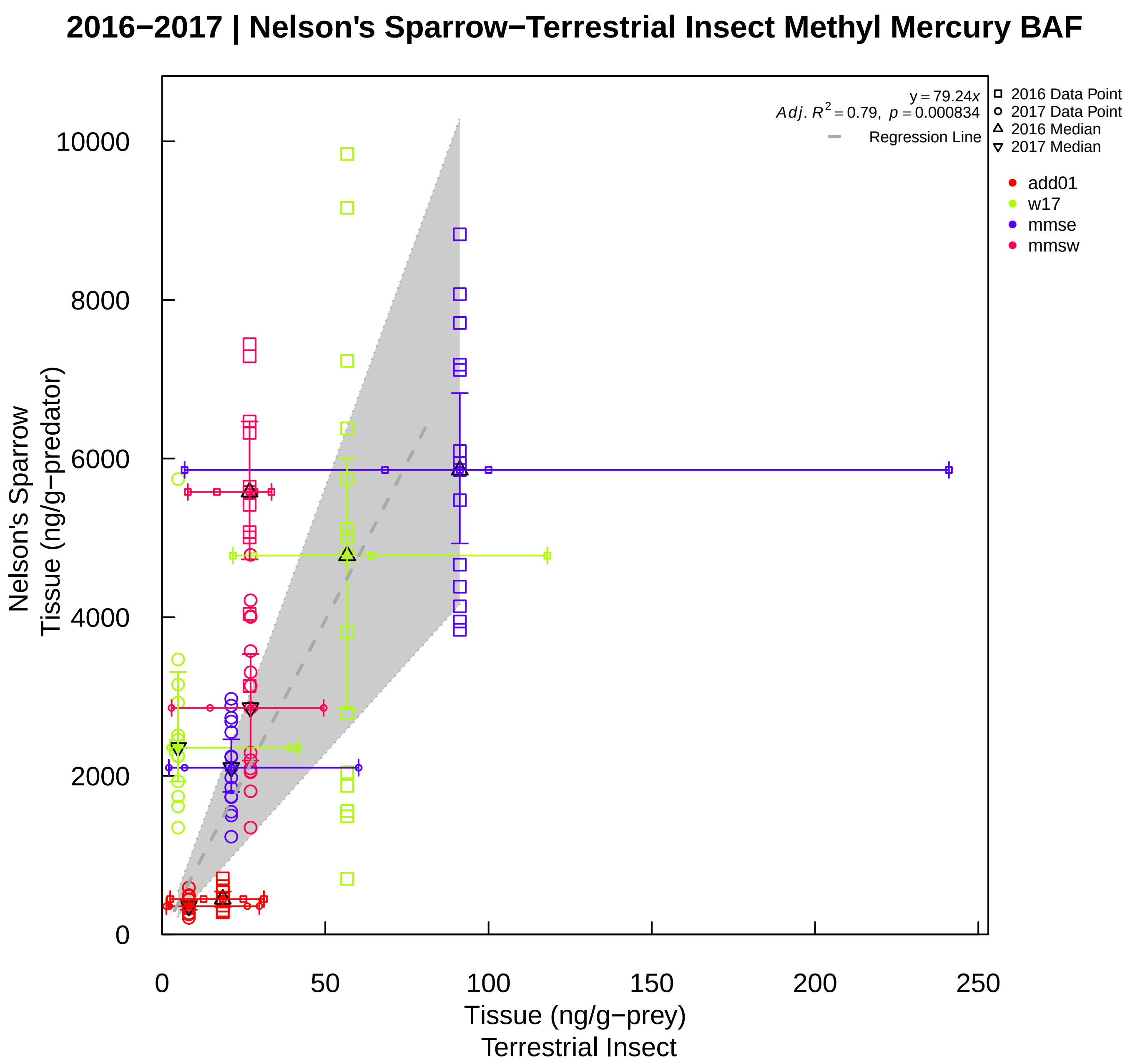
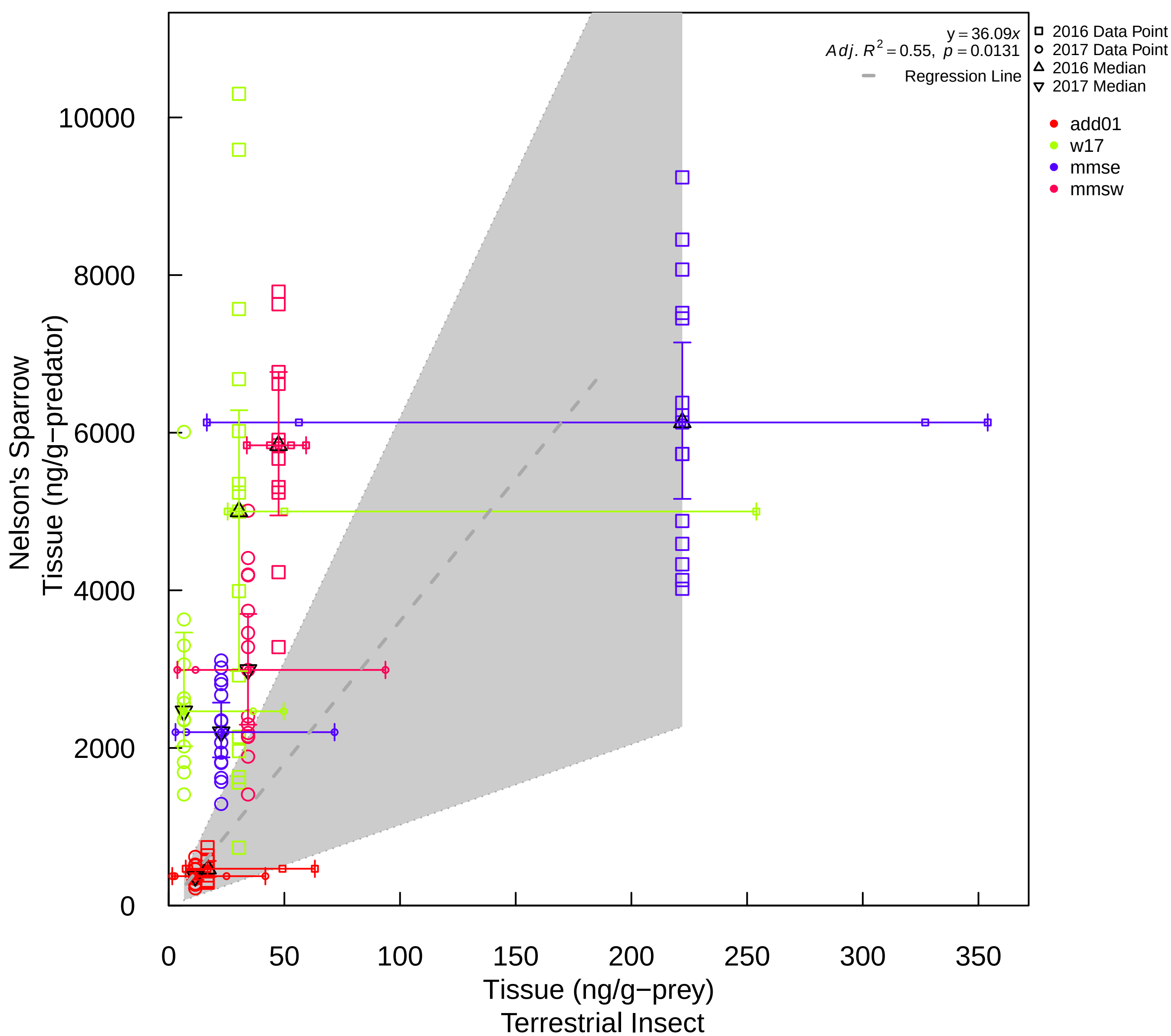


Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.

2016−2017 | Nelson's Sparrow−Terrestrial Insect Mercury BAF



Grey shaded region represents the regression 95% confidence interval.

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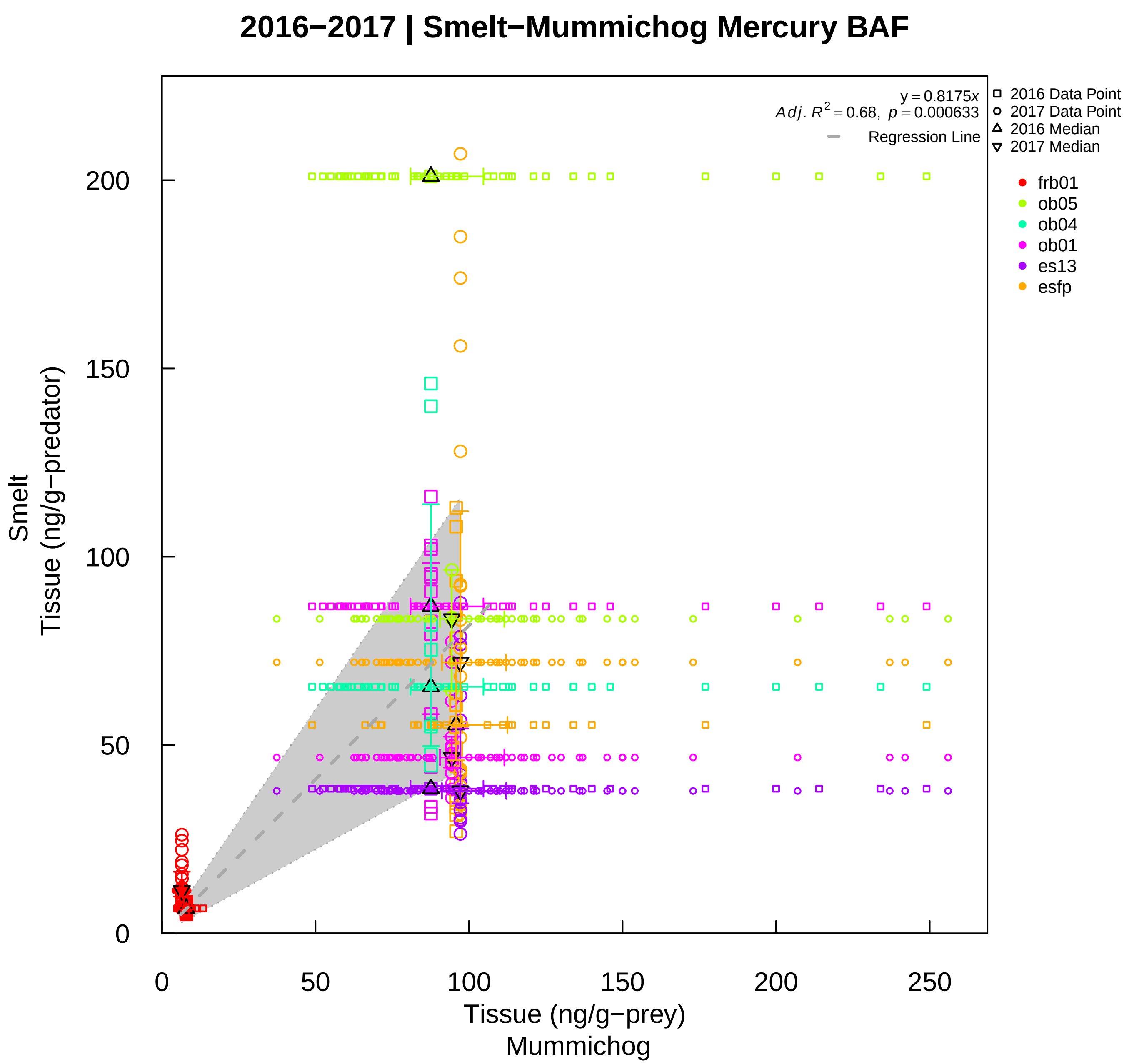

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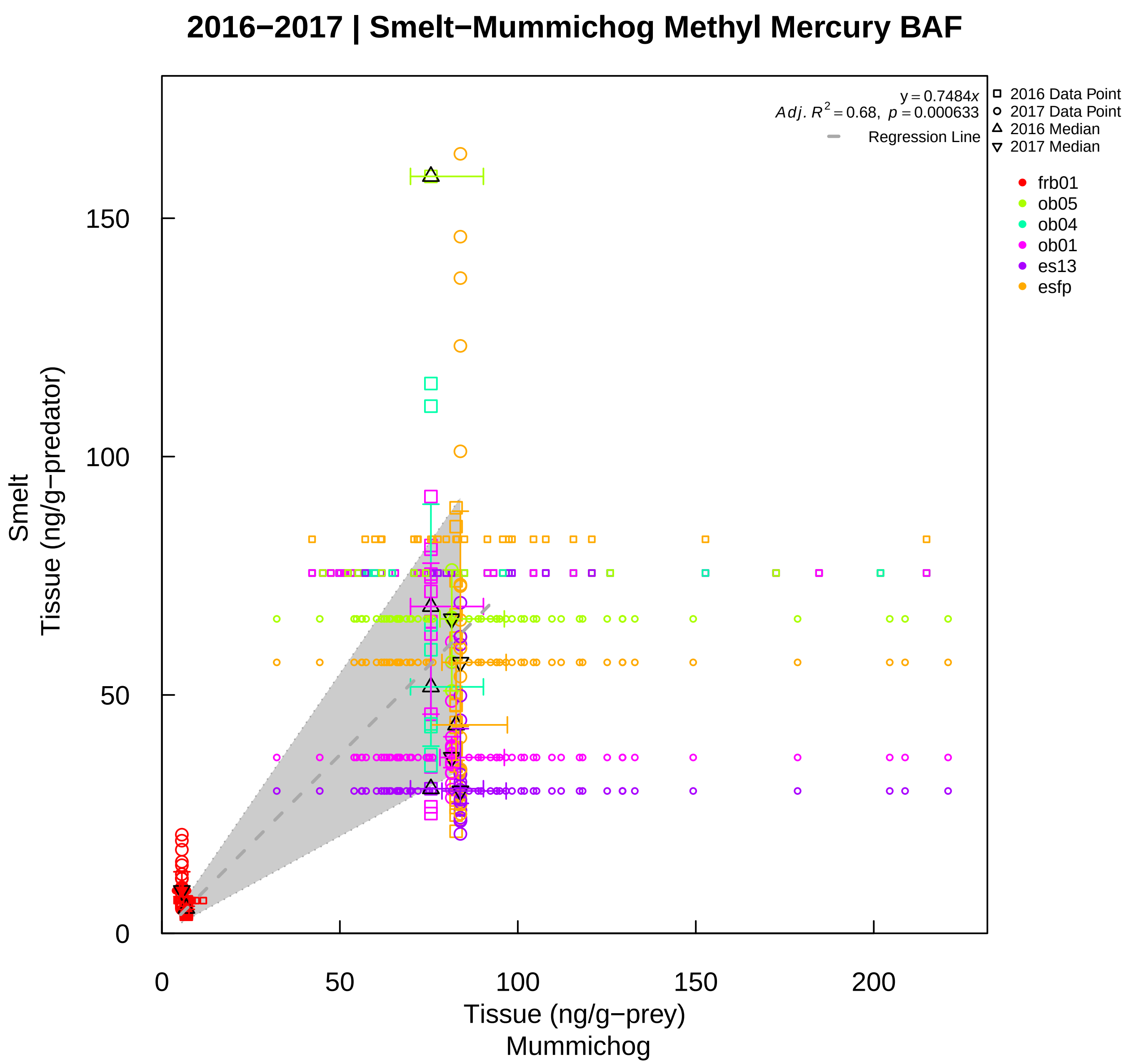
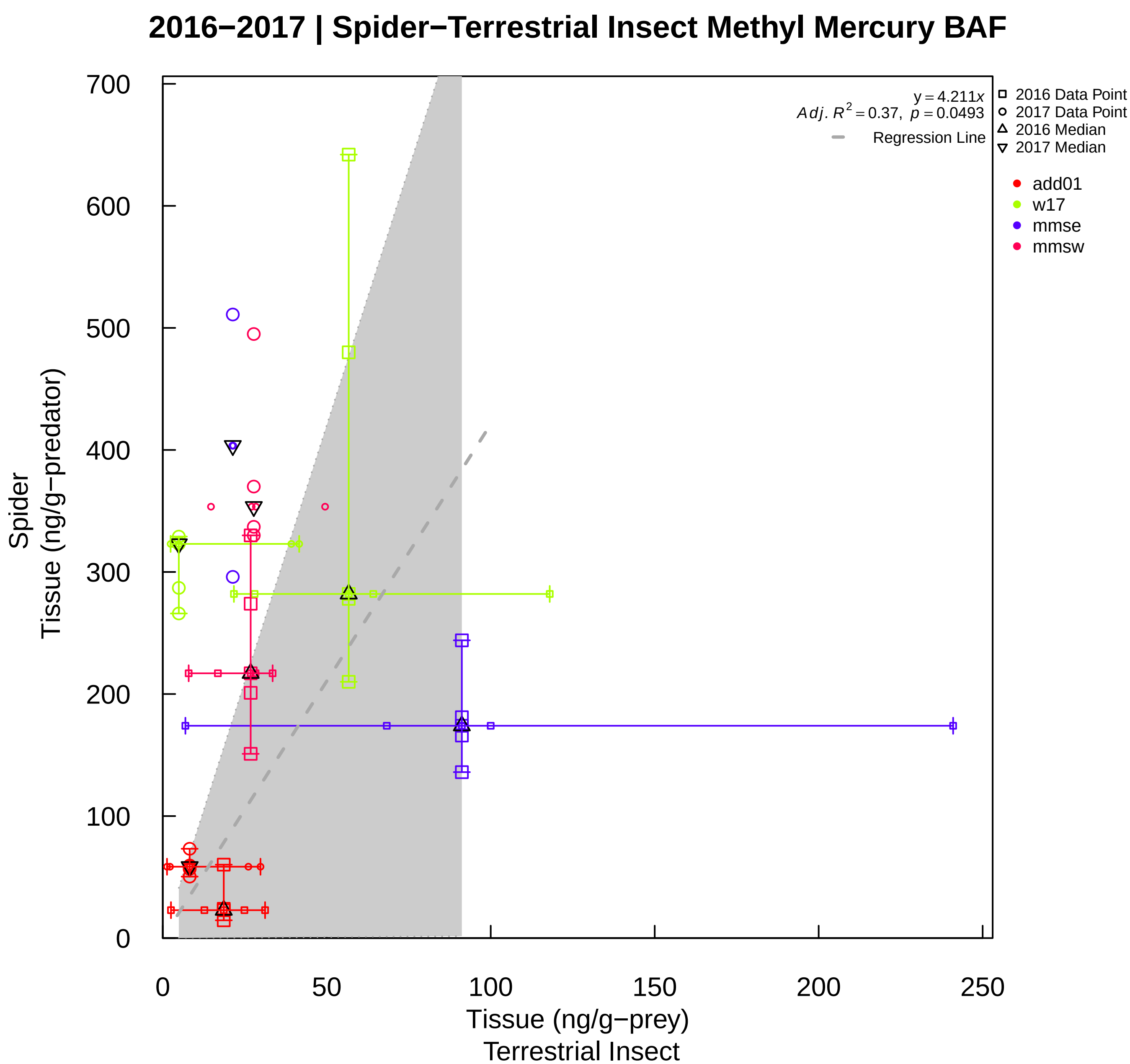
*-Indicates regression on outlier-free data.



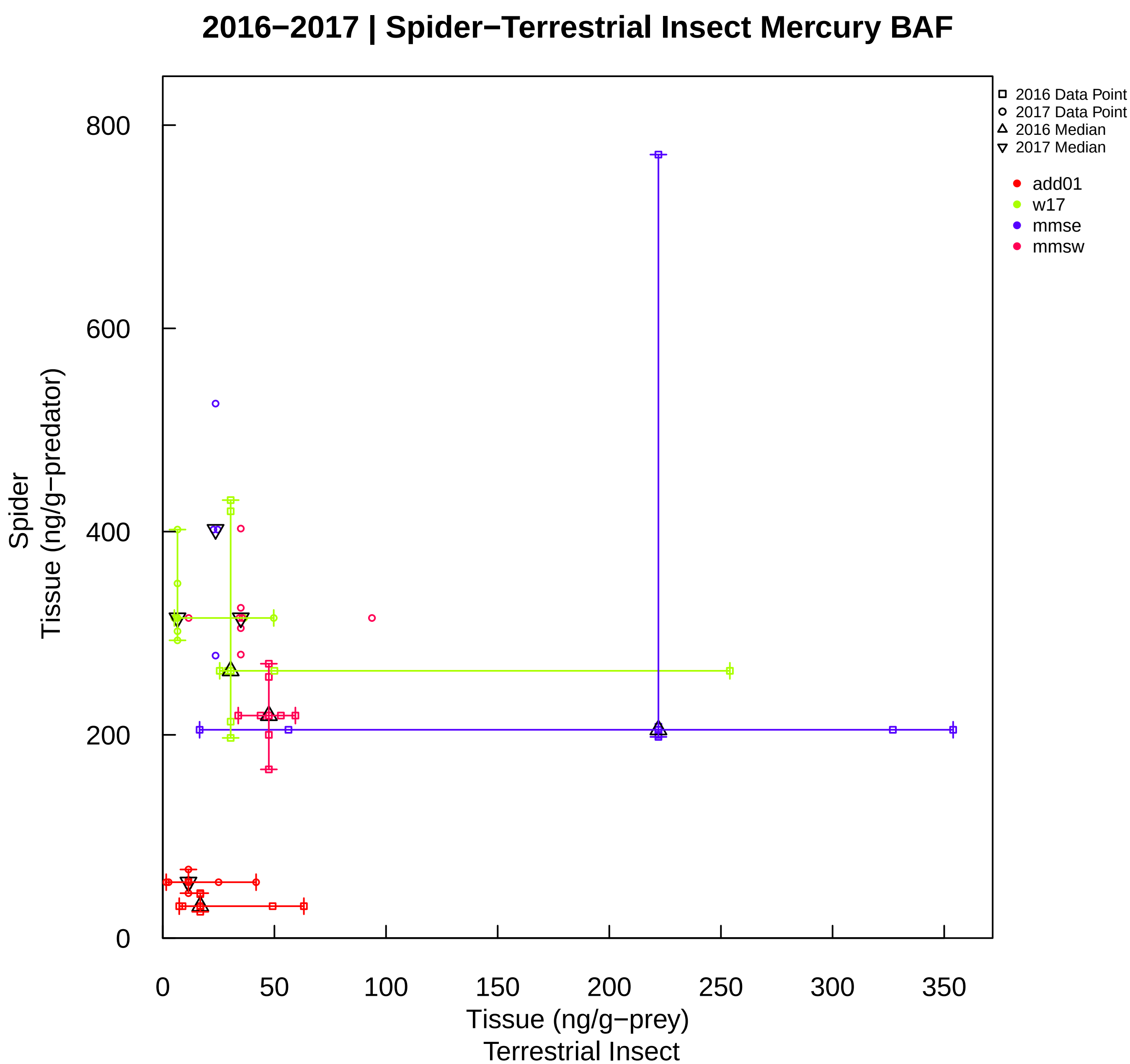
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



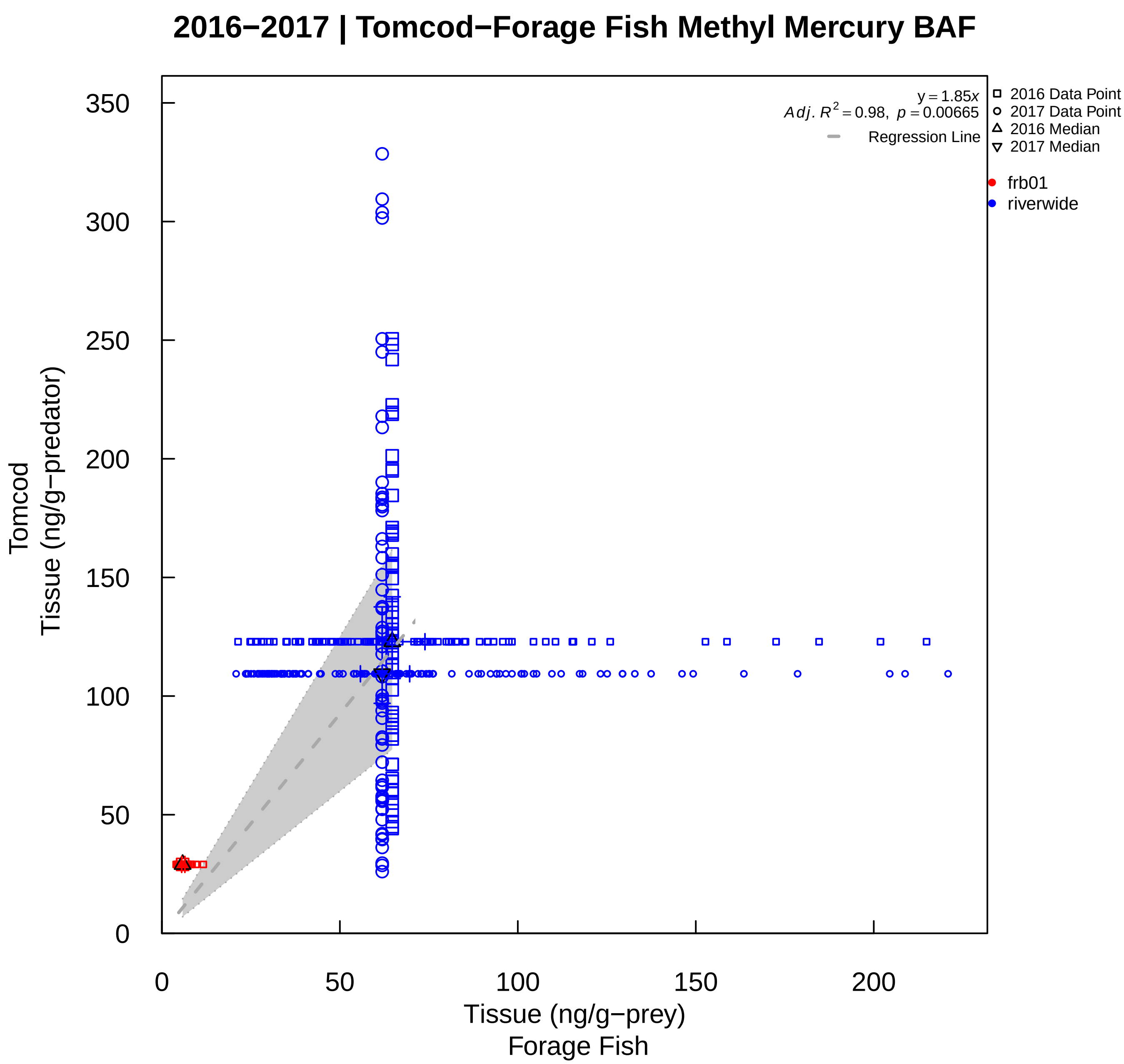
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



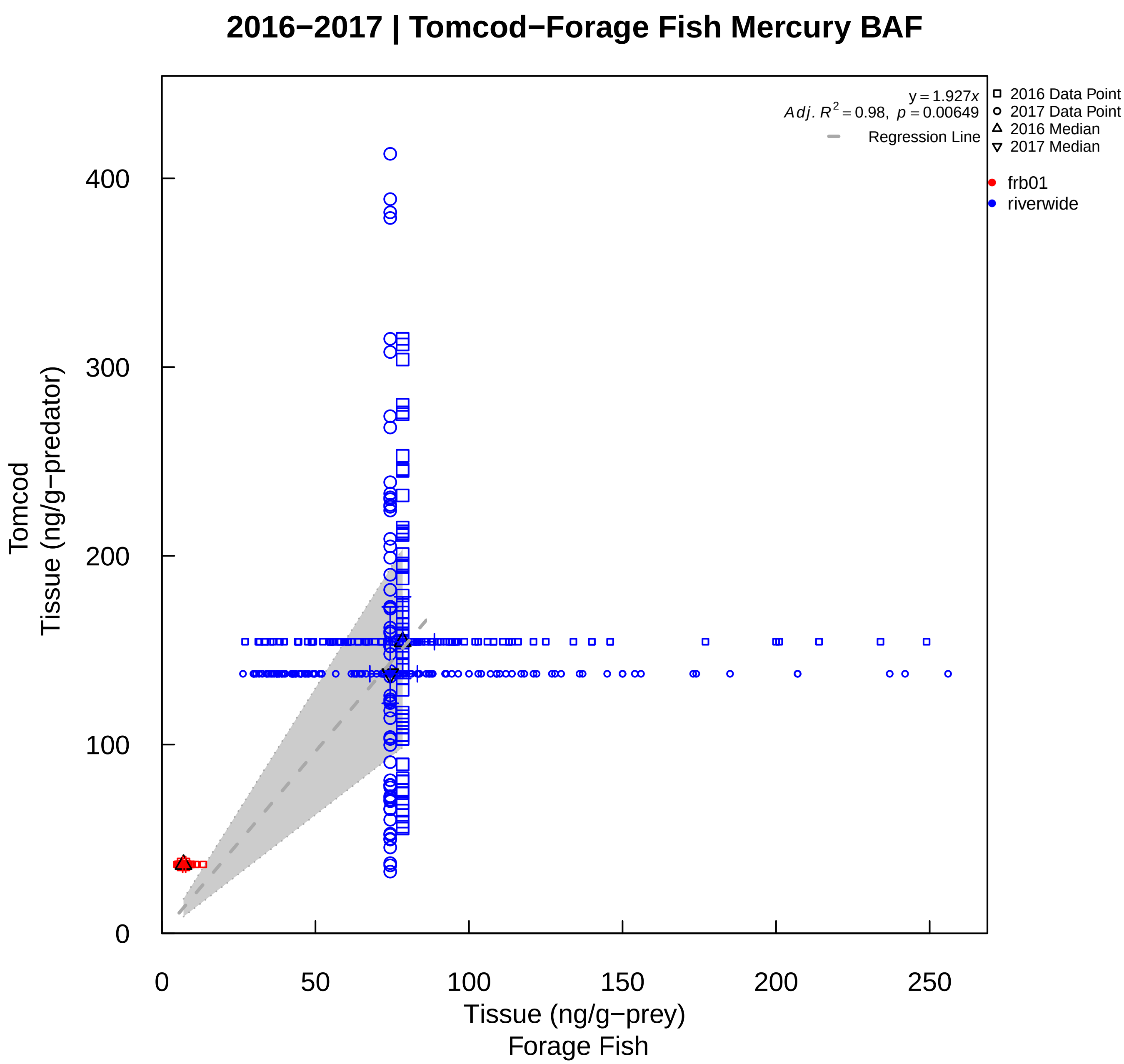
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

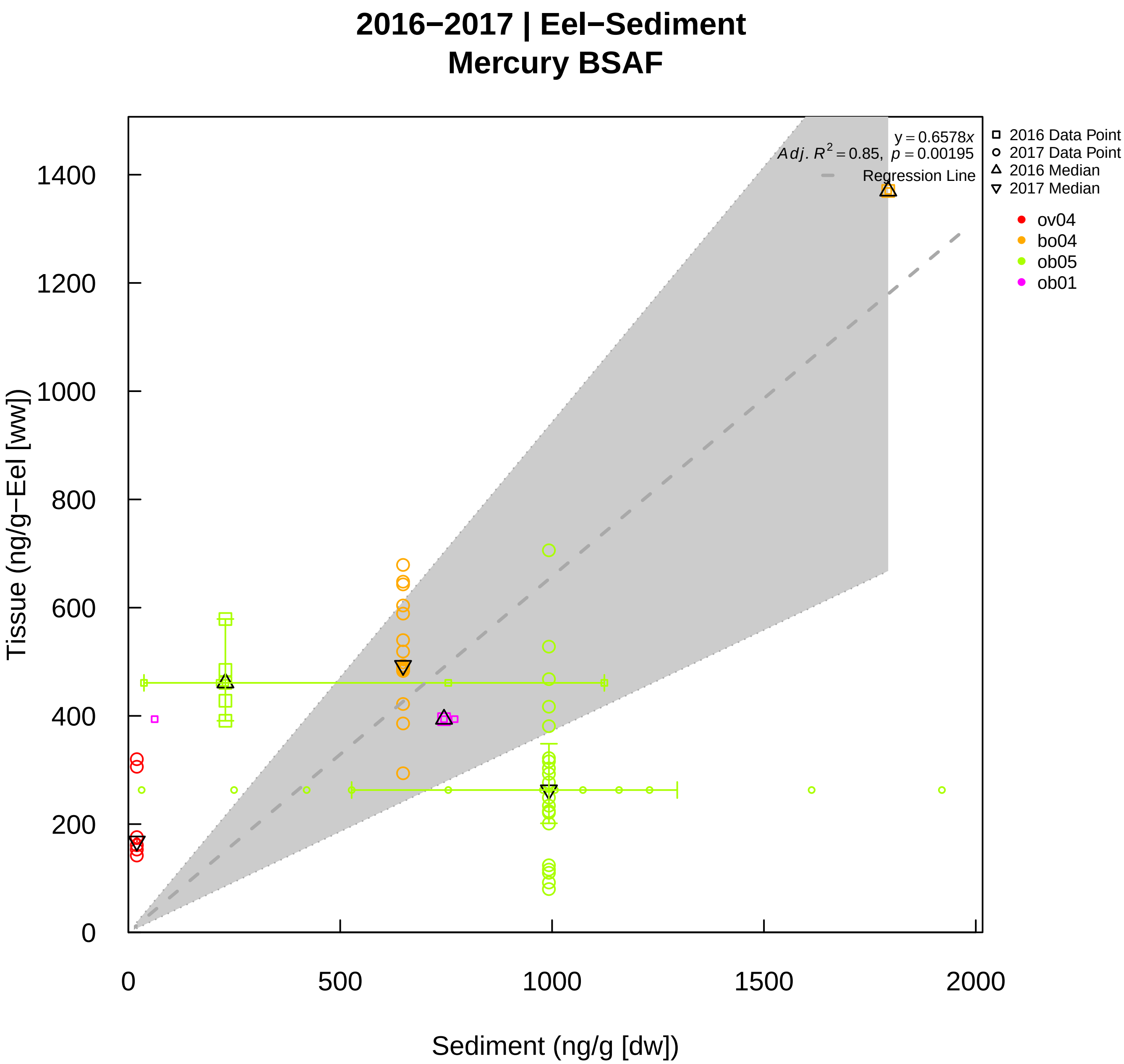
*-Indicates regression on outlier-free data.

SUMMARY OF BAF LINEAR REGRESSION MODEL RESULTS WITH EXTREME VALUES PRESENT

		Linear Regression Model Summary			
BAF Pair [1] (Predator-Prey)	**Parameter**	**estimate**	**std.error**	**p.value**	**adj.r.squared**
Eel-Mummichog	Mercury	5.8	2.6	0.092	0.44
Eel-Mummichog	Methyl Mercury	5.9	2.7	0.092	0.44
Eel-Polychaetes	Mercury	3.8	1.2	0.024	0.61
Eel-Polychaetes	Methyl Mercury	41	16	0.053	0.47
Eel-Smelt	Mercury	4.4	0.94	0.0055	0.78
Eel-Smelt	Methyl Mercury	4.9	1	0.0055	0.78
Eel-Terrestrial Insect	Mercury	9.8	5.5	0.17	0.35
Eel-Terrestrial Insect	Methyl Mercury	13	7	0.16	0.38
Eel-ForageFish	Mercury	6.1	2.2	0.042	0.51
Eel-ForageFish	Methyl Mercury	6.6	2.3	0.038	0.53
Mummichog-Terrestrial Insect	Mercury	0.68	0.21	0.087	0.75
Mummichog-Terrestrial Insect	Methyl Mercury	1.5	0.35	0.054	0.84
Nelson's Sparrow-Terrestrial Insect	Mercury	36	11	0.013	0.55
Nelson's Sparrow-Terrestrial Insect	Methyl Mercury	79	14	0.00083	0.79
Smelt-Mummichog	Mercury	0.82	0.17	0.00063	0.68
Smelt-Mummichog	Methyl Mercury	0.75	0.15	0.00063	0.68
Spider-Terrestrial Insect	Mercury	1.6	1	0.15	0.16
Spider-Terrestrial Insect	Methyl Mercury	4.2	1.8	0.049	0.37
Tomcod-Forage Fish	Mercury	1.9	0.16	0.0065	0.98
Tomcod-Forage Fish	Methyl Mercury	1.8	0.15	0.0066	0.98

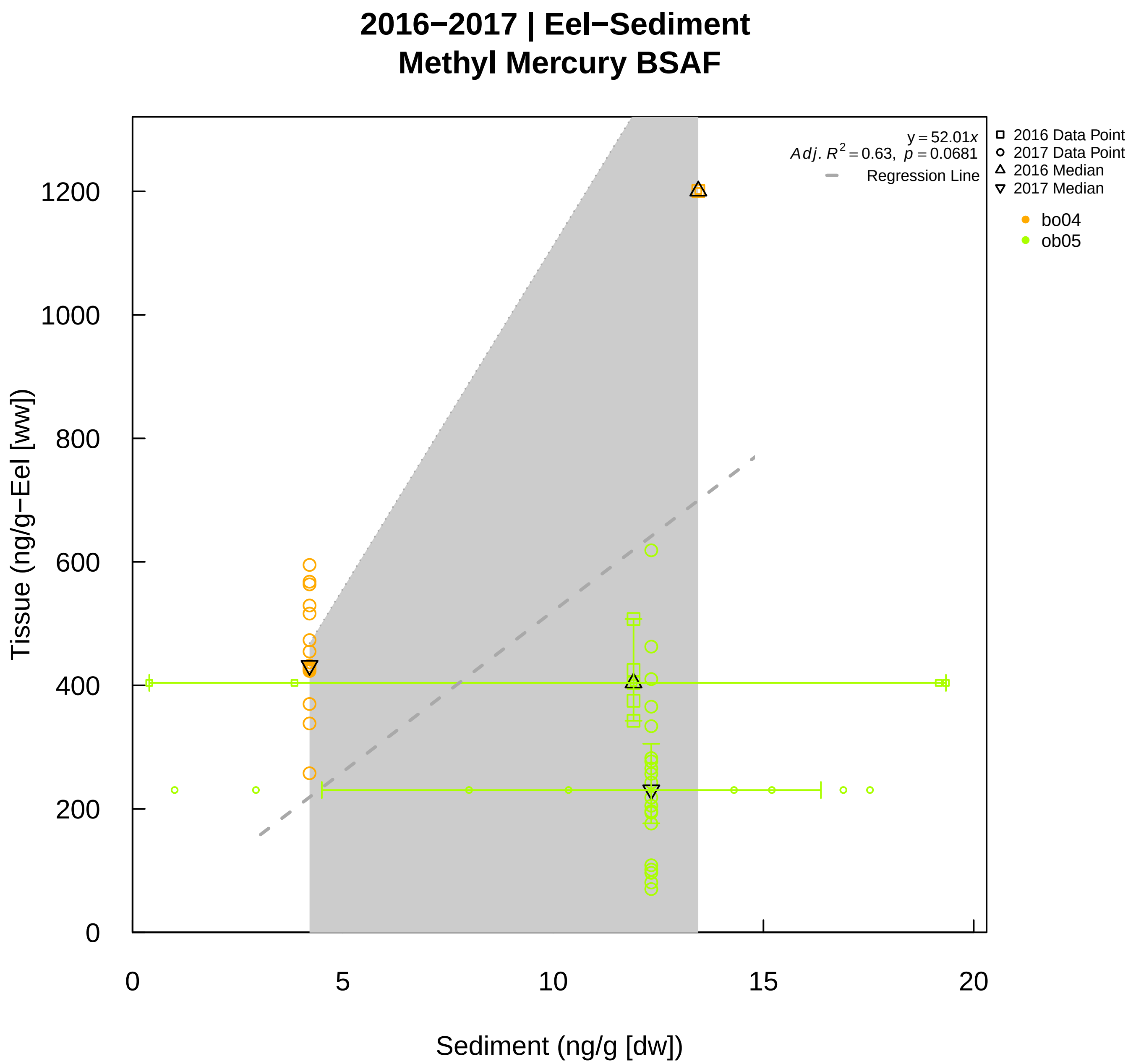
Notes:
1 Paired biota samples (Predator-Prey) collected 2016 - 2017, unless indicated otherwise.
2 Paired biota samples (Predator-Prey) collected in 2009.
3 Paired biota samples (Predator-Prey) collected in 2015.
4 Paired biota samples (Predator-Prey) collected in 2017.
5 -- indicates regression model not applicable (sample size < 2).
6 Highlighted cells indicate:

p-value < 0.05; statistically significant	0.049
0.10 > p-value ≥ 0.05; approaching significance	0.08
p-value > 0.10; not statistically different from zero	0.35



Grey shaded region represents the regression 95% confidence interval.

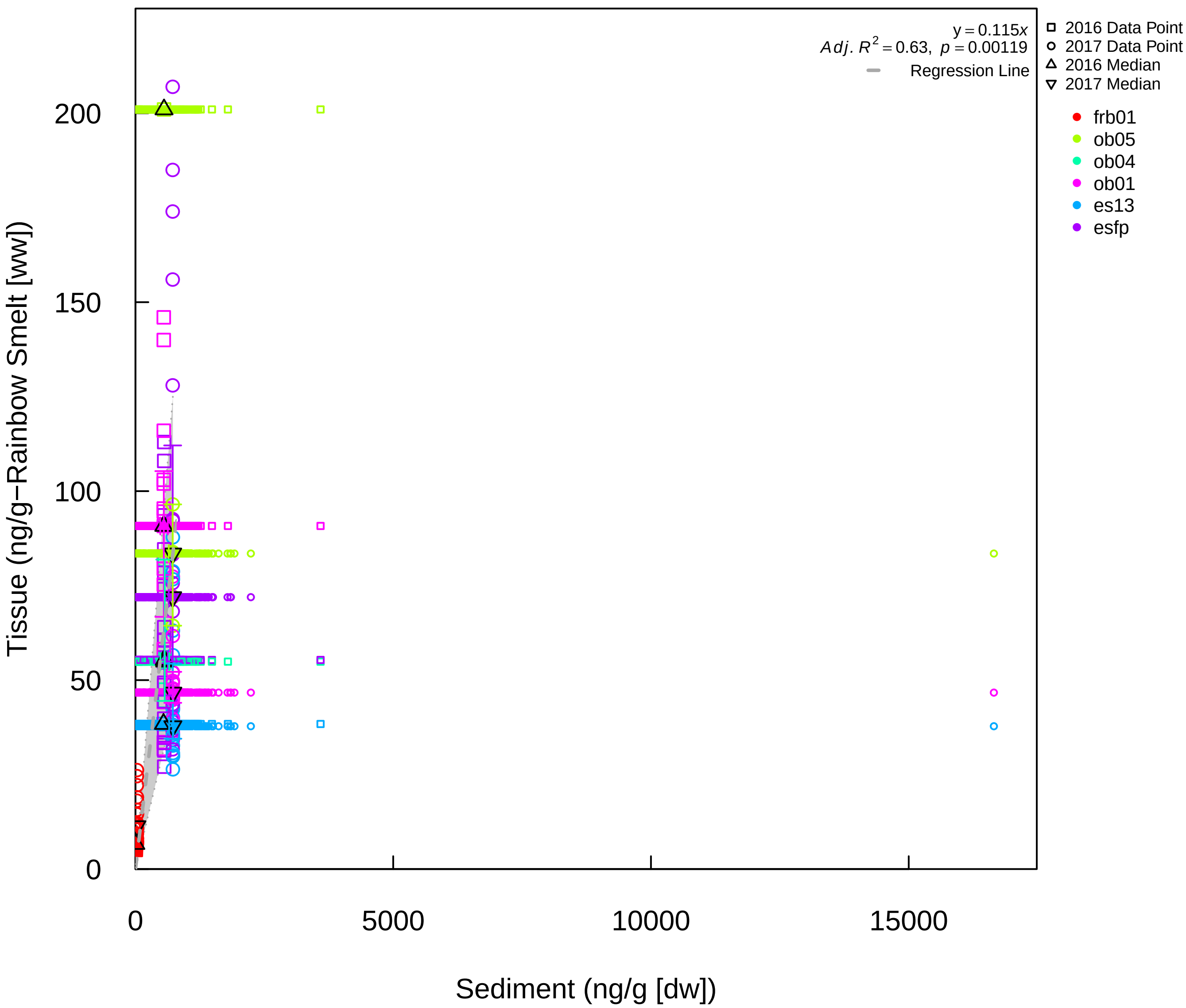
*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

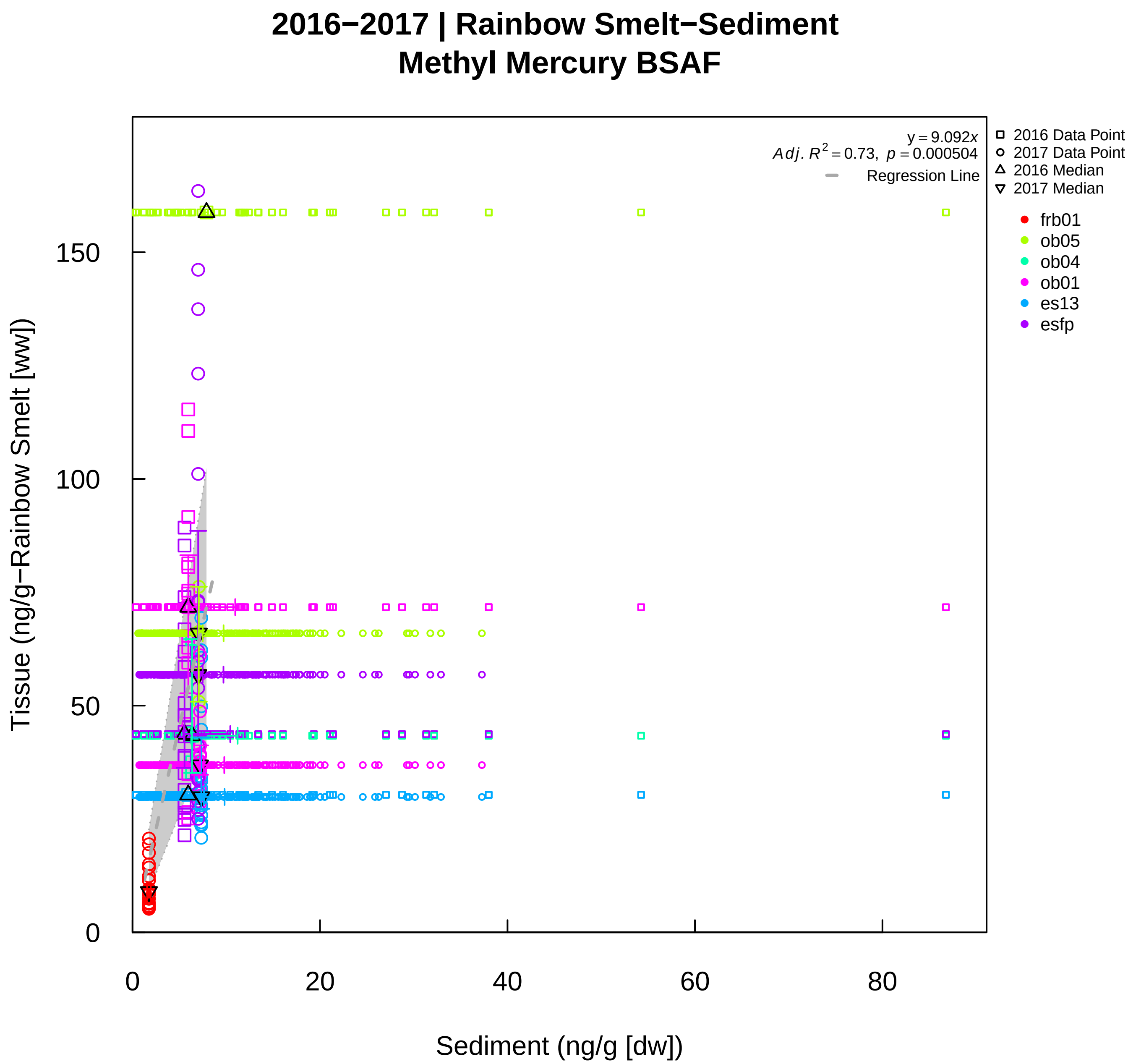
*-Indicates regression on outlier-free data.

2016−2017 | Rainbow Smelt−Sediment Mercury BSAF



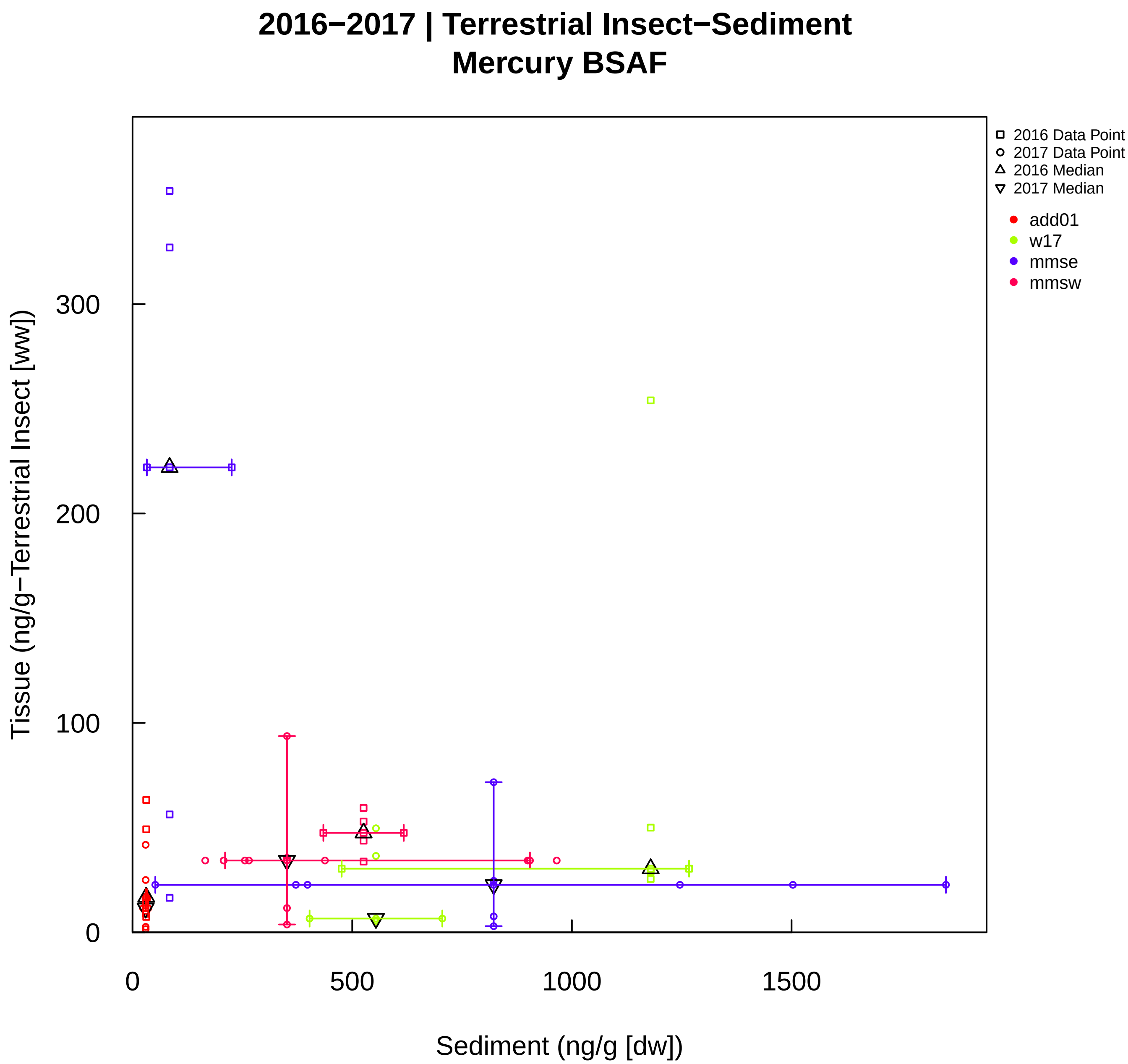
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



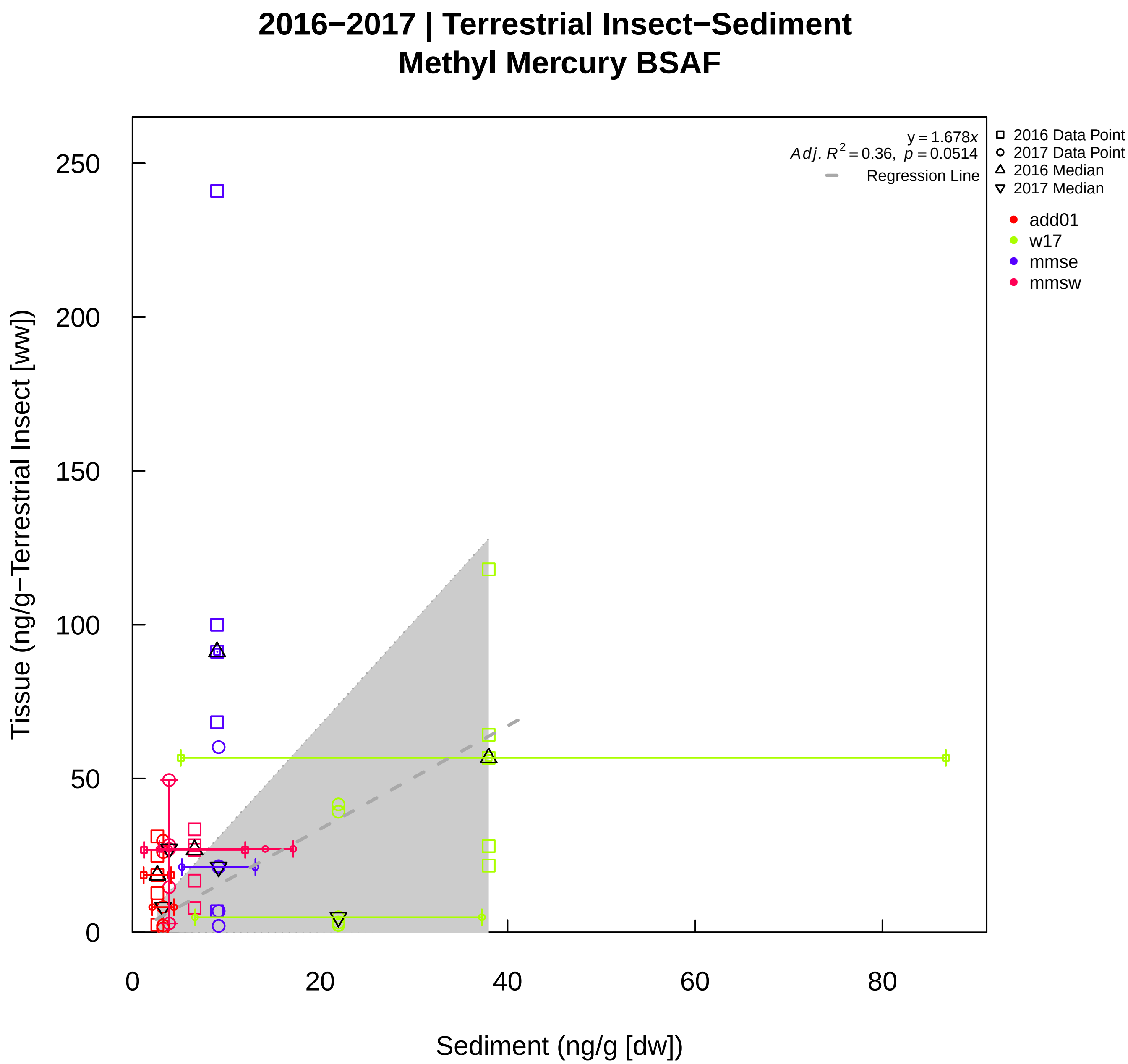
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.

SUMMARY OF BSAF LINEAR REGRESSION MODEL RESULTS WITH EXTREME VALUES PRESENT

		BSAF Linear Regression Model Summary			
Biota [1]	**Parameter**	**estimate**	**std.error**	**p.value**	**adj.r.squared**
Eel	Mercury	0.66	0.11	0.002	0.85
Eel	Methyl Mercury	52	19	0.068	0.63
Smelt	Mercury	0.12	0.026	0.0012	0.63
Smelt	Methyl Mercury	9.1	1.7	0.0005	0.73
Terrestrial Insects	Mercury	0.041	0.051	0.44	-0.044
Terrestrial Insects	Methyl Mercury	1.7	0.72	0.051	0.36

Notes:

1 Paired biota and sediment samples collected 2016 - 2017, unless indicated otherwise.

2 Paired biota and sediment samples collected in 2015.

3 Paired biota and sediment samples collected in 2016.

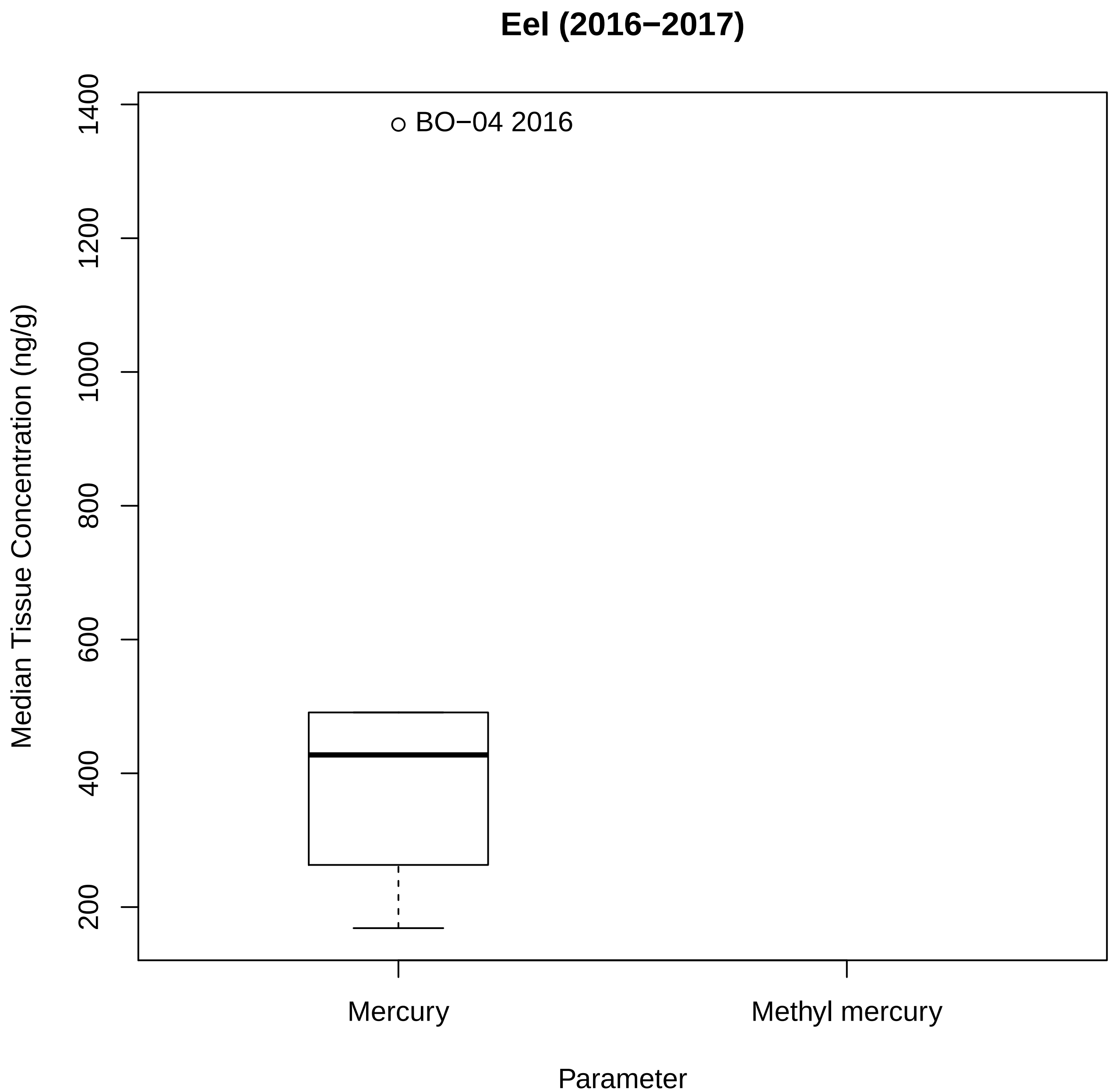
4 -- indicates regression model not applicable (sample size < 2).

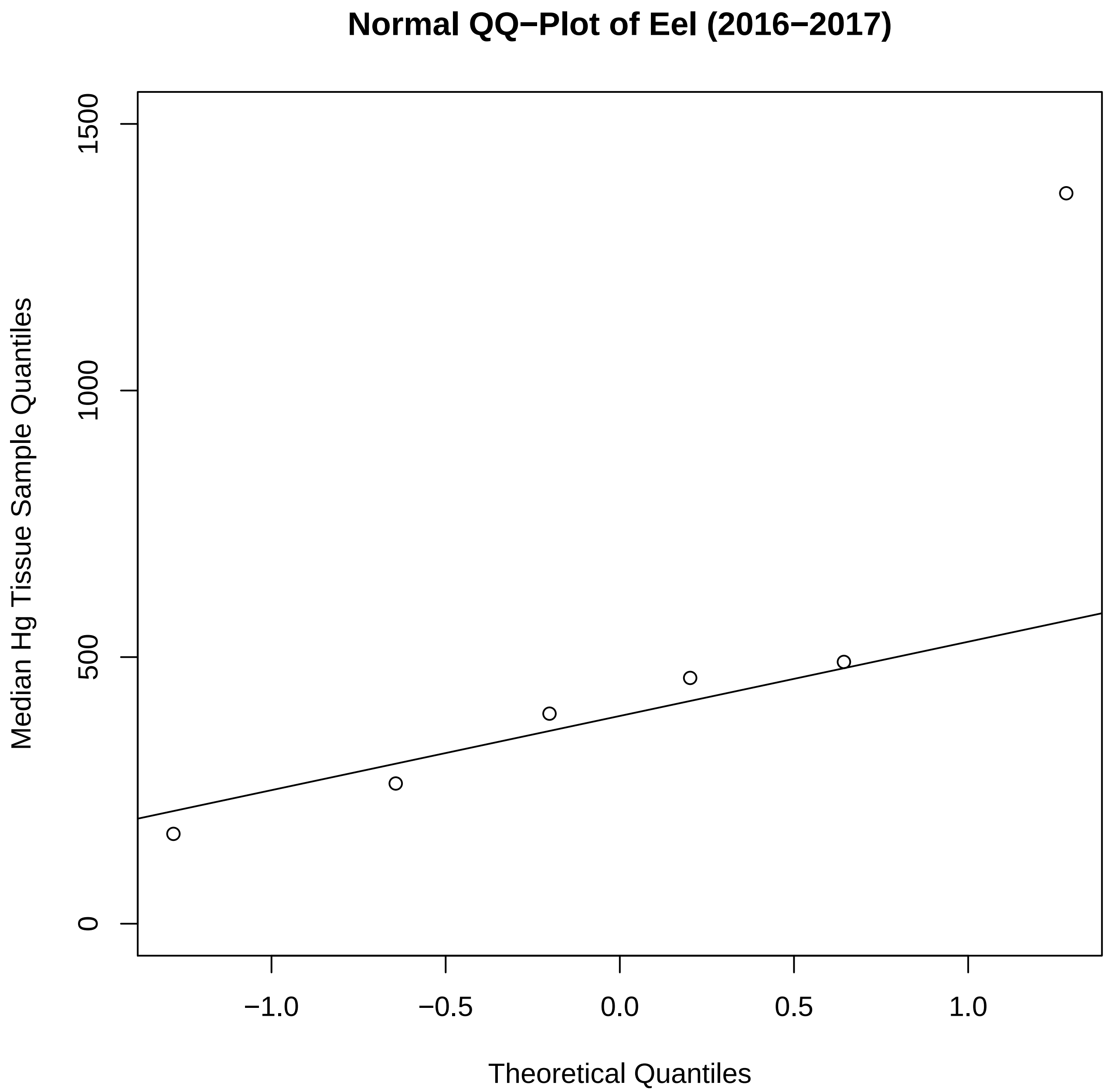
5 Highlighted cells indicate:

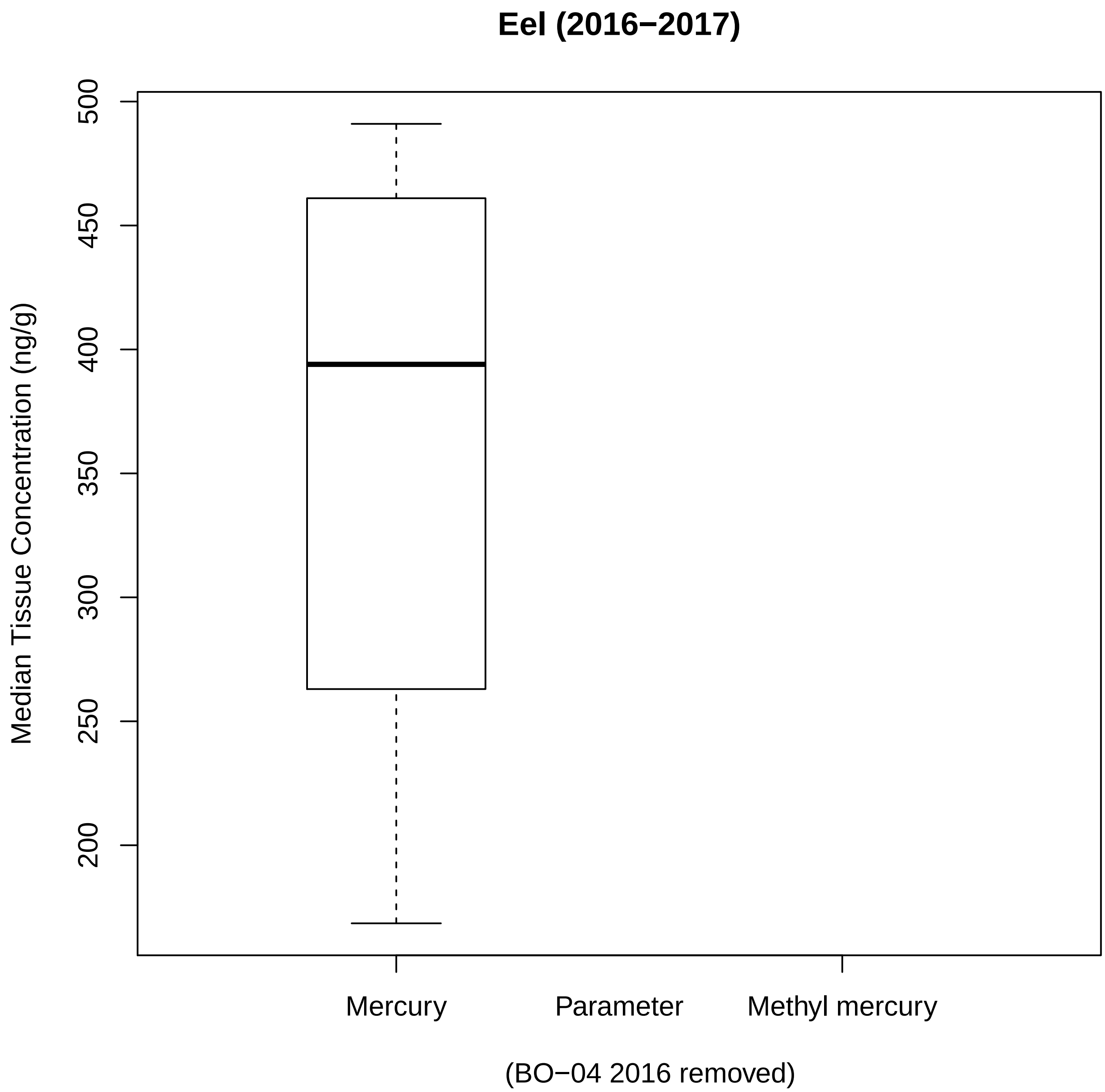
p-value < 0.05; statistically significant	0.04
0.10 > p-value ≥ 0.05; approaching significance	0.076
p-value ≥ 0.10; not statistically different from zero	0.34

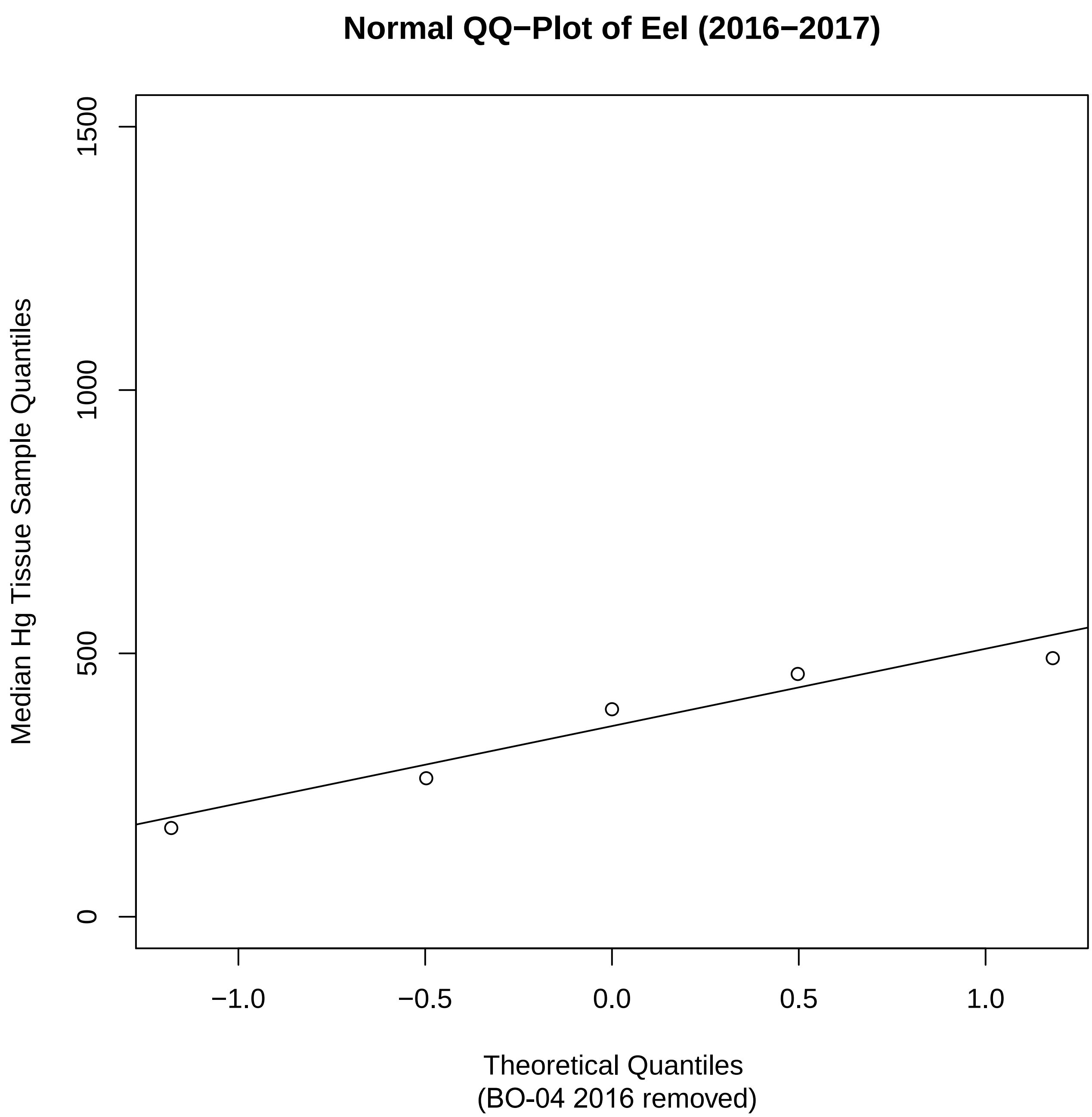
C-3

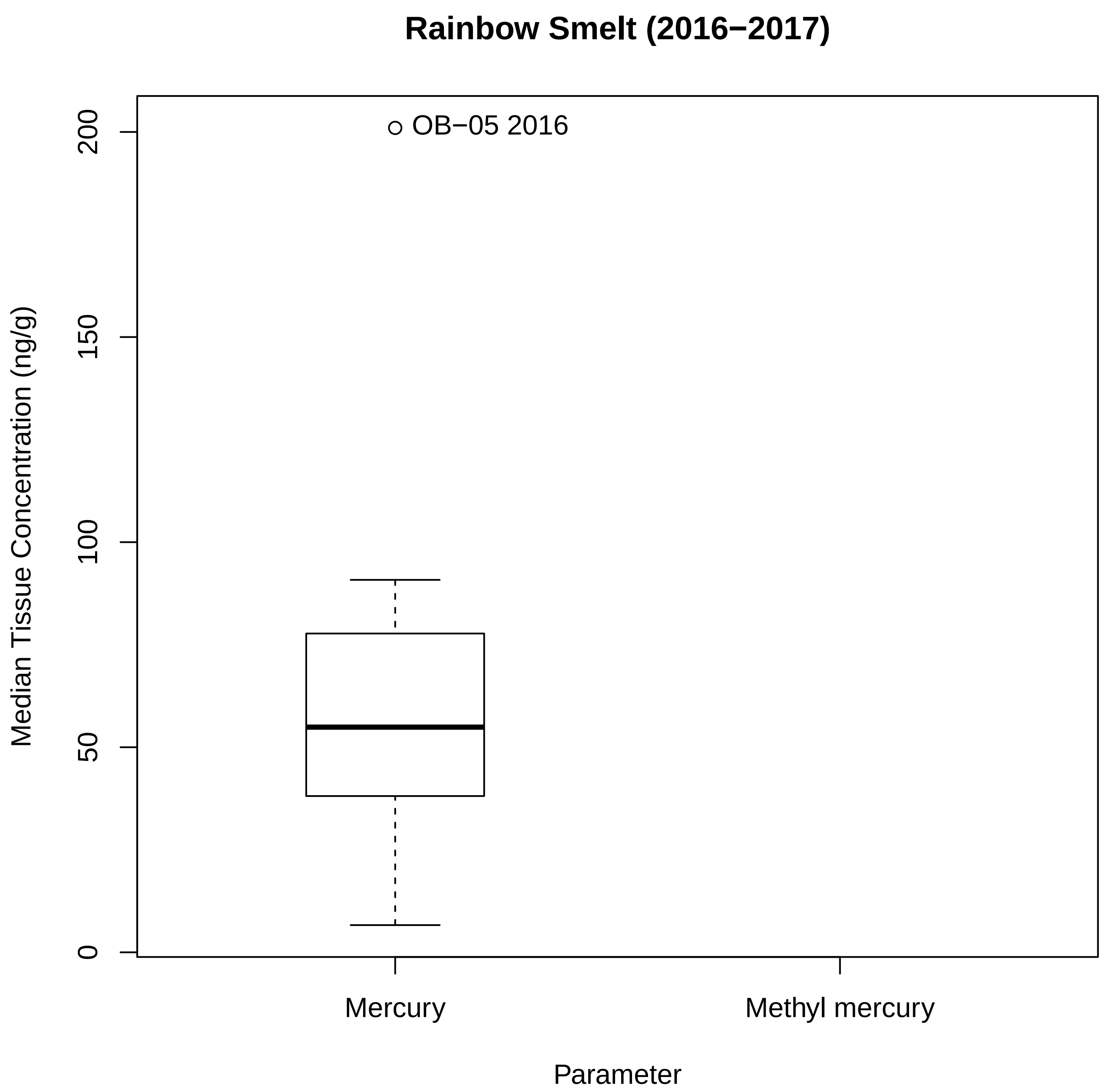
Outlier Testing

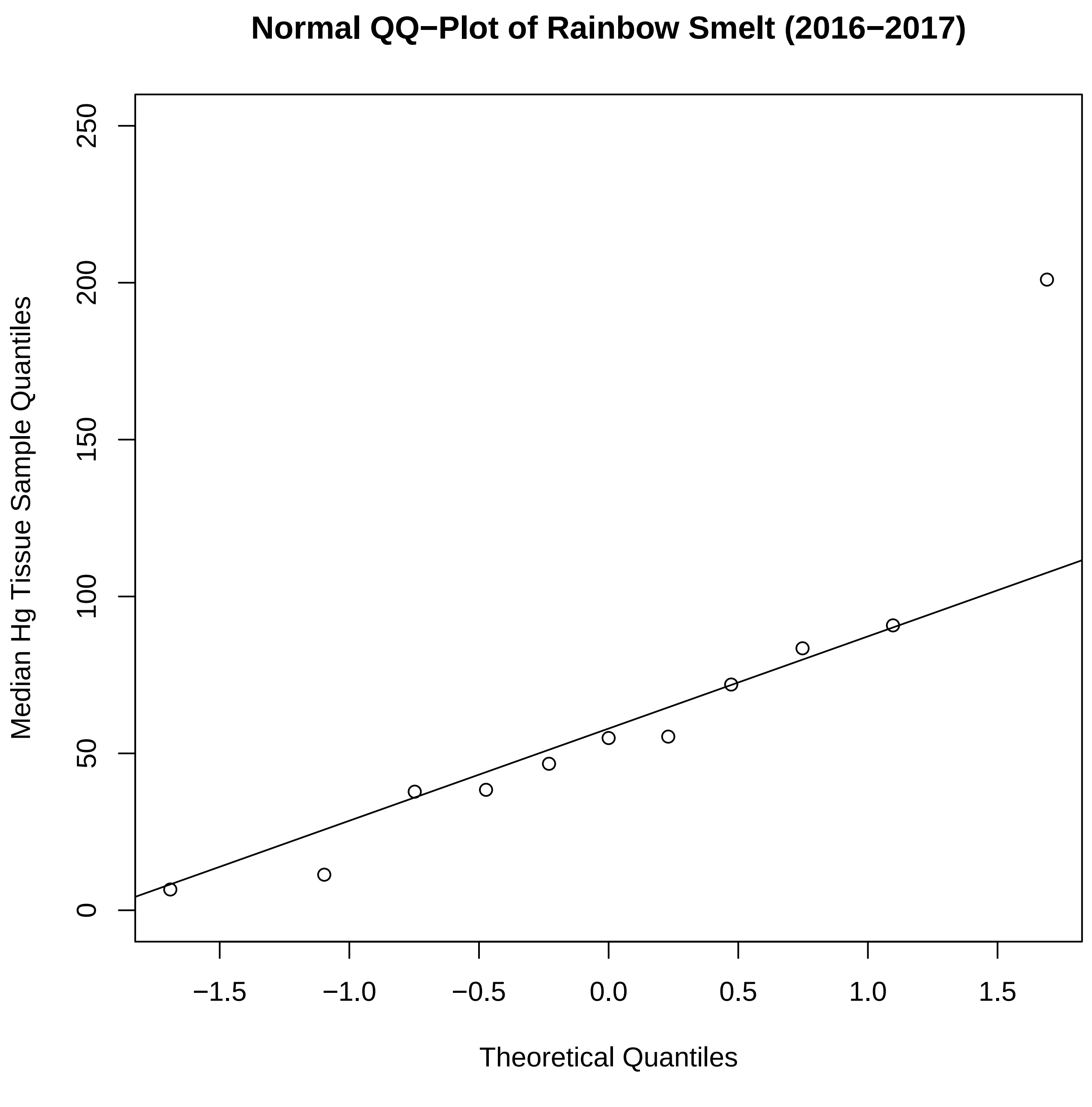

Eel (2016−2017)
Median Tissue Concentration (ng/g)
1400
1200
1000
800
600
400
200
BO−04 2016
Mercury
Methyl mercury
Parameter

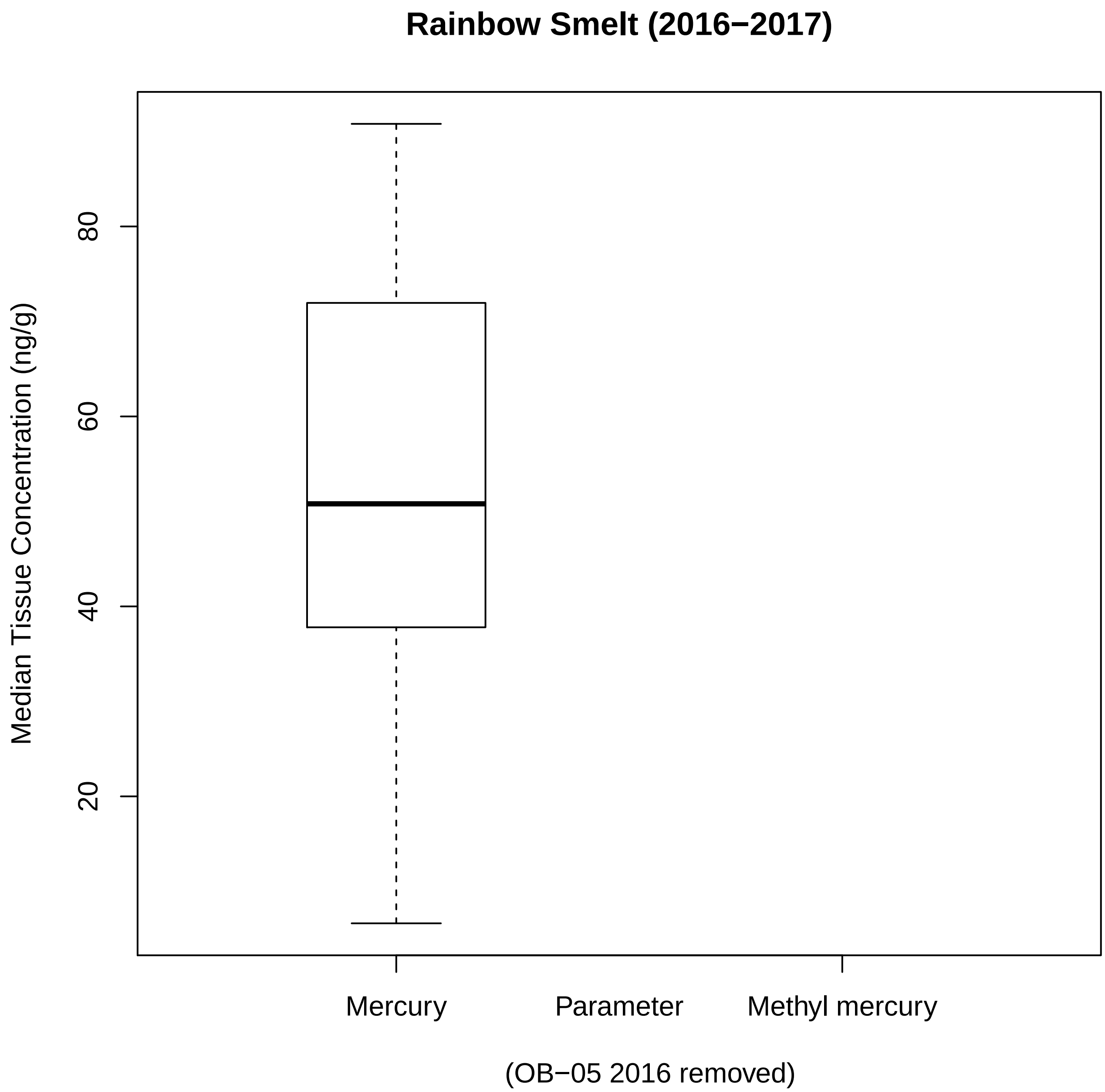

Normal QQ−Plot of Eel (2016−2017)
Median Hg Tissue Sample Quantiles
0
500
1000
1500
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles

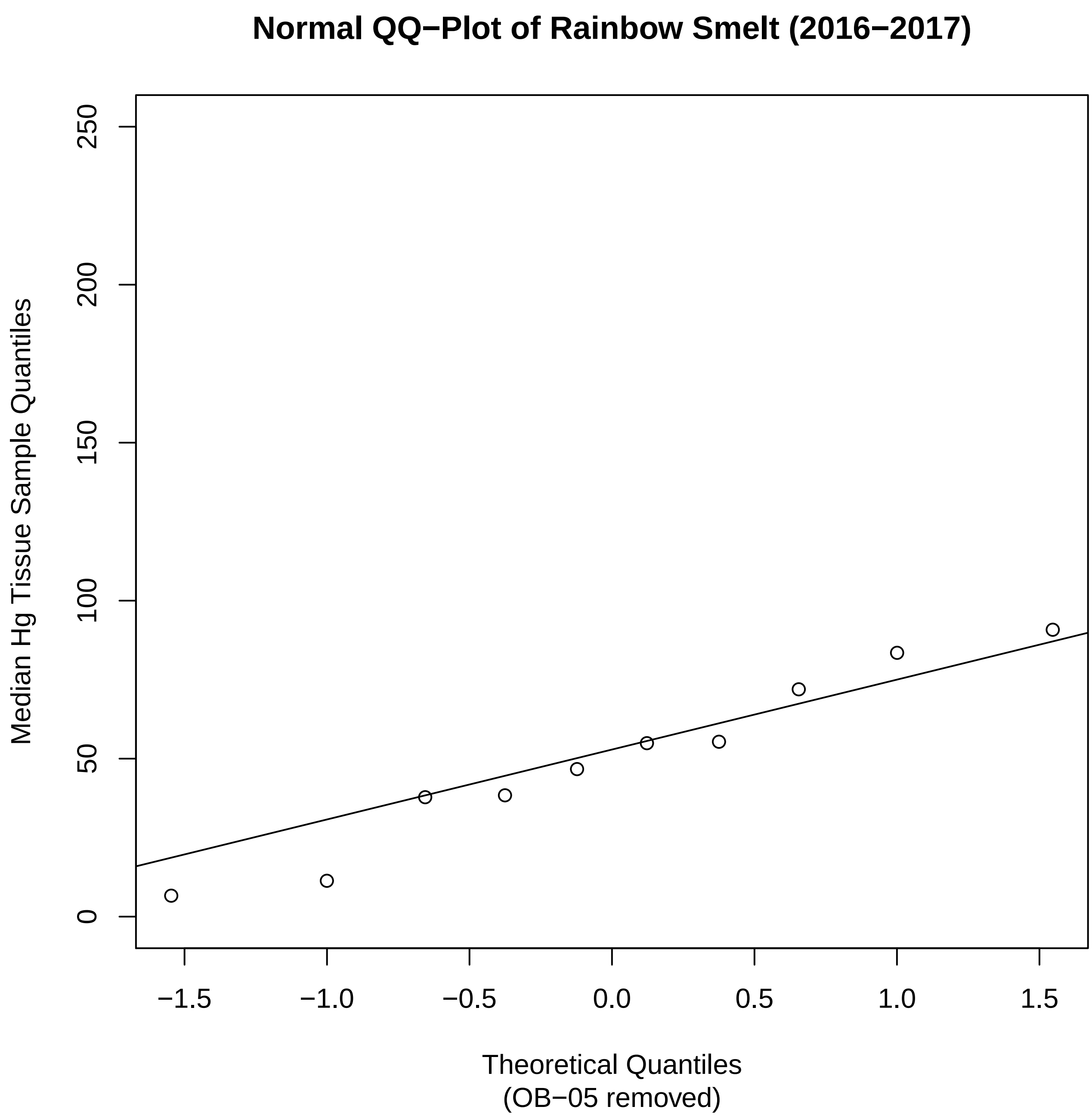

Eel (2016−2017)
Median Tissue Concentration (ng/g)
500
450
400
350
300
250
200
Mercury
Parameter
Methyl mercury
(BO−04 2016 removed)

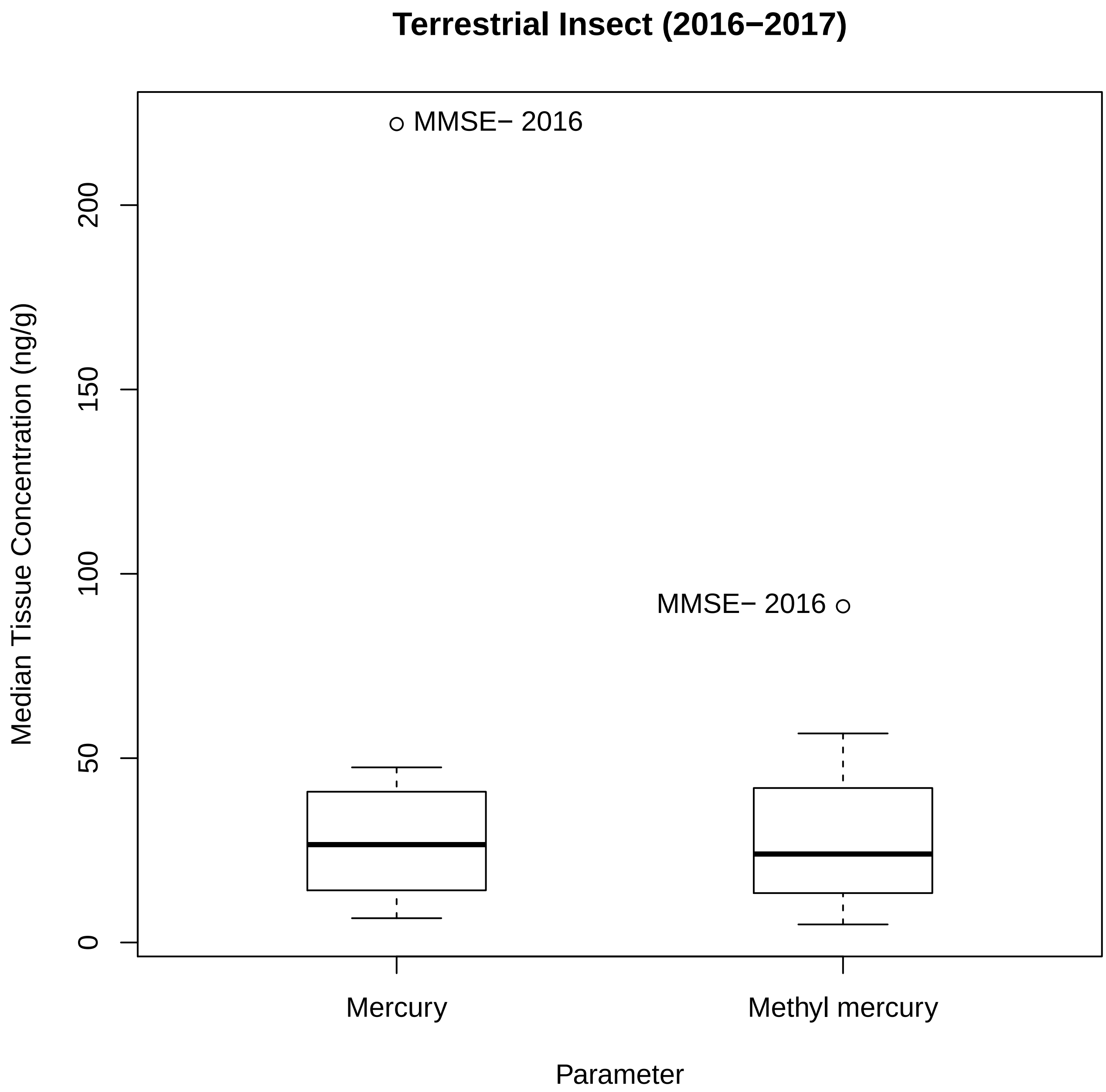

Normal QQ−Plot of Eel (2016−2017)
Median Hg Tissue Sample Quantiles
0
500
1000
1500
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles
(BO-04 2016 removed)

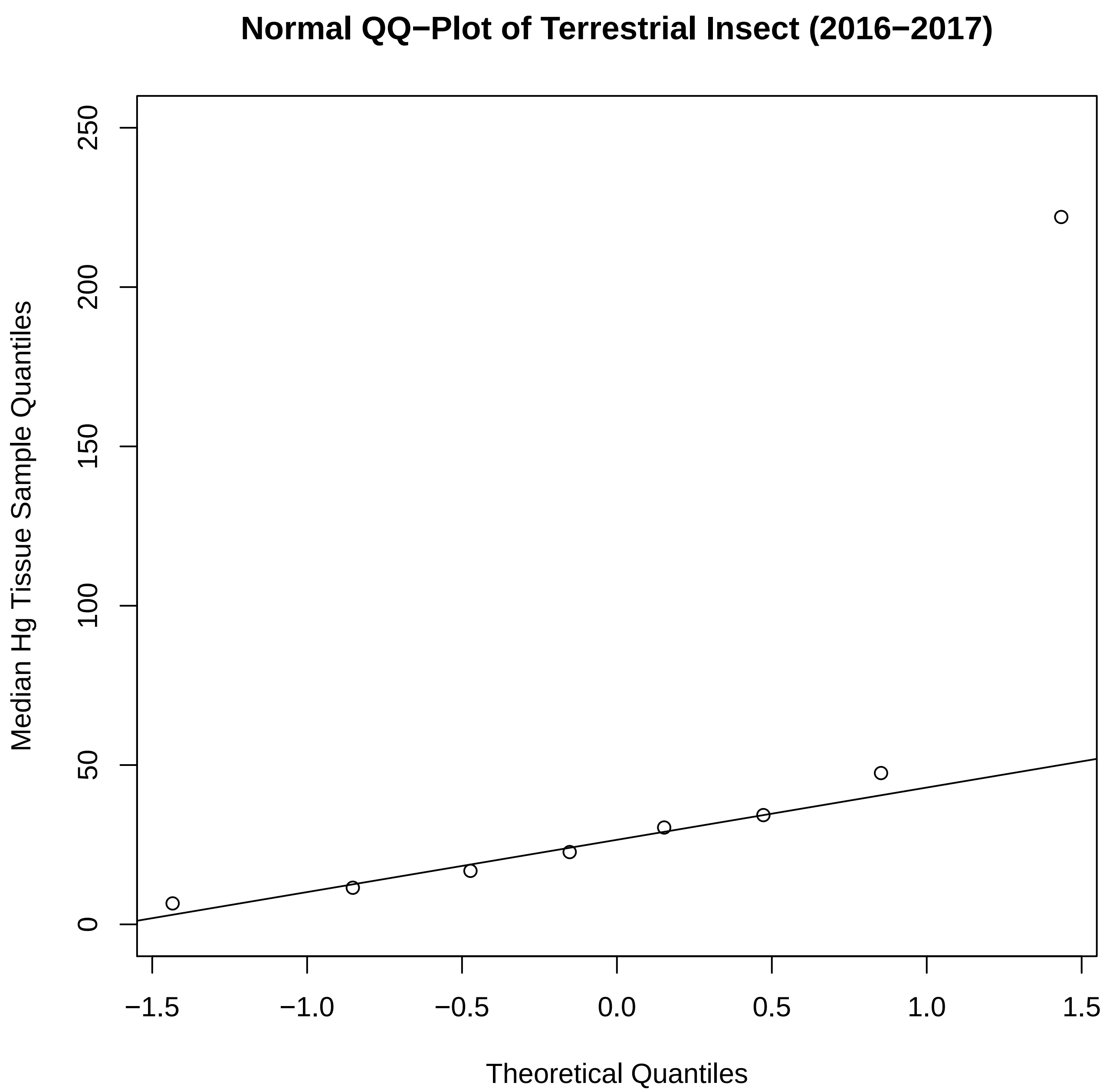

Rainbow Smelt (2016−2017)
OB−05 2016
Median Tissue Concentration (ng/g)
0
50
100
150
200
Mercury
Methyl mercury
Parameter

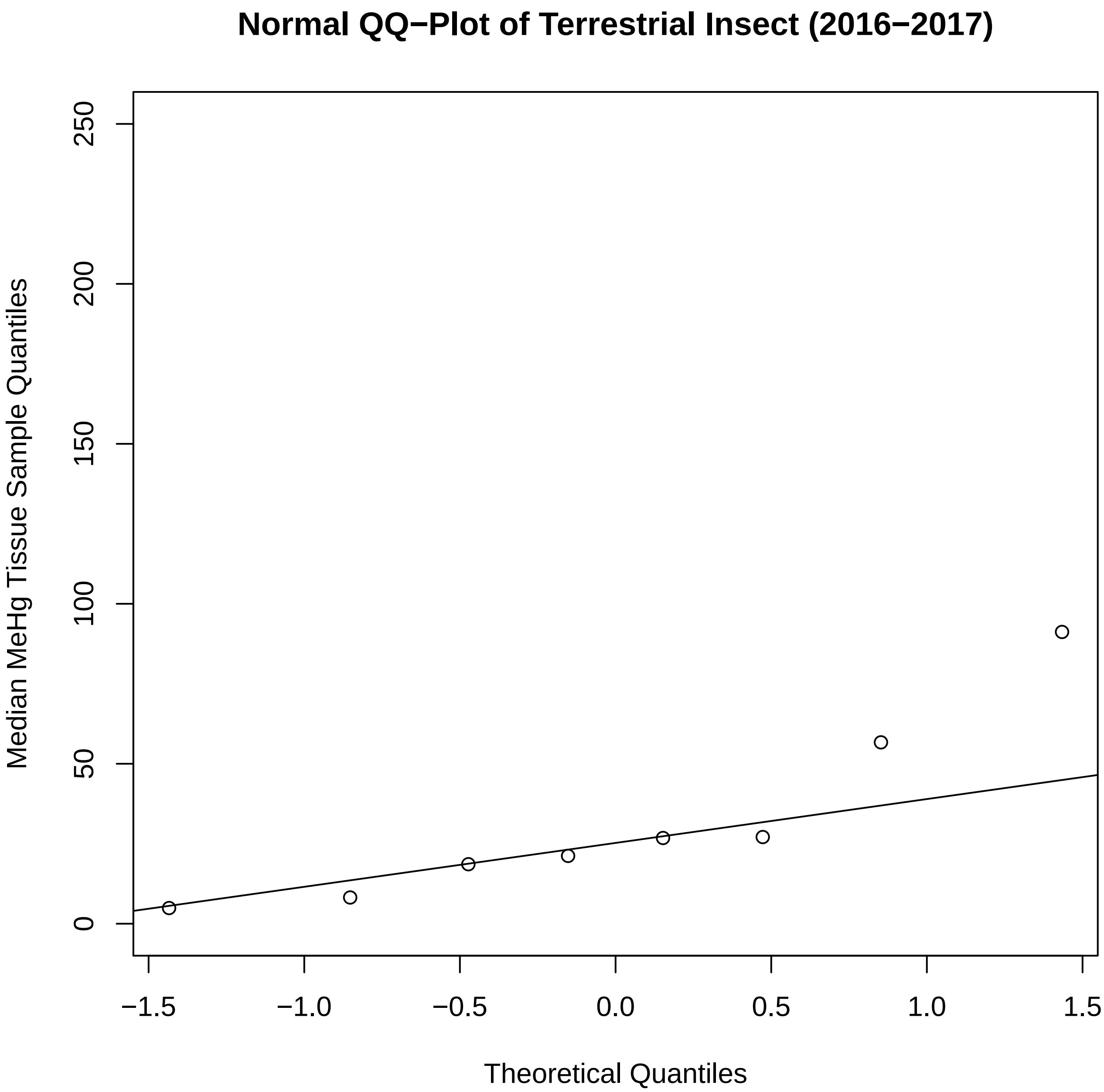

Normal QQ−Plot of Rainbow Smelt (2016−2017)
Median Hg Tissue Sample Quantiles
0
50
100
150
200
250
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles

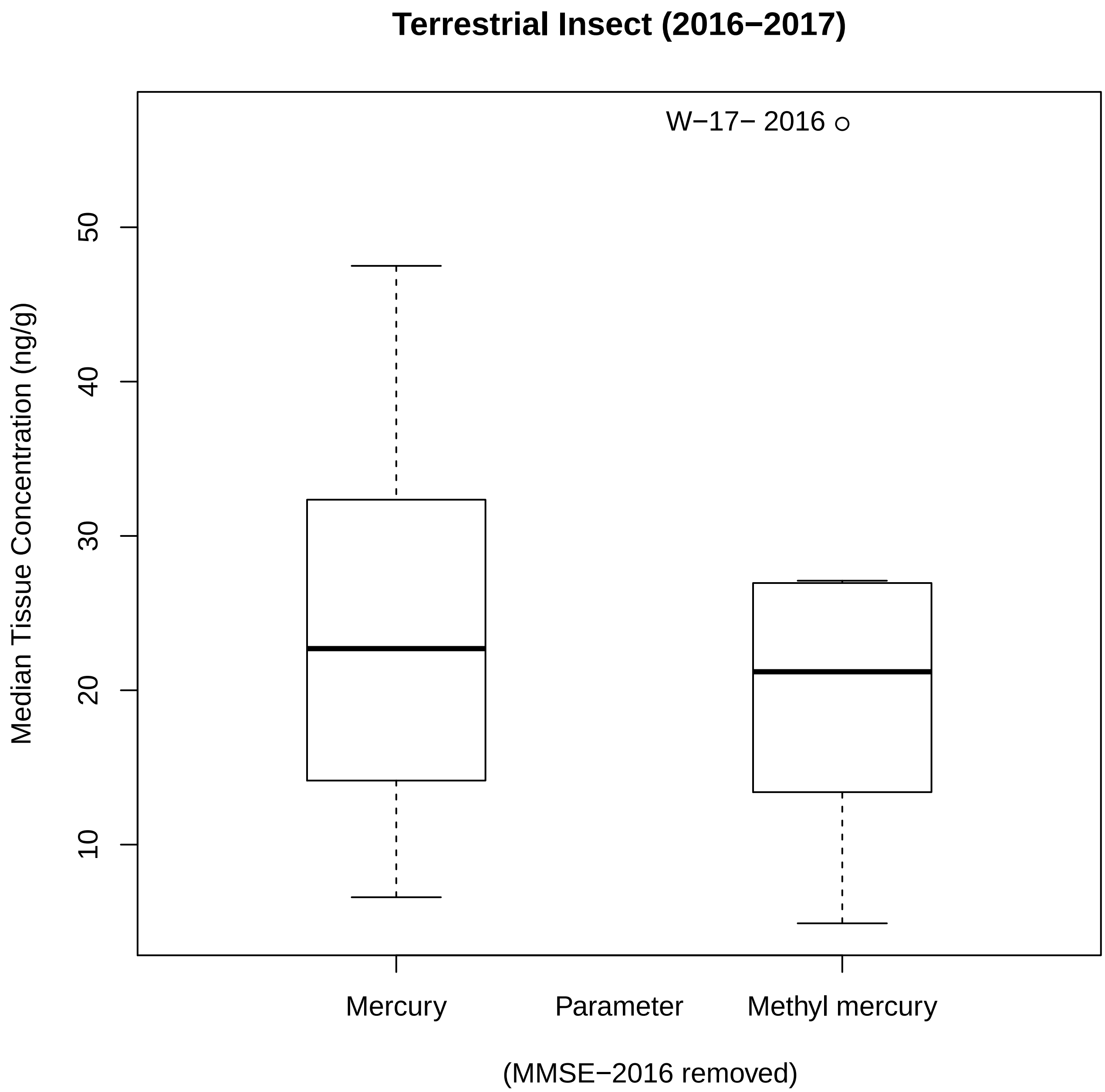

Rainbow Smelt (2016−2017)
Median Tissue Concentration (ng/g)
20
40
60
80
Mercury
Parameter
Methyl mercury
(OB−05 2016 removed)

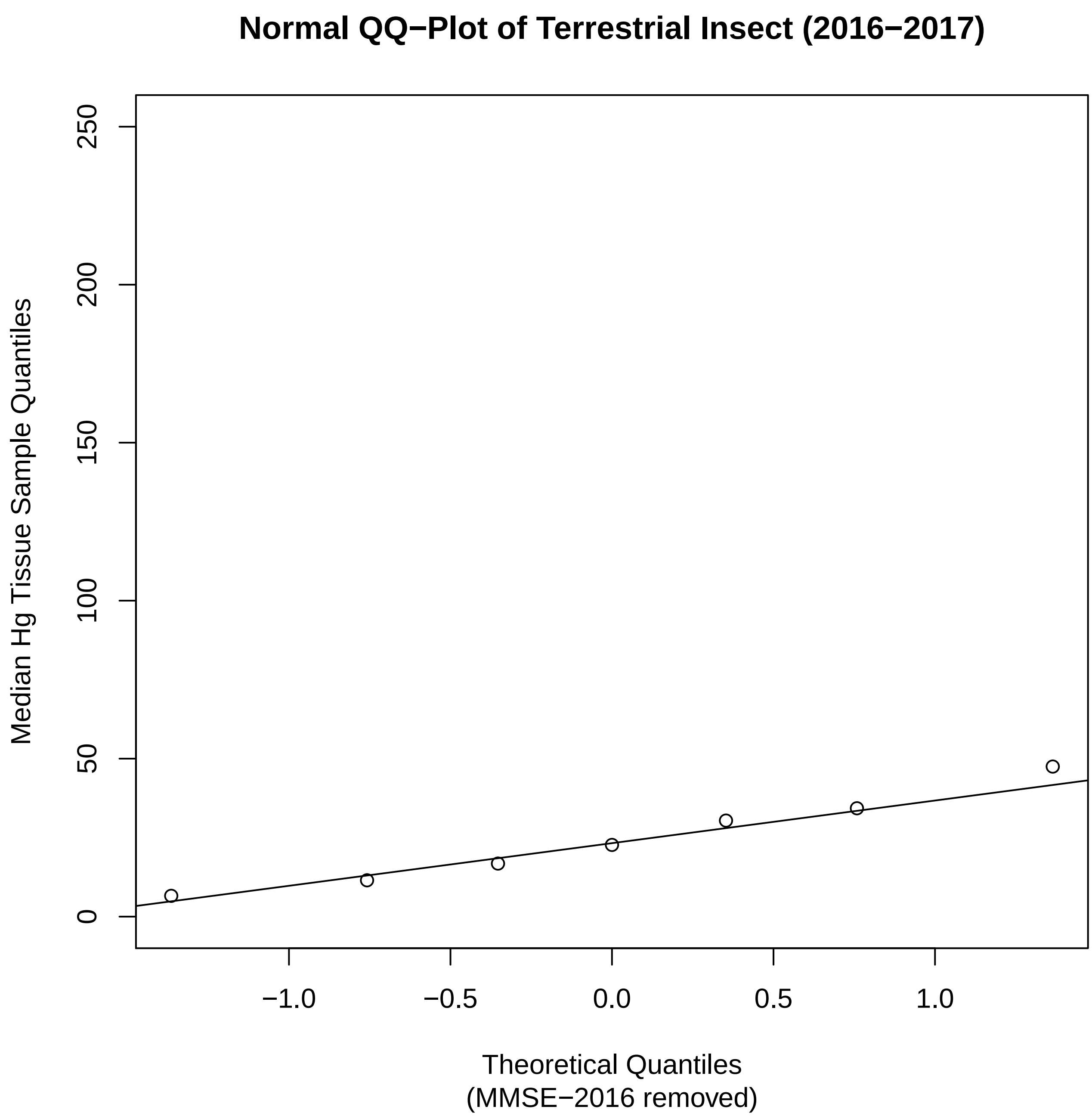

Normal QQ−Plot of Rainbow Smelt (2016−2017)
Median Hg Tissue Sample Quantiles
0
50
100
150
200
250
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles
(OB−05 removed)

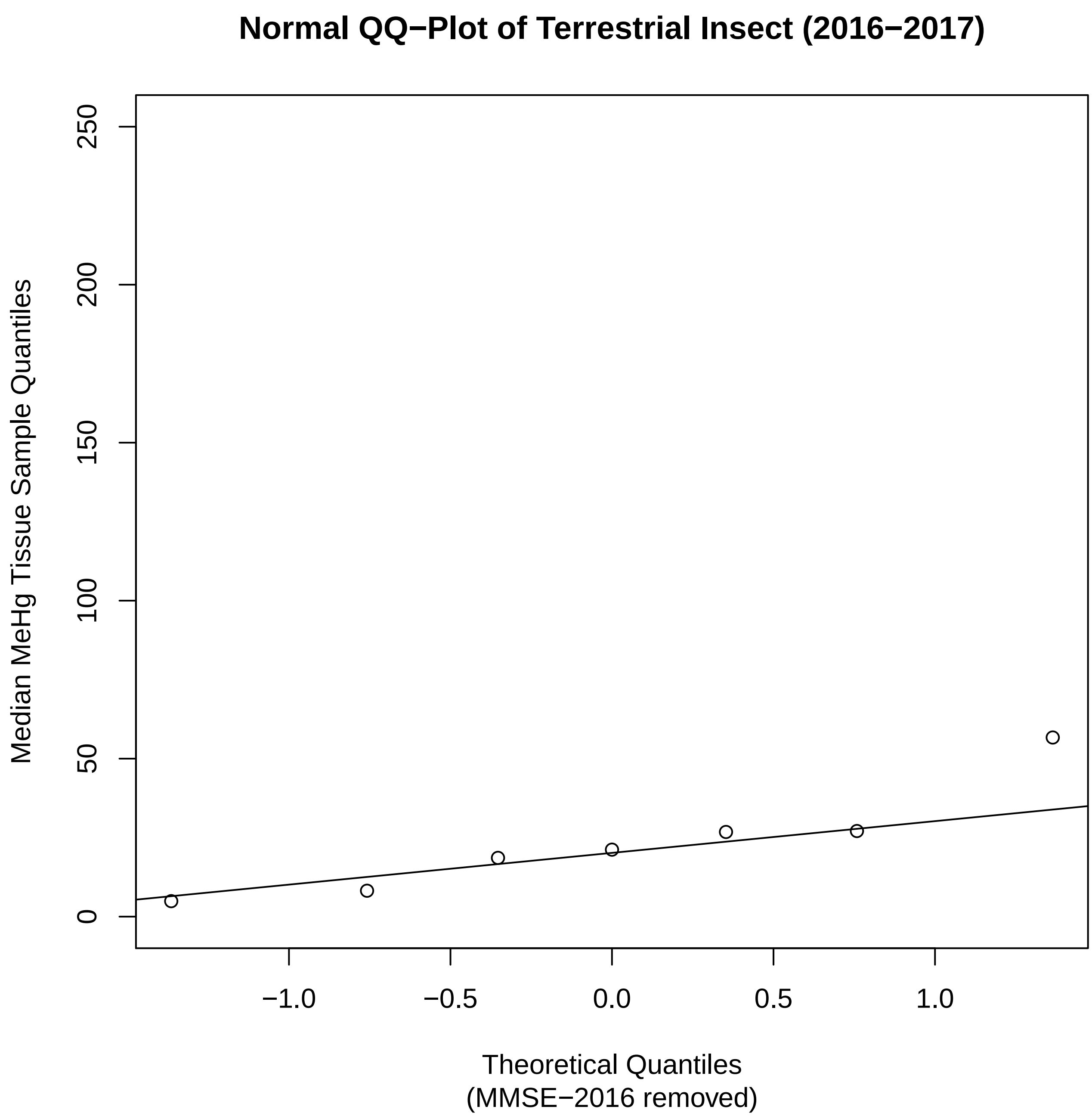

Terrestrial Insect (2016−2017)
MMSE− 2016
MMSE− 2016
Median Tissue Concentration (ng/g)
0
50
100
150
200
Mercury
Methyl mercury
Parameter


Normal QQ−Plot of Terrestrial Insect (2016−2017)
Median Hg Tissue Sample Quantiles
0
50
100
150
200
250
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles


Normal QQ−Plot of Terrestrial Insect (2016−2017)
Median MeHg Tissue Sample Quantiles
0
50
100
150
200
250
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles


Terrestrial Insect (2016−2017)
W−17− 2016
Median Tissue Concentration (ng/g)
10
20
30
40
50
Mercury
Parameter
Methyl mercury
(MMSE−2016 removed)


Normal QQ−Plot of Terrestrial Insect (2016−2017)
Median Hg Tissue Sample Quantiles
0
50
100
150
200
250
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles
(MMSE−2016 removed)


Normal QQ−Plot of Terrestrial Insect (2016−2017)
Median MeHg Tissue Sample Quantiles
0
50
100
150
200
250
−1.0
−0.5
0.0
0.5
1.0
Theoretical Quantiles
(MMSE−2016 removed)

Extreme Value Identified in 2016 - 2017 Biota Data

MED_T	ID	DATE	LOC_YEAR
Terrestrial Insect	MMSE-1_072016_TIN_01_WB	7/20/2016	MMSE- 2016
Terrestrial Insect	MMSE-1_072016_TIN_02_WB	7/20/2016	MMSE- 2016
Terrestrial Insect	MMSE-1_072016_TIN_03_WB	7/20/2016	MMSE- 2016
Terrestrial Insect	MMSE-1_072016_TIN_04_WB	7/20/2016	MMSE- 2016
Terrestrial Insect	MMSE-1_072016_TIN_05_WB	7/20/2016	MMSE- 2016
Rainbow Smelt	OB-05_092116_RAS_01_WB	9/21/2016	OB-05 2016
Eel	BO-04_080516_EEL_01_WB	8/5/2016	BO-04 2016

Notes:

1 Analytical mercury and methyl mercury data are available for Terrestrial Insect samples listed above.

2 Analytical data for Rainbow smelt and Eel samples listed above are limited to mercury. However, methyl mercury concentrations are estimated from mercury and are therefore also considered an extreme value.

C-4

BAF and BSAF Regression Plots & Summary with Extreme Values Excluded

Biota tissue median concentrations listed below were identified as extreme values (see Appendix C-3 Outlier Testing):

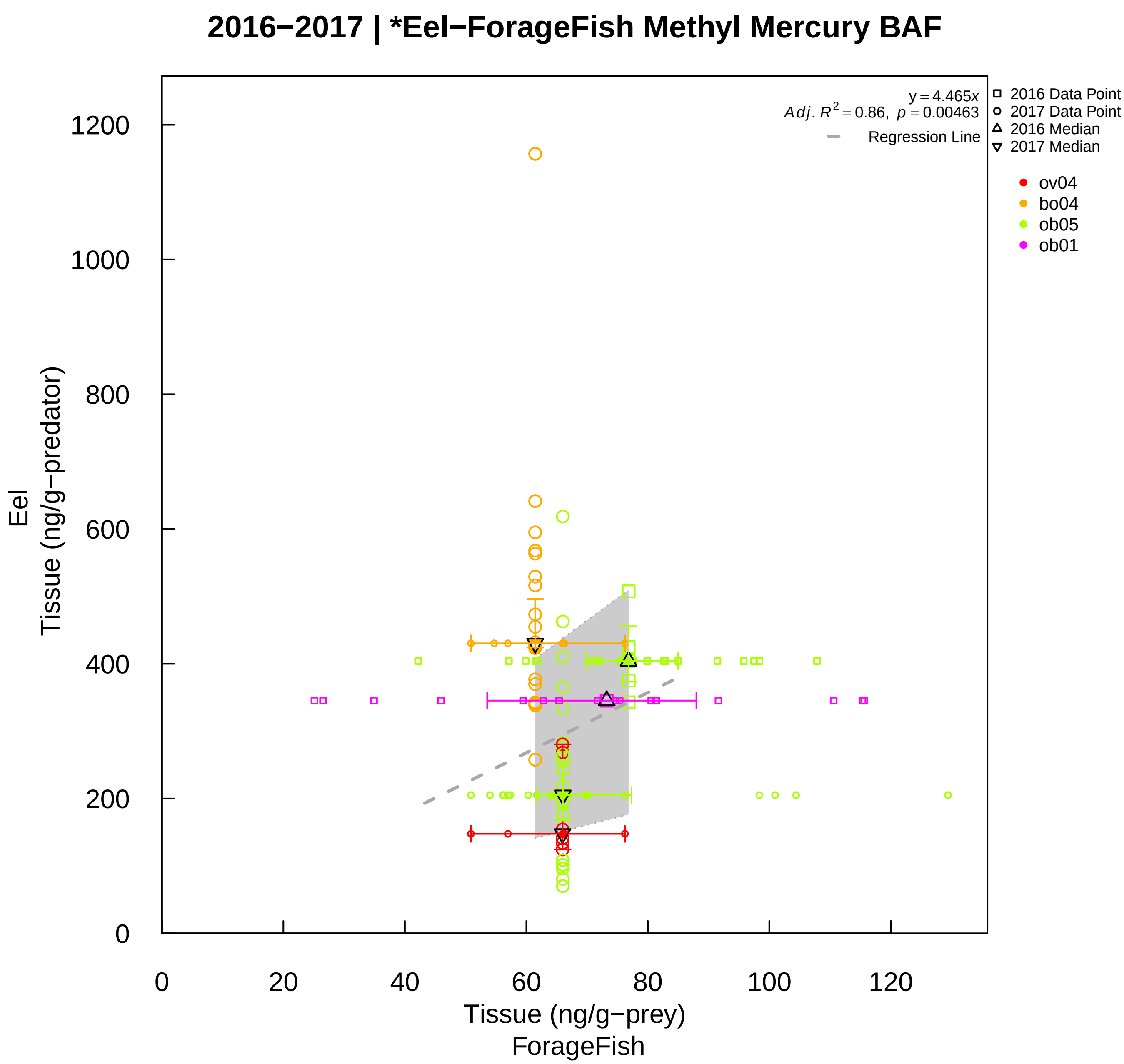
1. Eel – Mercury tissue median for location BO-04 2016 (n=1)
    a. Sample ID: BO-04_080516_EEL_01_WB
2. Rainbow Smelt – Mercury tissue median for location OB-05 2016 (n=1)
    a. Sample ID: OB-05_092116_RAS_01_WB
3. Terrestrial Insects – Mercury and Methyl Mercury tissue median for location MMSE 2016 (n=5)
    a. Sample ID: MMSE-1_072016_TIN_01_WB
       MMSE-1_072016_TIN_02_WB
       MMSE-1_072016_TIN_03_WB
       MMSE-1_072016_TIN_04_WB
       MMSE-1_072016_TIN_05_WB

The BAF regression plots revised to omit the above sample(s) comprising one or more extreme median value(s) are listed below:

1. 2016-2017 | *Smelt-Mummichog Mercury BAF
2. 2016-2017 | *Smelt-Mummichog Methyl Mercury BAF
3. 2016-2017 | *Spider-Terrestrial Insect Mercury BAF
4. 2016-2017 | *Spider-Terrestrial Insect Methyl Mercury BAF
5. 2016-2017 | *Tomcod-Forage Fish Mercury BAF
6. 2016-2017 | *Tomcod-Forage Fish Methyl Mercury BAF
7. 2016-2017 | *Eel-Forage Fish Mercury BAF
8. 2016-2017 | *Eel-Forage Fish Methyl Mercury BAF
9. 2016-2017 | *Eel-Mummichog Mercury BAF
10. 2016-2017 | *Eel-Mummichog Methyl Mercury BAF
11. 2016-2017 | *Eel-Polychaetes Mercury BAF
12. 2016-2017 | *Eel-Polychaetes Methyl Mercury BAF
13. 2016-2017 | *Eel-Smelt Mercury BAF
14. 2016-2017 | *Eel-Smelt Methyl Mercury BAF
15. 2016-2017 | *Eel-Terrestrial Insect Mercury BAF
16. 2016-2017 | *Eel-Terrestrial Insect Methyl Mercury BAF
17. 2016-2017 | *Mummichog-Terrestrial Insect Mercury BAF
18. 2016-2017 | *Mummichog-Terrestrial Insect Methyl Mercury BAF
19. 2016-2017 | *Nelson’s Sparrow-Terrestrial Insect Mercury BAF
20. 2016-2017 | *Nelson’s Sparrow-Terrestrial Insect Methyl Mercury BAF

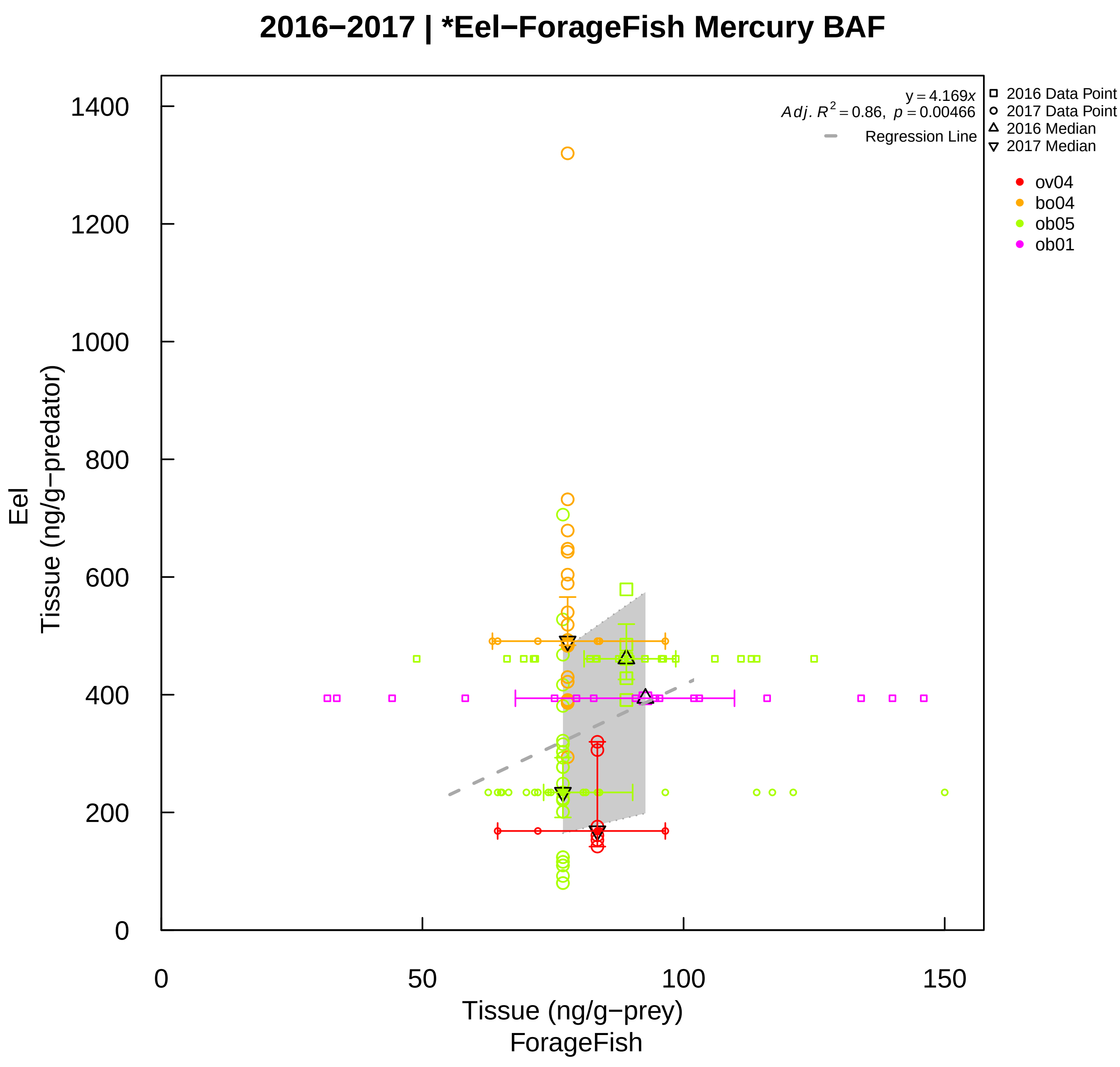
The BSAF regression plots revised to omit the above sample(s) comprising extreme median value(s) are listed below:

1. 2016-2017 | *Eel-Sediment Mercury BSAF
2. 2016-2017 | *Eel-Sediment Methyl Mercury BSAF
3. 2016-2017 | *Rainbow Smelt-Sediment Mercury BSAF
4. 2016-2017 | *Rainbow Smelt-Sediment Methyl Mercury BSAF
5. 2016-2017 | *Terrestrial Insects-Sediment Mercury BSAF
6. 2016-2017 | *Terrestrial Insects-Sediment Methyl Mercury BSAF



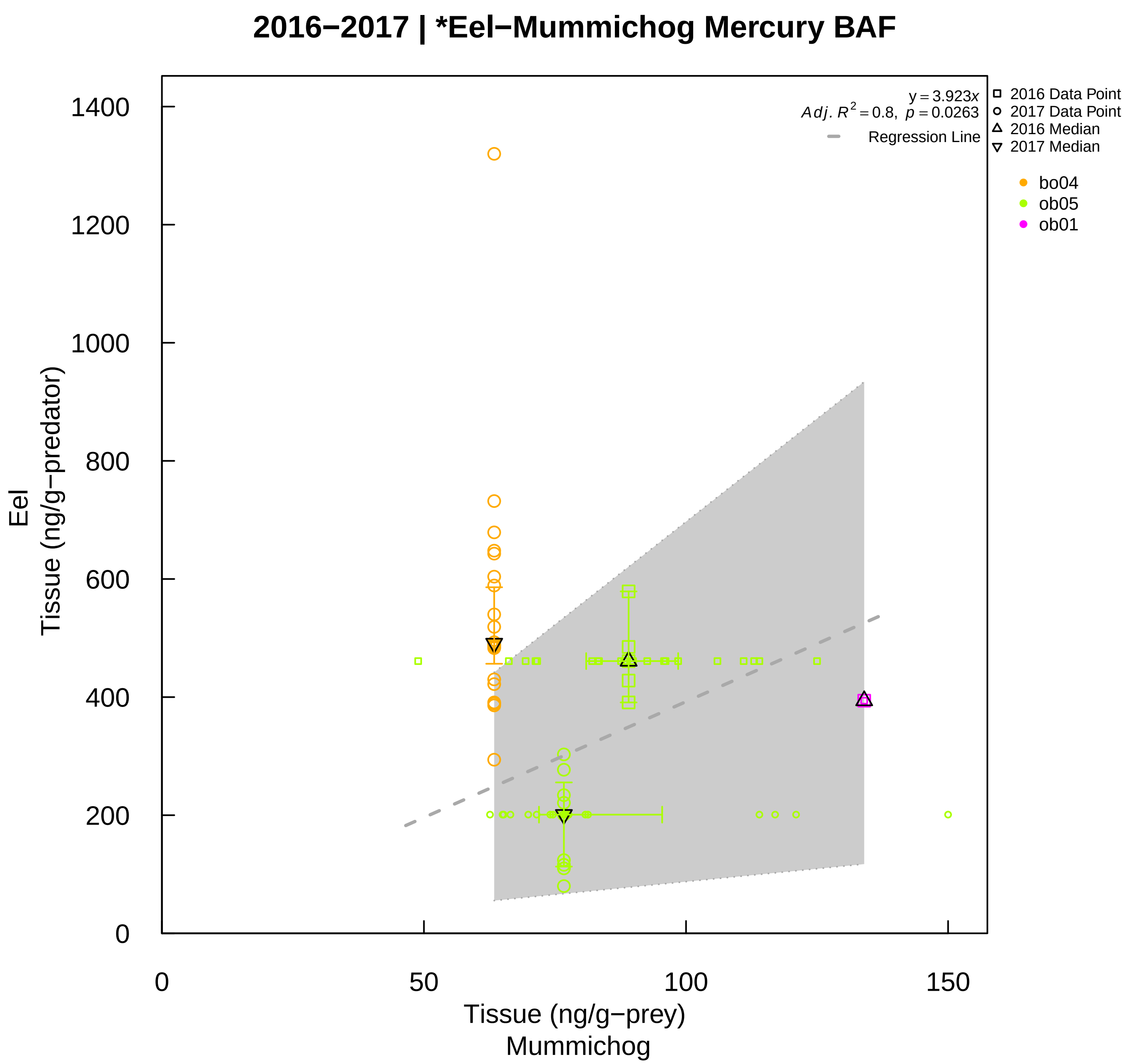
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



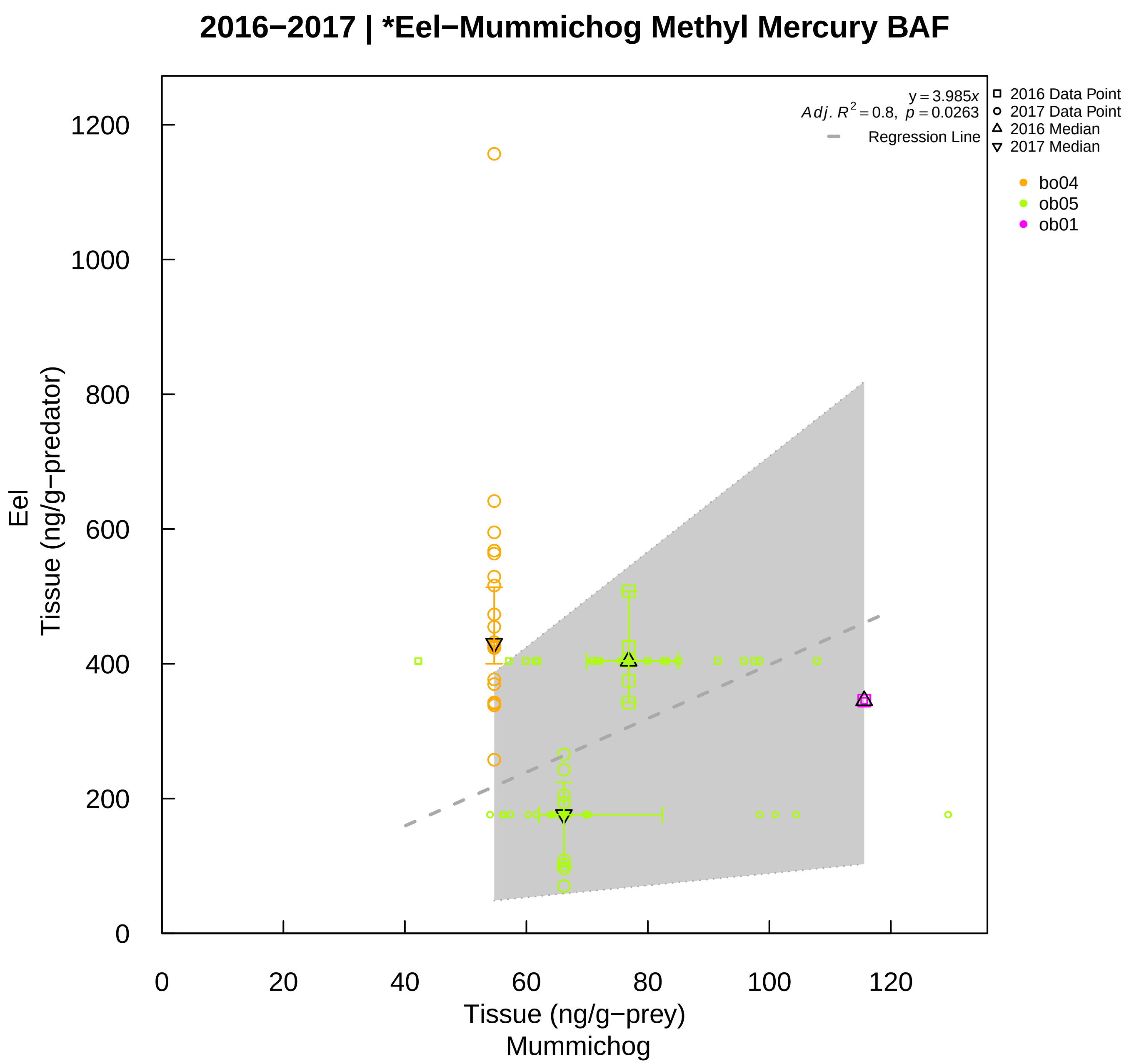
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



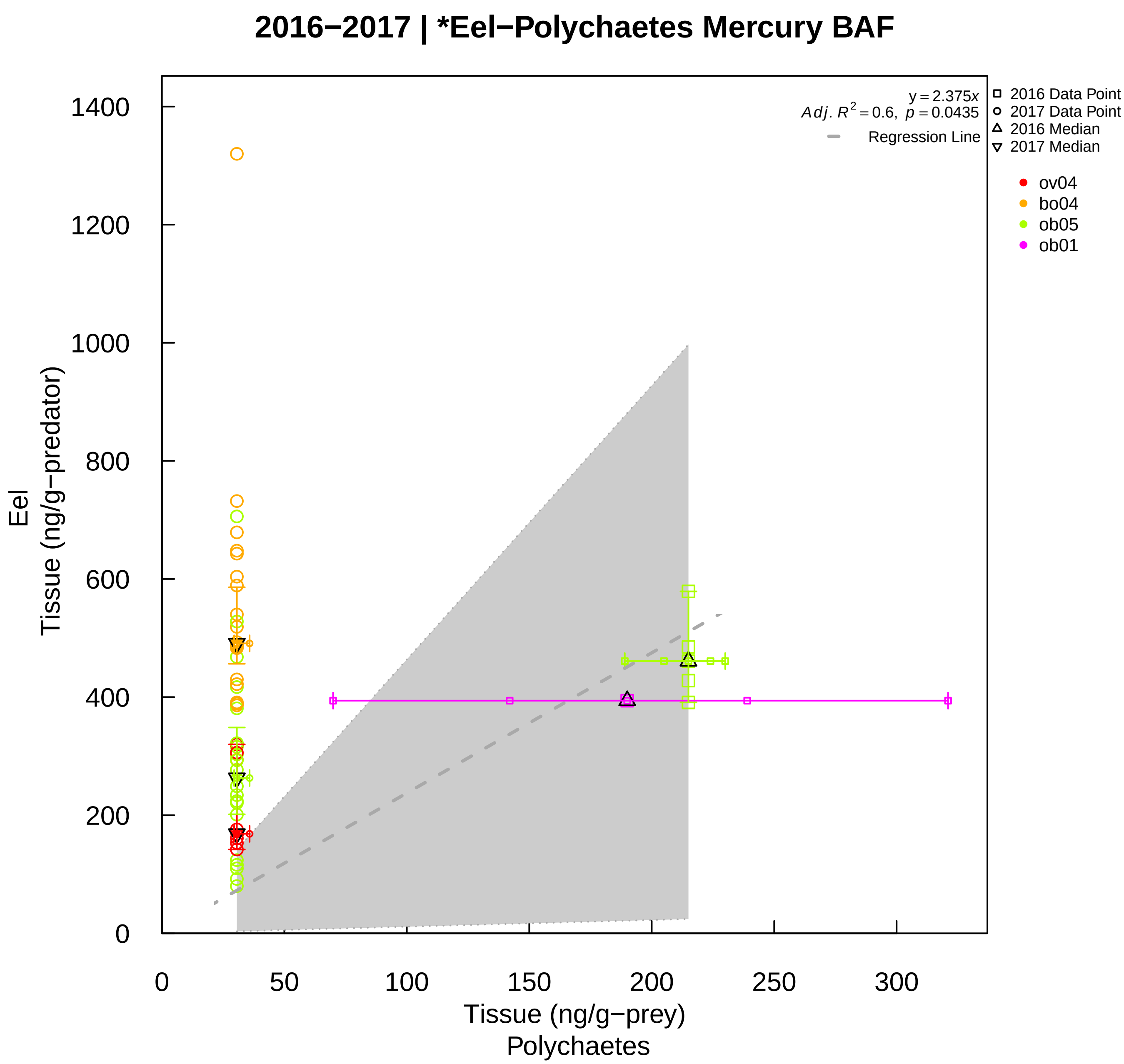
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



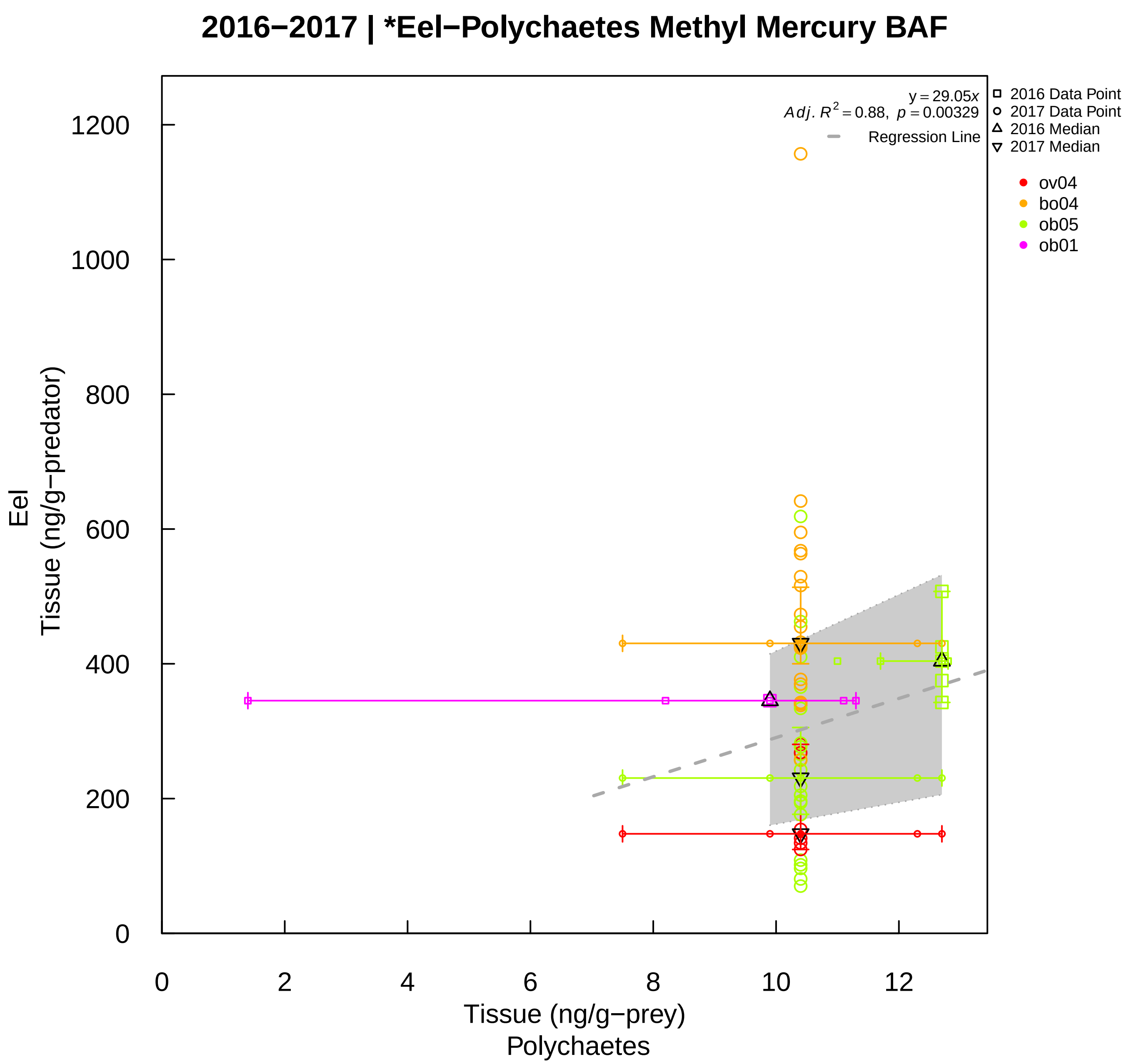
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



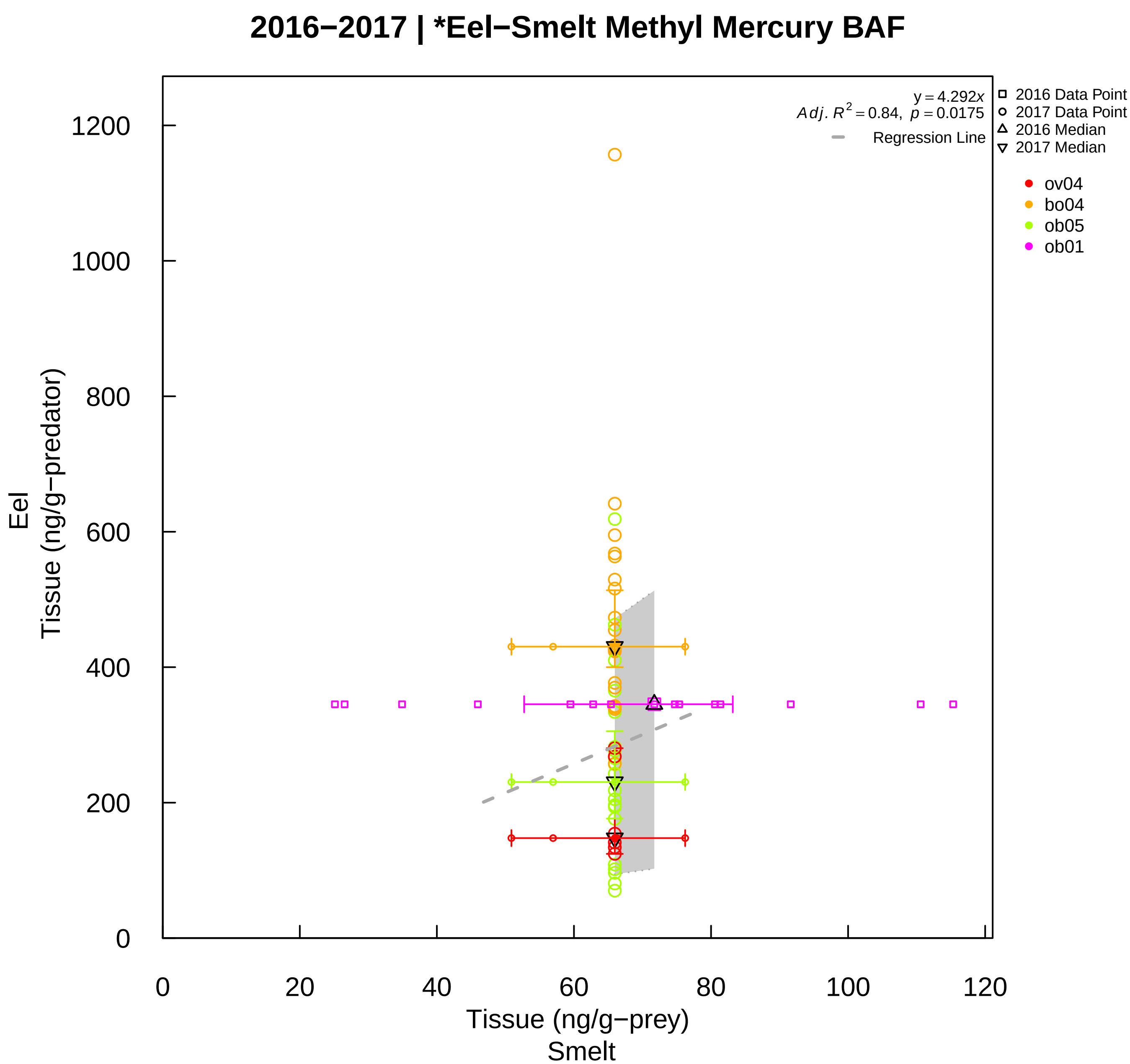
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



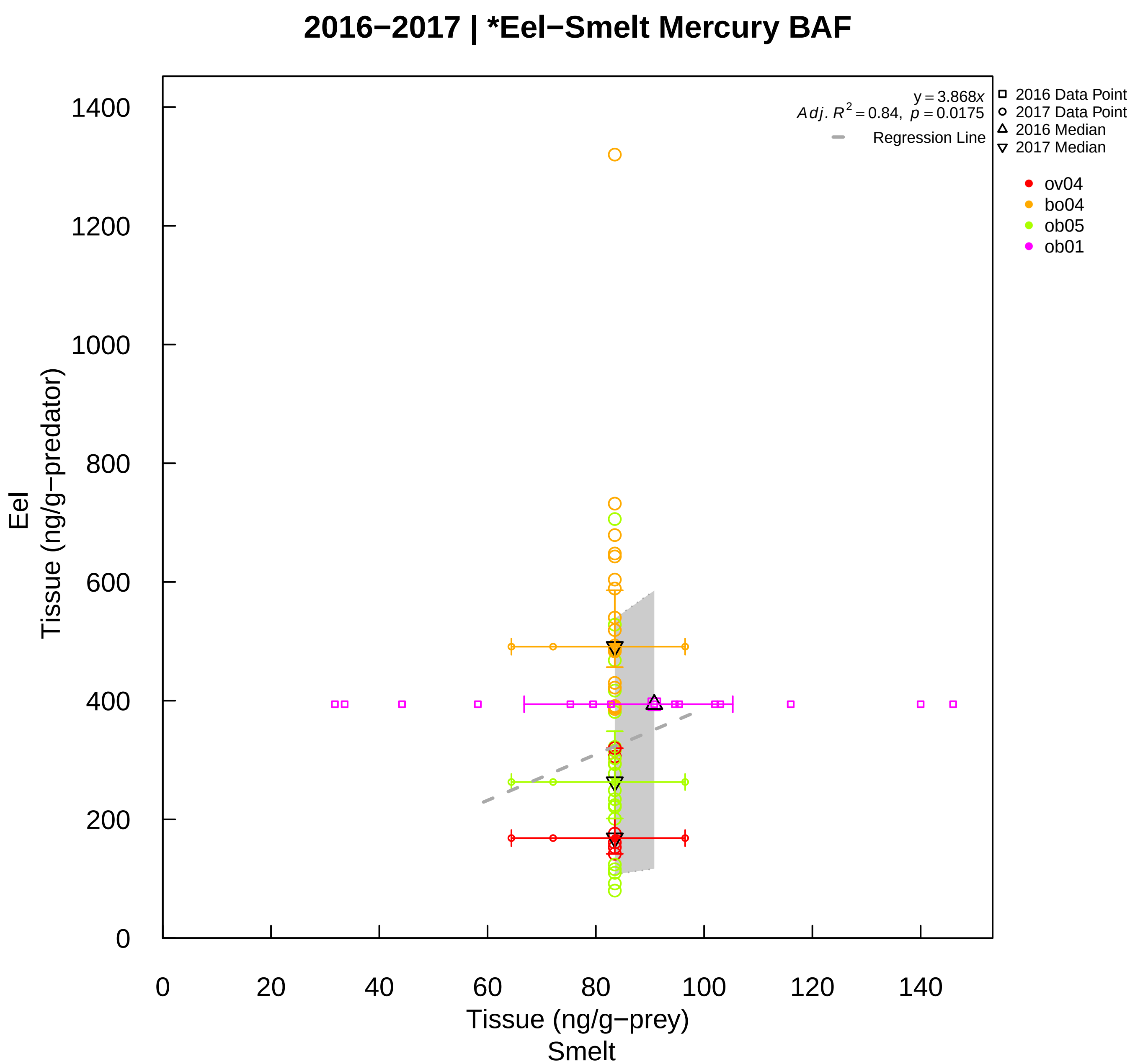
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



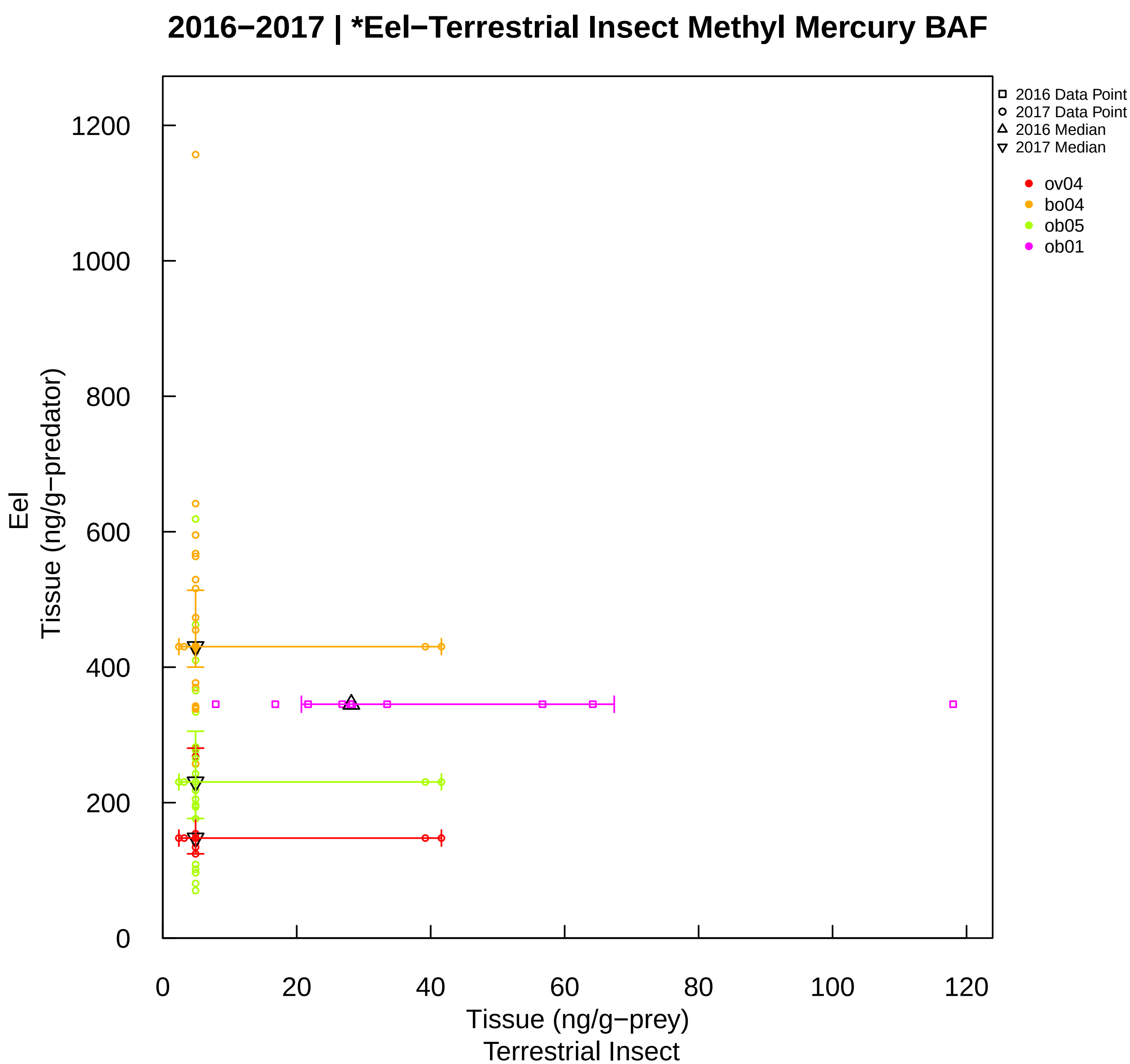
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



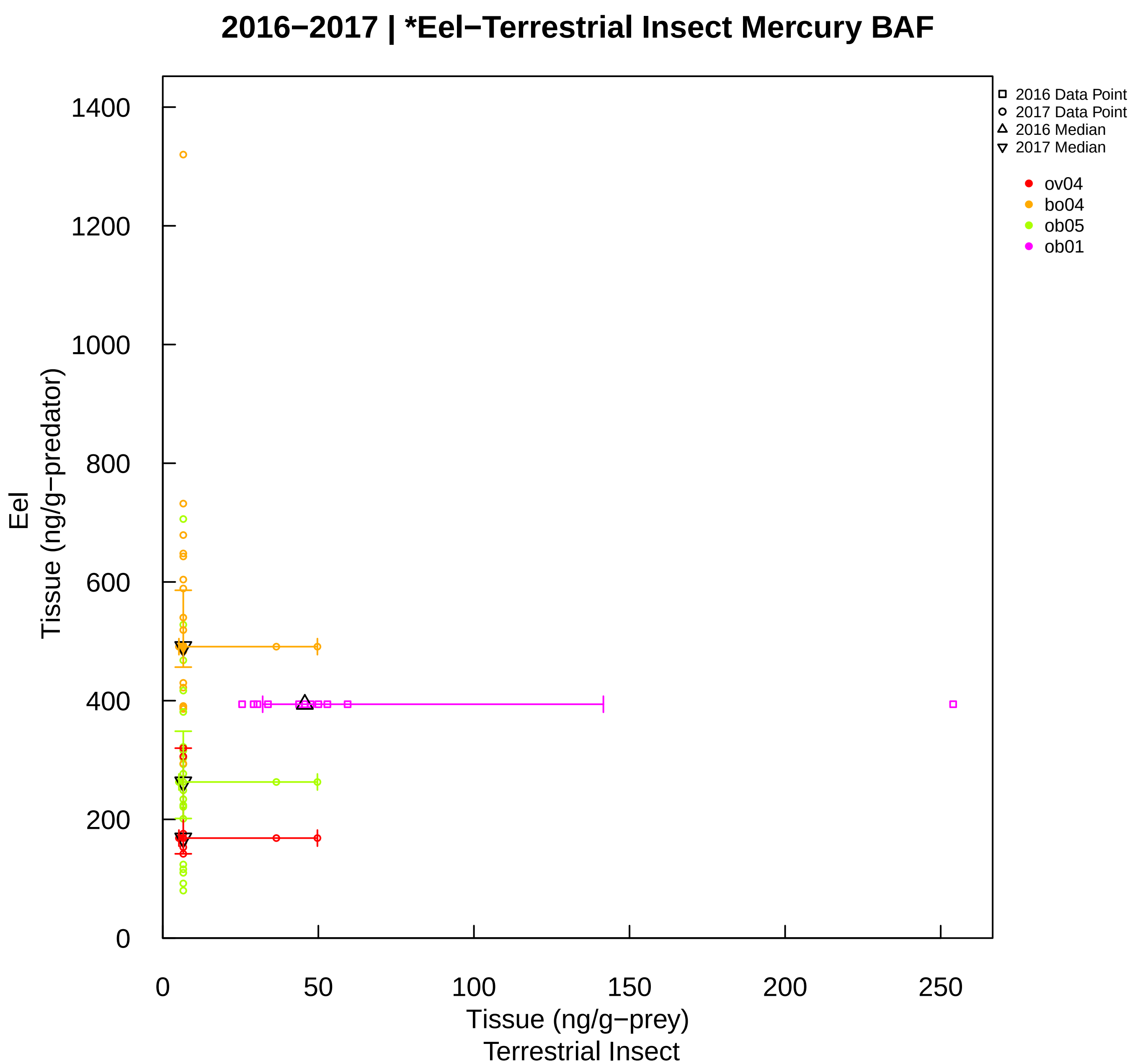
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



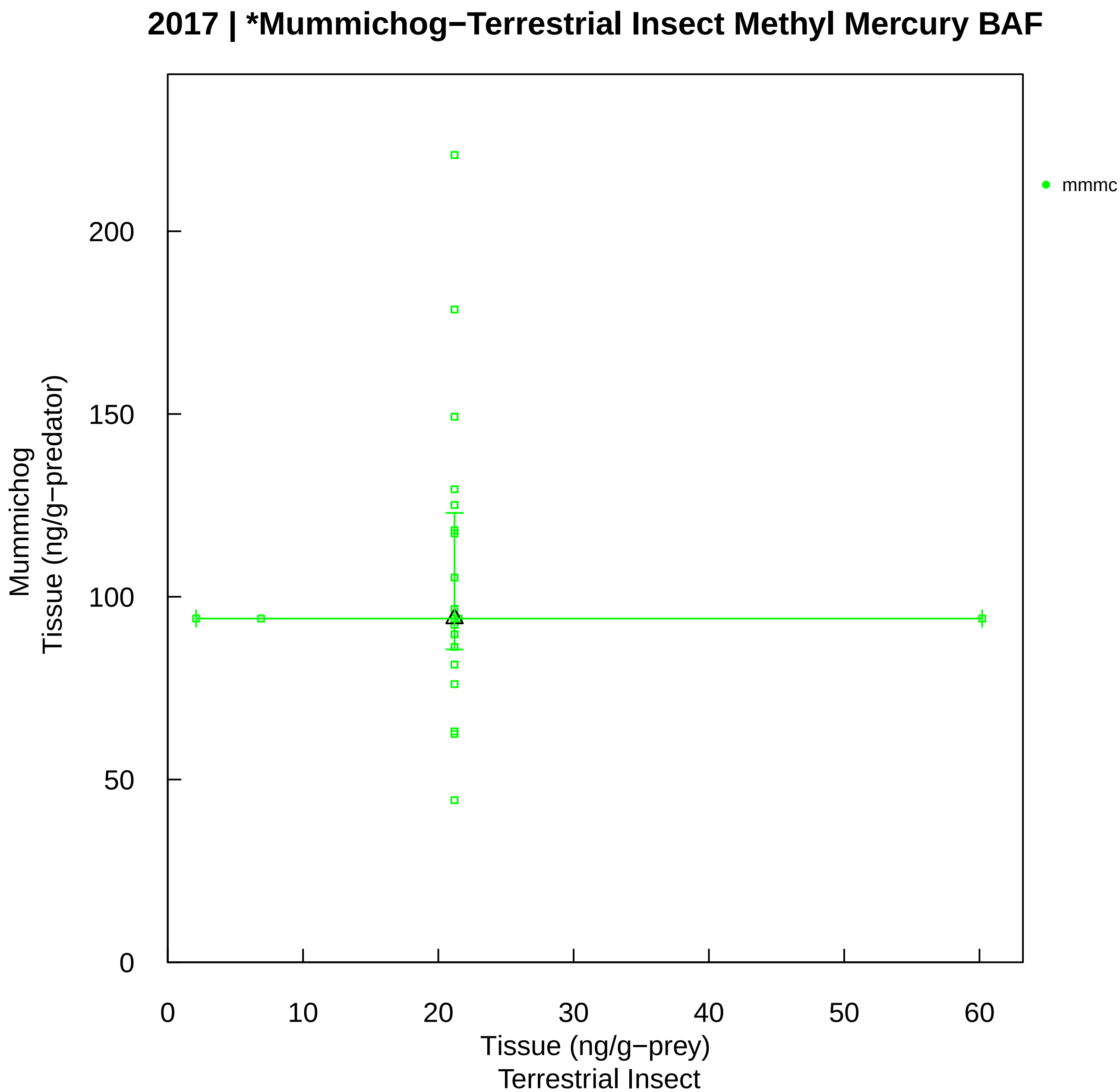
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



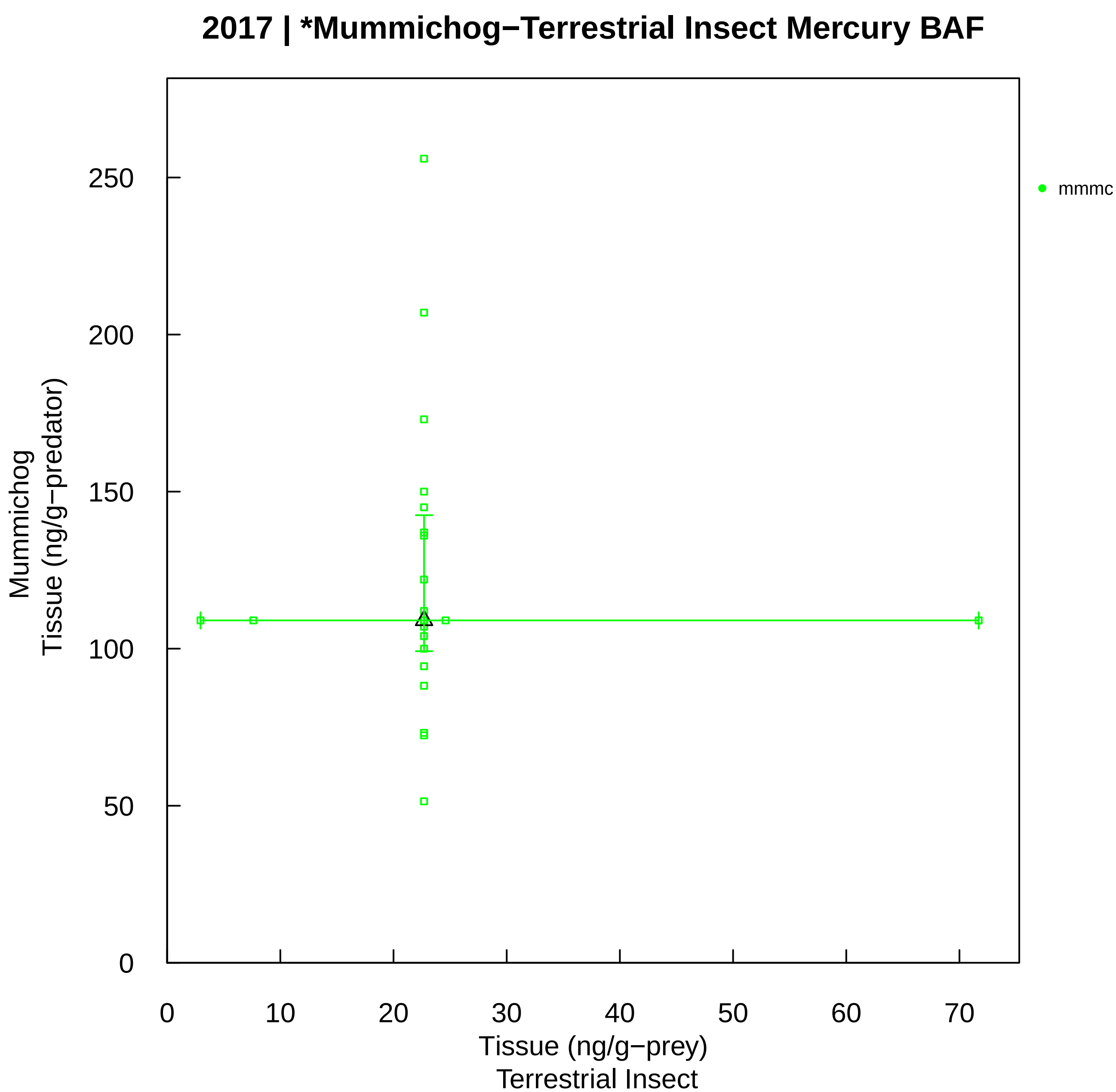
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

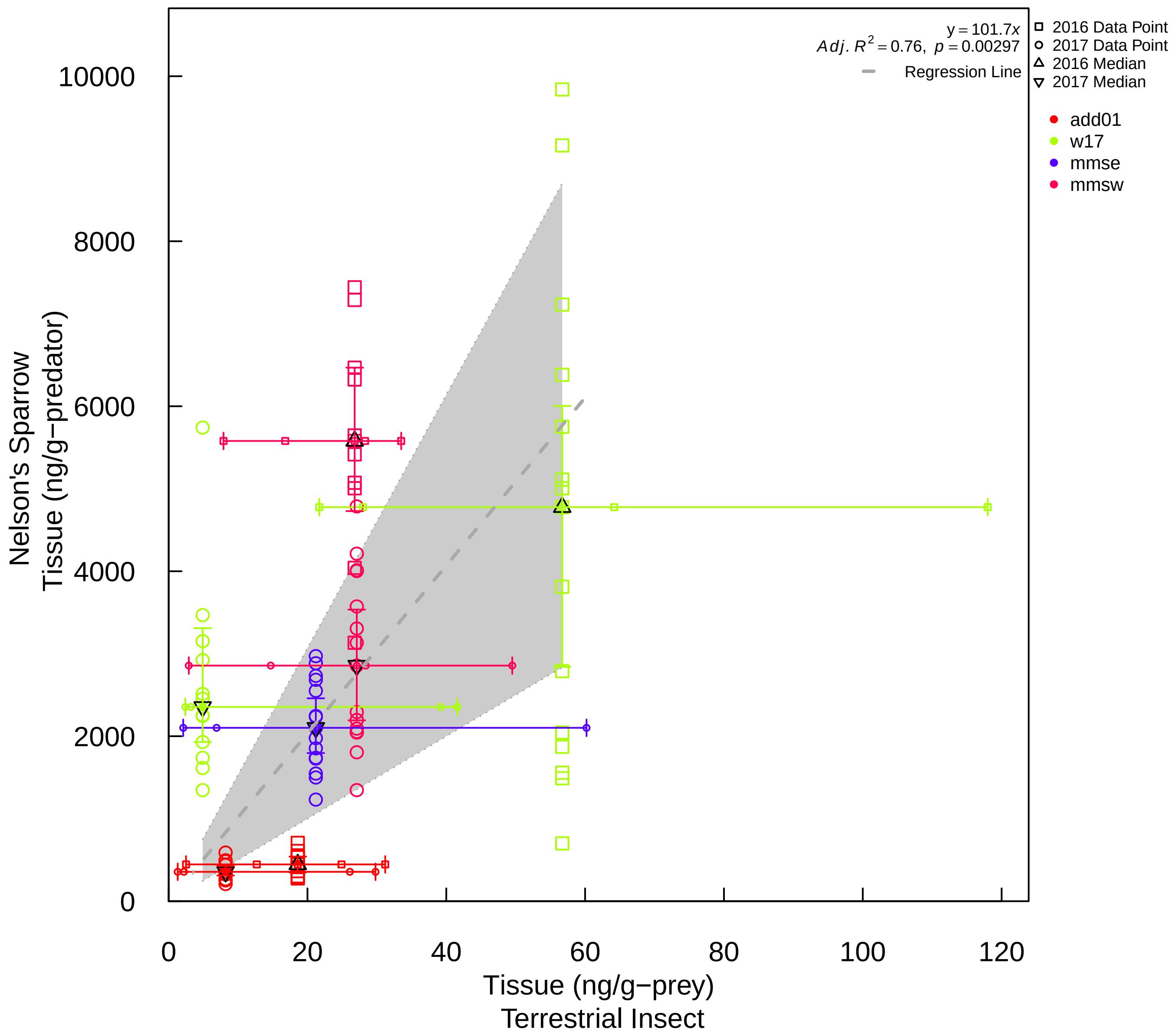
*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

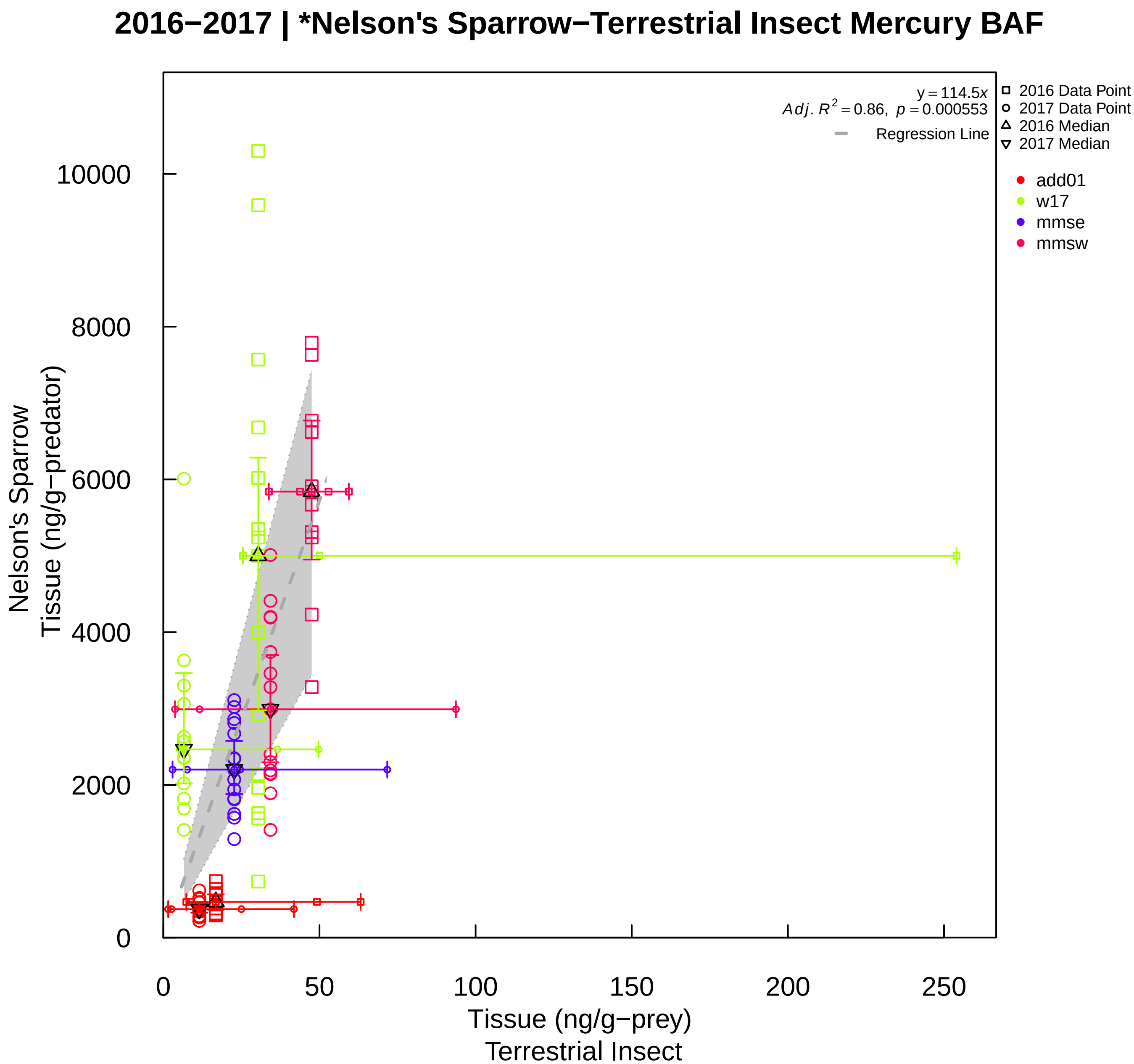
*-Indicates regression on outlier-free data.

2016−2017 | *Nelson's Sparrow−Terrestrial Insect Methyl Mercury BAF



Grey shaded region represents the regression 95% confidence interval.

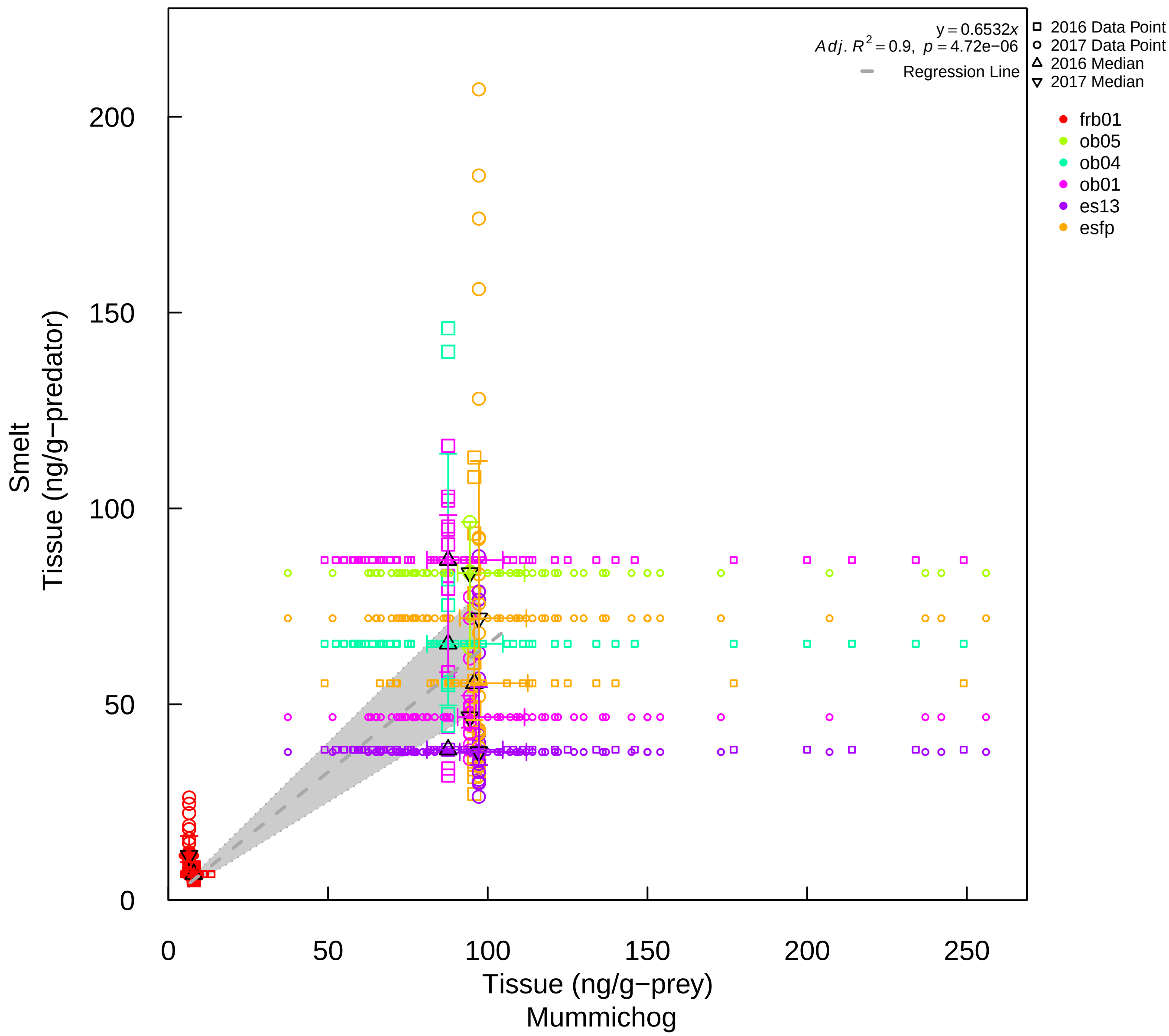
*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

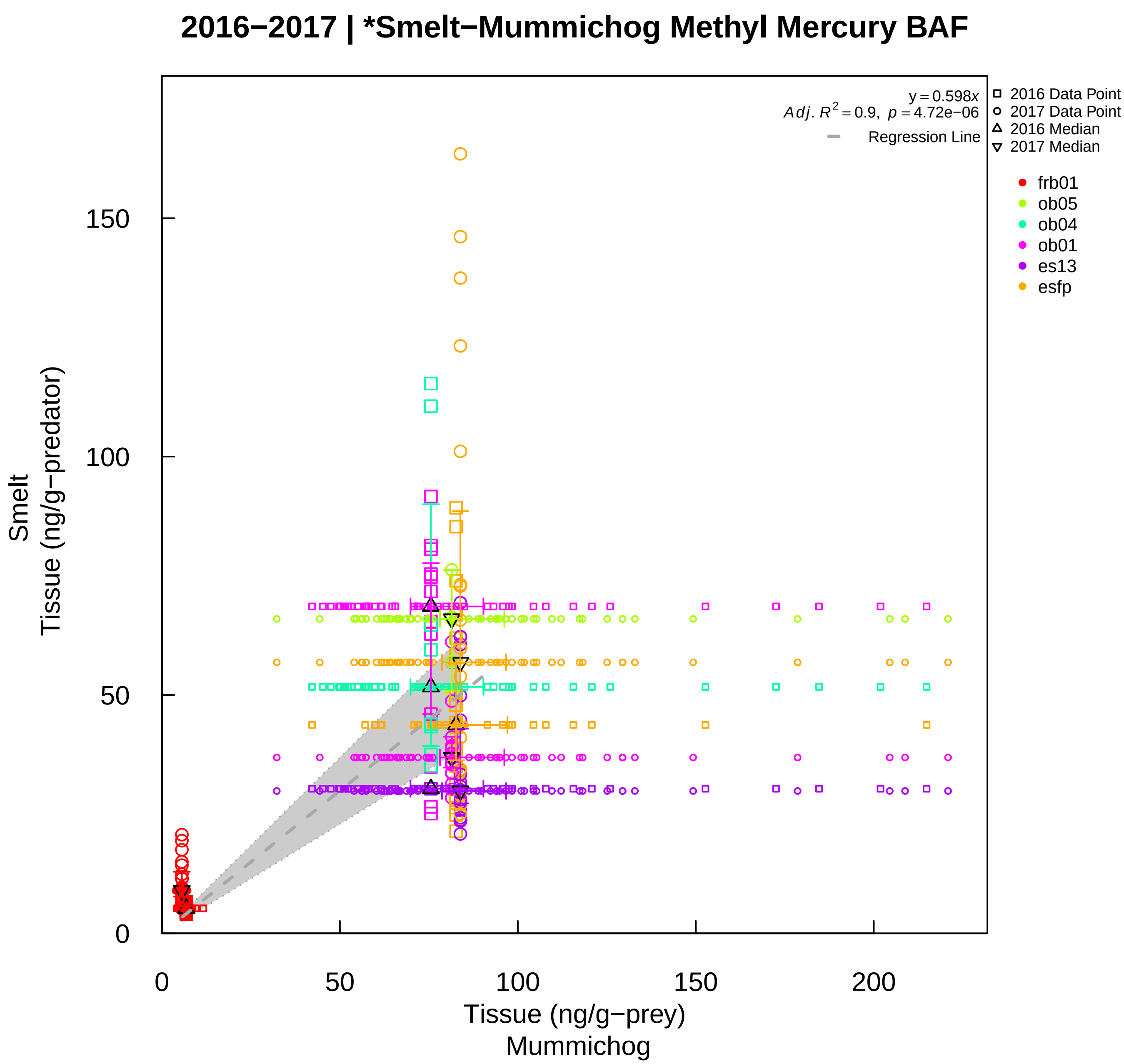
*-Indicates regression on outlier-free data.

2016−2017 | *Smelt−Mummichog Mercury BAF



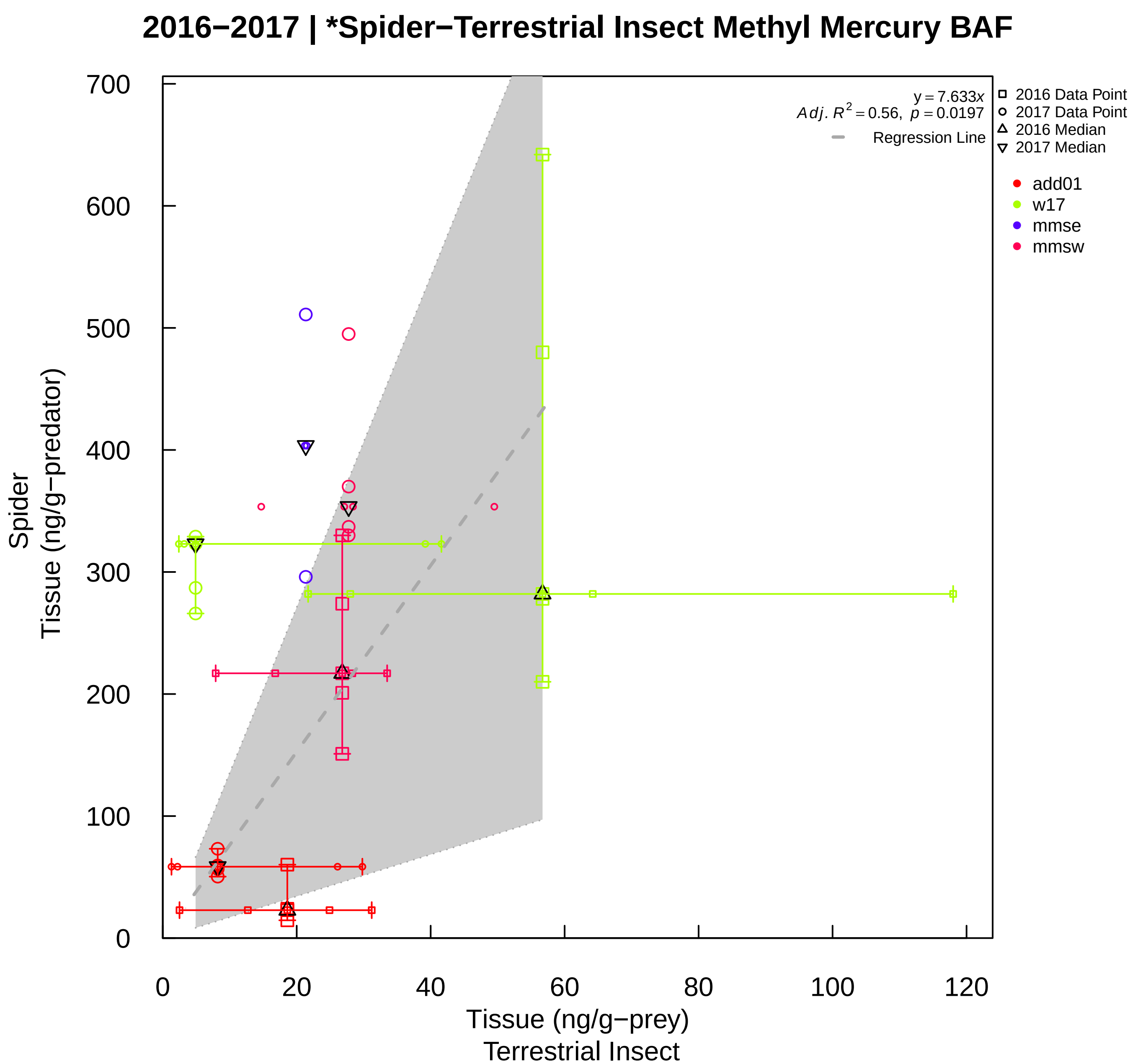
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



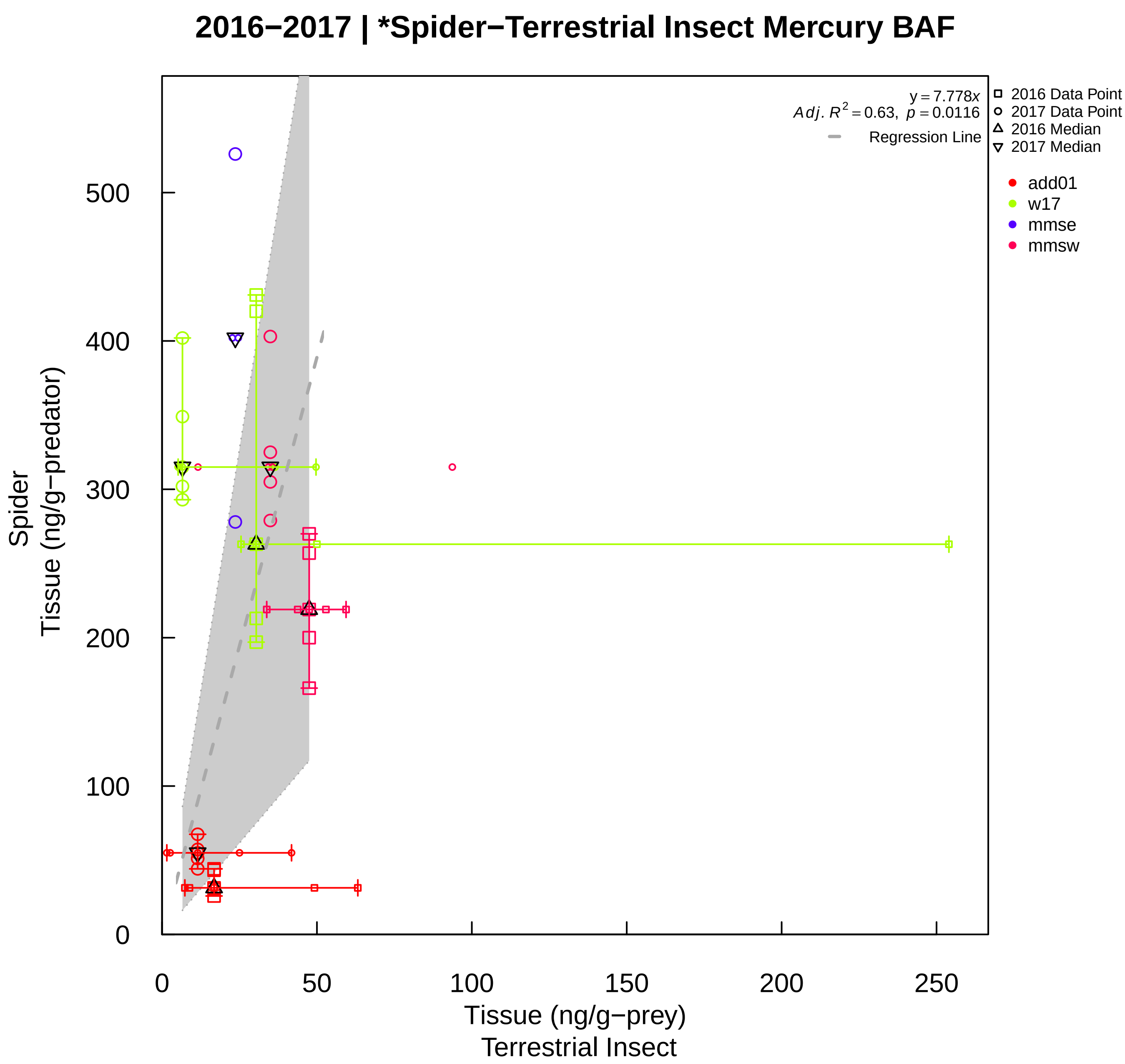
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



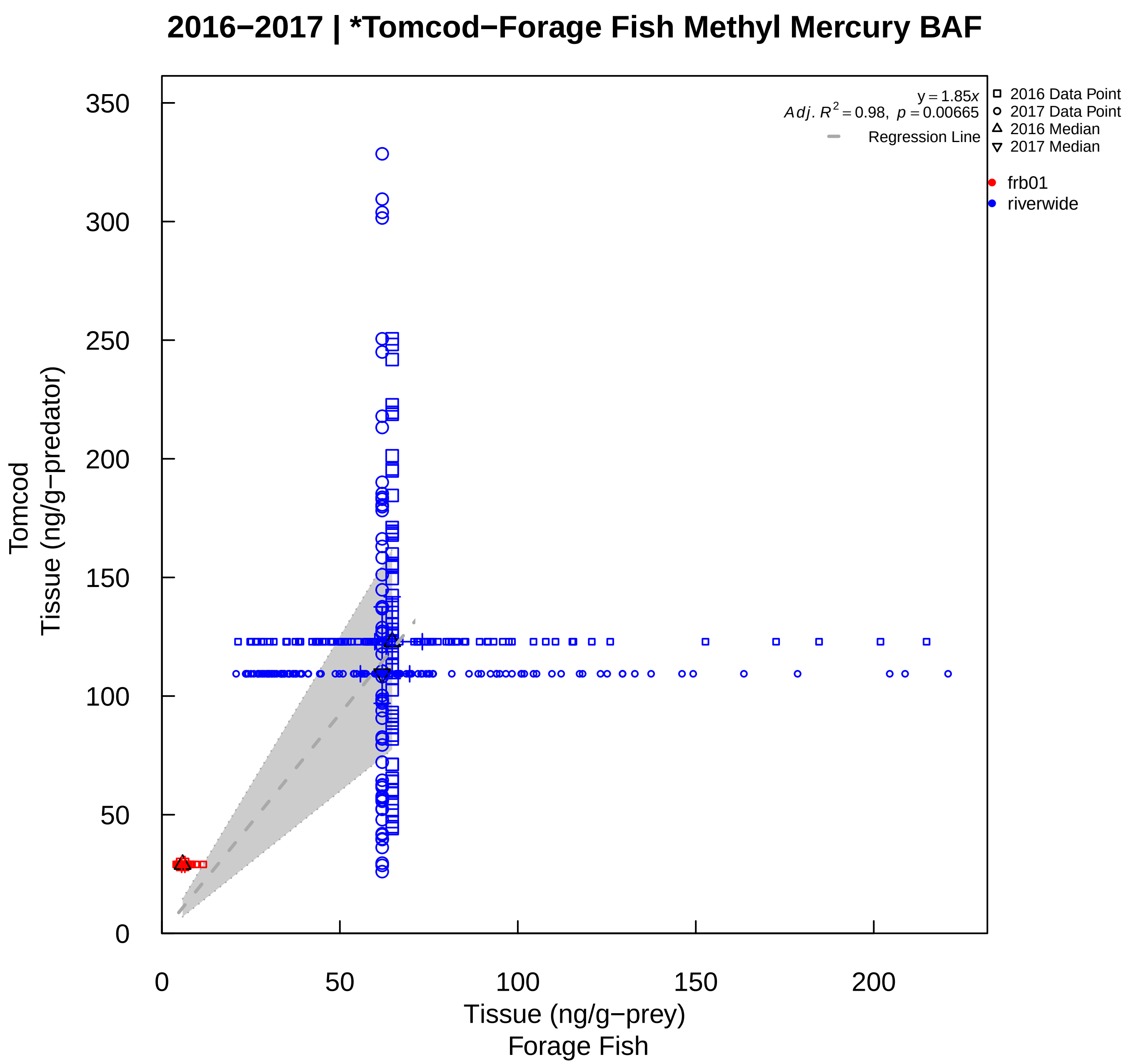
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



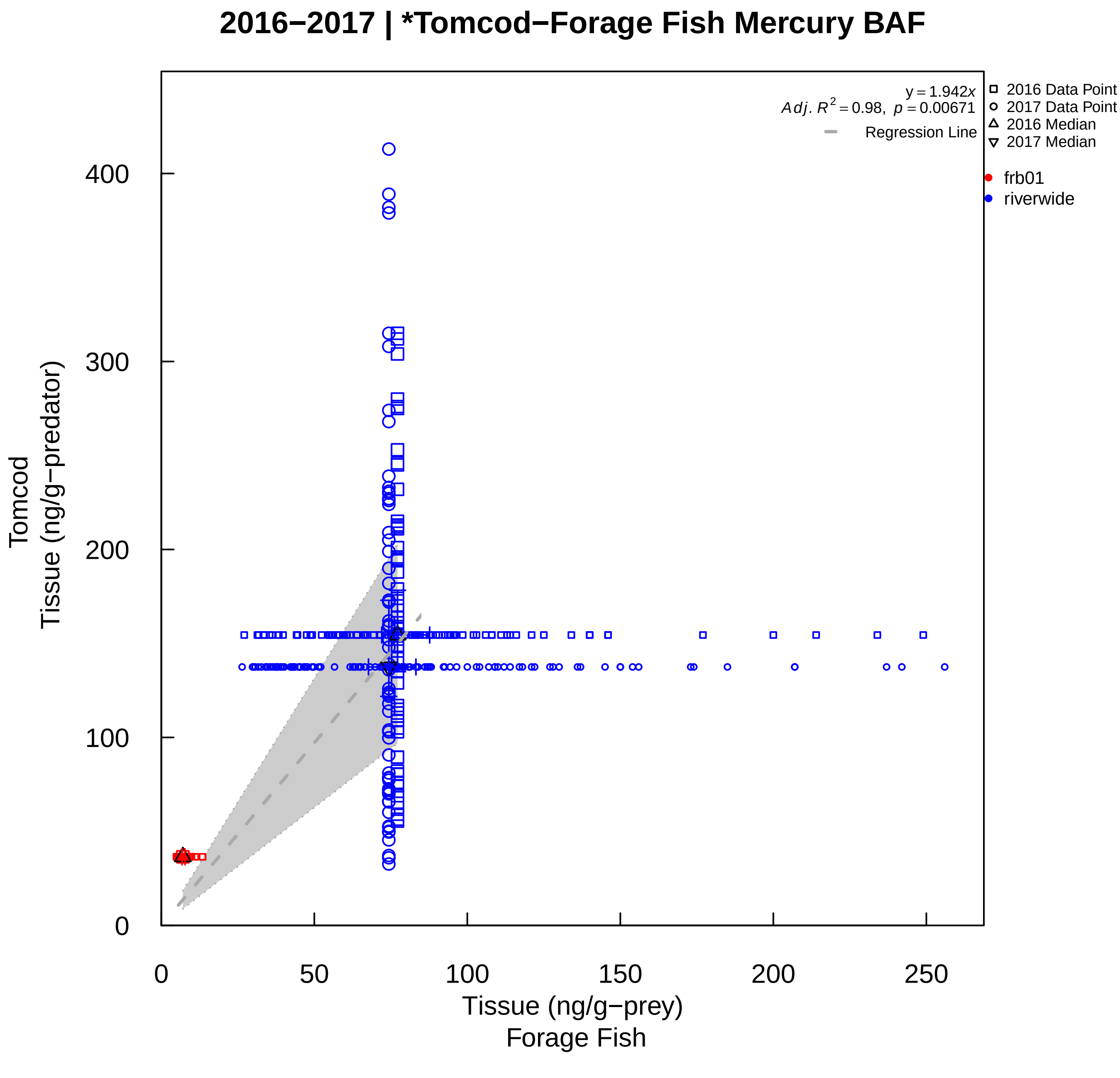
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.

SUMMARY OF BAF LINEAR REGRESSION MODEL RESULTS
WITH EXTREME VALUES PRESENT

		Linear Regression Model Summary			
BAF Pair [1] (Predator-Prey)	**Parameter**	**estimate**	**std.error**	**p.value**	**adj.r.squared**
Eel-Mummichog	Mercury	5.8	2.6	0.092	0.44
Eel-Mummichog	Methyl Mercury	5.9	2.7	0.092	0.44
Eel-Polychaetes	Mercury	3.8	1.2	0.024	0.61
Eel-Polychaetes	Methyl Mercury	41	16	0.053	0.47
Eel-Smelt	Mercury	4.4	0.94	0.0055	0.78
Eel-Smelt	Methyl Mercury	4.9	1	0.0055	0.78
Eel-Terrestrial Insect	Mercury	9.8	5.5	0.17	0.35
Eel-Terrestrial Insect	Methyl Mercury	13	7	0.16	0.38
Eel-ForageFish	Mercury	6.1	2.2	0.042	0.51
Eel-ForageFish	Methyl Mercury	6.6	2.3	0.038	0.53
Mummichog-Terrestrial Insect	Mercury	0.68	0.21	0.087	0.75
Mummichog-Terrestrial Insect	Methyl Mercury	1.5	0.35	0.054	0.84
Nelson's Sparrow-Terrestrial Insect	Mercury	36	11	0.013	0.55
Nelson's Sparrow-Terrestrial Insect	Methyl Mercury	79	14	0.00083	0.79
Smelt-Mummichog	Mercury	0.82	0.17	0.00063	0.68
Smelt-Mummichog	Methyl Mercury	0.75	0.15	0.00063	0.68
Spider-Terrestrial Insect	Mercury	1.6	1	0.15	0.16
Spider-Terrestrial Insect	Methyl Mercury	4.2	1.8	0.049	0.37
Tomcod-Forage Fish	Mercury	1.9	0.16	0.0065	0.98
Tomcod-Forage Fish	Methyl Mercury	1.8	0.15	0.0066	0.98

Notes:

1 Paired biota samples (Predator-Prey) collected 2016 - 2017, unless indicated otherwise.

2 Paired biota samples (Predator-Prey) collected in 2009.

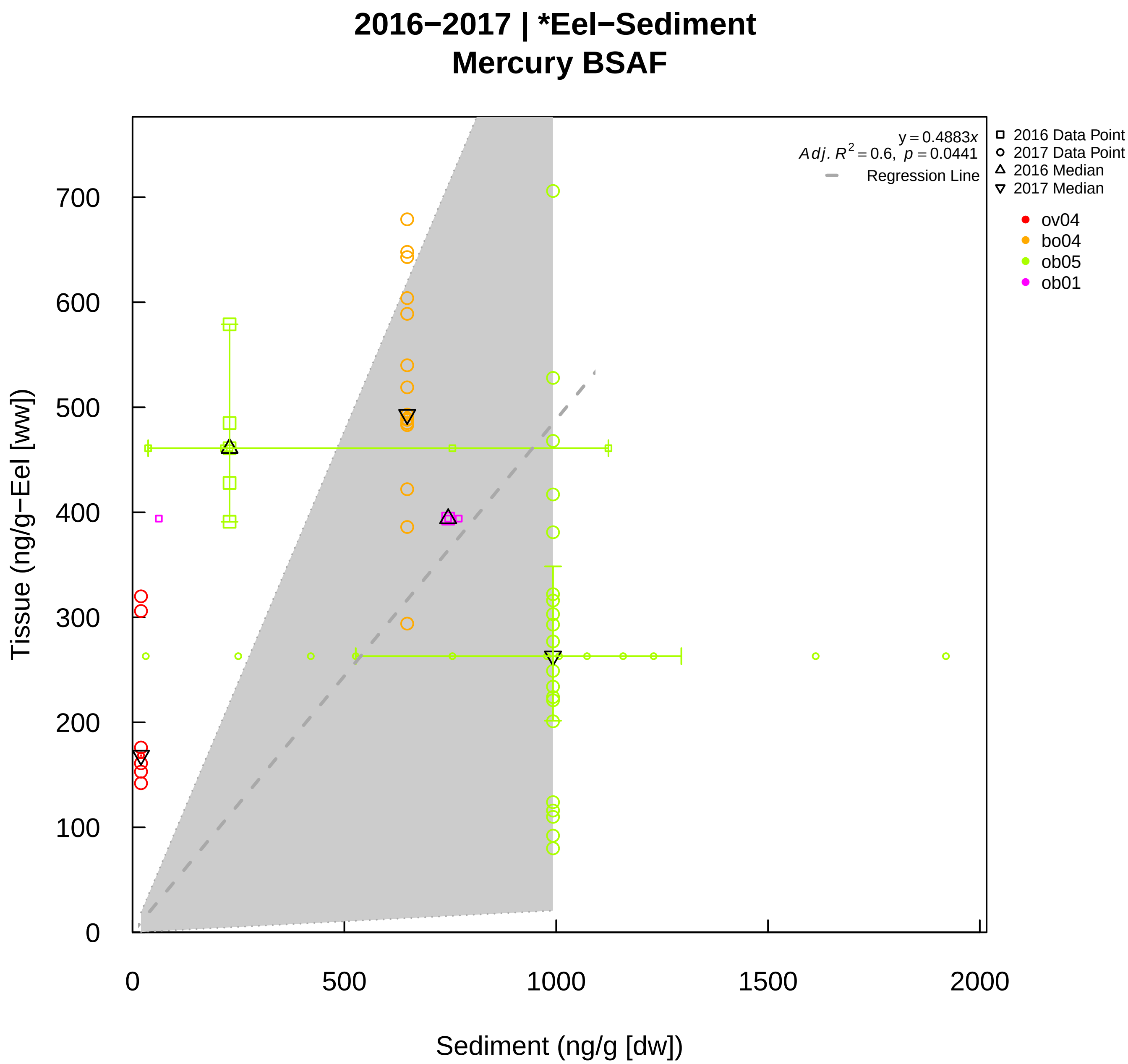
3 Paired biota samples (Predator-Prey) collected in 2015.

4 Paired biota samples (Predator-Prey) collected in 2017.

5 -- indicates regression model not applicable (sample size < 2).

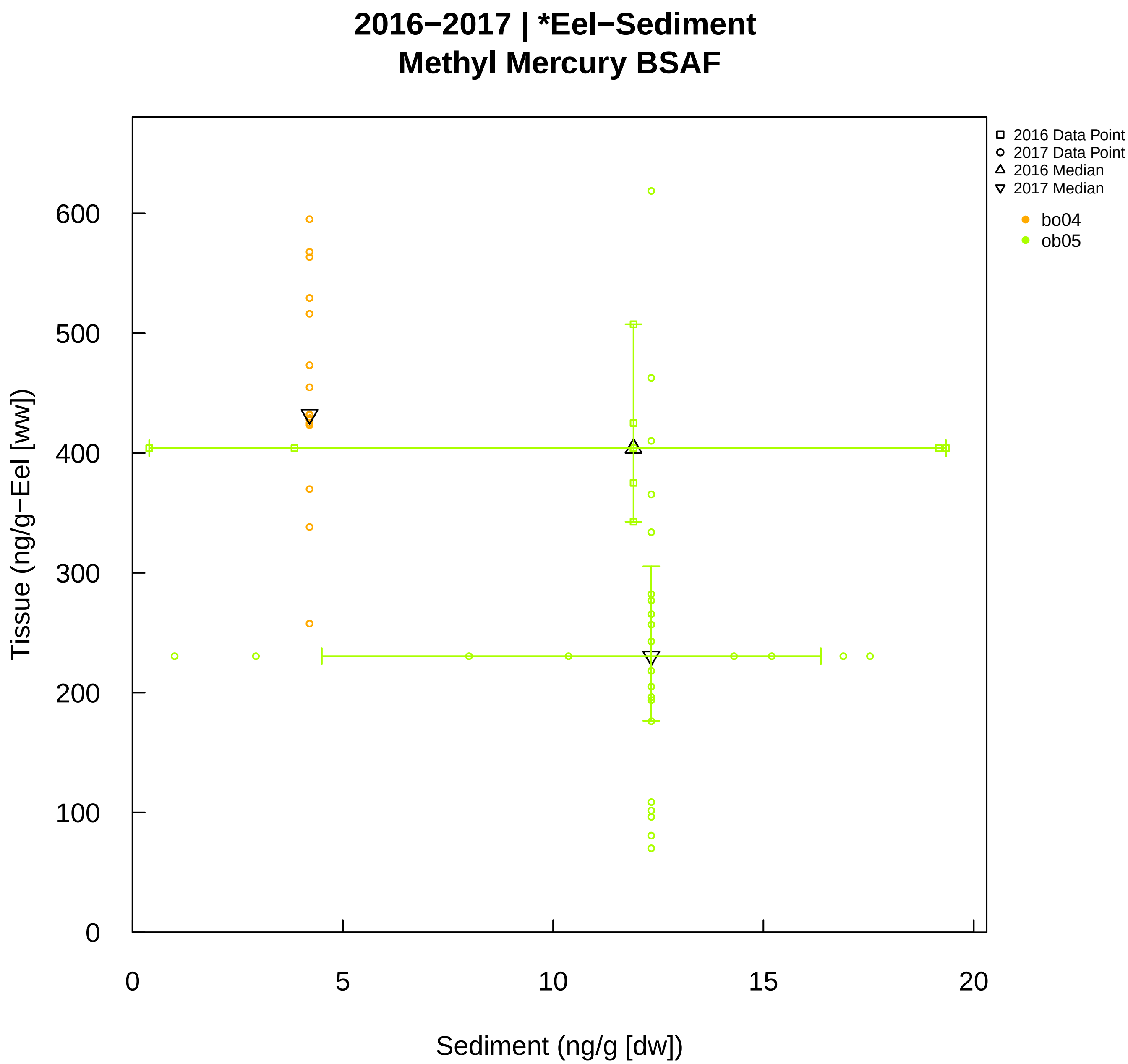
6 Highlighted cells indicate:

p-value < 0.05; statistically significant	0.049
0.10 > p-value ≥ 0.05; approaching significance	0.08
p-value > 0.10; not statistically different from zero	0.35



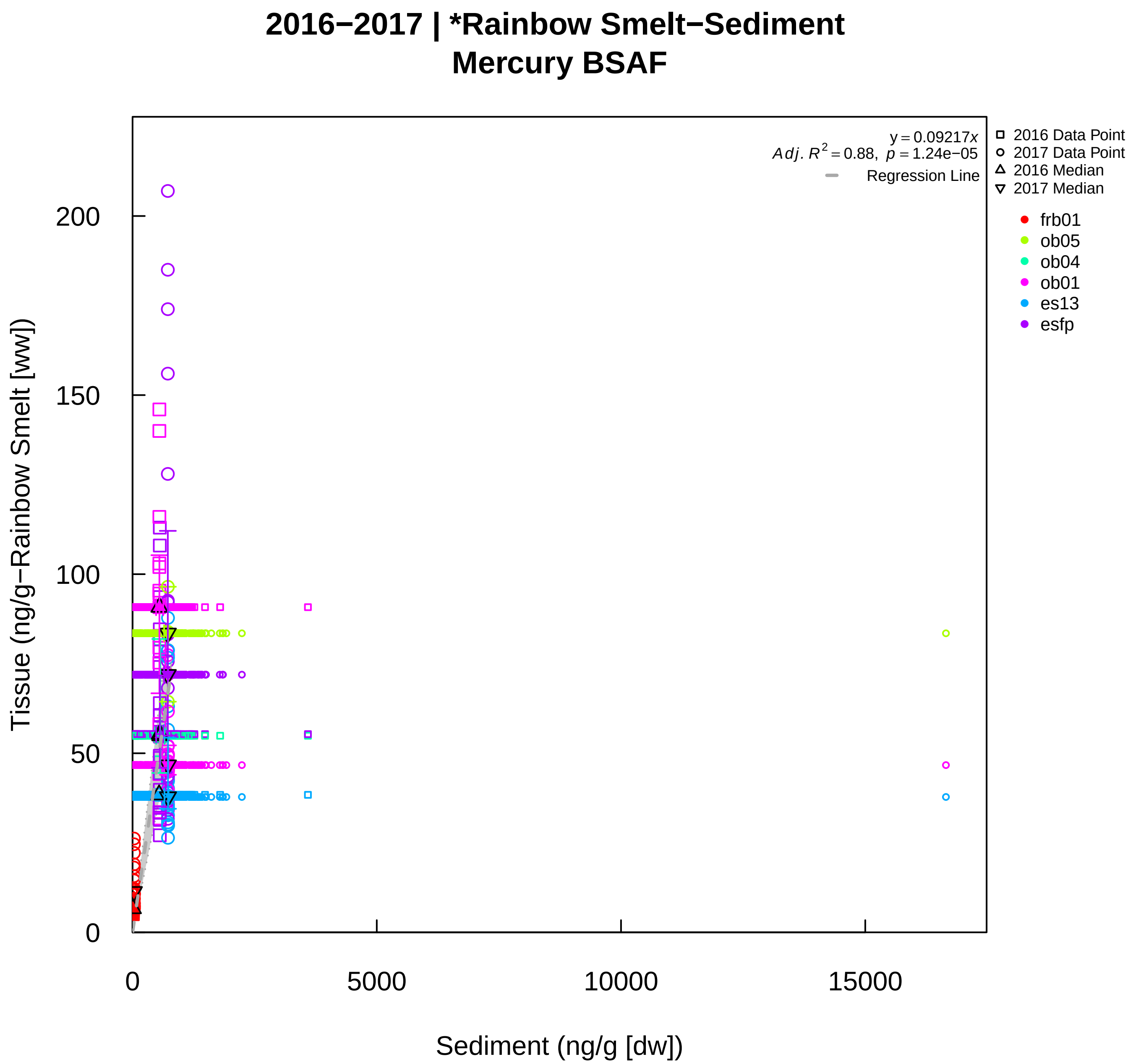
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



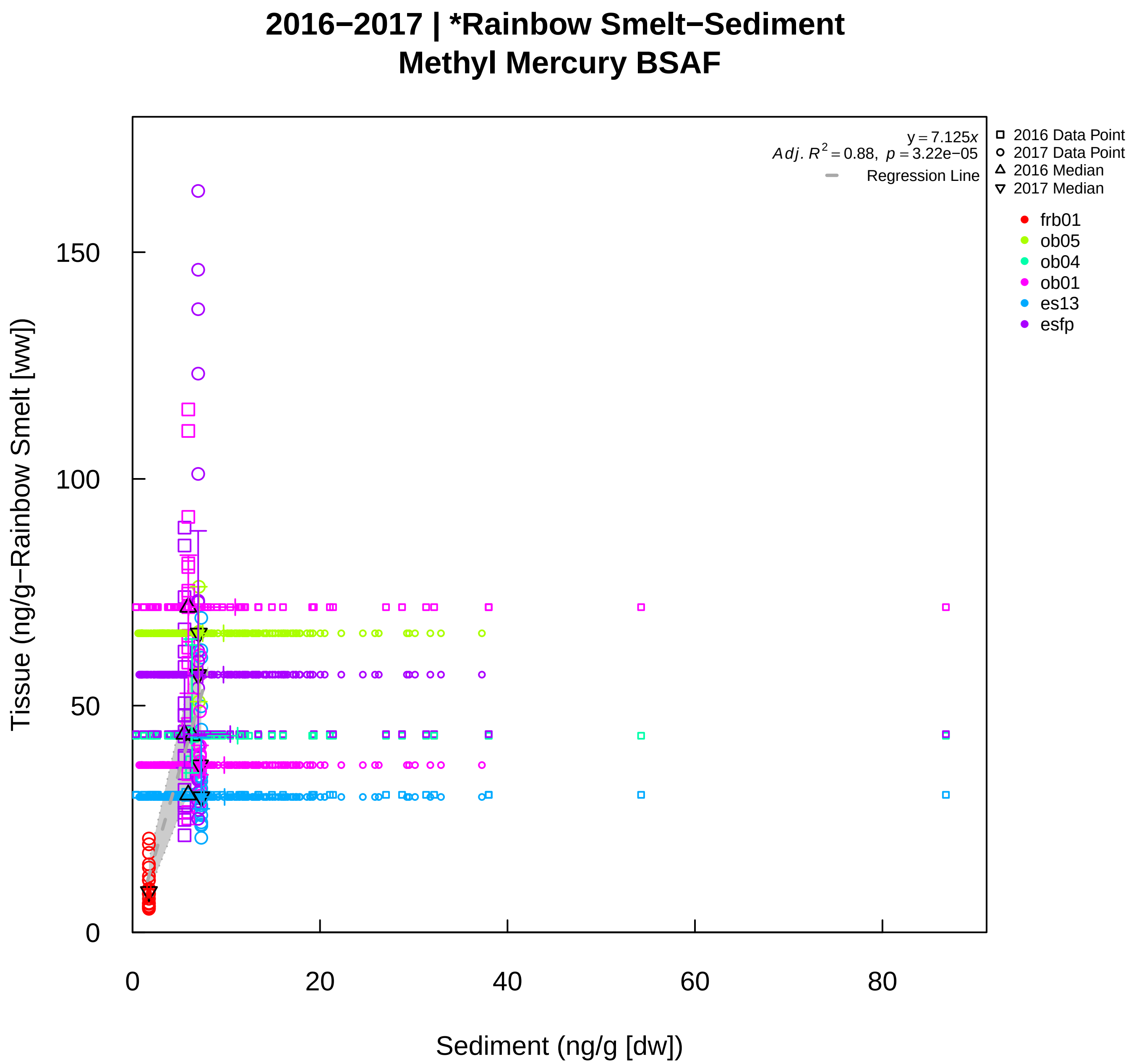
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



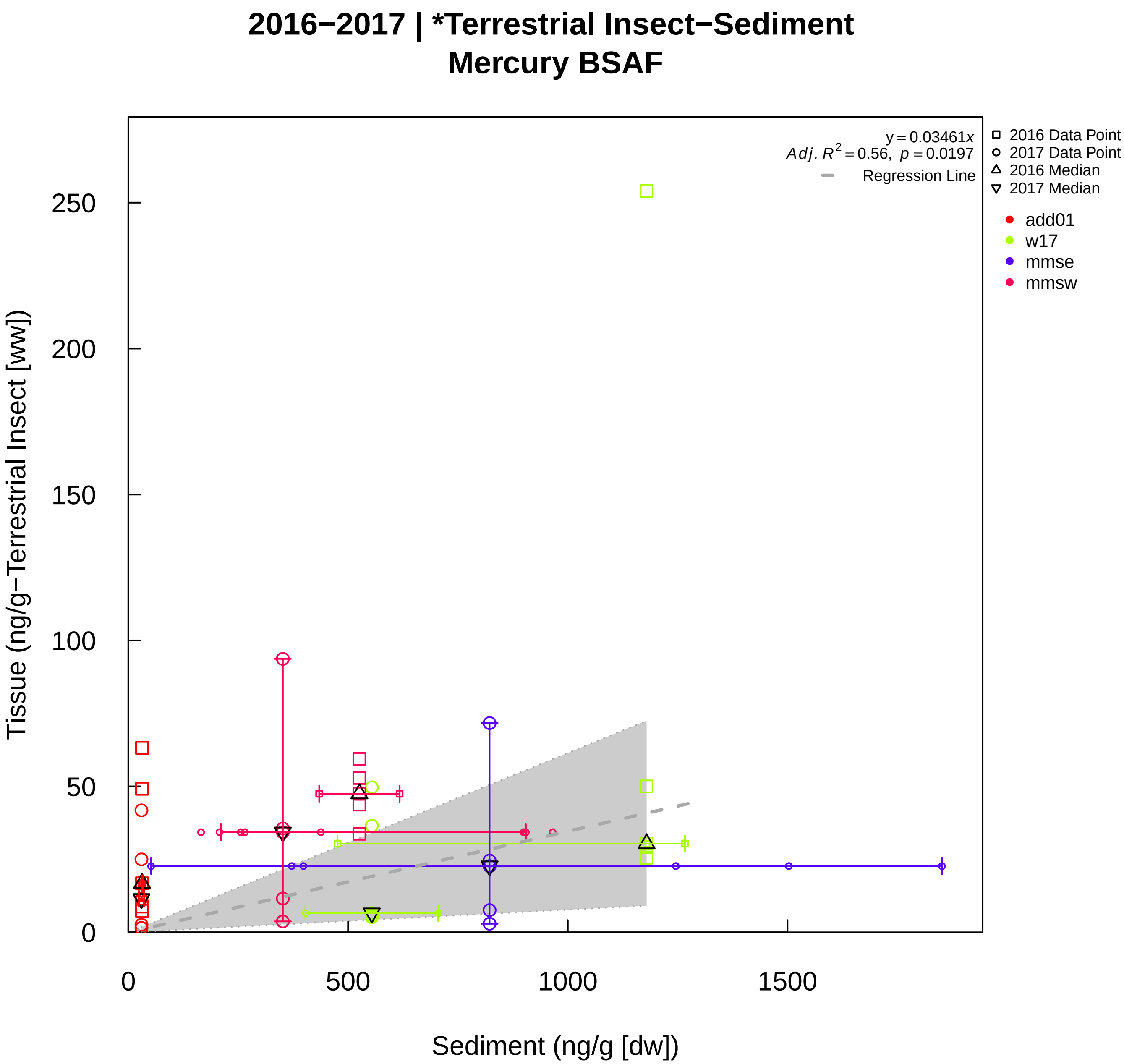
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



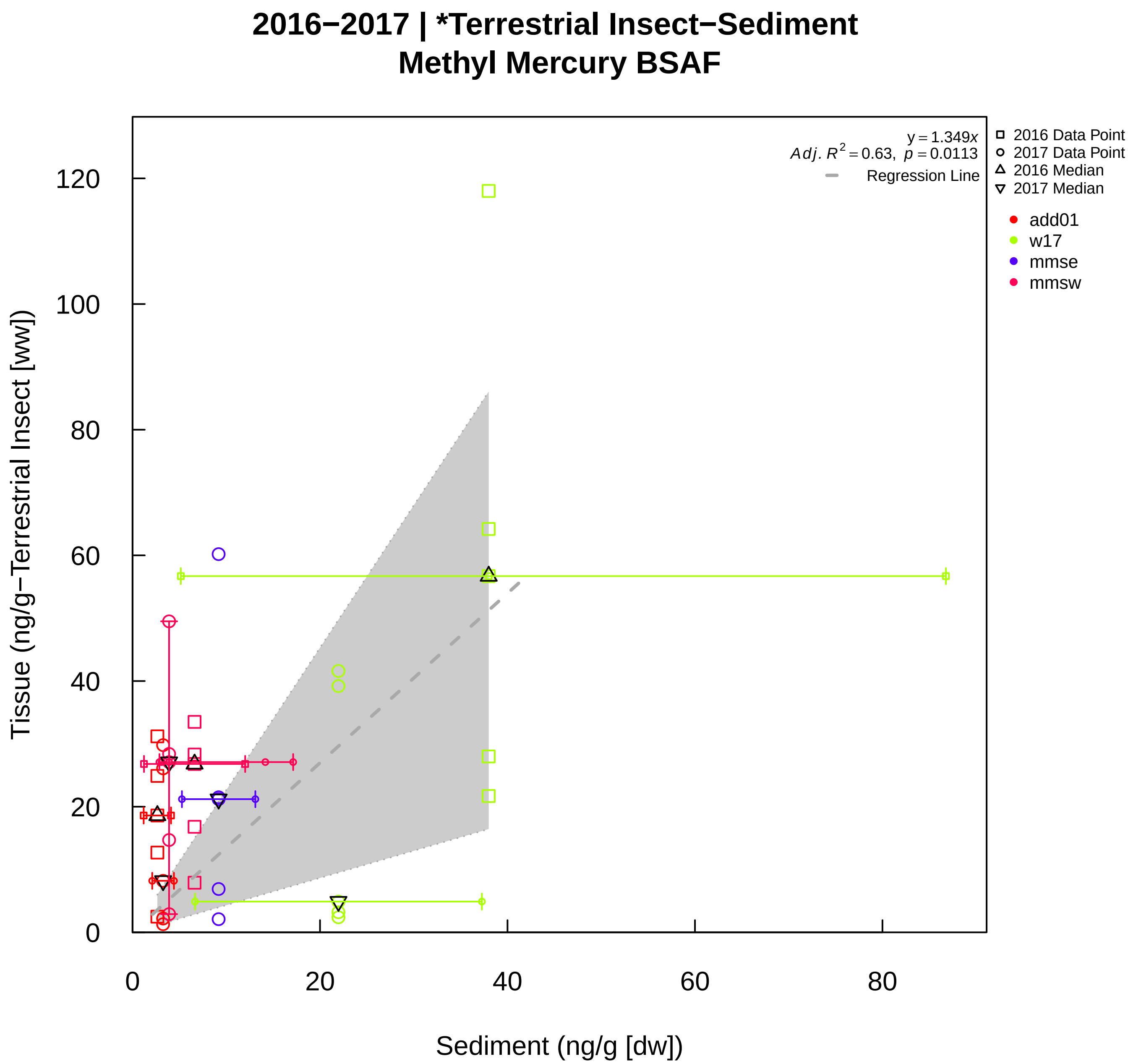
Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.



Grey shaded region represents the regression 95% confidence interval.

*-Indicates regression on outlier-free data.

SUMMARY OF BSAF LINEAR REGRESSION MODEL RESULTS WITH EXTREME VALUES REMOVED

		BSAF Linear Regression Model Summary			
Biota [1]	**Parameter**	**estimate**	**std.error**	**p.value**	**adj.r.squared**
Eel	Mercury	0.49	0.17	0.044	0.6
Eel	Methyl Mercury	30	14	0.15	0.57
Smelt	Mercury	0.092	0.011	0.000012	0.88
Smelt	Methyl Mercury	7.1	0.85	0.000032	0.88
Terrestrial Insects	Mercury	0.035	0.011	0.02	0.56
Terrestrial Insects	Methyl Mercury	1.3	0.37	0.011	0.63

Notes:

1 Paired biota and sediment samples collected 2016 - 2017, unless indicated otherwise.

2 Paired biota and sediment samples collected in 2015.

3 Paired biota and sediment samples collected in 2016.

4 -- indicates regression model not applicable (sample size < 2).

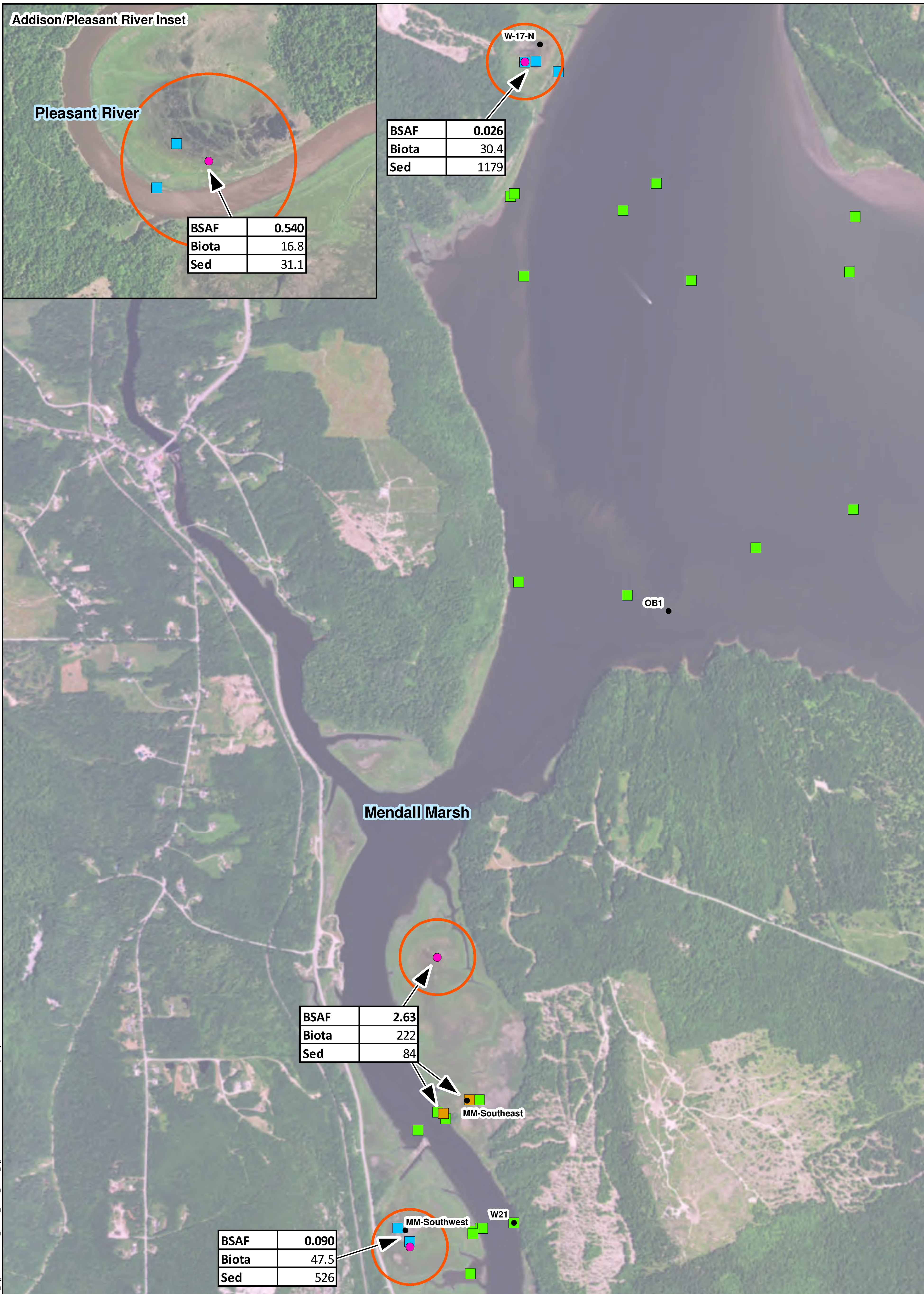
5 * indicates omission of one or more extreme median values from regression.

6 Highlighted cells indicate:

p-value < 0.05; statistically significant	0.04
0.10 > p-value ≥ 0.05; approaching significance	0.076
p-value ≥ 0.10; not statistically different from zero	0.34

C-5

BSAF Figures (2016-2017)



amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Mendall Marsh Geographic Area Label

N

0 0.25 0.5 Miles

Legend

- City
- Relevant Site Landmark
- Area ID
- Terrestrial Insect Sample Location
- Collocated Sediment Sample Location
- Sediment Sample Location Outside of Radius
- Sediment Sample Location within Radius
- Terrestrial Insect Home Range Radius - 500ft

Figure 1a
2016 Terrestrial Insects
Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Mendall Marsh Geographic Area Label

N

0 0.25 0.5 Miles

Legend

- City
- Relevant Site Landmark
- Area ID
- Terrestrial Insect Sample Location
- Sediment Sample Location within Radius
- Collocated Sediment Sample Location
- Sediment Sample Location Outside of Radius
- Terrestrial Insect Home Range Radius - 500ft

Figure 1b
2016 Terrestrial Insects
Methyl Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

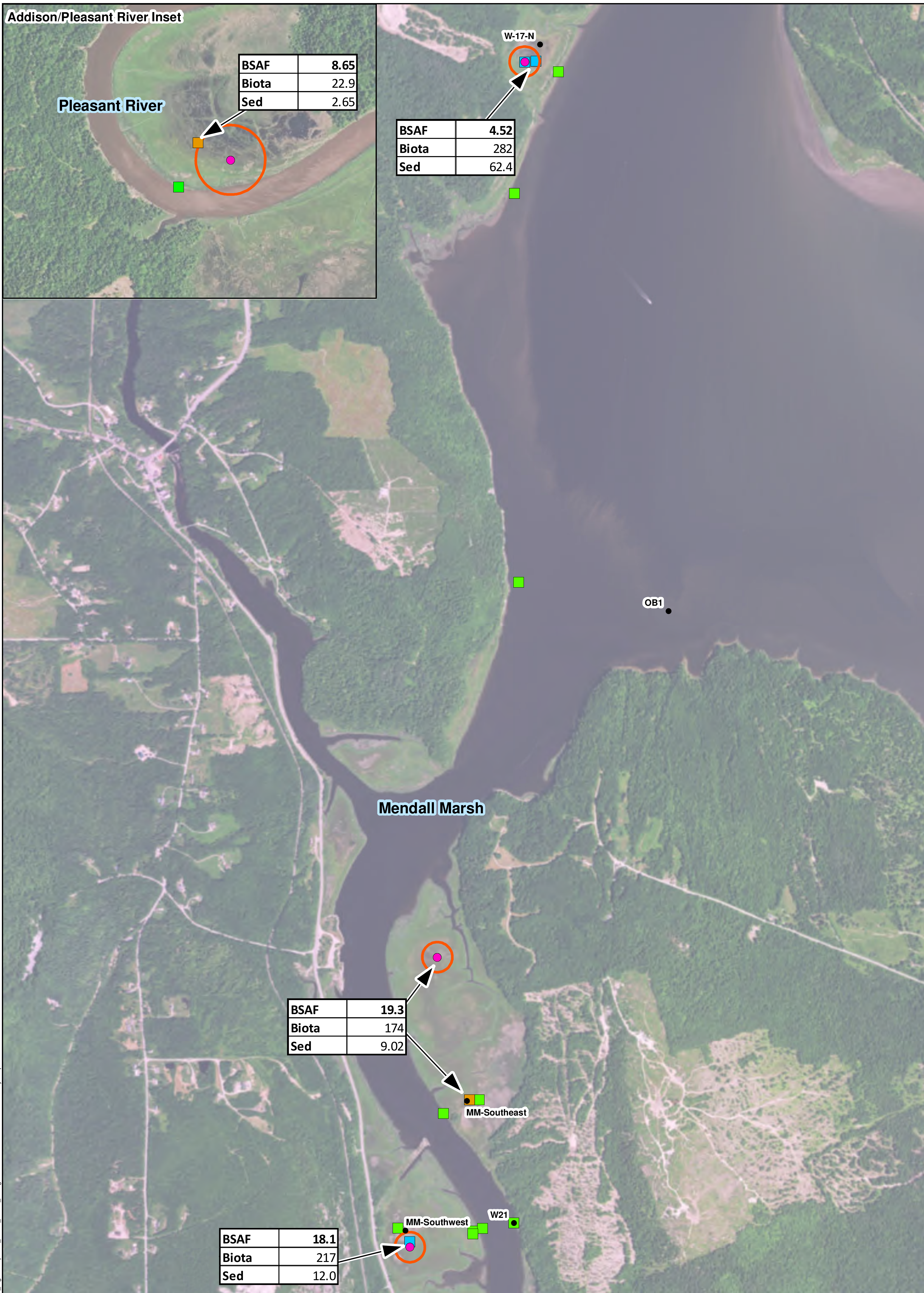
Legend

- City
- Relevant Site Landmark
- Area ID
- Biota
- Collocated Sediment Sample Location
- Sediment Sample Location within Radius
- Sediment Sample Location Outside of Radius
- Spider Home Range Radius - 200ft
- Mendall Marsh: Geographic Area Label

Figure 2a
2016 Spider Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet



BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Legend

- ▲ City
- Relevant Site Landmark
- ● Area ID
- ● Biota
- Sediment Sample Location within Radius
- Collocated Sediment Sample Location
- Sediment Sample Location Outside of Radius
- Spider Home Range Radius - 200ft
- **Mendall Marsh** Geographic Area Label

N

0 0.25 0.5 Miles

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Figure 2b
2016 Spider
Methyl Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

N

Note:
Circle represents combination of 0.4 mile radius home ranges of each sample location

0 0.25 0.5 Miles

Legend

- City
- Relevant Site Landmark
- Area ID
- **Mendall Marsh** Geographic Area Label
- Nelson's Sparrow Sample Location
- Sediment Sample Location within Radius
- Sediment Sample Location Outside of Radius
- Nelson's Sparrow Home Range Radius - 0.4mi

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Figure 3a
2016 Nelson's Sparrow
Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Circle represents combination of 0.4 mile radius home ranges of each sample location

0 0.25 0.5 Miles

N

Legend

- ▲ City
- Relevant Site Landmark
- ● Area ID
- **Mendall Marsh** Geographic Area Label
- Sediment Sample Location within Radius
- Nelson's Sparrow Sample Location
- Sediment Sample Location Outside of Radius
- Nelson's Sparrow Home Range Radius - 0.4mi

Figure 3b
2016 Nelson's Sparrow
Methyl Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

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Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

N

Note:
Circle represents combination of 300 foot radius home ranges of each sample location

0 250 500 Feet

Legend

- Area ID
- Biota
- Sediment Sample Location within Radius
- Sediment Sample Location Outside of Radius
- Red-winged Blackbird Home Range Radius - 300ft
- **Mendall Marsh** Geographic Area Label

Figure 4a
2016 Red-winged Blackbird Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

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Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

N

Mendall Marsh Geographic Area Label

Legend

- Area ID
- Biota
- Sediment Sample Location within Radius
- Sediment Sample Location Outside of Radius
- Red-winged Blackbird Home Range Radius - 300ft

Notes:
1.Circle represents combination of 300 foot radius home ranges of each sample location
2.BSAFs based on conversion of total mercury to methyl mercury in tissue base on historical site-specific data.

0 250 500 Feet

Figure 4b
2016 Red-winged Blackbird
Methyl Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

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Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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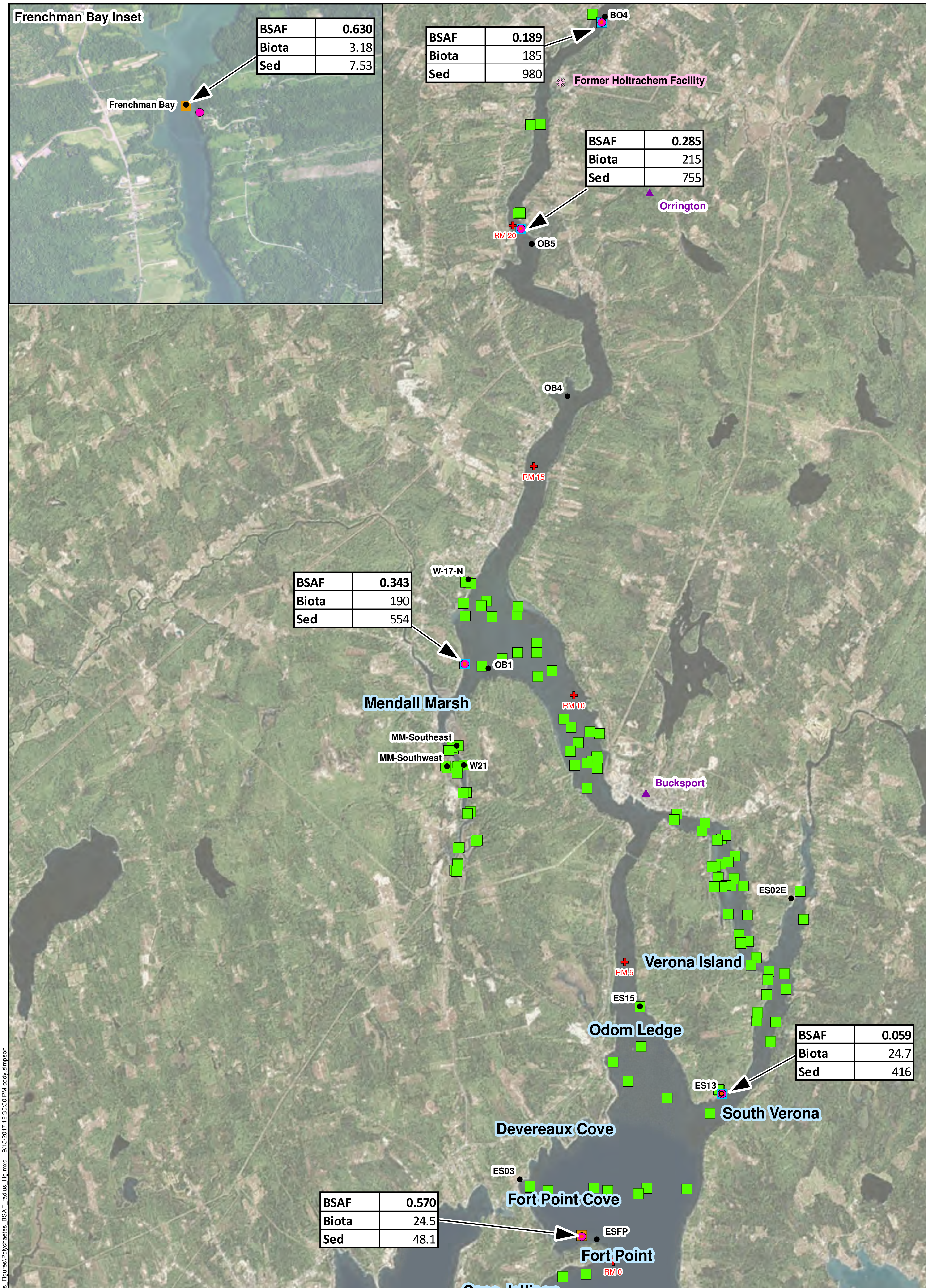

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Mendall Marsh Geographic Area Label

N

0 1 2 Miles

Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Polychaete Sample Location
- Collocated Sediment Sample Location
- Sediment Sample within Radius
- Sediment Sample Location Outside of Radius
- Polychaete Home Range Radius - 50ft

Figure 5a
2016 Polychaetes
Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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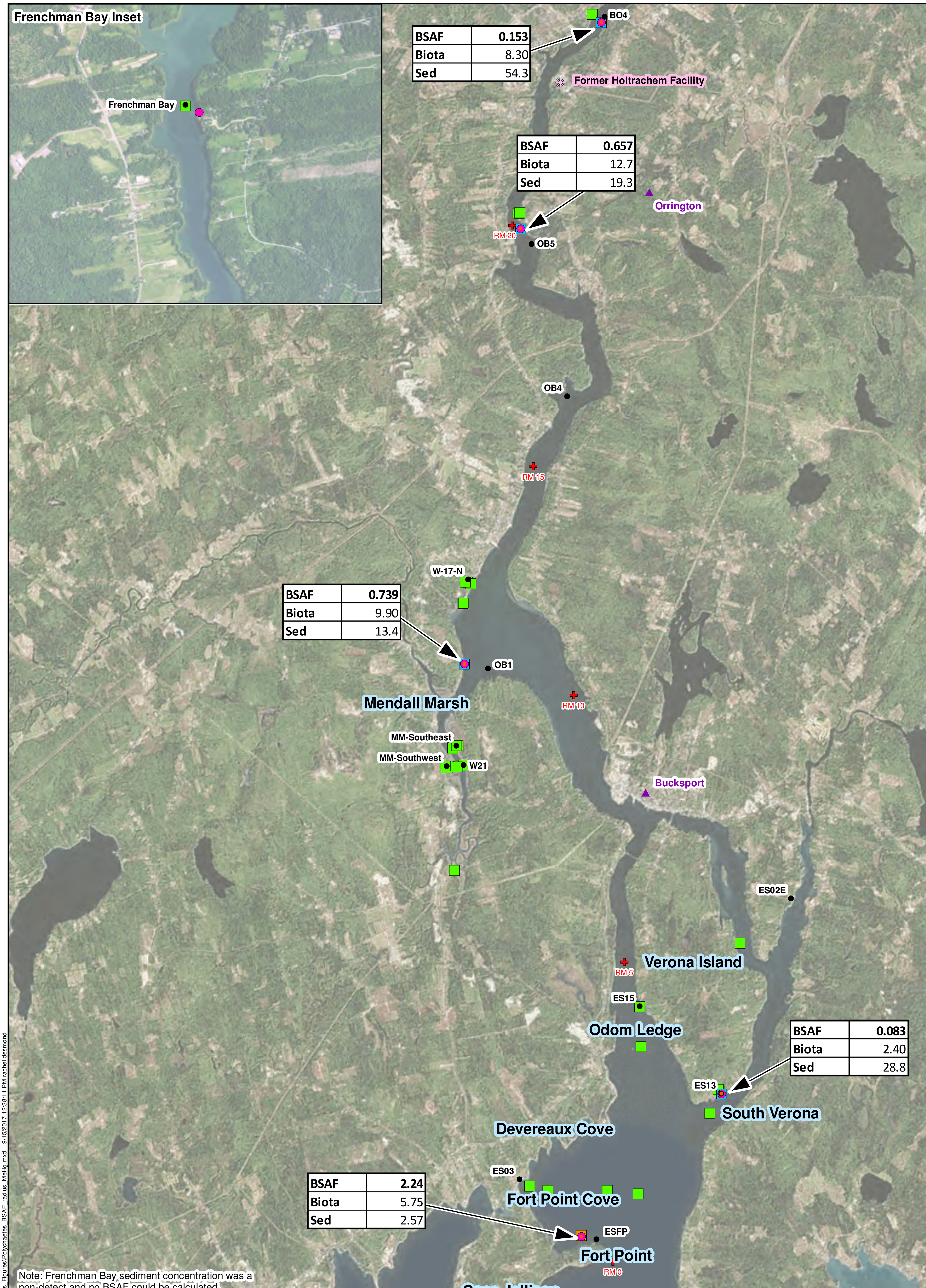


amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Mendall Marsh Geographic Area Label

N

0 1 2 Miles

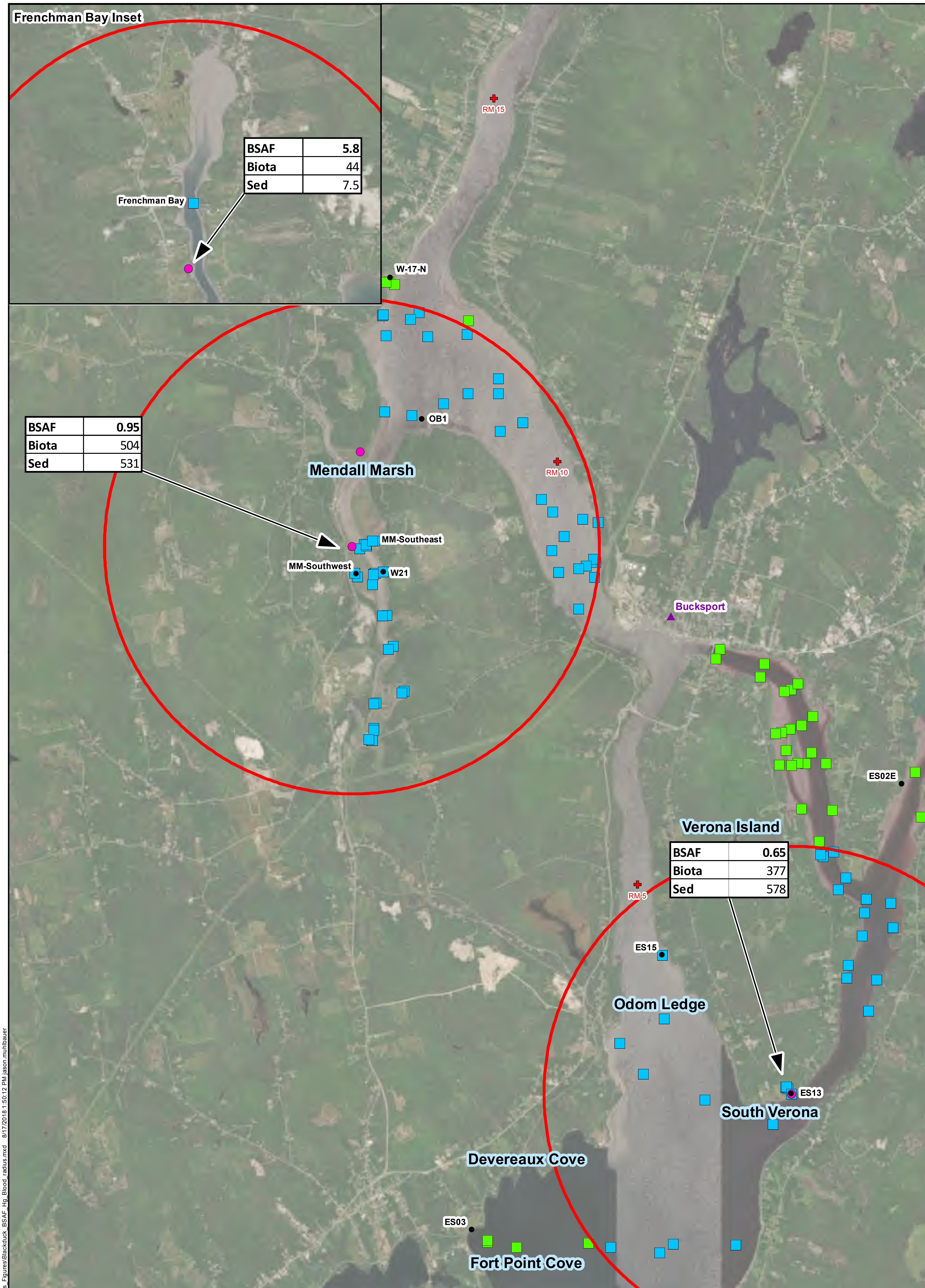
Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Sediment Sample within Radius
- Polychaete Sample Location
- Collocated Sediment Sample Location
- Sediment Sample Location Outside of Radius
- Polychaete Home Range Radius - 50ft

Figure 5b
2016 Polychaetes
Methyl Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 10/11/2017 | Checked/Date: KPH 10/11/2017 | NAD83 State Plane Maine East, US Survey Feet



amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Legend

- River Mile Marker
- City
- Area ID
- Black Duck Sample Location
- Sediment Sample Location within Radius
- Sediment Sample Location Outside of Radius
- Black Duck Home Range Radius - 2.5mi
- **Mendall Marsh** Geographic Area Label

N 0 1 2 Miles

Figure 6a
2016 Black Duck
Mercury Blood BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 8/17/2018 | Checked/Date: LO 8/17/2018 | NAD83 State Plane Maine East, US Survey Feet

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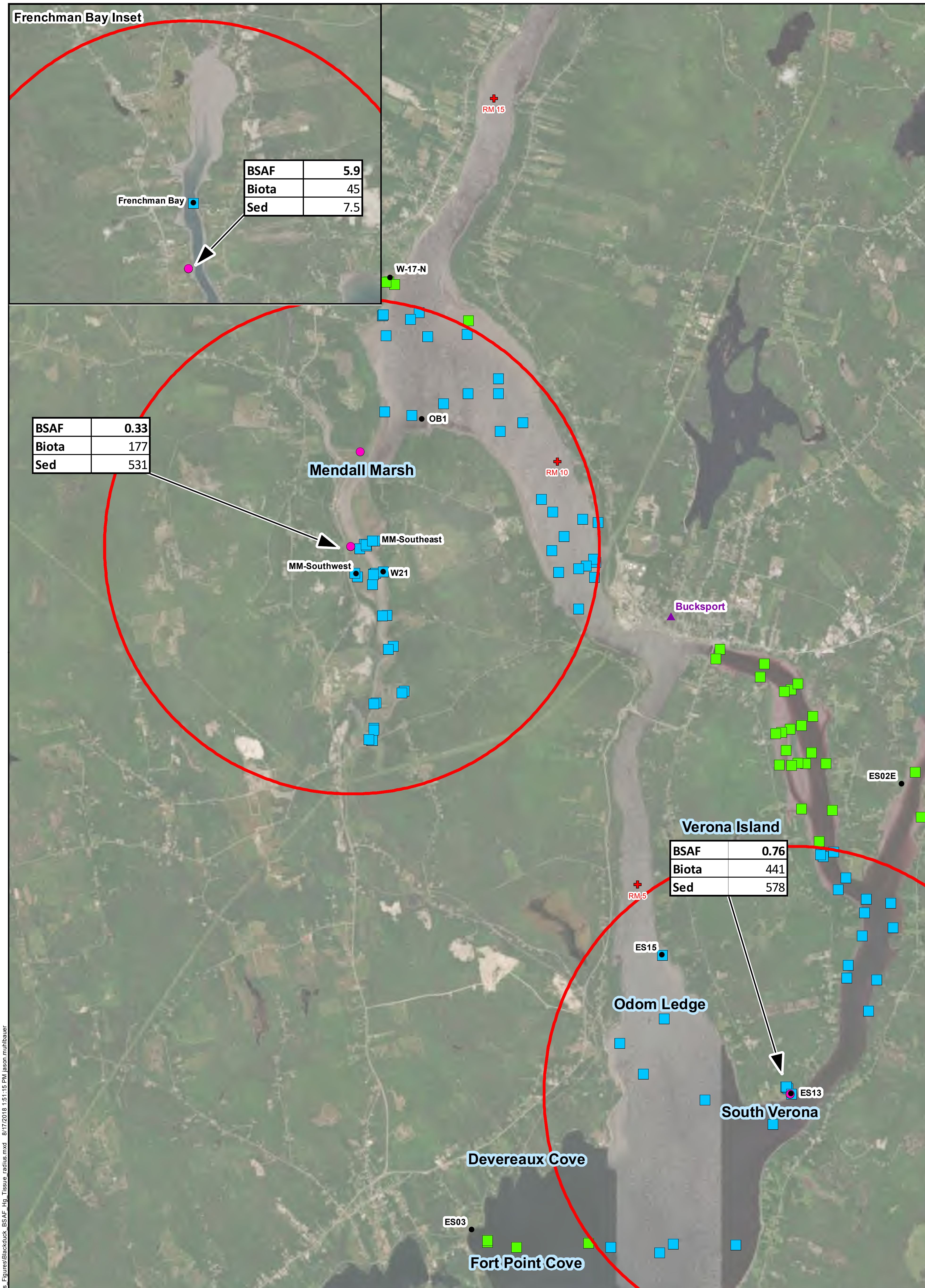

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

River Mile Marker
City
Area ID
Black Duck Sample Location

Legend

Sediment Sample Location within Radius
Sediment Sample Location Outside of Radius
Black Duck Home Range Radius - 2.5mi

Mendall Marsh Geographic Area Label

N
0 1 2 Miles

Figure 6b
2016 Black Duck
Mercury Tissue BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

amec foster wheeler

Project: 3616166052 | Prepared/Date: RD 8/17/2018 | Checked/Date: LO 8/17/2018 | NAD83 State Plane Maine East, US Survey Feet

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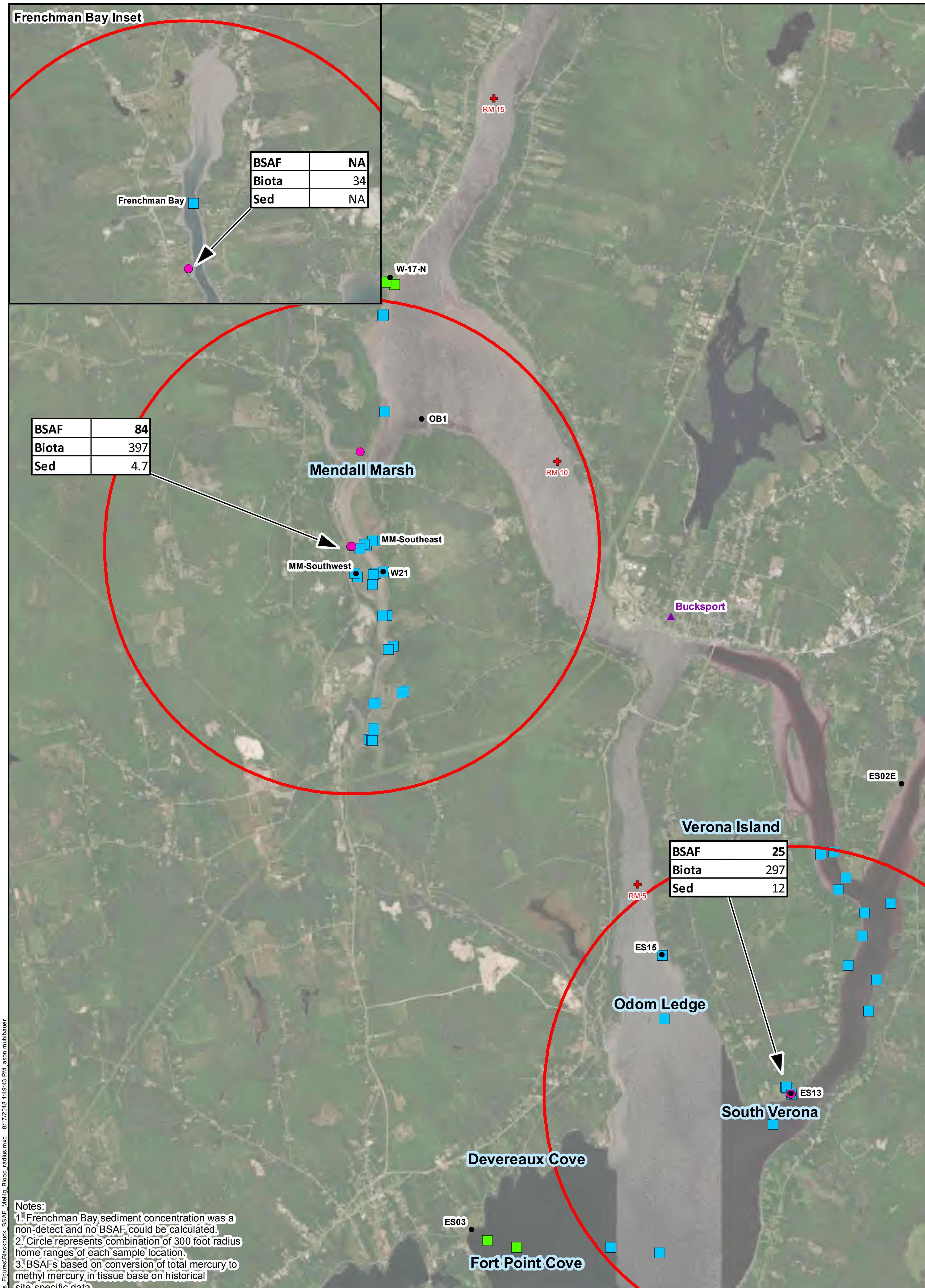

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Mendall Marsh Geographic Area Label

0 1 2 Miles

Legend

- River Mile Marker
- City
- Area ID
- Black Duck Sample Location
- Sediment Sample Location Outside of Radius
- Sediment Sample Location Inside of Radius
- Black Duck Home Range Radius - 2.5mi

Figure 6c
2016 Black Duck
Methyl Mercury Blood BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 8/17/2018 | Checked/Date: LO 8/17/2018 | NAD83 State Plane Maine East, US Survey Feet

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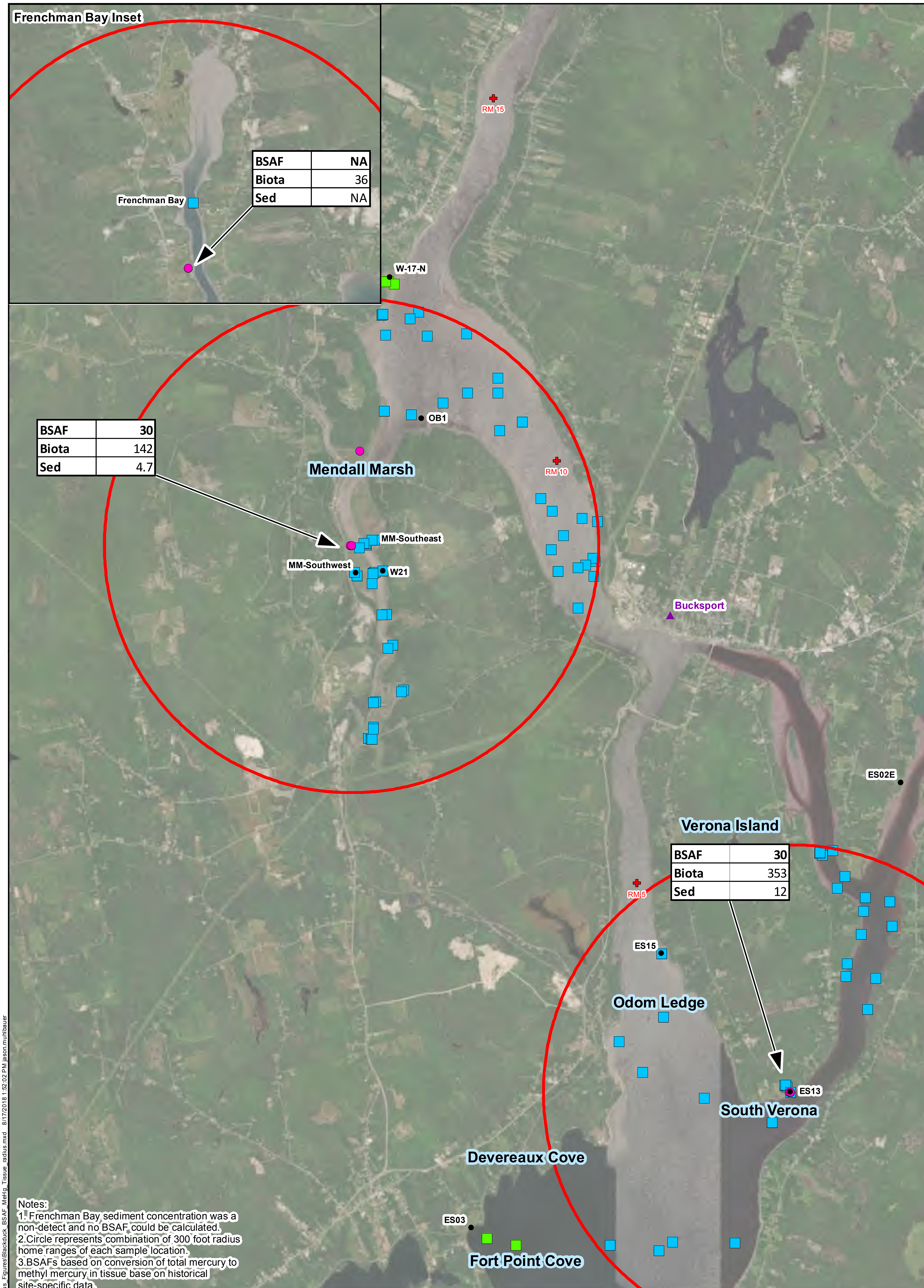

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Mendall Marsh Geographic Area Label

N

0 1 2 Miles

Legend

- River Mile Marker
- City
- Area ID
- Black Duck Sample Location
- Sediment Sample Location Inside of Radius
- Sediment Sample Location Outside of Radius
- Black Duck Home Range Radius - 2.5mi

Figure 6d
2016 Black Duck
Methyl Mercury Tissue BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052	Prepared/Date: RD 8/17/2018	Checked/Date: LO 8/17/2018	NAD83 State Plane Maine East, US Survey Feet

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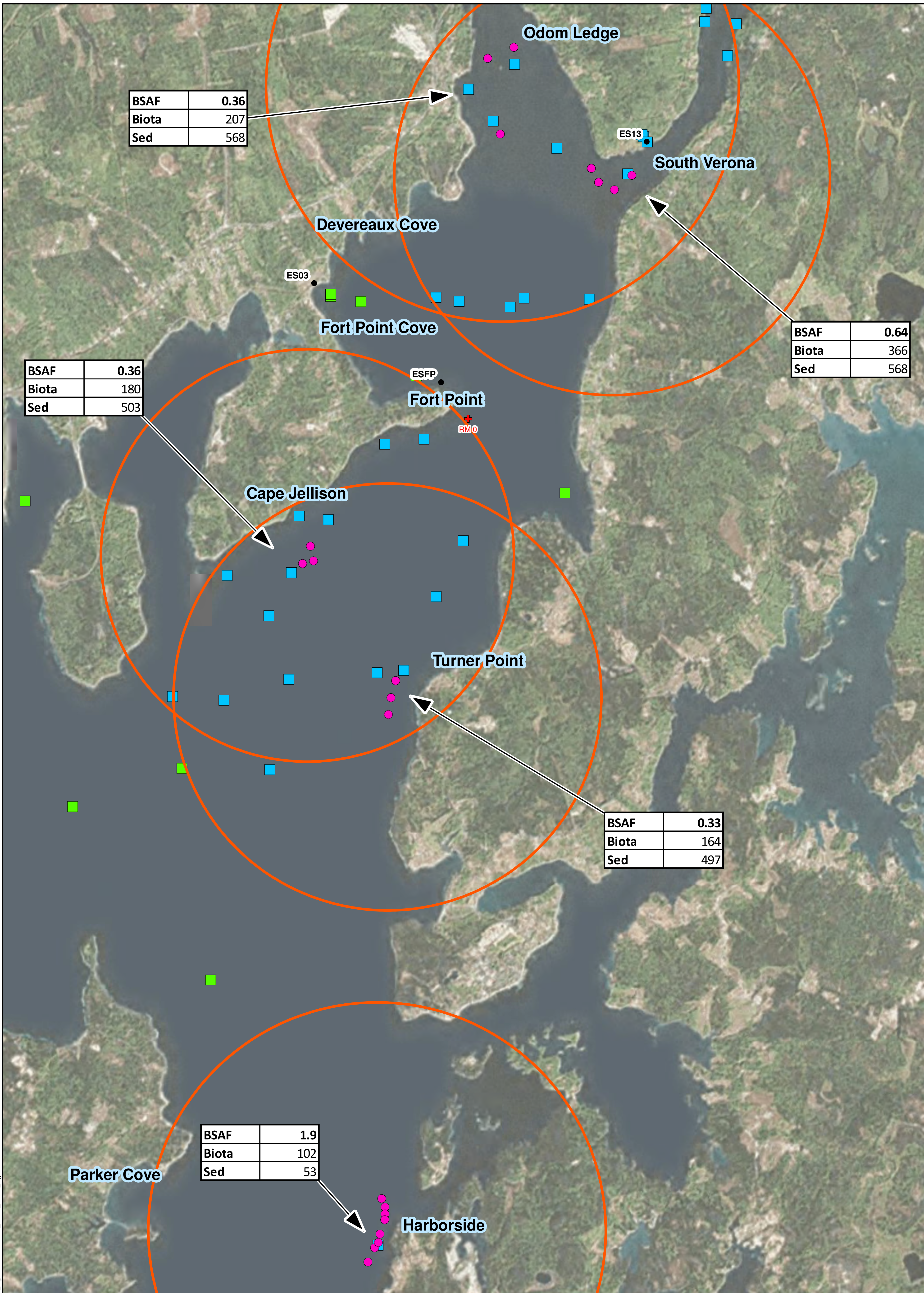

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

N

Note:
Circle represents combination of 1.9 mile radius home ranges of each sample location

0 1 2 Miles

Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Lobster Sample Location
- Sediment Sample Location within Radius
- Sediment Sample Location Outside of Radius
- Lobster Home Range Radius - 1.9mi
- **Mendall Marsh** Geographic Area Label

amec foster wheeler

Figure 7a
2016 Lobster
Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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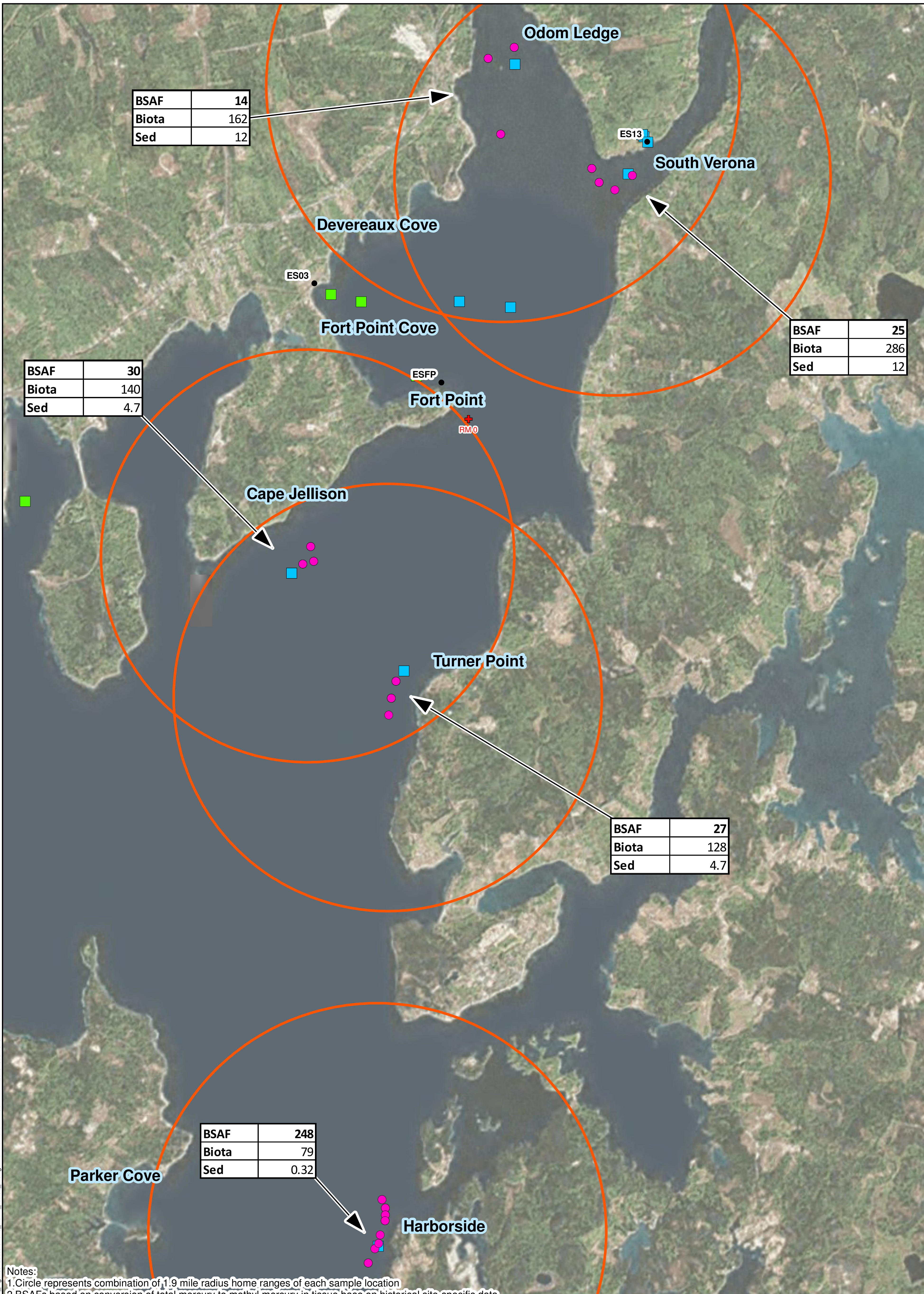

Notes:
1. Circle represents combination of 1.9 mile radius home ranges of each sample location
2. BSAFs based on conversion of total mercury to methyl mercury in tissue base on historical site-specific data.

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

N

0 1 2 Miles

Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Sediment Sample Location within Radius
- Lobster Sample Location
- Sediment Sample Location Outside of Radius
- Lobster Home Range Radius - 1.9mi
- **Mendall Marsh** Geographic Area Label

Figure 7b
2016 Lobster
Methyl Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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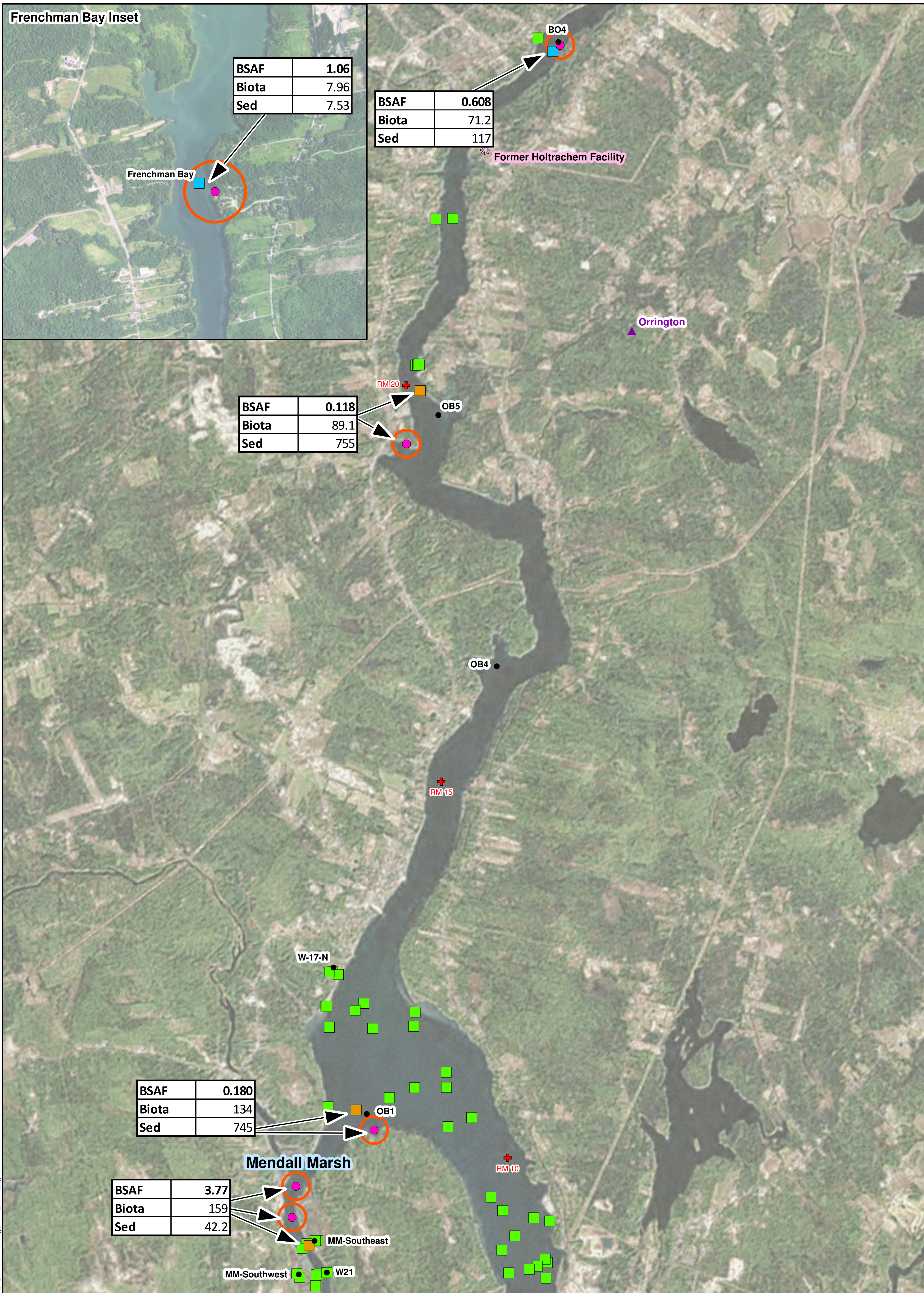

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Mendall Marsh Geographic Area Label

N

0 1 2 Miles

Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Mummichog Sample Location
- Collocated Sediment Sample Location
- Sediment Sample Location within Radius
- Sediment Sample Location Outside of Radius
- Mummichog Home Range Radius - 700ft

amec foster wheeler

Figure 8a
2016 Mummichog
Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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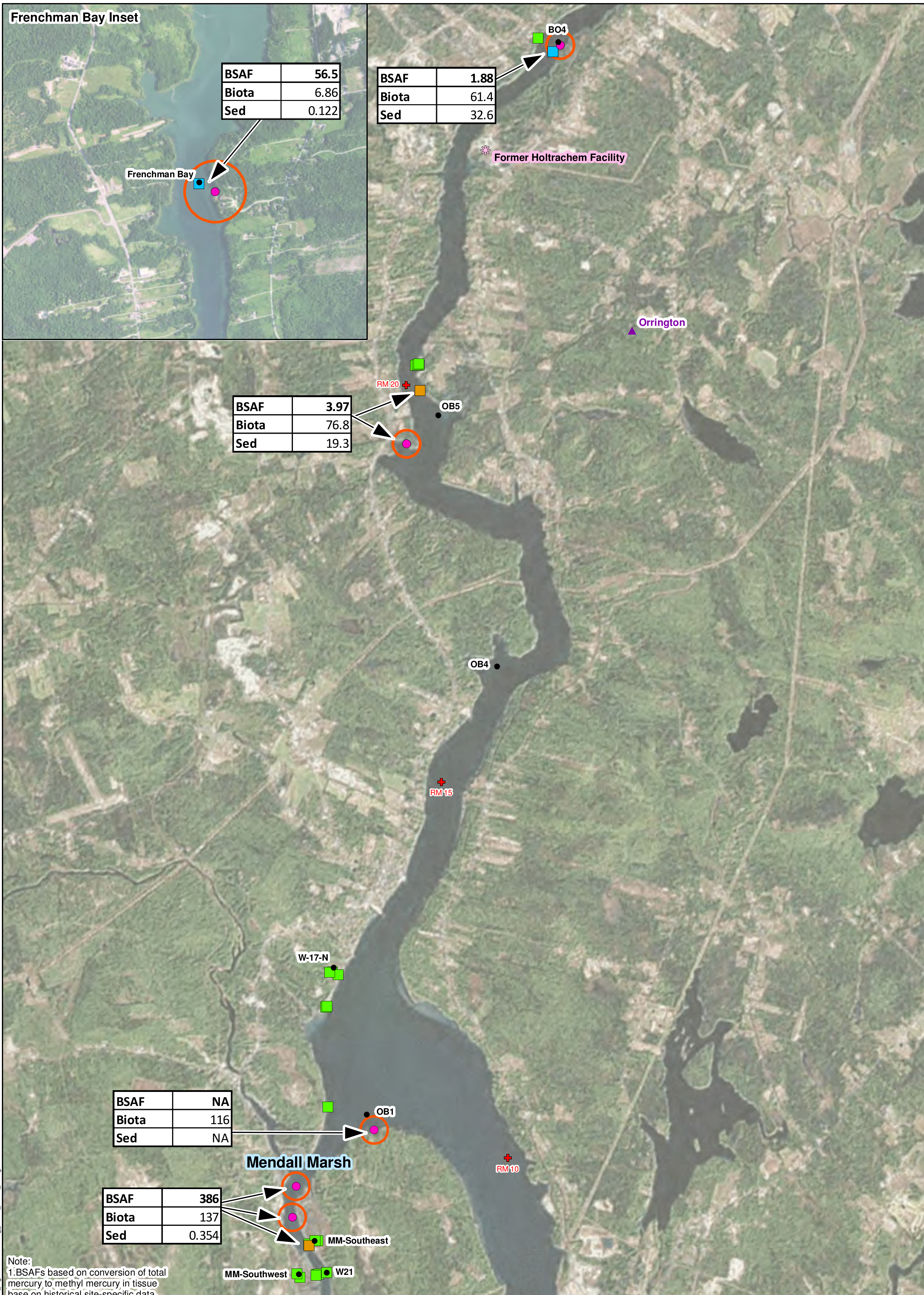

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Mendall Marsh Geographic Area Label

N

0 1 2 Miles

Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Sediment Sample Location within Radius
- Mummichog Sample Location
- Co-located Sediment Sample Location
- Sediment Sample Location Outside of Radius
- Mummichog Home Range Radius - 700ft

Figure 8b
2016 Mummichog
Methyl Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

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Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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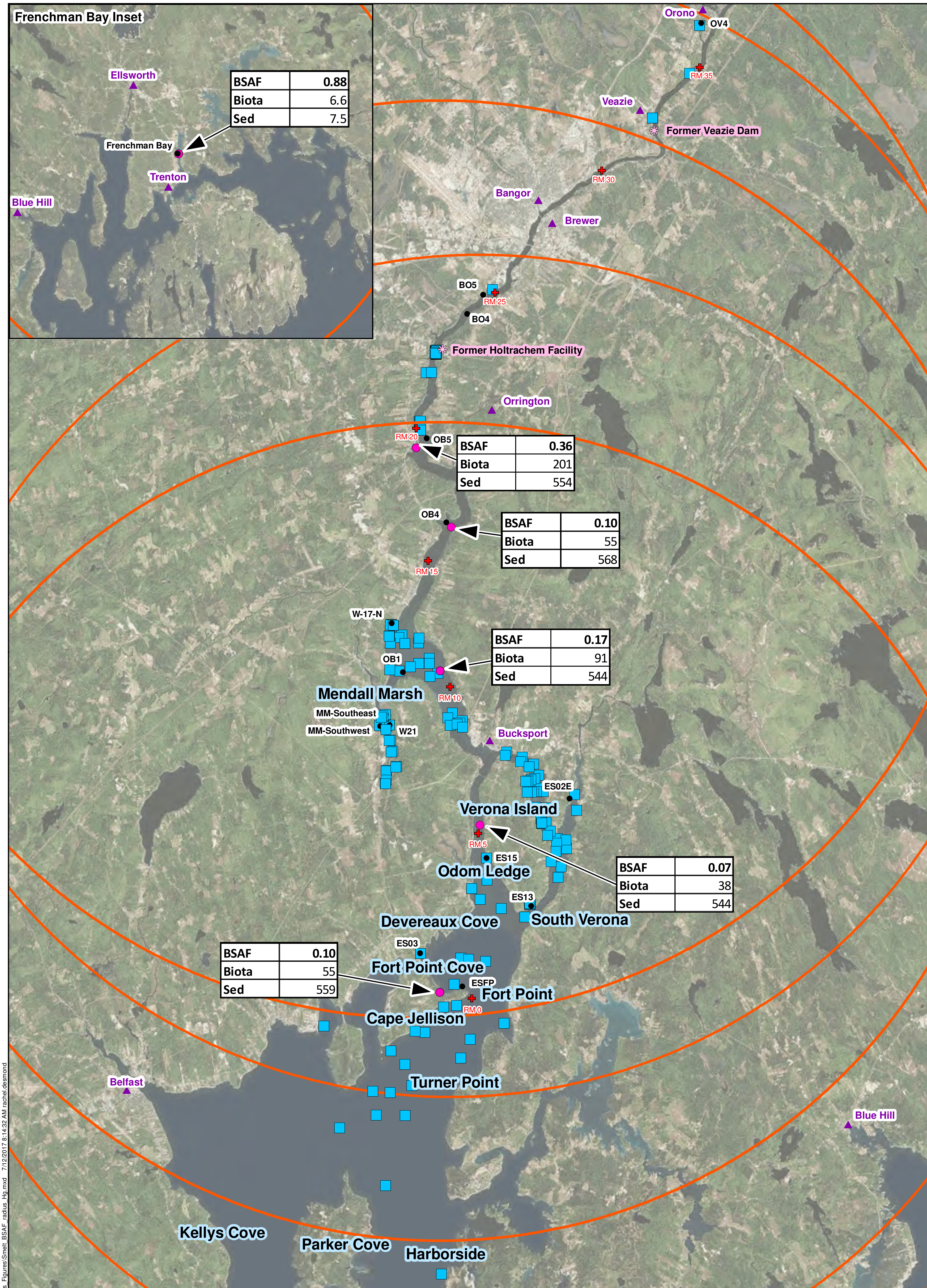

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Circle represents combination of 16.6 mile radius home ranges of each sample location

Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Rainbow Smelt Sample Location
- Sediment Sample Location within Radius
- Rainbow Smelt Home Range Radius - 16.6mi
- **Mendall Marsh** Geographic Area Label

N
0 1 2 Miles

Figure 9a
2016 Rainbow Smelt
Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

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Project: 3616166052	Prepared/Date: RD 9/15/2017	Checked/Date: KPH 9/15/2017	NAD83 State Plane Maine East, US Survey Feet

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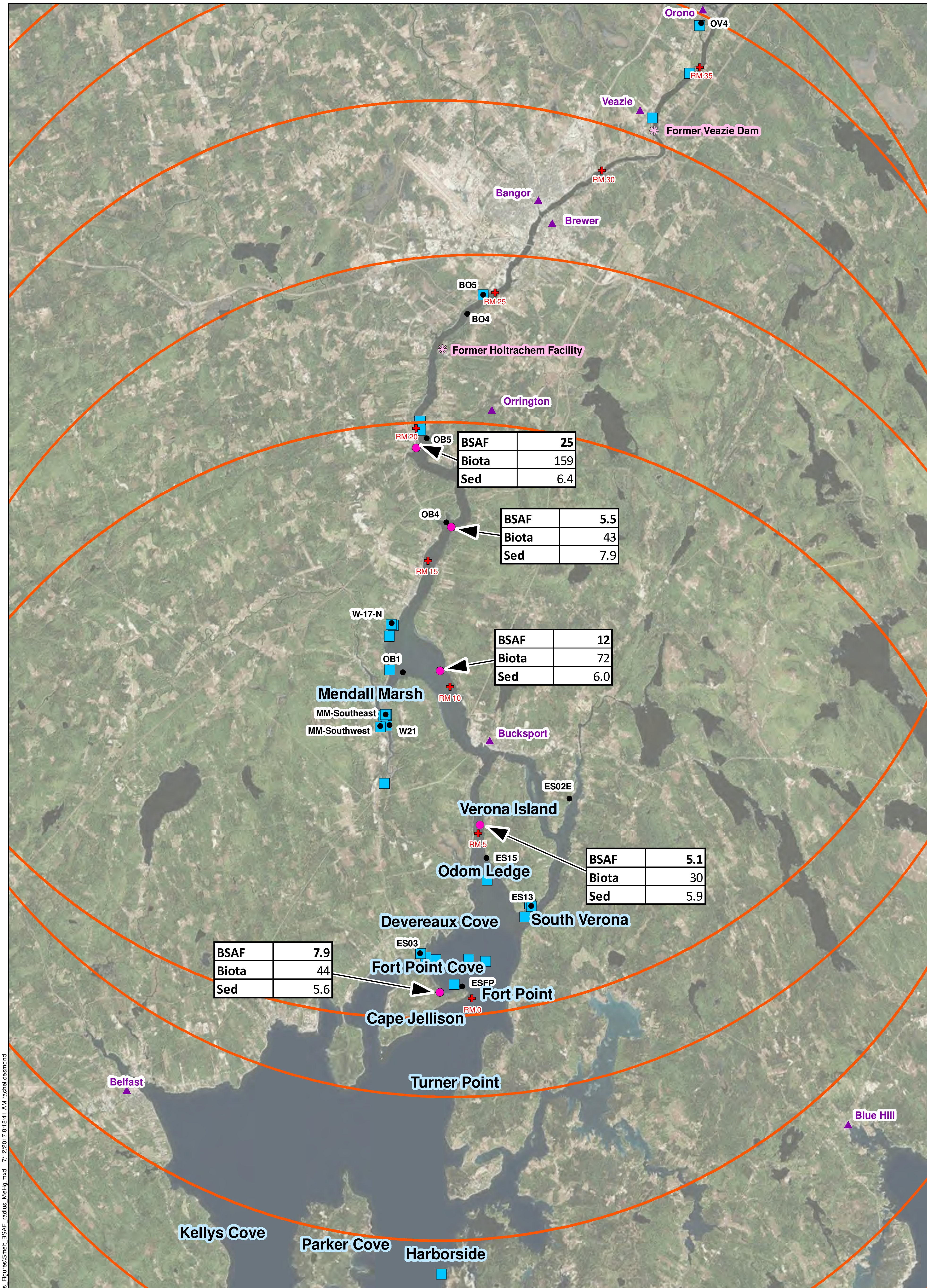

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

N

0 1 2 Miles

Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Rainbow Smelt Sample Location
- Sediment Sample Location within Radius
- Rainbow Smelt Home Range Radius - 16.6mi
- **Mendall Marsh** Geographic Area Label

Notes:
1. Circle represents combination of 16.6 mile radius home ranges of each sample location
2. BSAFs based on conversion of total mercury to methyl mercury in tissue base on historical site-specific data.

Figure 9b
2016 Rainbow Smelt Methyl Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

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Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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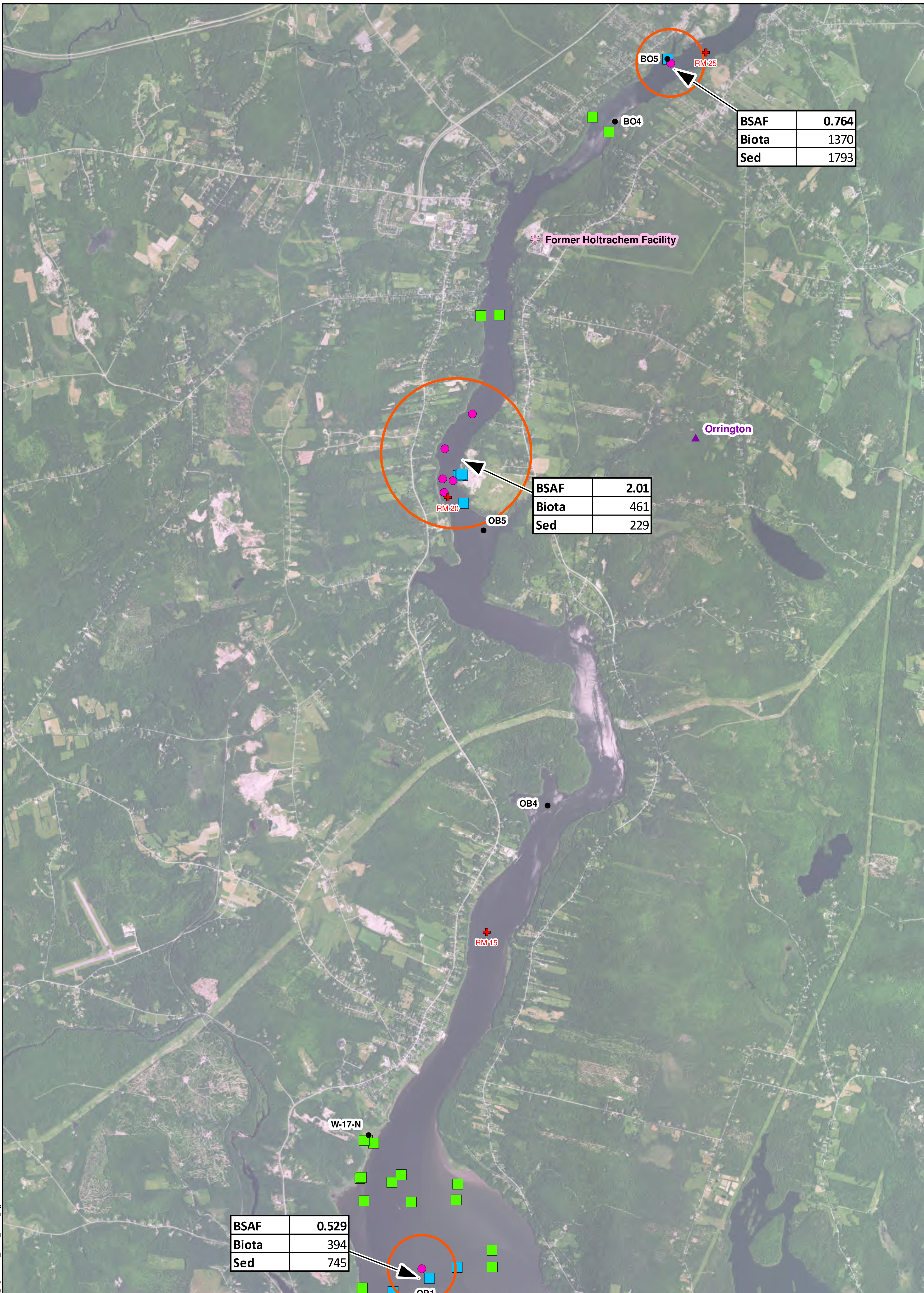

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amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Circle represents combination of 0.3 mile radius home ranges of each sample location

N

Mendall Marsh Geographic Area Label

0 1 2 Miles

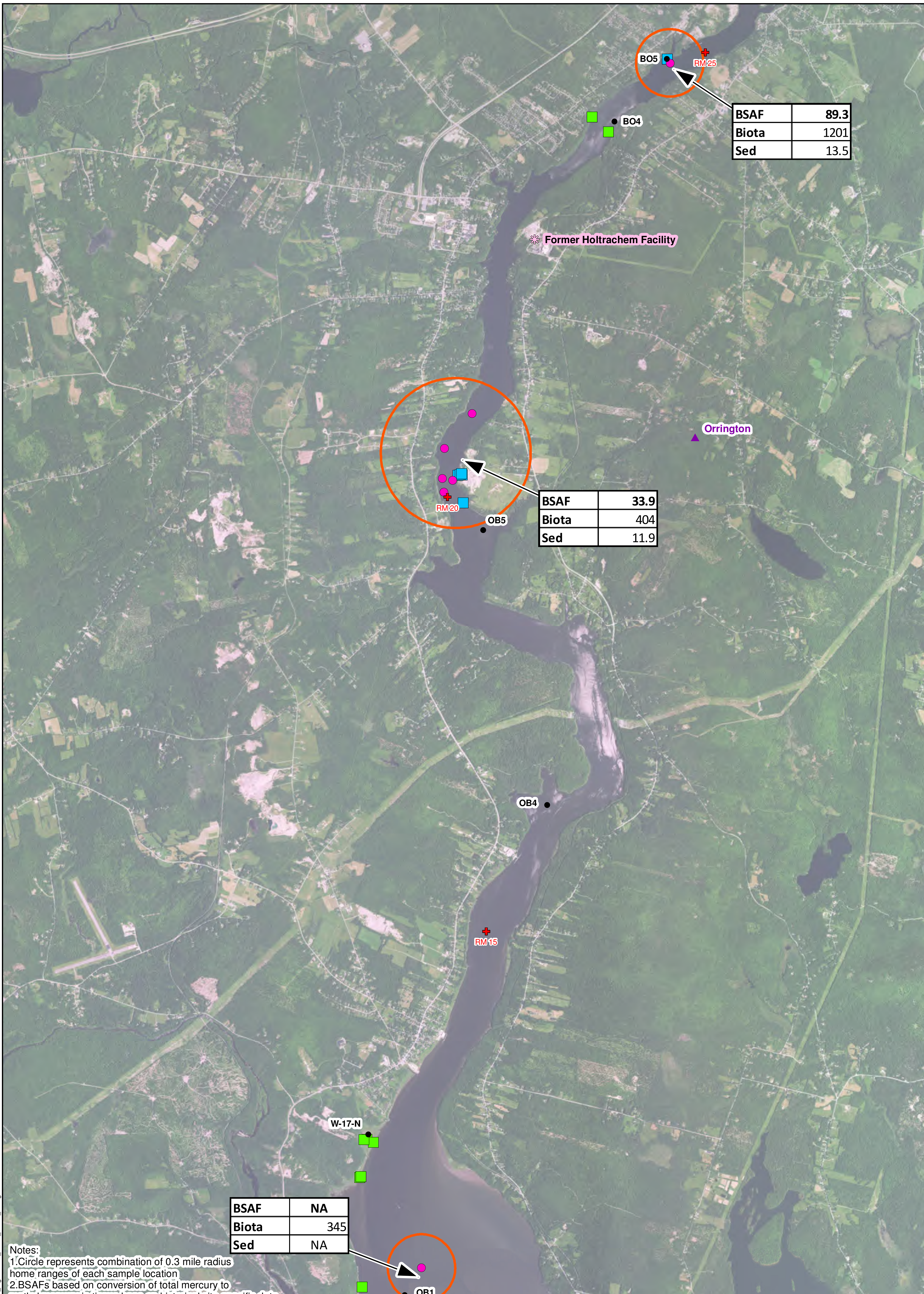
Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Eel Sample Location
- Sediment Sample Location within Radius
- Sediment Sample Location Outside of Radius
- Eel Home Range Radius - 0.3mi

Figure 10a
2016 Eel
Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet



amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Mendall Marsh Geographic Area Label

N

0 1 2 Miles

Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Sediment Sample Location within Radius
- Eel Sample Location
- Sediment Sample Location Outside of Radius
- Eel Home Range Radius - 0.3mi

Figure 10b
2016 Eel
Methyl Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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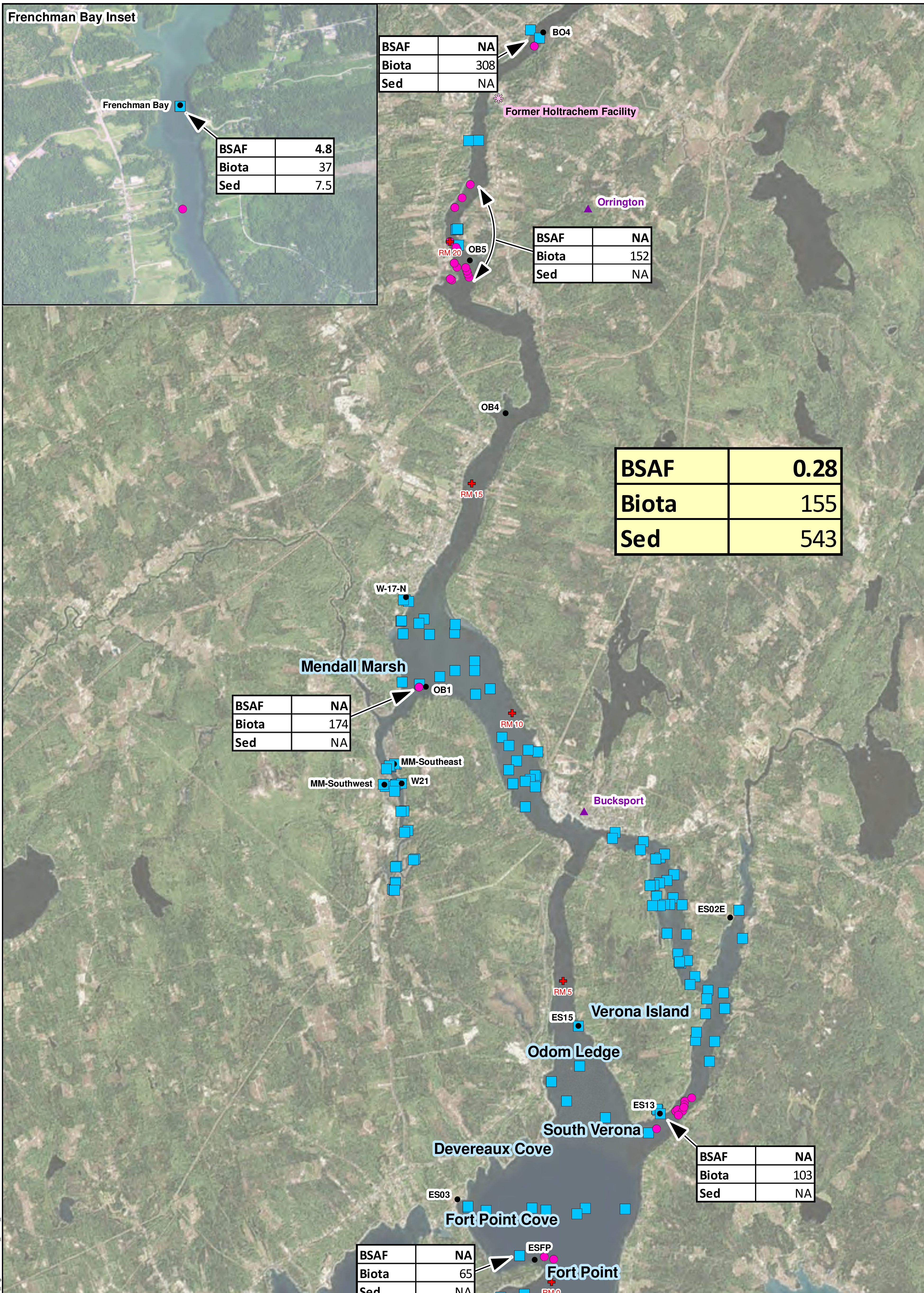

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

N
0 1 2 Miles

Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Tomcod Sample Location
- Sediment Sampl Location within Radius
- **Mendall Marsh** Geographic Area Label

Figure 11a
2016 Tomcod
Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet

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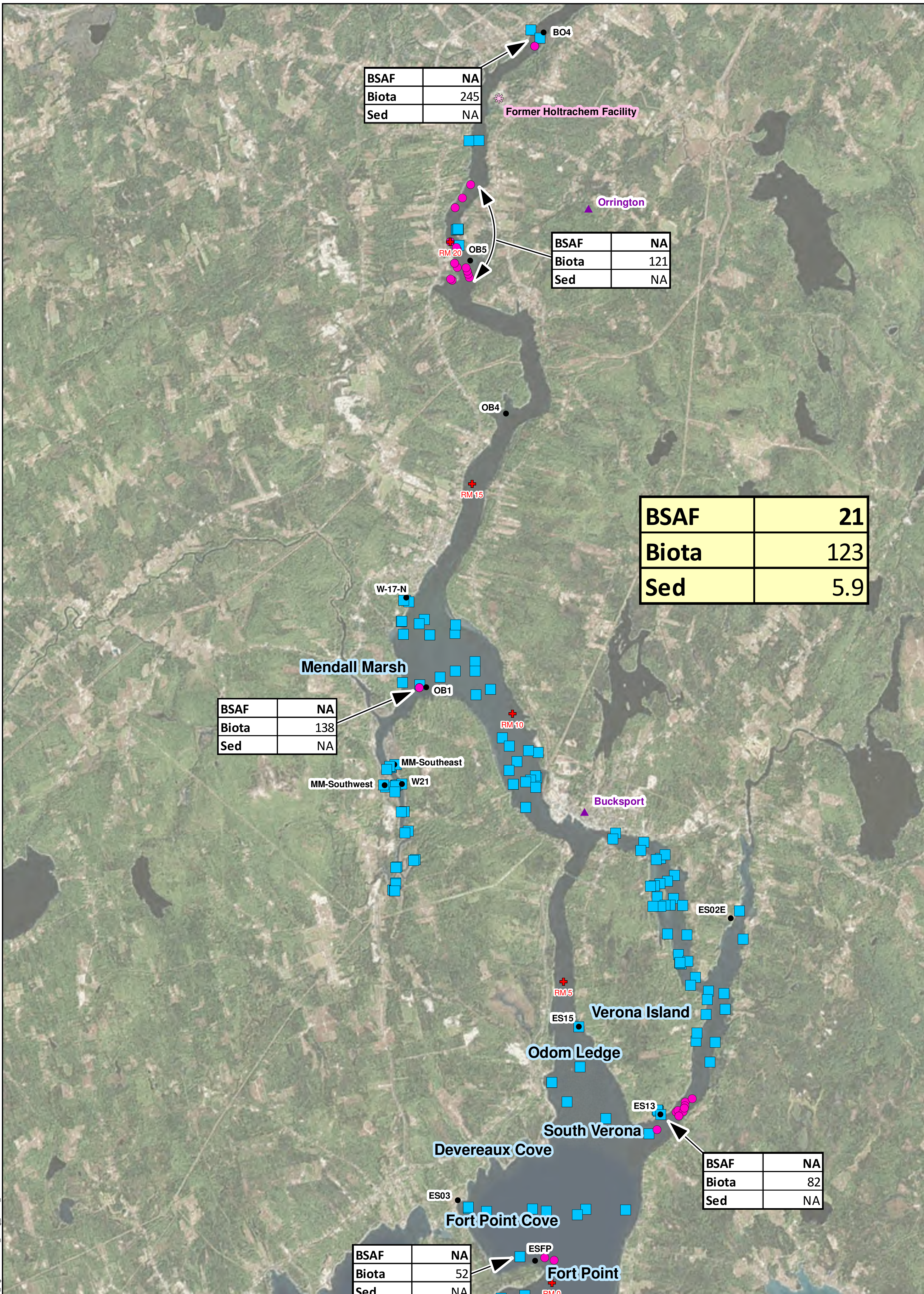

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

N

Note:
1.BSAFs based on conversion of total mercury to methyl mercury in tissue base on historical site-specific data.

Legend

- River Mile Marker
- City
- Relevant Site Landmark
- Area ID
- Tomcod Sample Location
- Sediment Sampl Location within Radius
- Mendall Marsh — Geographic Area Label

0 1 2 Miles

NAD83 State Plane Maine East, US Survey Feet

Figure 11b
2016 Tomcod
Methyl Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017

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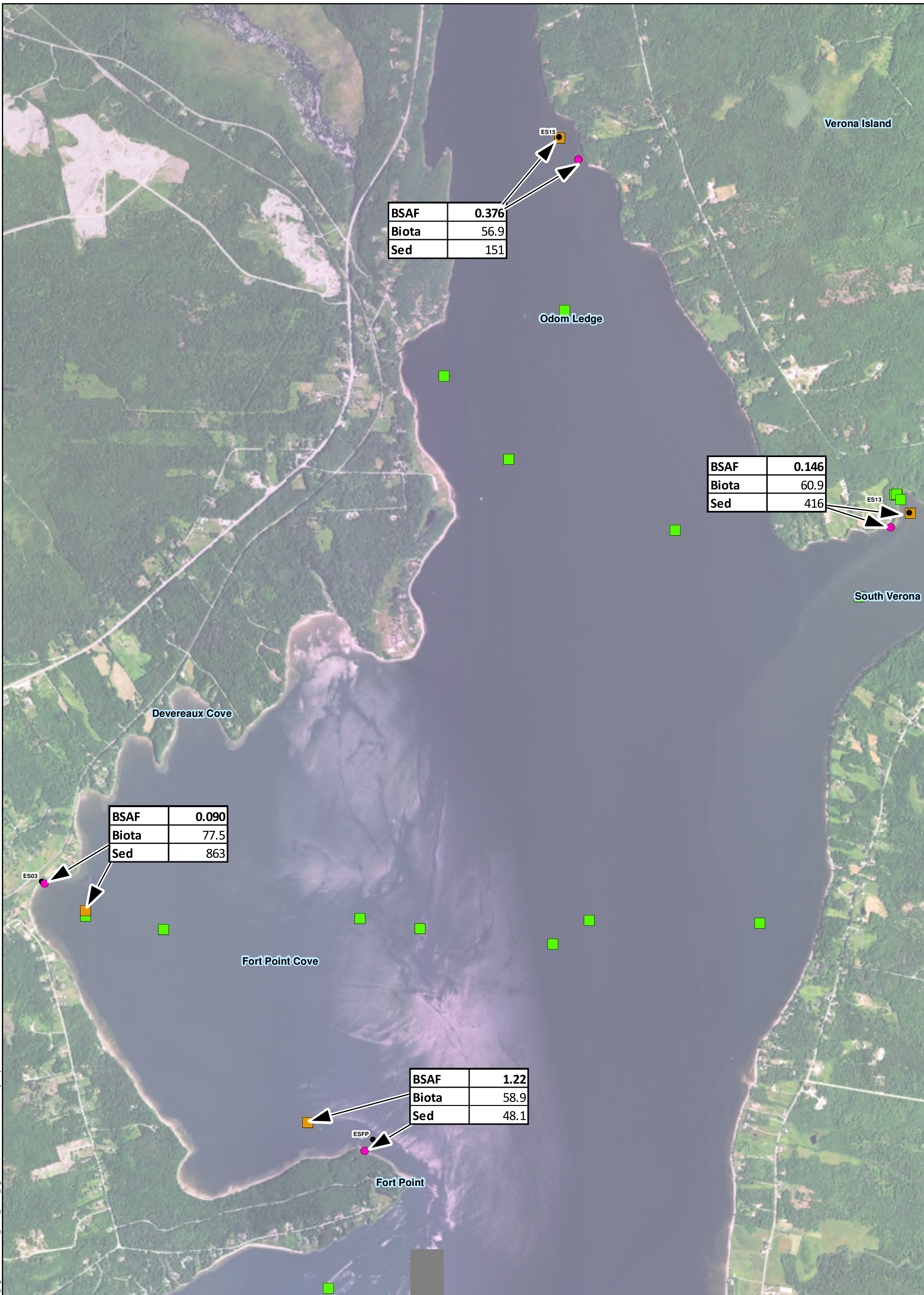

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

N

0 0.25 0.5 Miles

Legend

- City
- Relevant Site Landmark
- Area ID
- **Mendall Marsh** Geographic Area Label
- Blue Mussel Sample Location
- Co-located Sediment Sample Location
- Sediment Sample Location Outside of Radius

Figure 12a
2016 Blue Mussel
Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052	Prepared/Date: RD 9/15/2017	Checked/Date: KPH 9/15/2017	NAD83 State Plane Maine East, US Survey Feet

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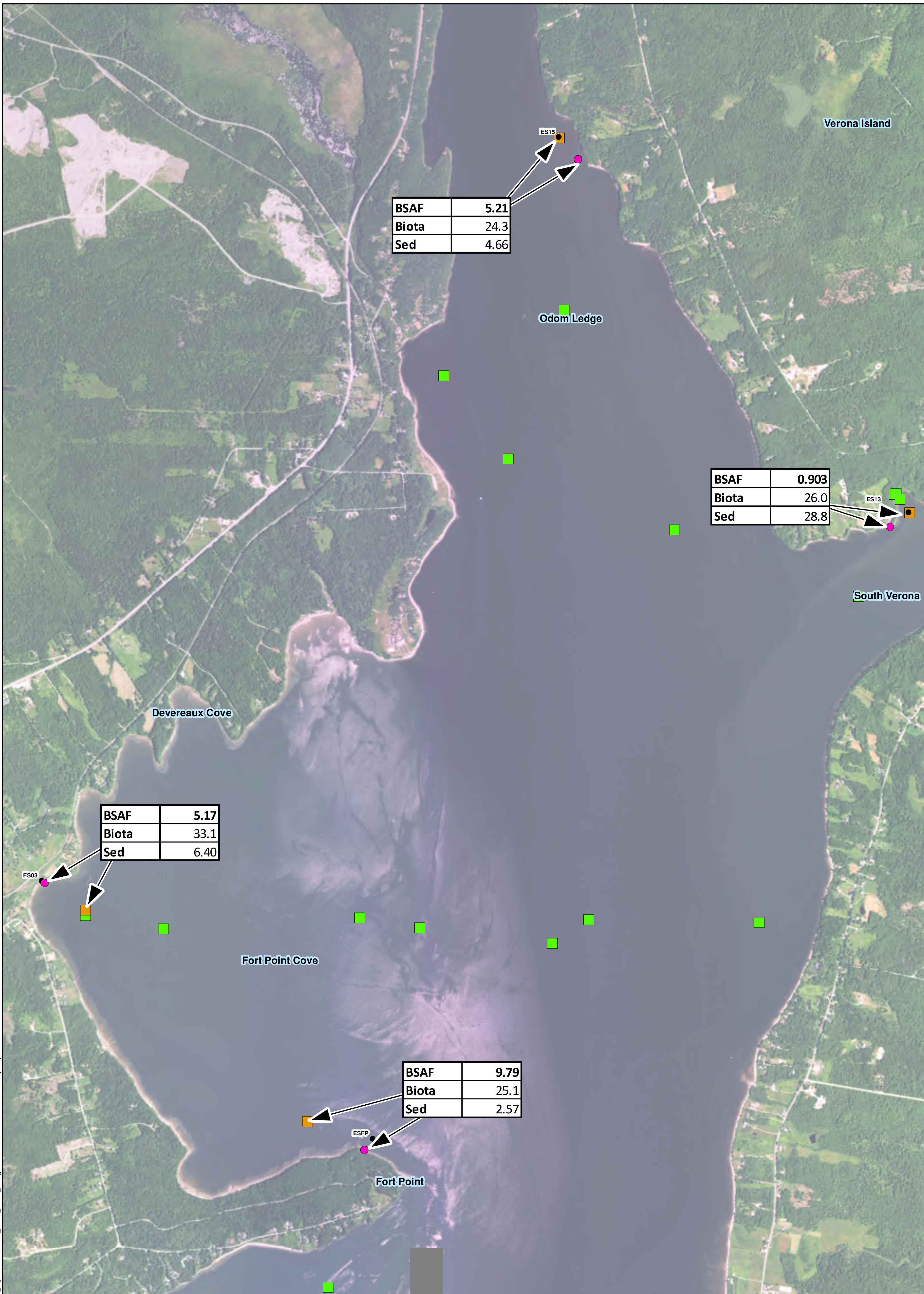

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amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

N

Legend

- City
- Relevant Site Landmark
- Area ID
- Blue Mussel Sample Location
- Co-located Sediment Sample Location
- Sediment Sample Location Outside of Radius

Mendall Marsh Geographic Area Label

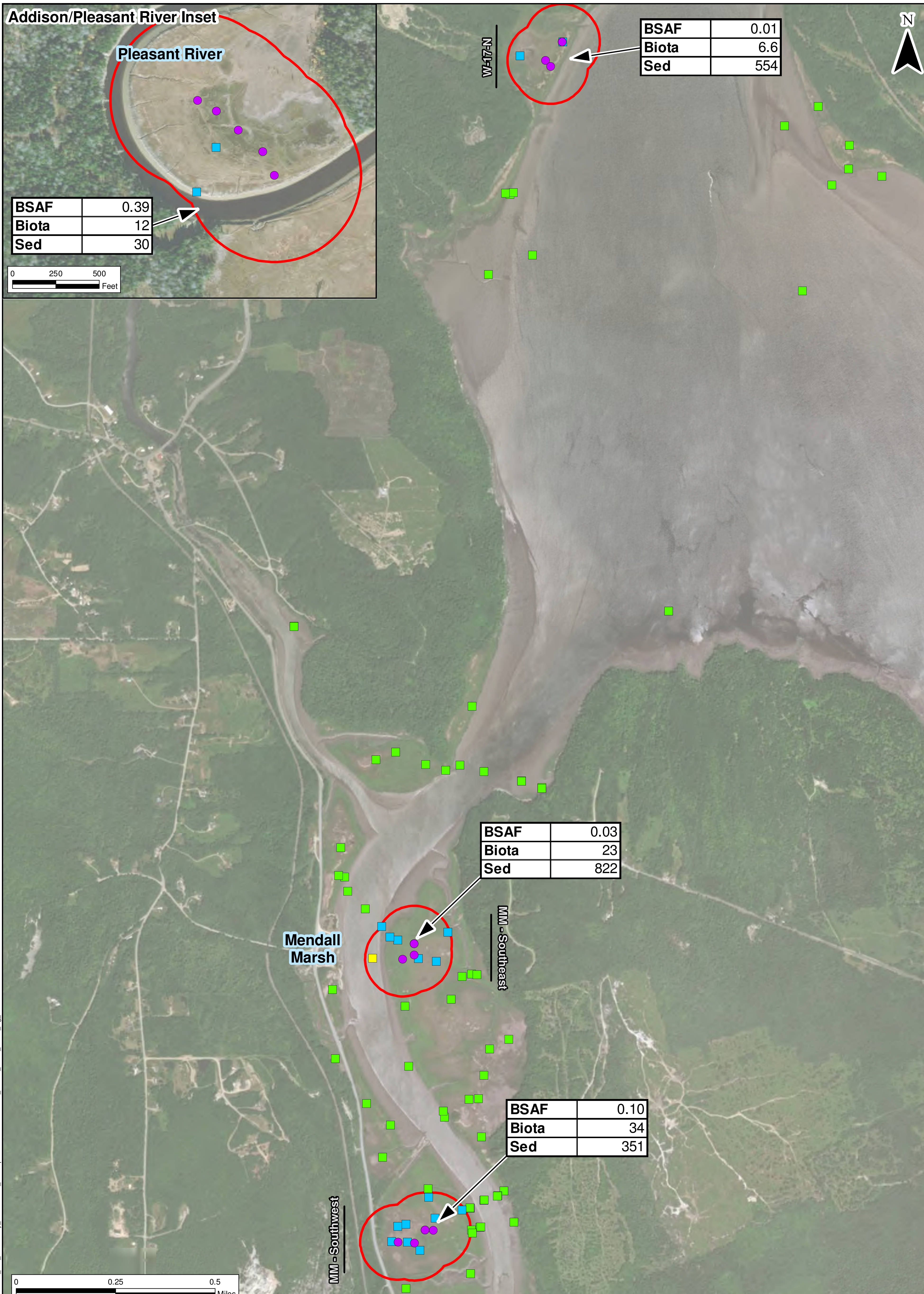
Notes:
1.Circle represents combination of 300 foot radius home ranges of each sample location
2.BSAFs based on conversion of total mercury to methyl mercury in tissue base on historical site-specific data.

0 0.25 0.5 Miles

Figure 12b
2016 Blue Mussel
Methyl Mercury BSAFs

Tech. Memo.
BSAF Calculations
Penobscot River
Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 9/15/2017 | Checked/Date: KPH 9/15/2017 | NAD83 State Plane Maine East, US Survey Feet



BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Legend

- 2017 Terrestrial Insect Sample
- Sediment Sample within Radius
- Subtidal Sediment Excluded from BSAF
- Sediment Sample Outside of Radius
- Terrestrial Insect Home Range Radius - 500ft

W-17-N Sampling Location

Mendall Marsh Geographic Area Label

Note:
Home range radius overlaps shown.

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Project: 3616166052 | Prepared/Date: RD 2/1/2018 | Checked/Date: KPH 2/1/2018

Figure 1a
2017 Terrestrial Insects
Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

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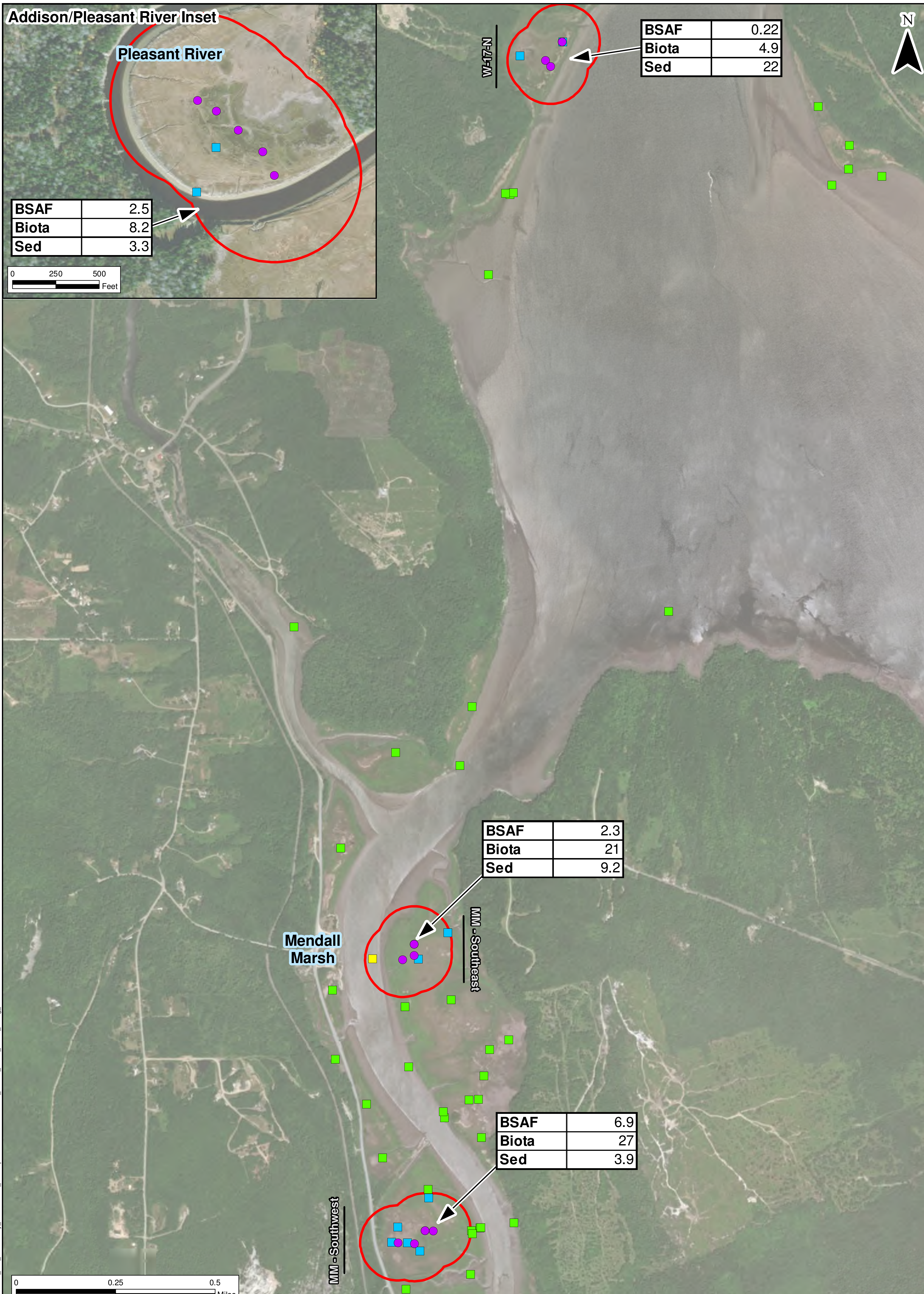

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Legend

- 2017 Terrestrial Insect Sample
- Sediment Sample within Radius
- Subtidal Sediment Excluded from BSAF
- Sediment Sample Outside of Radius
- Terrestrial Insect Home Range Radius - 500ft

W-17-N Sampling Location

Mendall Marsh Geographic Area Label

Note:
Home range radius overlaps shown.

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Project: 3616166052 | Prepared/Date: RD 2/1/2018 | Checked/Date: KPH 2/1/2018

Figure 1b
2017 Terrestrial Insects
Methyl Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

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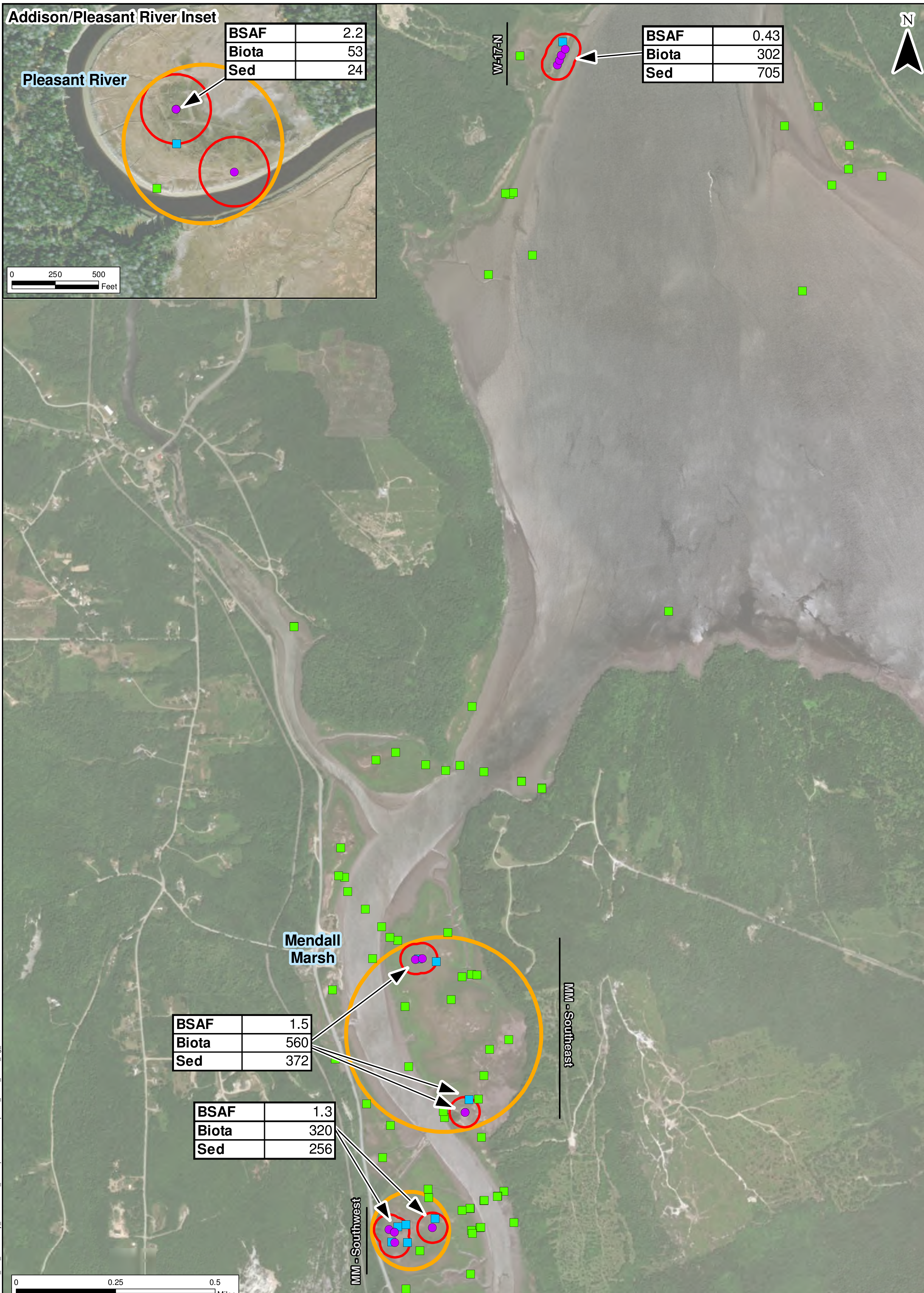

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Home range radius overlaps shown.
Orange circle represents combination of 200 foot radius home ranges of each sample location.

Legend

- 2017 Spider Sample
- Sediment Sample within Radius
- Sediment Sample Outside of Radius
- Spider Home Range Radius - 200ft
- W-17-N Sampling Location
- Mendall Marsh Geographic Area Label

Figure 2a
2017 Spider Mercury BSAFs

Penobscot River Risk Assessment and Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

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Project: 3616166052 | Prepared/Date: RD 2/1/2018 | Checked/Date: KPH 2/1/2018

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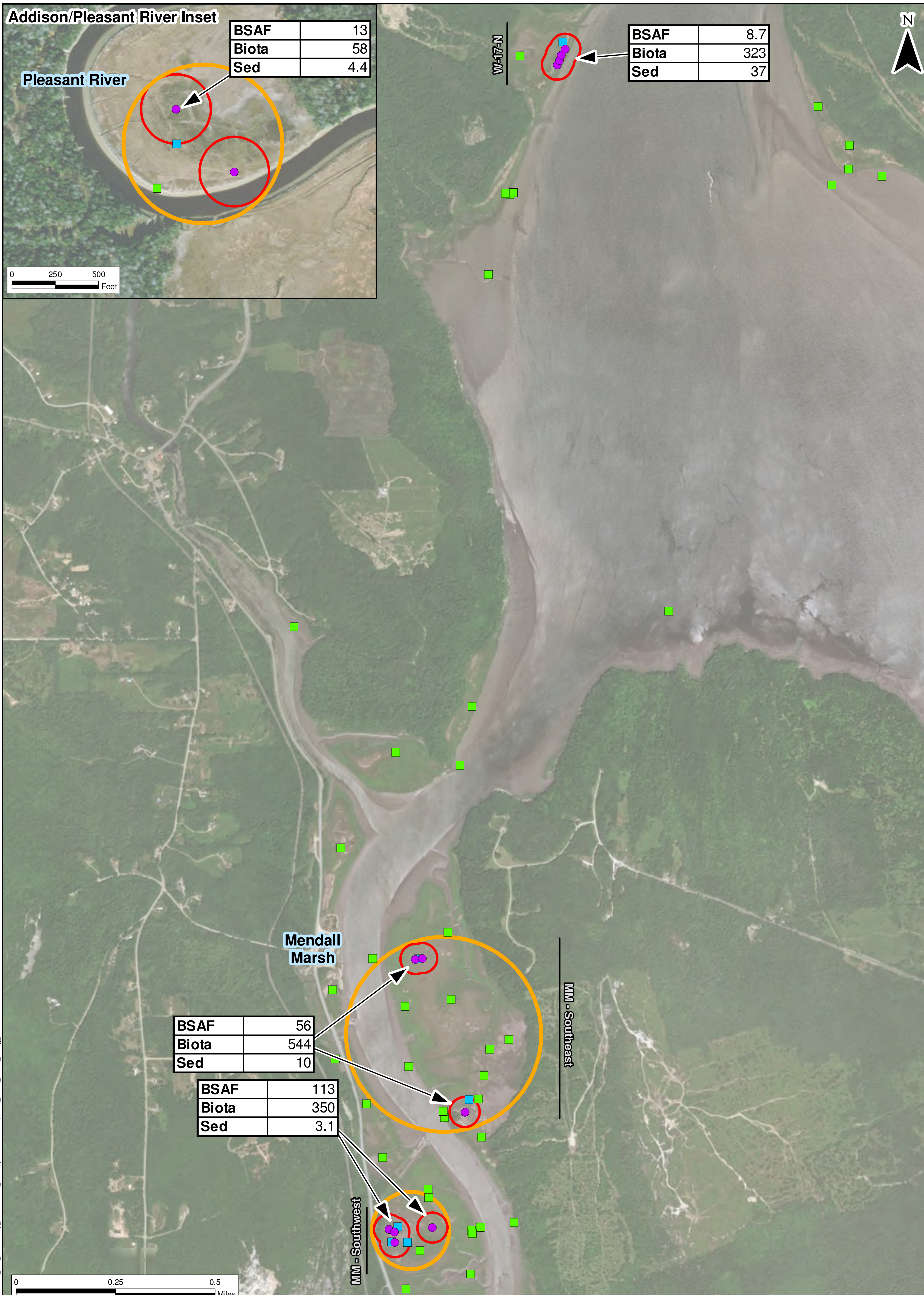

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Home range radius overlaps shown.
Orange circle represents combination of 200 foot radius home ranges of each sample location.

Legend

- 2017 Spider Sample
- Sediment Sample within Radius
- Sediment Sample Outside of Radius
- Spider Home Range Radius - 200ft
- W-17-N Sampling Location
- **Mendall Marsh** Geographic Area Label

Figure 2b
2017 Spider
Methyl Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052	Prepared/Date: RD 2/1/2018	Checked/Date: KPH 2/1/2018

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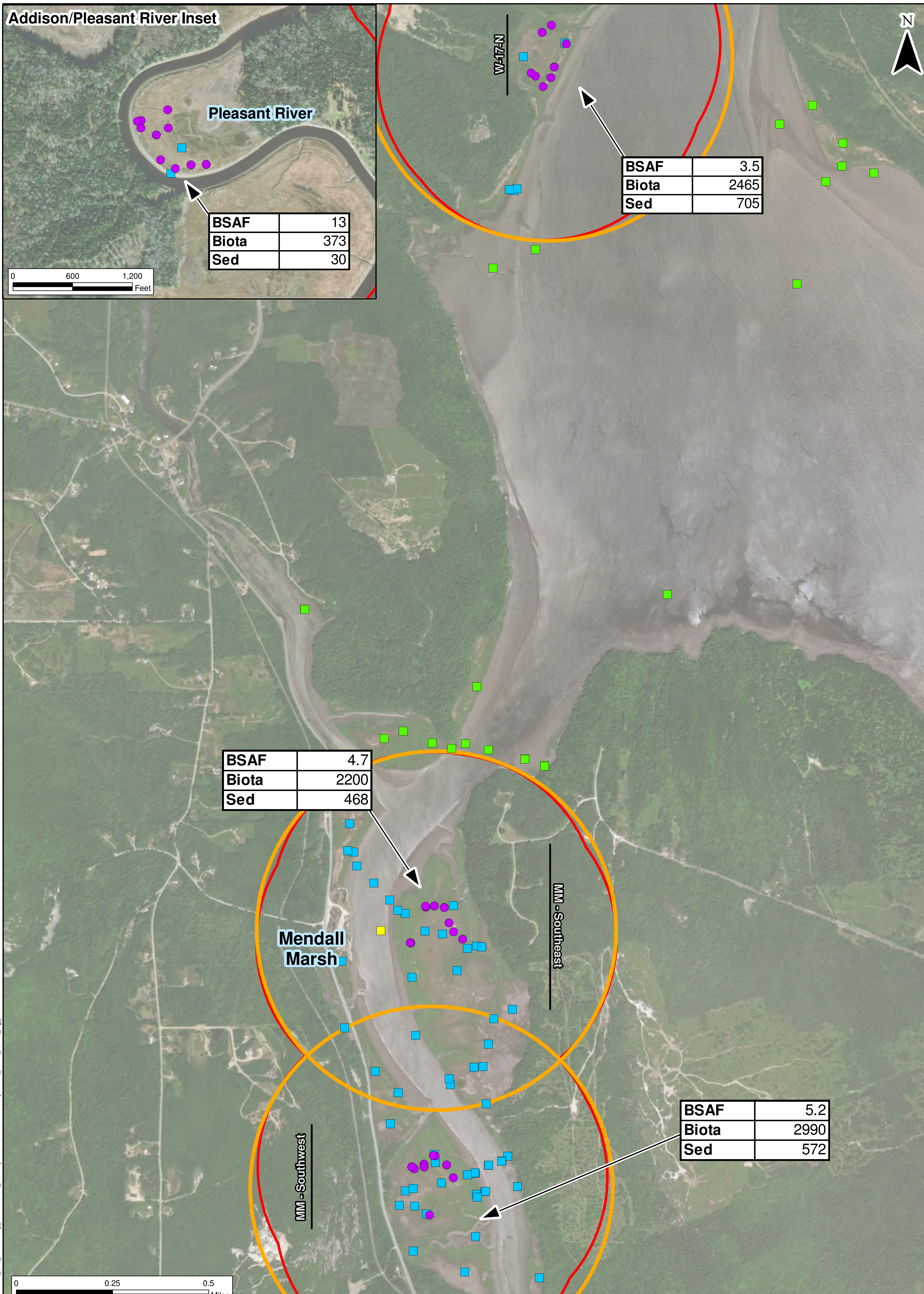

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Home range radius overlaps shown. Orange circle represents combination of 0.4 mile radius home ranges of each sample location.

Legend

- Nelson's Sparrow Sample
- Sediment Sample within Radius
- Subtidal Sediment Excluded from BSAF
- Sediment Sample Outside of Radius
- Nelson's Sparrow Home Range Radius - 0.4mi
- W-17-N — Sampling Location
- Mendall Marsh — Geographic Area Label

Figure 3a
2017 Nelson's Sparrow Mercury BSAFs

Penobscot River Risk Assessment and Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 2/2/2018 | Checked/Date: KPH 2/2/2018

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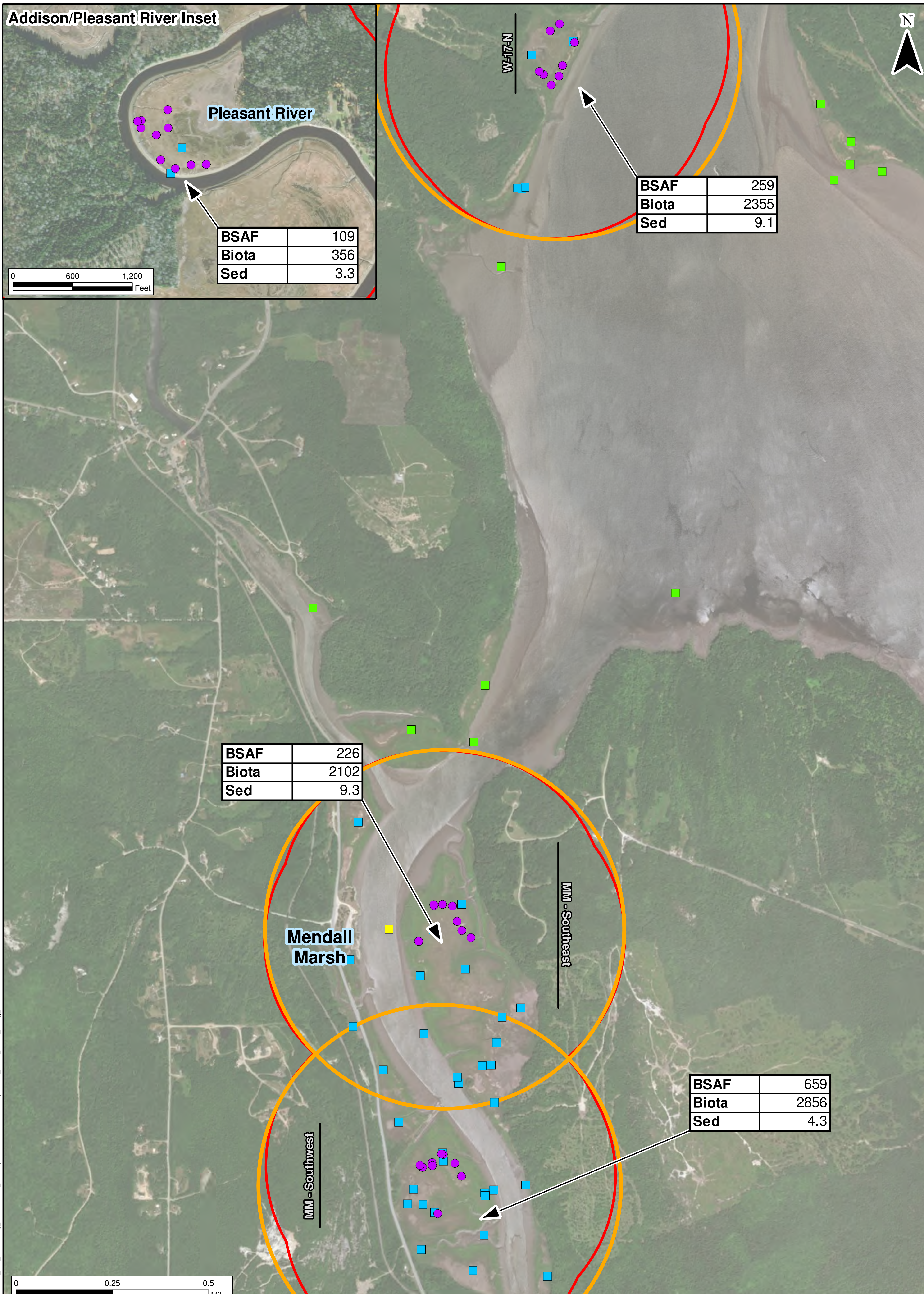

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Home range radius overlaps shown.
Orange circle represents combination of 0.4 mile radius home ranges of each sample location.

Legend

- Nelson's Sparrow Sample
- Sediment Sample within Radius
- Subtidal Sediment Excluded from BSAF
- Sediment Sample Outside of Radius
- Nelson's Sparrow Home Range Radius - 0.4mi
- W-17-N: Sampling Location
- Mendall Marsh: Geographic Area Label

Figure 3b
2017 Nelson's Sparrow
Methyl Mercury BSAFs

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Penobscot River Phase III Engineering Study

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Project: 3616166052 | Prepared/Date: RD 2/2/2018 | Checked/Date: KPH 2/2/2018

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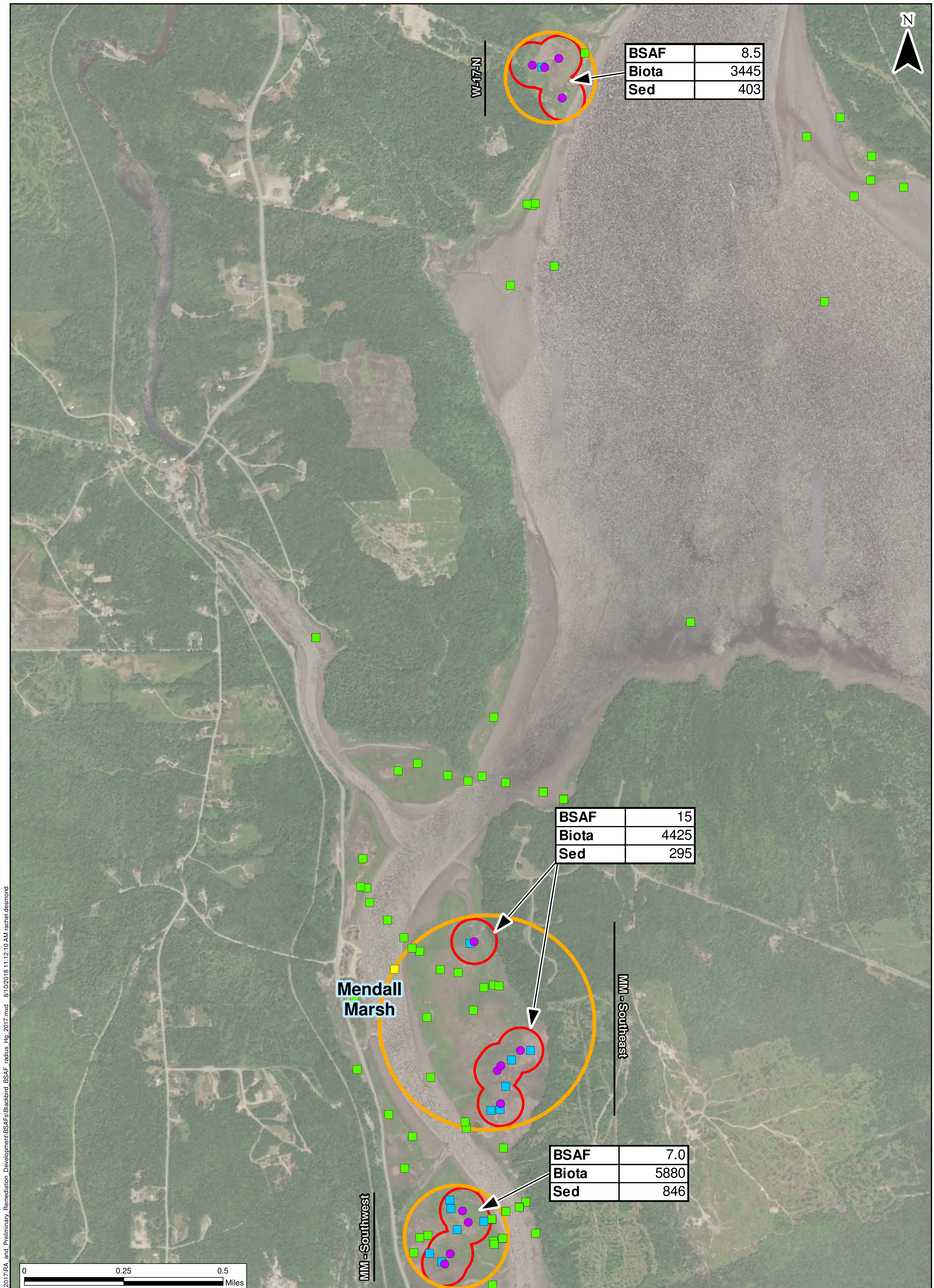


amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Home range radius overlaps shown. Orange circle represents combination of 300 foot radius home ranges of each sample location.

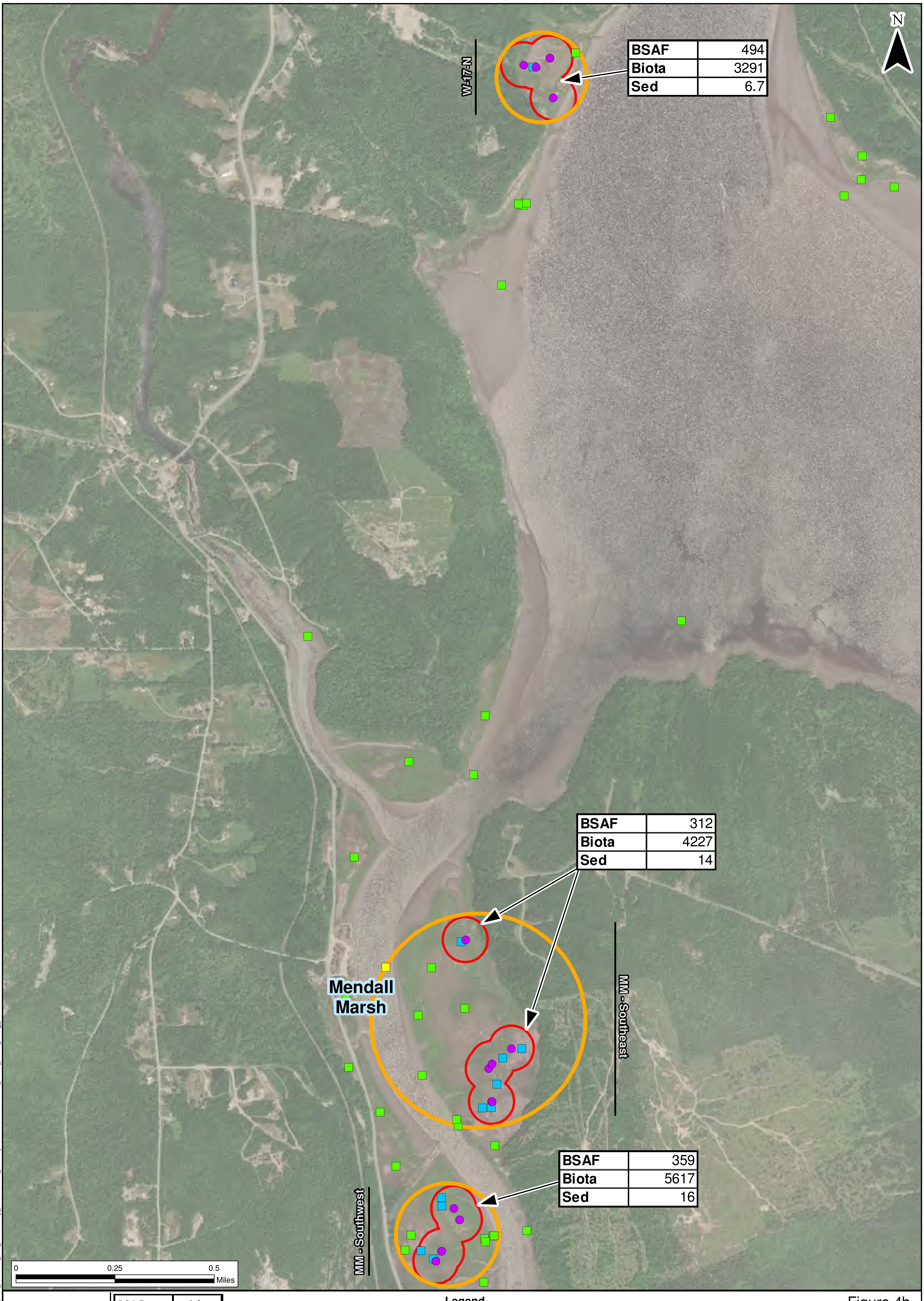
Legend

- Red-winged Blackbird Sample
- Sediment Sample within Radius
- Subtidal Sediment Excluded from BSAF
- Sediment Sample Outside of Radius
- Red-winged Blackbird Home Range Radius - 300ft
- W-17-N Sampling Location
- Mendall Marsh Geographic Area Label

Figure 4a
2017 Red-winged Blackbird Mercury BSAFs

Penobscot River Risk Assessment and Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 8/10/2018 | Checked/Date: KPH 8/10/2018



amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Home range radius overlaps shown. Orange circle represents combination of 300 foot radius home ranges of each sample location.

Legend

- Red-winged Blackbird Sample
- Sediment Sample within Radius
- Subtidal Sediment Excluded from BSAF
- Sediment Sample Outside of Radius
- Red-winged Blackbird Home Range Radius - 300ft

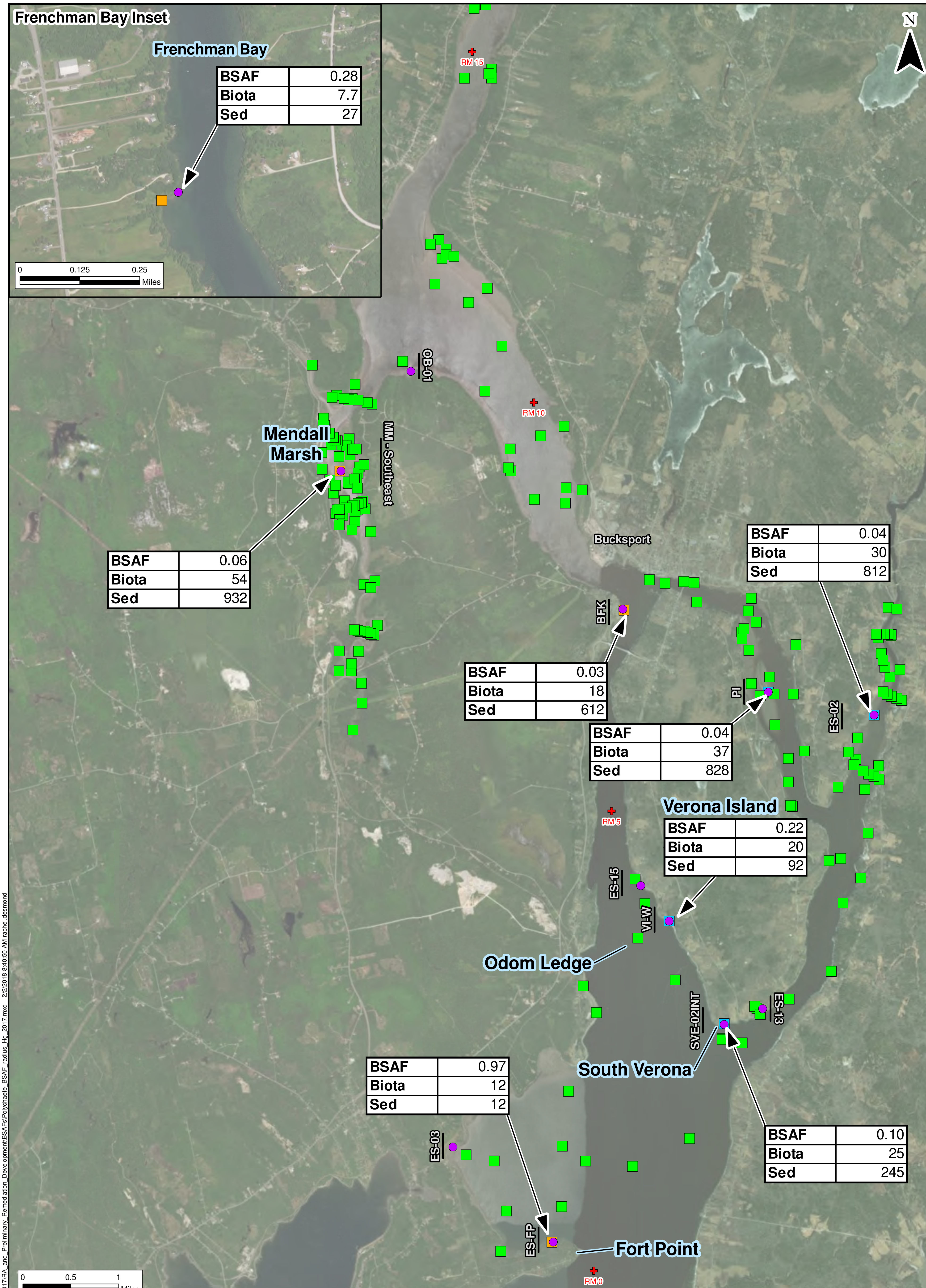
W-17-N Sampling Location

Mendall Marsh Geographic Area Label

Figure 4b
2017 Red-winged Blackbird Methyl Mercury BSAFs

Penobscot River Risk Assessment and Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052	Prepared/Date: RD 8/10/2018	Checked/Date: KPH 8/10/2018



amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Notes:
Polychaete home range radius is 50 feet.

Collocated sediments that fell just outside of the home range radius were utilized in pairings due to proximity or initial collocated intent

Legend

- River Mile Marker
- Polychaete Sample
- Sediment Sample within Radius
- Co-located Sediment Sample
- Sediment Sample Outside of Radius
- W-17-N Sampling Location
- Mendall Marsh Geographic Area Label

Figure 5a
2017 Polychaete
Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 2/2/2018 | Checked/Date: KPH 2/2/2018

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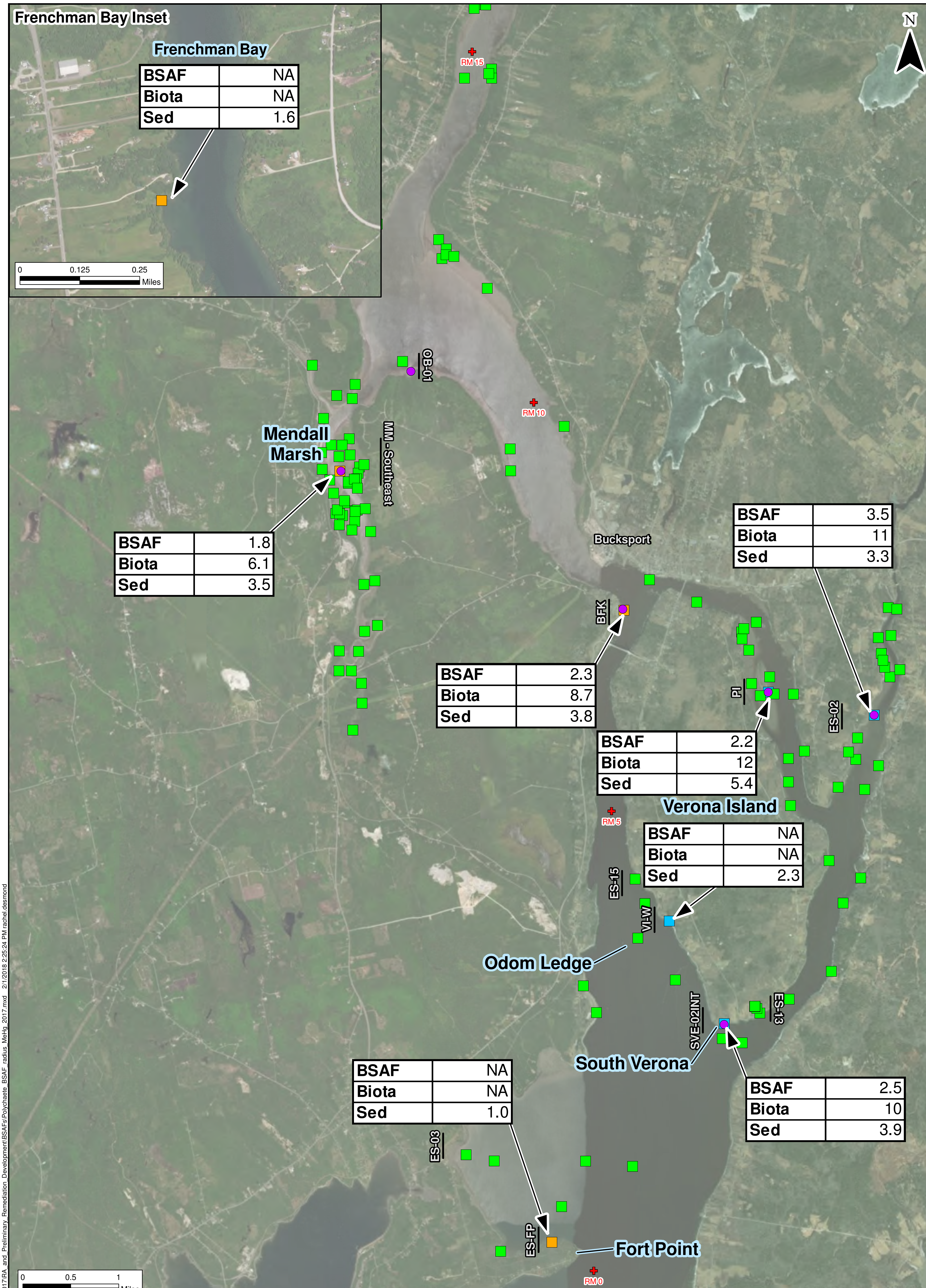

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Notes:
Polychaete home range radius is 50 feet.

Collocated sediments that fell just outside of the home range radius were utilized in pairings due to proximity or initial collocated intent

Legend

- River Mile Marker
- Polychaete Sample
- Sediment Sample within Radius
- Co-located Sediment Sample
- Sediment Sample Outside of Radius
- W-17-N — Sampling Location
- Mendall Marsh — Geographic Area Label

Figure 5b
2017 Polychaete
Methyl Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 2/2/2018 | Checked/Date: KPH 2/2/2018

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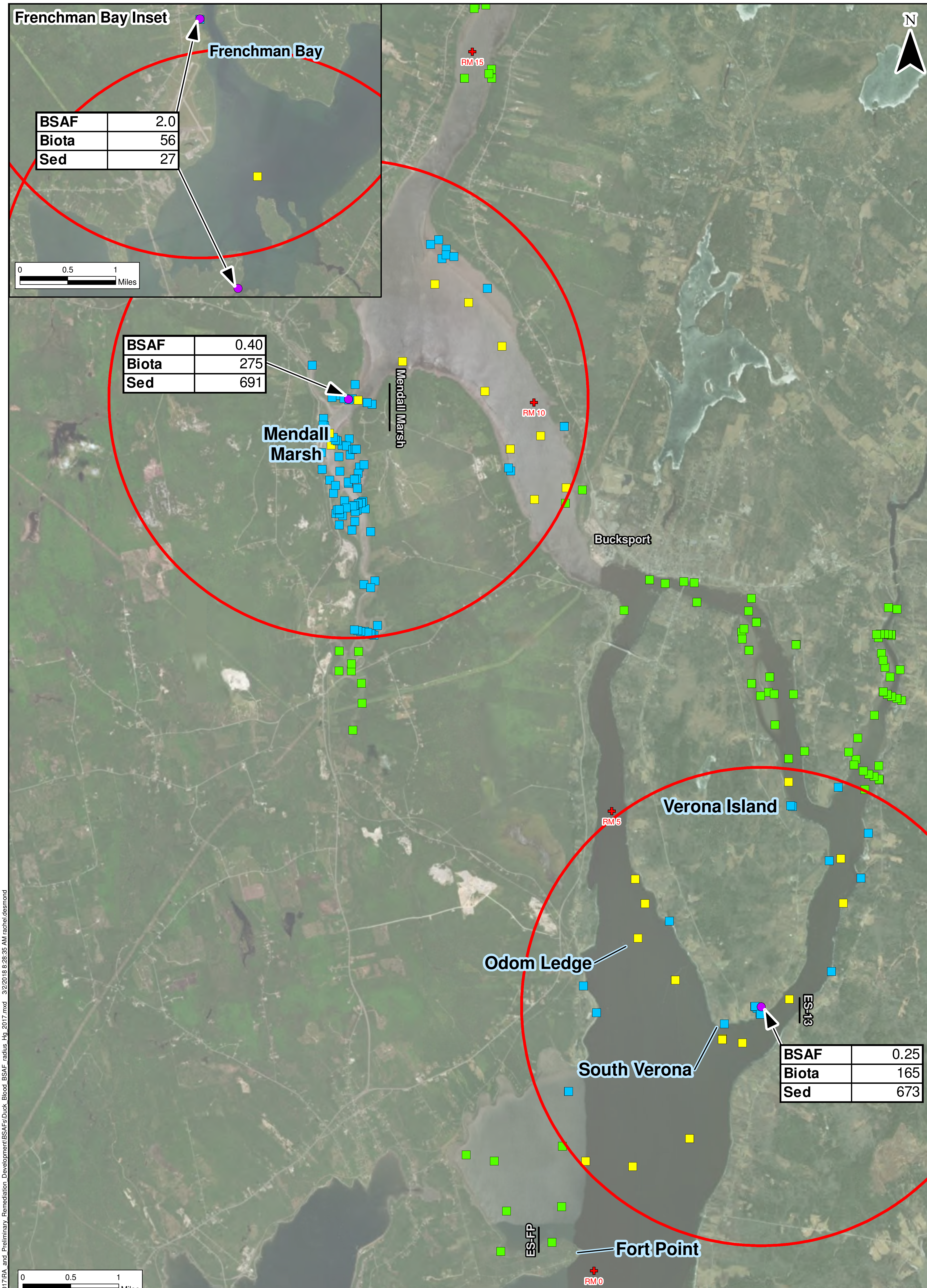

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Legend

- River Mile Marker
- Black Duck Sample
- Sediment Sample within Radius
- Subtidal Sediment Sample Excluded from BSAF
- Sediment Sample Outside of Radius
- Black Duck Home Range Radius - 2.5mi
- W-17-N Sampling Location
- Mendall Marsh Geographic Area Label

Figure 6a
2018 Black Duck
Mercury Blood BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 3/2/2018 | Checked/Date: KPH 3/2/2018

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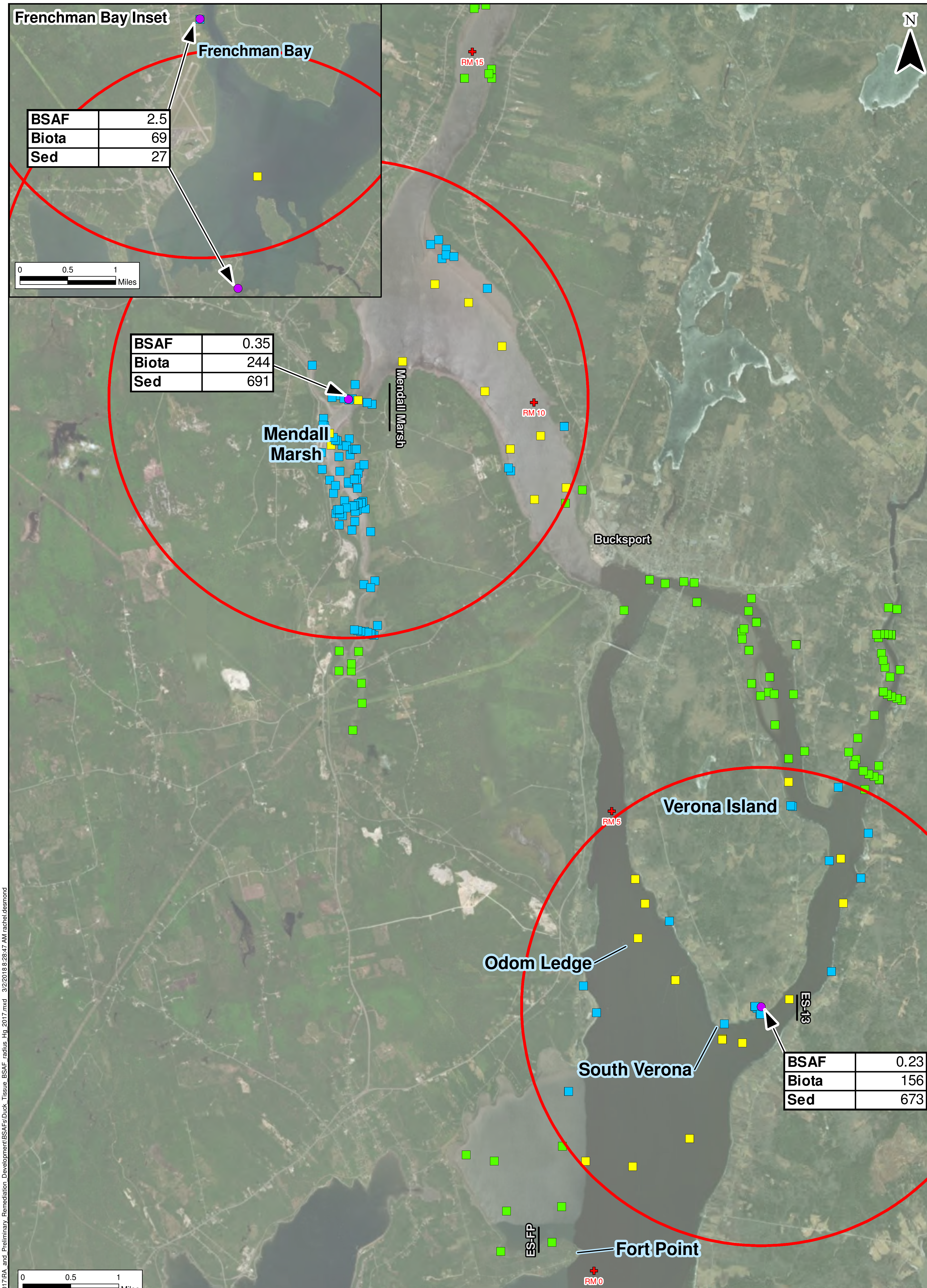

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
2018 duck tissue concentrations were estimated using the duck blood-tissue regression equation

Legend

- River Mile Marker
- Black Duck Sample
- Sediment Sample within Radius
- Subtidal Sediment Sample Excluded from BSAF
- Sediment Sample Outside of Radius
- Black Duck Home Range Radius - 2.5mi

W-17-N Sampling Location

Mendall Marsh Geographic Area Label

Figure 6b
2018 Black Duck
Mercury Tissue BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 3/2/2018 | Checked/Date: KPH 3/2/2018

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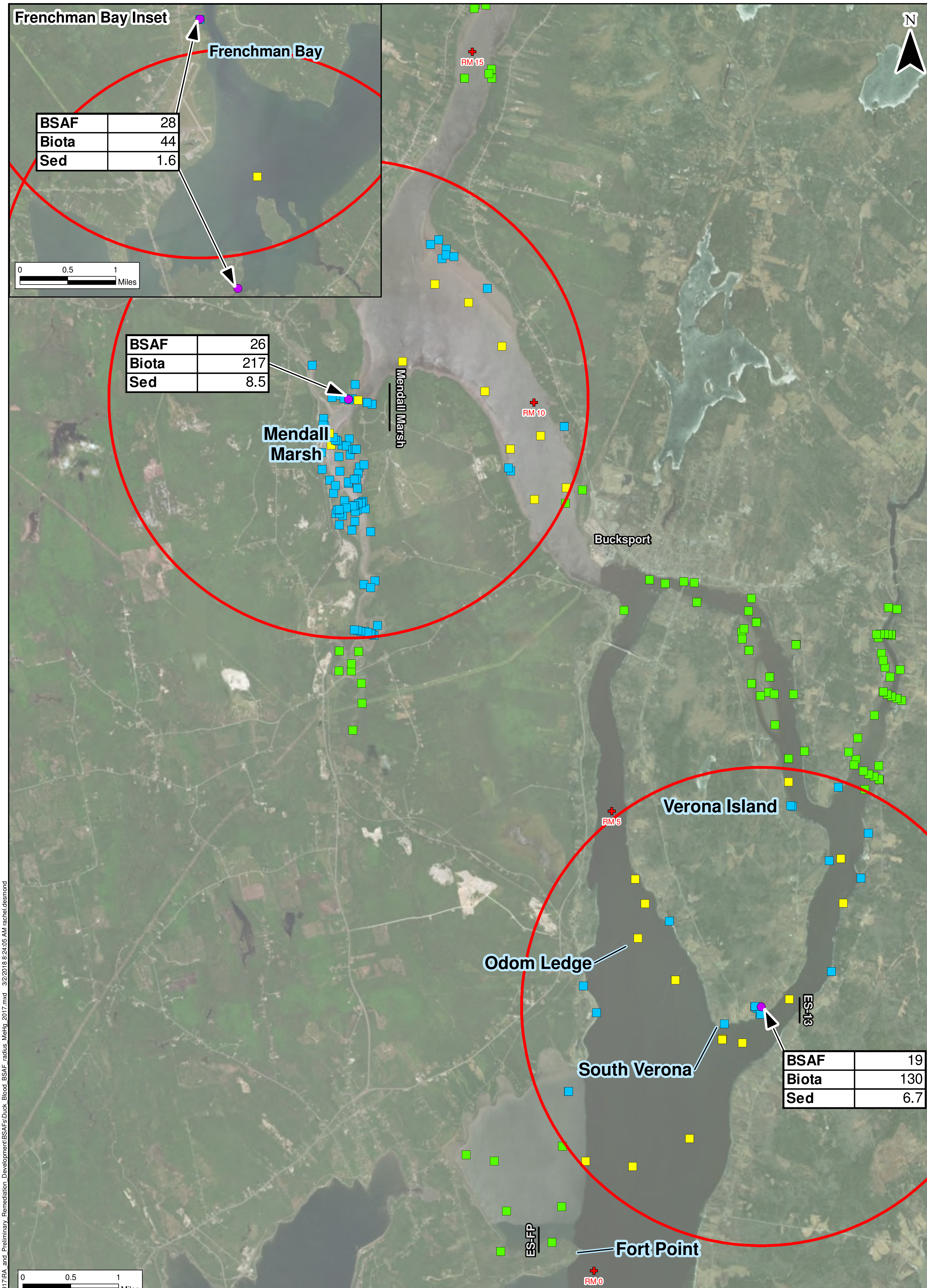

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Legend

- River Mile Marker
- Black Duck Sample
- Sediment Sample within Radius
- Subtidal Sediment Sample Excluded from BSAF
- Sediment Sample Outside of Radius
- Black Duck Home Range Radius - 2.5mi
- W-17-N Sampling Location
- Mendall Marsh Geographic Area Label

Figure 6c
2018 Black Duck
Methyl Mercury Blood BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 3/2/2018 | Checked/Date: KPH 3/2/2018

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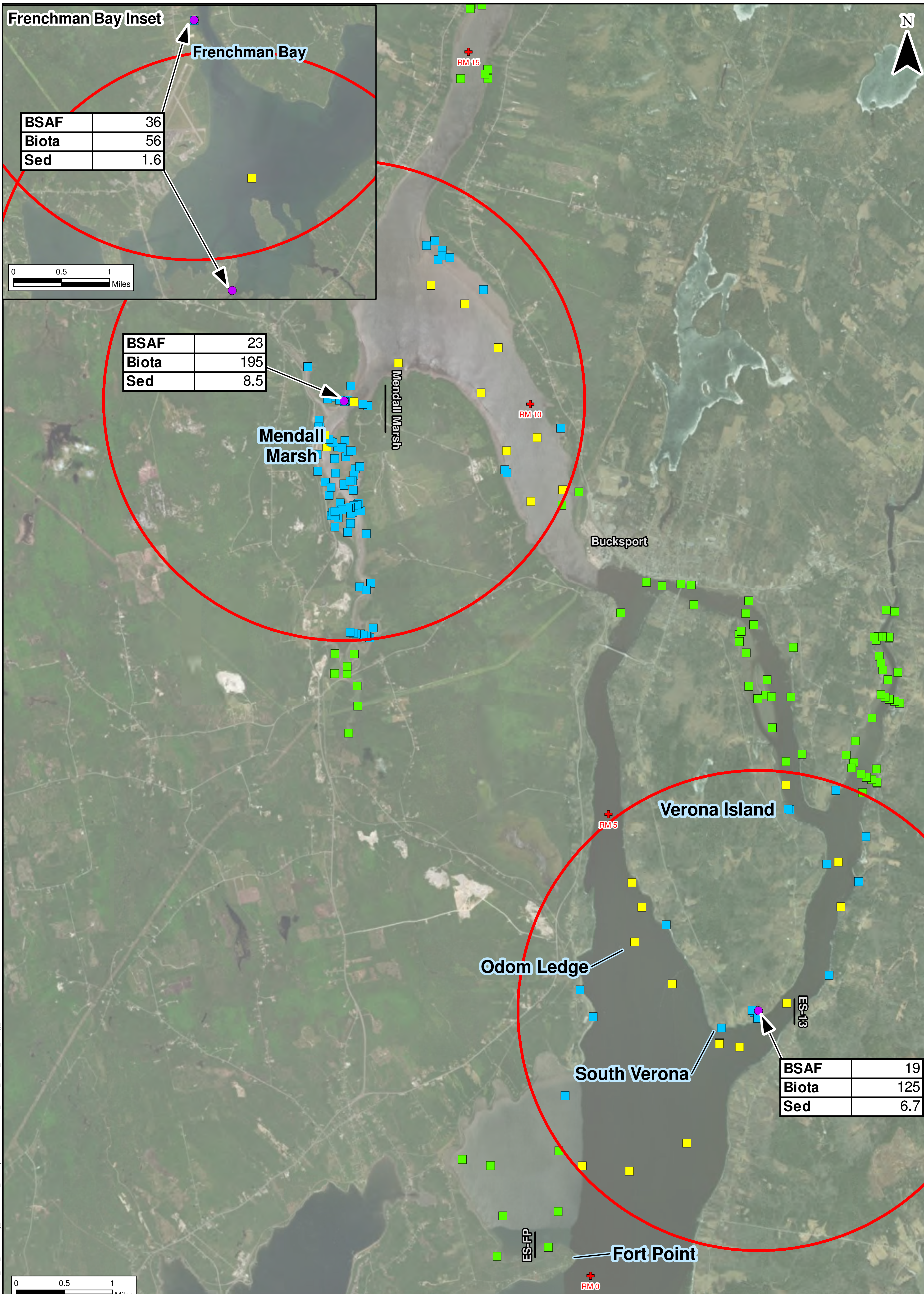

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
2018 duck tissue concentrations were estimated using the duck blood-tissue regression equation

Legend

- River Mile Marker
- Black Duck Sample
- Sediment Sample within Radius
- Subtidal Sediment Sample Excluded from BSAF
- Sediment Sample Outside of Radius
- Black Duck Home Range Radius - 2.5mi

W-17-N Sampling Location

Mendall Marsh Geographic Area Label

Figure 6d
2018 Black Duck
Methyl Mercury Tissue BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

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Project: 3616166052	Prepared/Date: RD 3/2/2018	Checked/Date: KPH 3/2/2018

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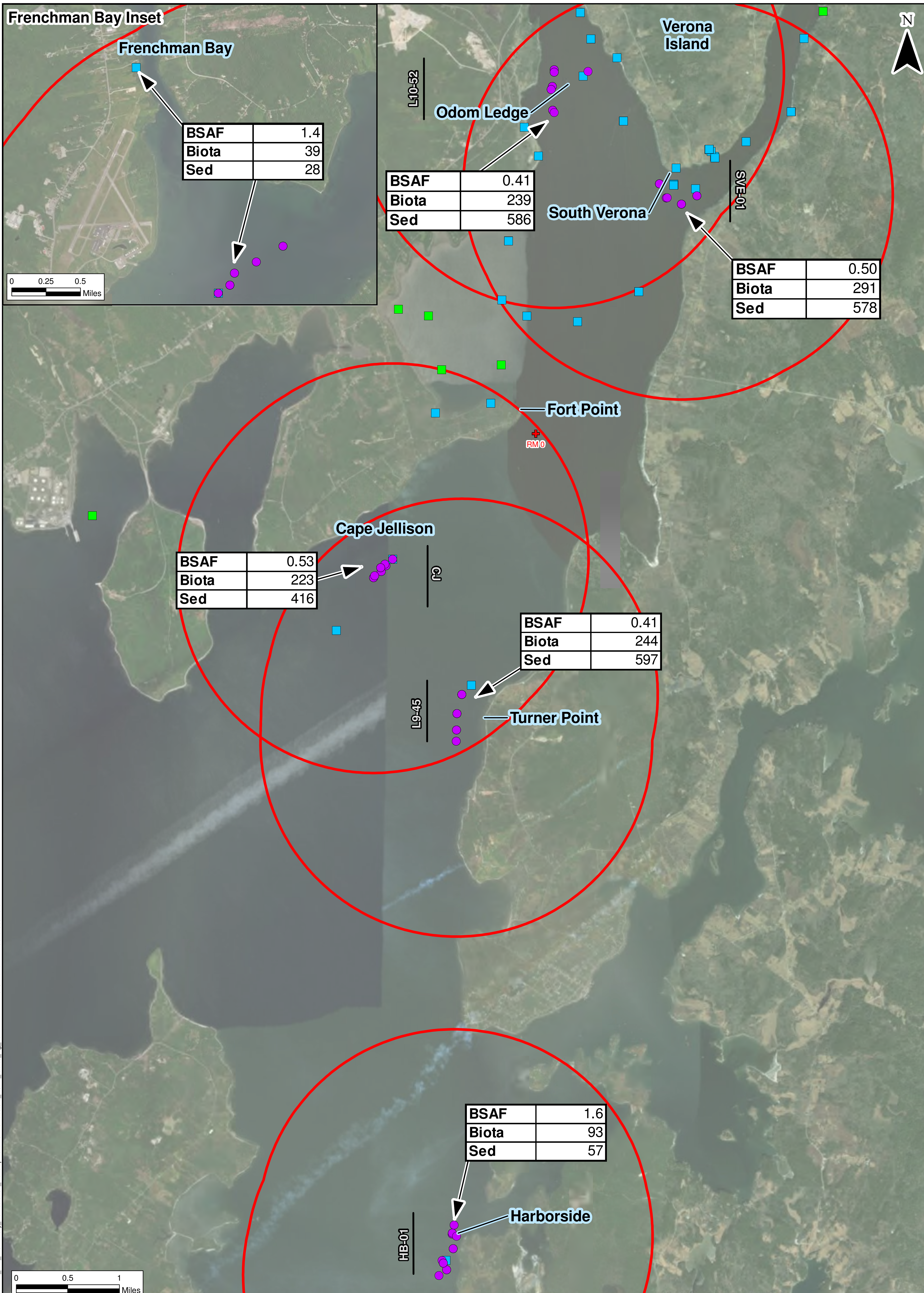

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Home range radius overlaps shown.

Legend

- River Mile Marker
- Lobster Sample
- Sediment Sample within Radius
- Sediment Sample Outside of Radius
- Lobster Home Range Radius - 1.9mi
- South Verona — Geographic Area Label
- OB-01 — Sampling Location

Figure 7a
2017 Lobsters Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 2/2/2018 | Checked/Date: KPH 2/2/2018

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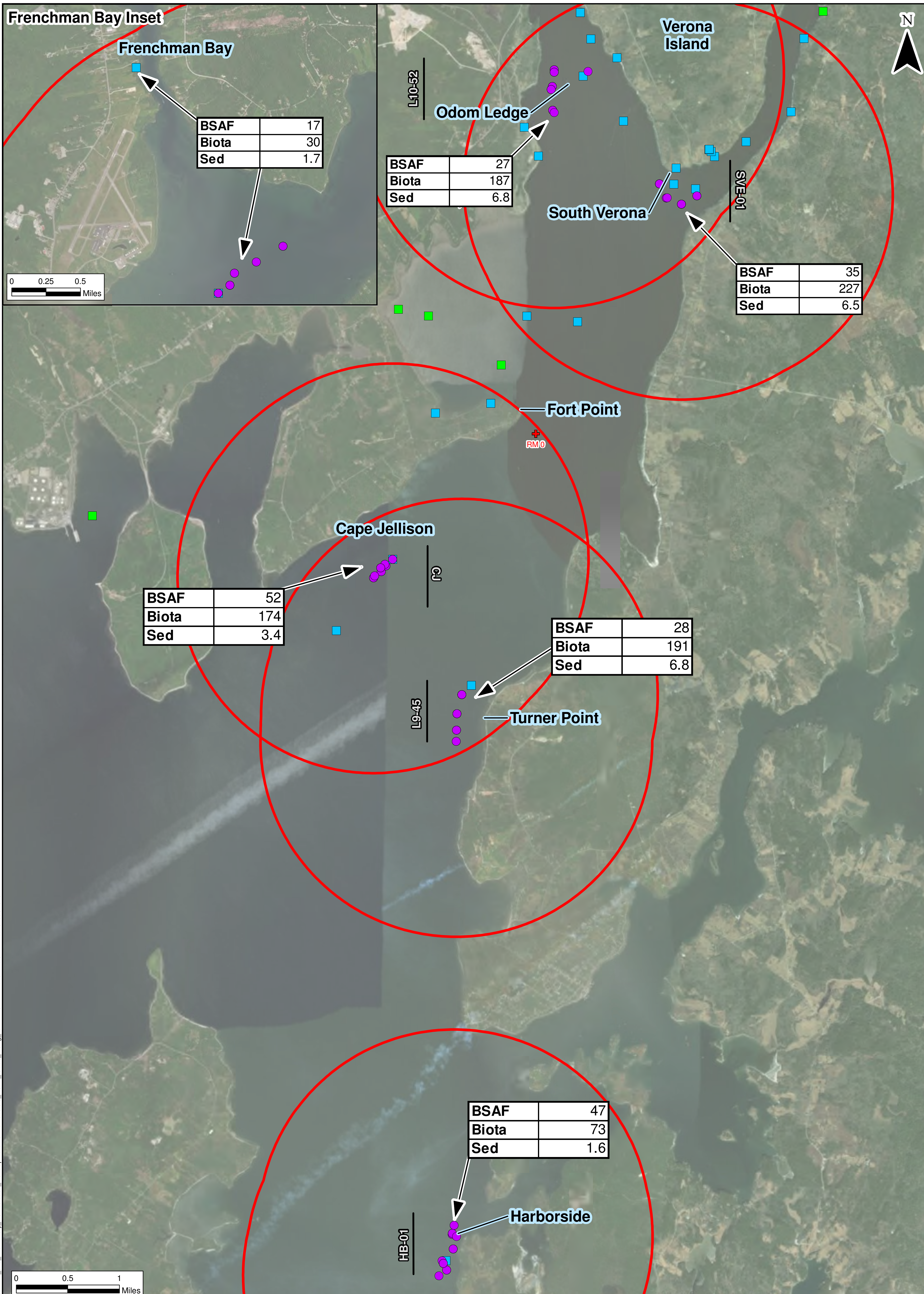

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Legend

- River Mile Marker
- Lobster Sample
- Sediment Sample within Radius
- Sediment Sample Outside of Radius
- Lobster Home Range Radius - 1.9mi
- South Verona — Geographic Area Label
- OB-01 — Sampling Location

Note:
Home range radius overlaps shown.

amec foster wheeler

Figure 7b
2017 Lobsters
Methyl Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 2/2/2018 | Checked/Date: KPH 2/2/2018

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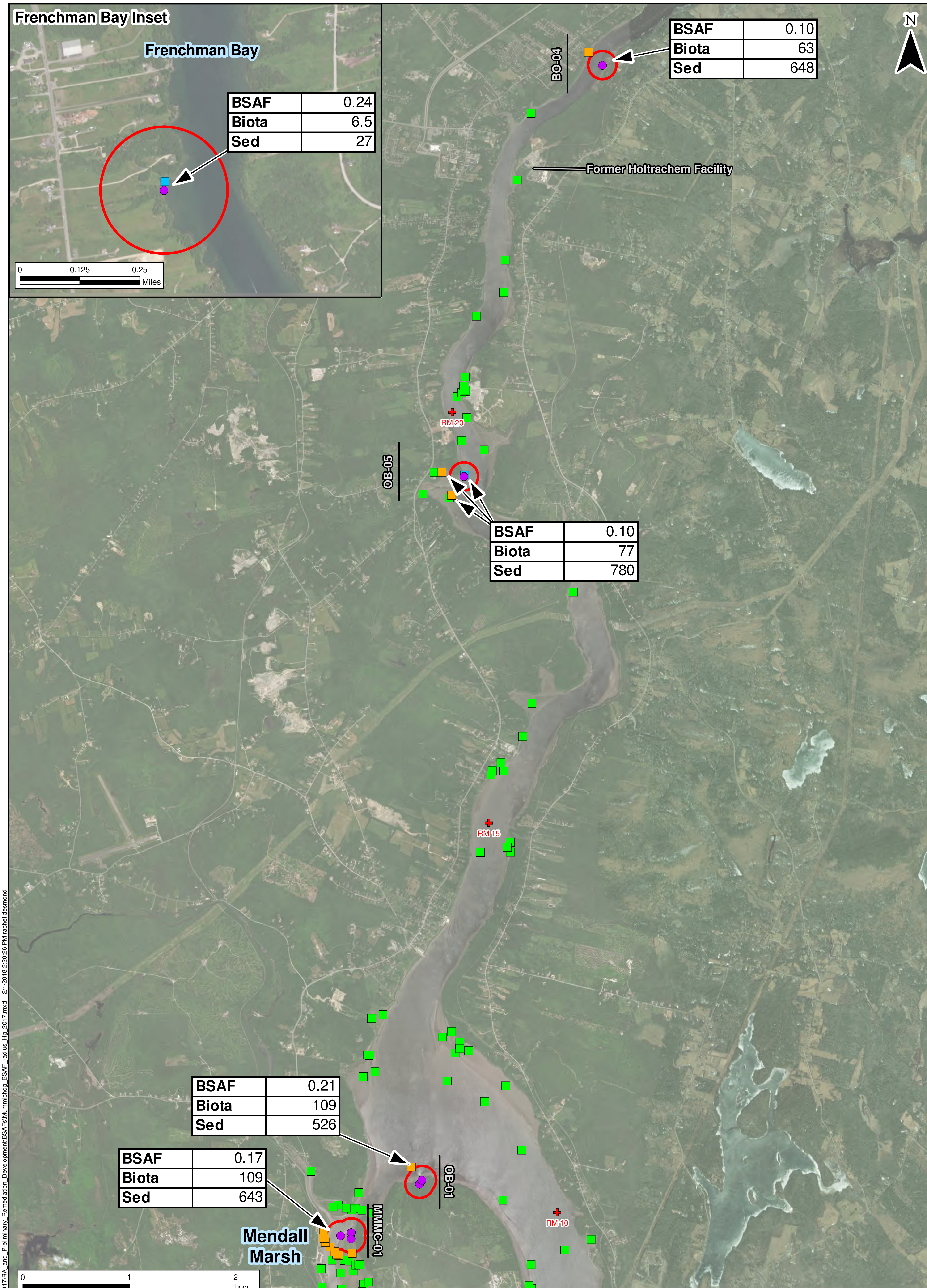

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Notes:
Home range radius overlaps shown.

Collocated sediments that fell just outside of the home range radius were utilized in pairings due to proximity or initial collocated intent

Legend

- River Mile Marker
- Mummichog Sample
- Sediment Sample within Radius
- Co-located Sediment Sample
- Sediment Sample Outside of Radius
- Mummichog Home Range Radius - 700ft
- Mendall Marsh — Geographic Area Label
- W-17-N — Sampling Location

Figure 8a
2017 Mummichog
Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

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Project: 3616166052	Prepared/Date: RD 2/1/2018	Checked/Date: KPH 2/1/2018

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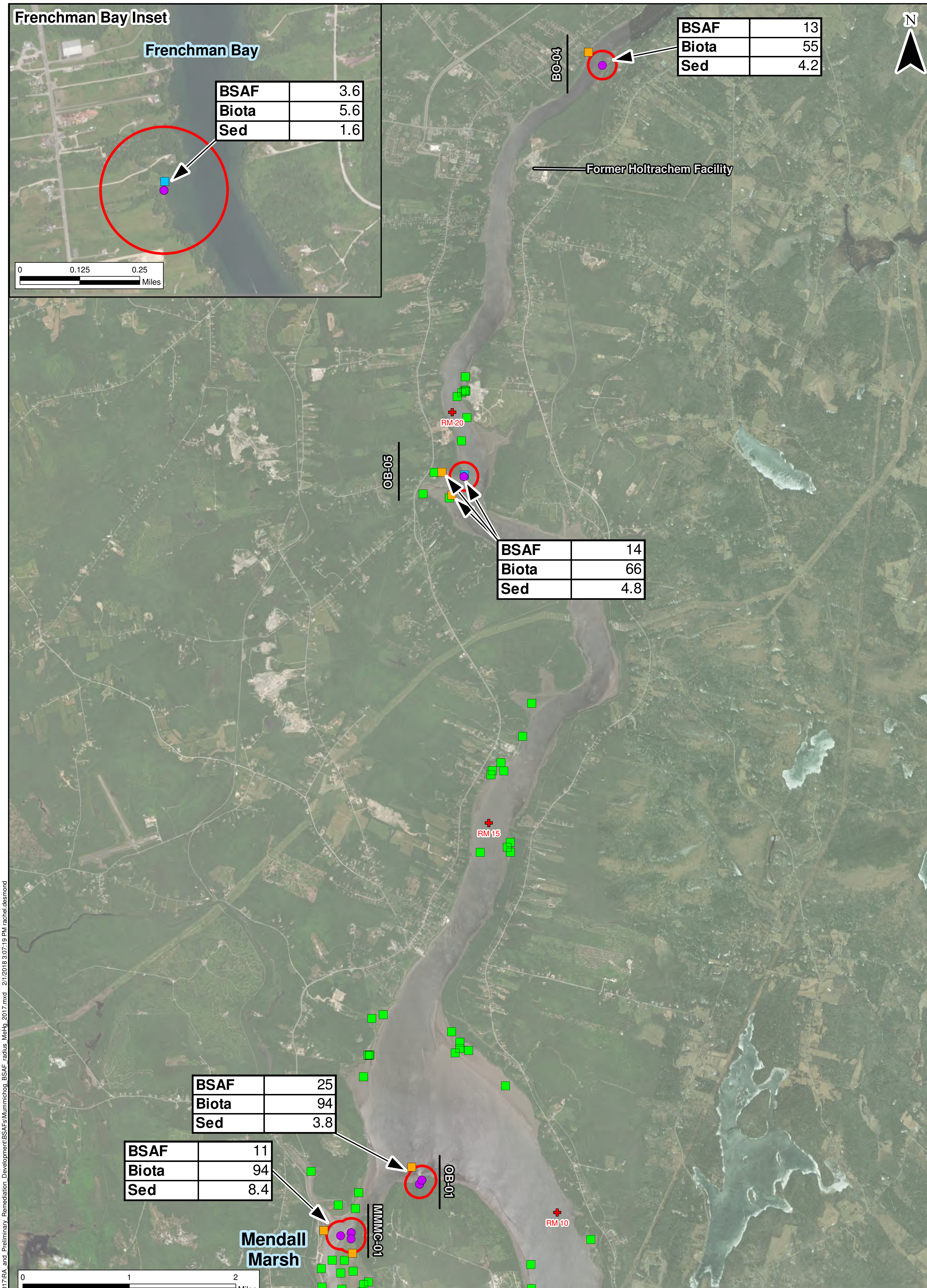

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Notes:
Home range radius overlaps shown.

Collocated sediments that fell just outside of the home range radius were utilized in pairings due to proximity or initial collocated intent

Legend

- ✚ River Mile Marker
- Mummichog Sample
- Co-located Sediment Sample
- Sediment Sample within Radius
- Sediment Sample Outside of Radius
- Mummichog Home Range Radius - 700ft
- **Mendall Marsh** Geographic Area Label
- **W-17-N** Sampling Location

Figure 8b
2017 Mummichog
Methyl Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052	Prepared/Date: RD 2/1/2018	Checked/Date: KPH 2/1/2018

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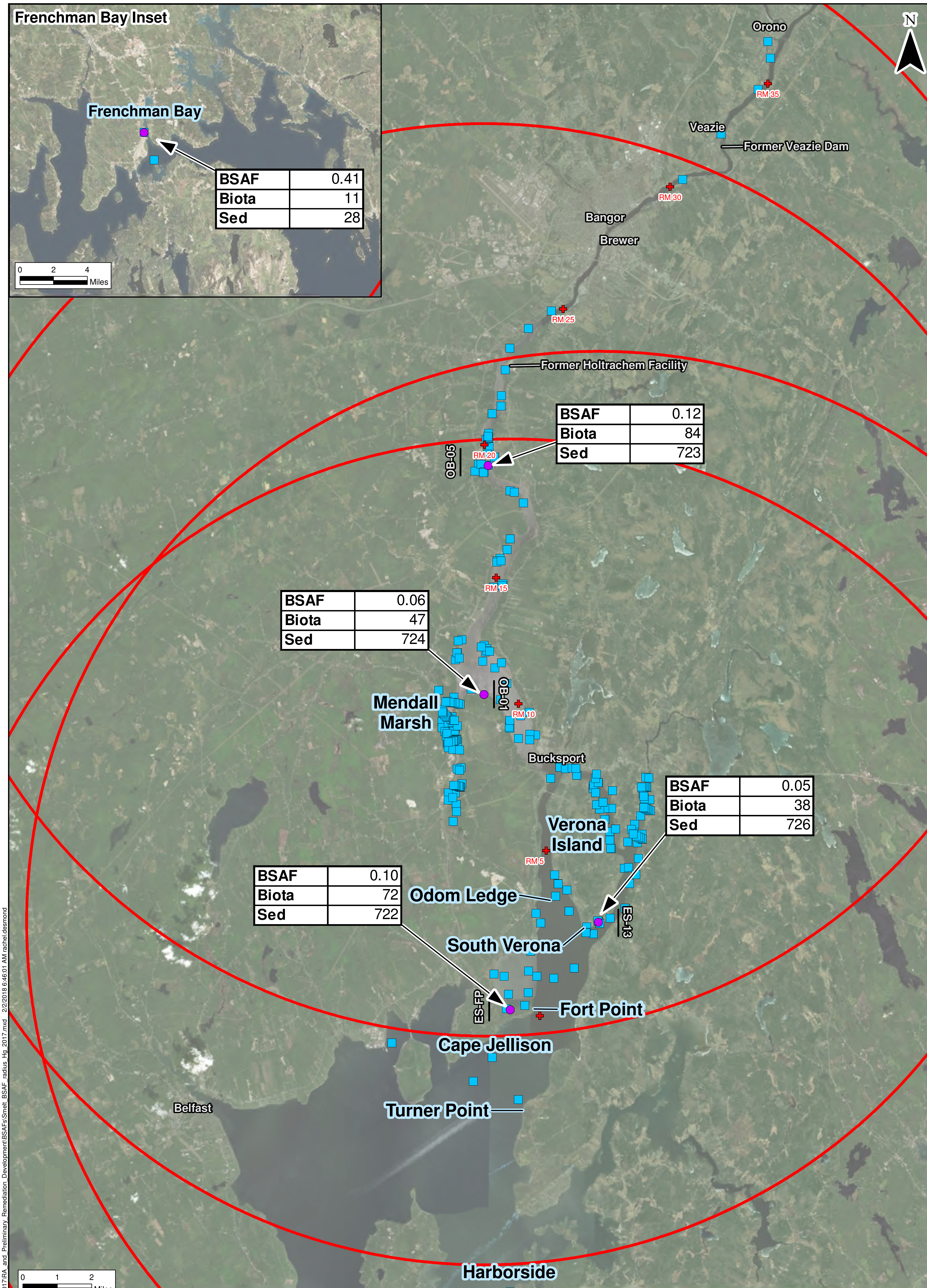

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Legend

- River Mile Marker
- Rainbow Smelt Sample
- Sediment Sample within Radius
- Smelt Home Range Radius - 16.6mi
- W-17-N Sampling Location
- **Mendall Marsh** Geographic Area Label

Figure 9a
2017 Rainbow Smelt
Mercury BSAFs

Penobscot River Risk Assessment and
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Penobscot River Phase III Engineering Study

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Project: 3616166052 | Prepared/Date: RD 2/2/2018 | Checked/Date: KPH 2/2/2018

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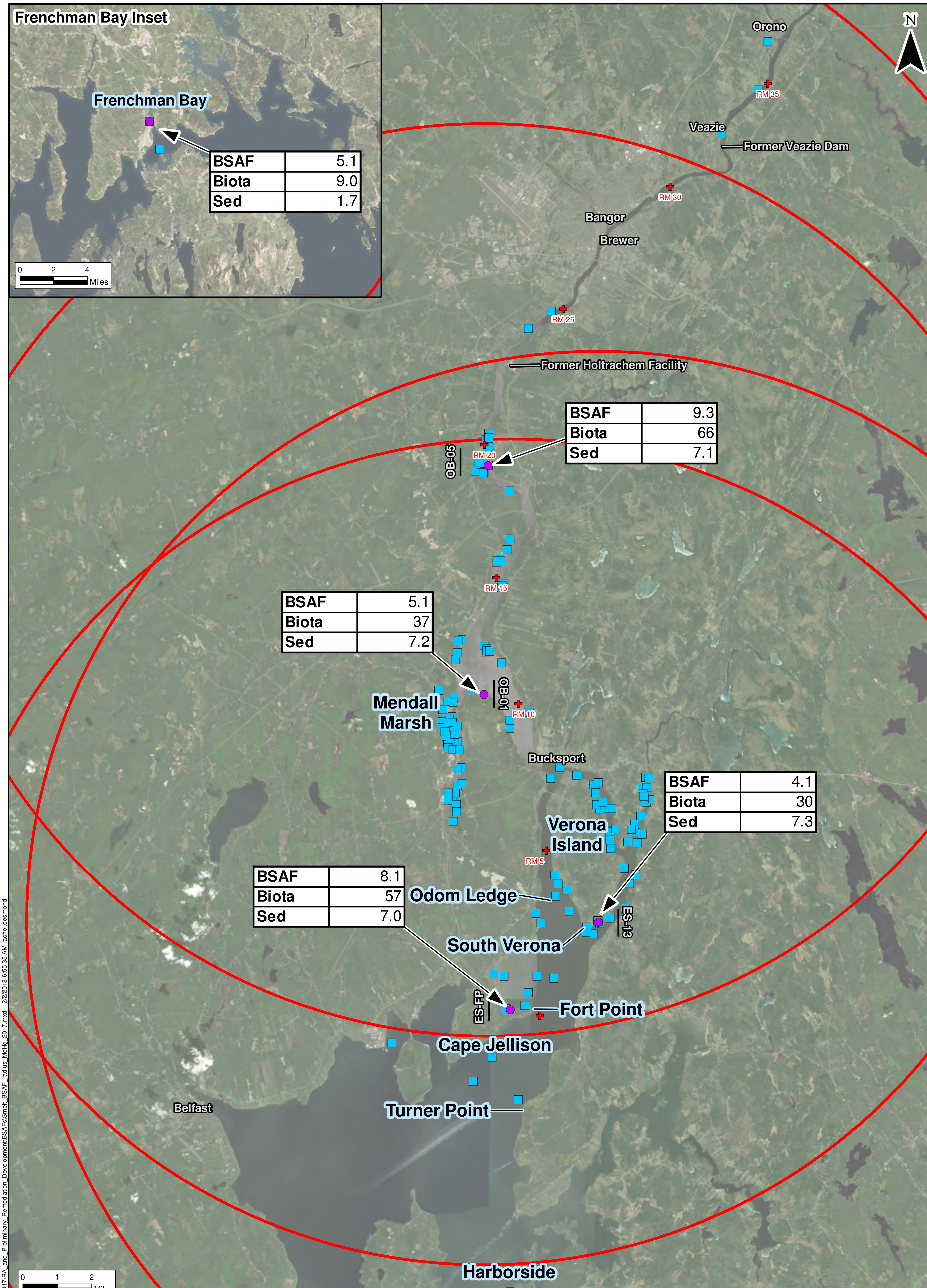

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Legend

- River Mile Marker
- Rainbow Smelt Sample
- Sediment Sample within Radius
- Smelt Home Range Radius - 16.6mi
- W-17-N Sampling Location
- **Mendall Marsh** Geographic Area Label

Figure 9b
2017 Rainbow Smelt
Methyl Mercury BSAFs

Penobscot River Risk Assessment and
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Penobscot River Phase III Engineering Study

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Project: 3616166052 | Prepared/Date: RD 2/2/2018 | Checked/Date: KPH 2/2/2018

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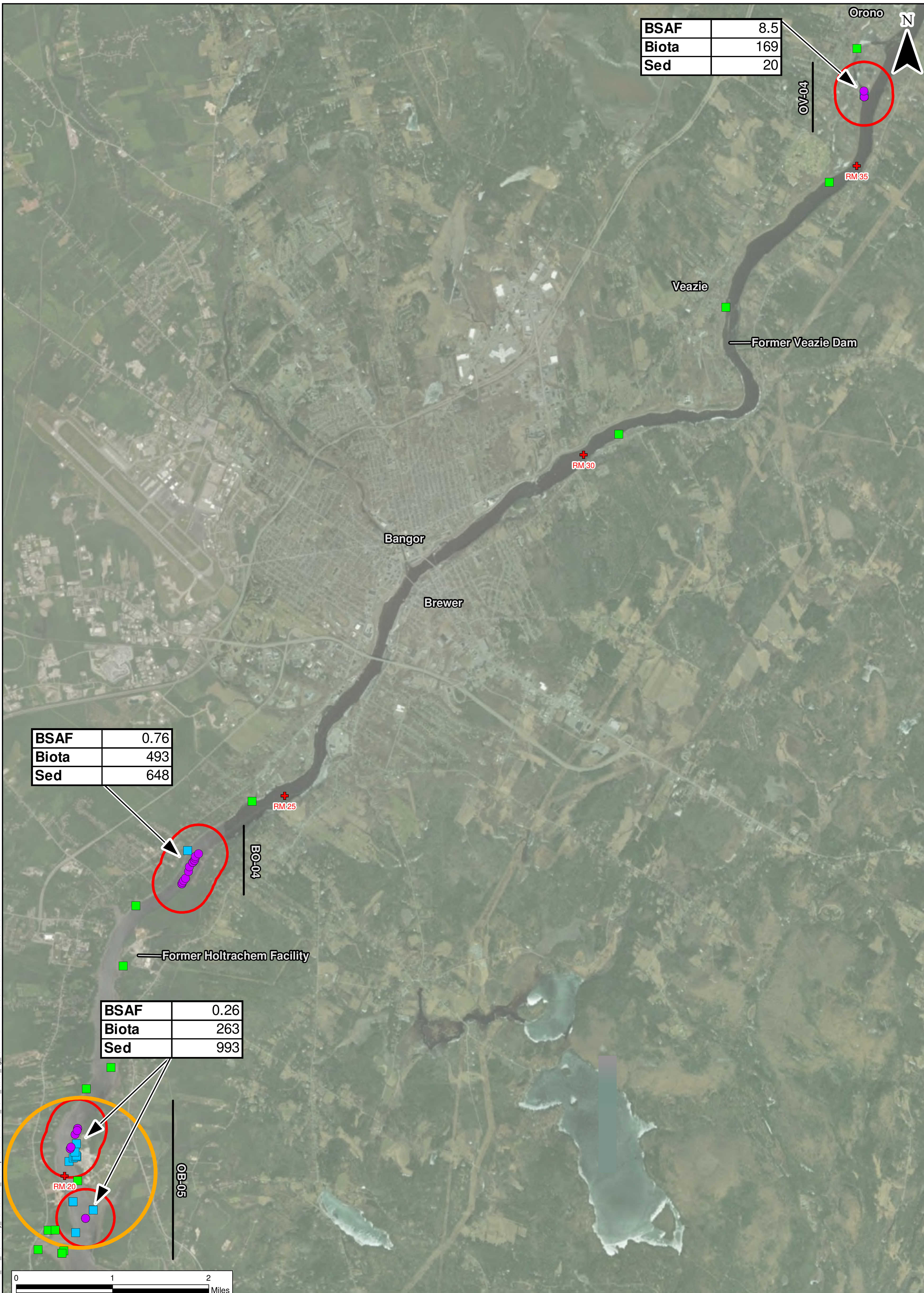

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Home range radius overlaps shown. Orange circle represents combination of 0.3 mile radius home ranges of each sample location.

Legend

- River Mile Marker
- Eel Sample
- Sediment Sample within Radius
- Sediment Sample Outside of Radius
- Eel Home Range Radius - 0.3mi
- South Verona — Geographic Area Label
- OB-01 — Sampling Location

Figure 10a
2017 Eel Mercury BSAFs

Penobscot River Risk Assessment and
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Penobscot River Phase III Engineering Study

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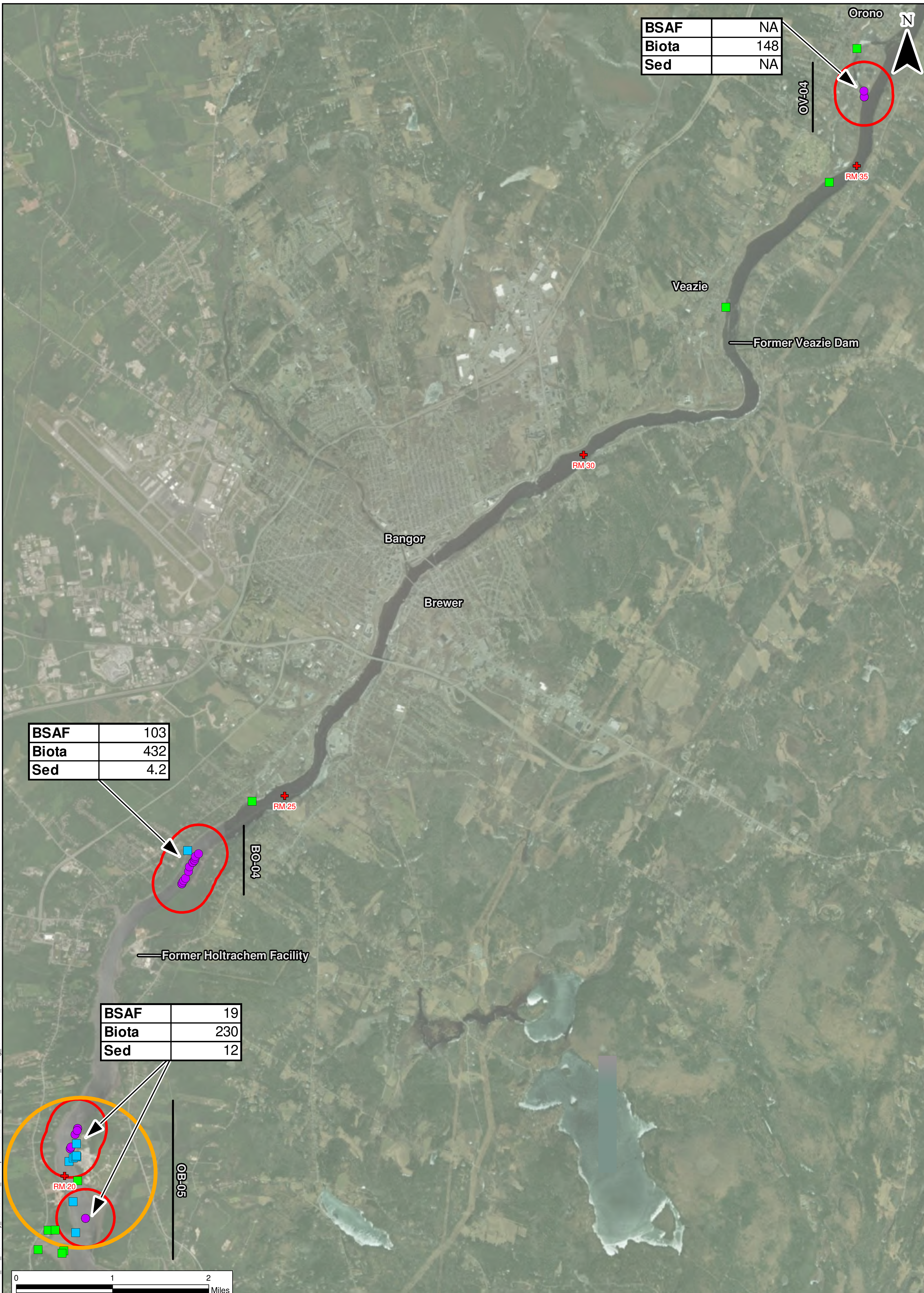

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Home range radius overlaps shown. Orange circle represents combination of 0.3 mile radius home ranges of each sample location.

Legend

- River Mile Marker
- Eel Sample
- Sediment Sample within Radius
- Sediment Sample Outside of Radius
- Eel Home Range Radius - 0.3mi
- South Verona — Geographic Area Label
- OB-01 — Sampling Location

Figure 10b
2017 Eel
Methyl Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

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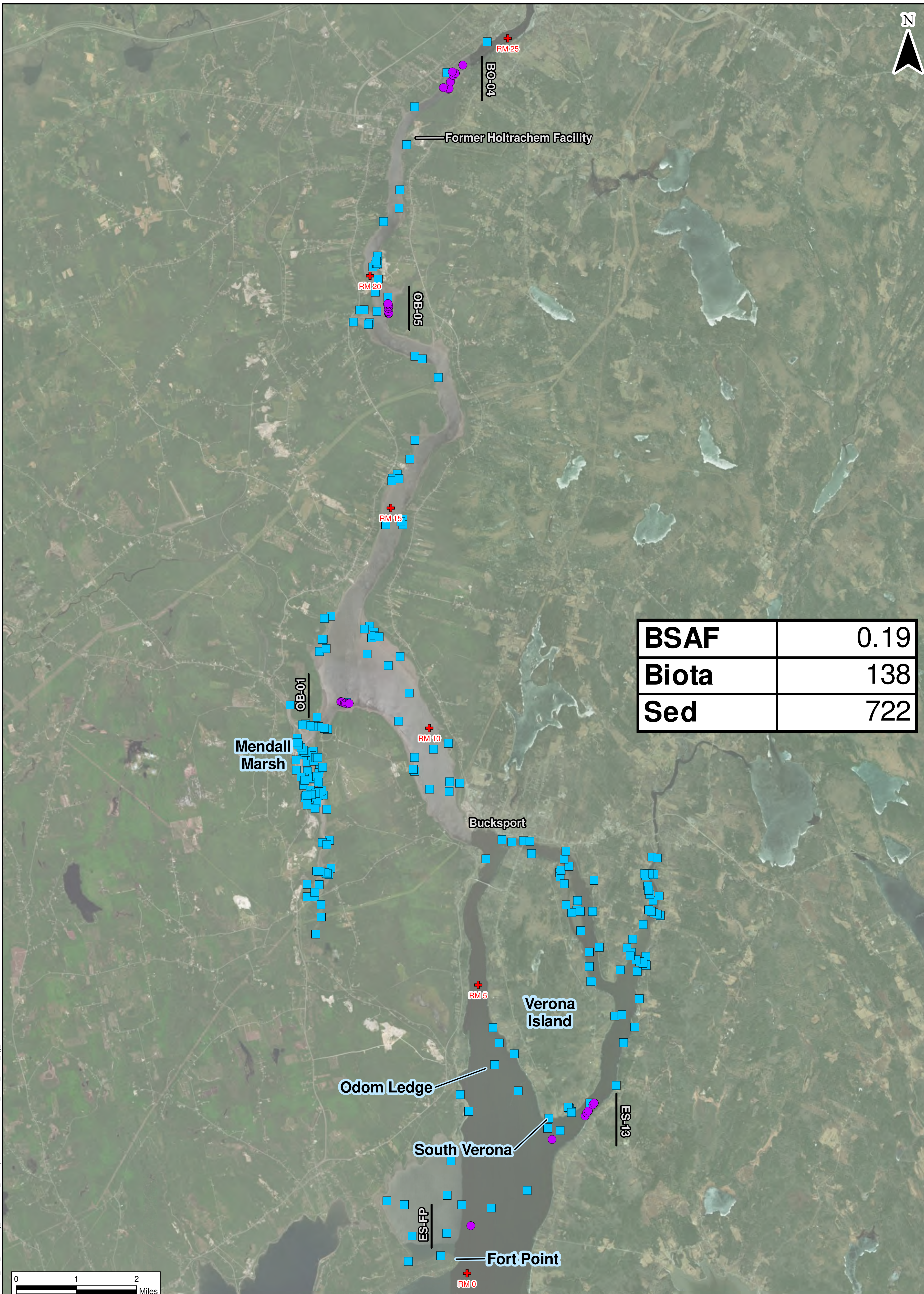

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Tomcod home range radius is 35 miles.

Legend

- River Mile Marker
- Tomcod Sample
- Sediment Sample within Radius
- South Verona: Geographic Area Label
- OB-01: Sampling Location

Figure 11a
2017 Tomcod Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

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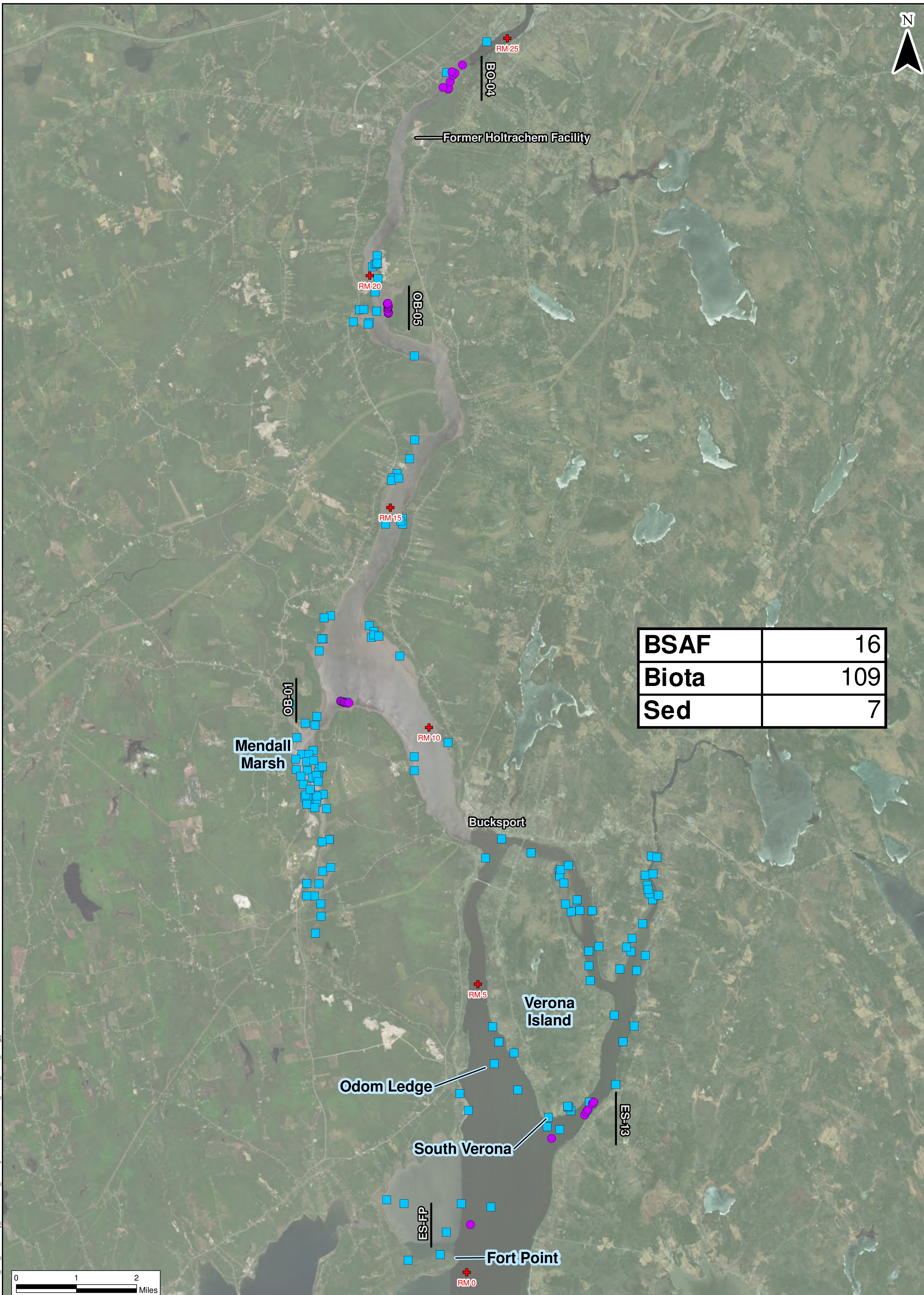

BSAF	16
Biota	109
Sed	7

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Note:
Tomcod home range radius is 35 miles.

Legend

- River Mile Marker
- Tomcod Sample
- Sediment Sample within Radius
- South Verona: Geographic Area Label
- OB-01: Sampling Location

Figure 11b
2017 Tomcod
Methyl Mercury BSAFs

Penobscot River Risk Assessment and Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

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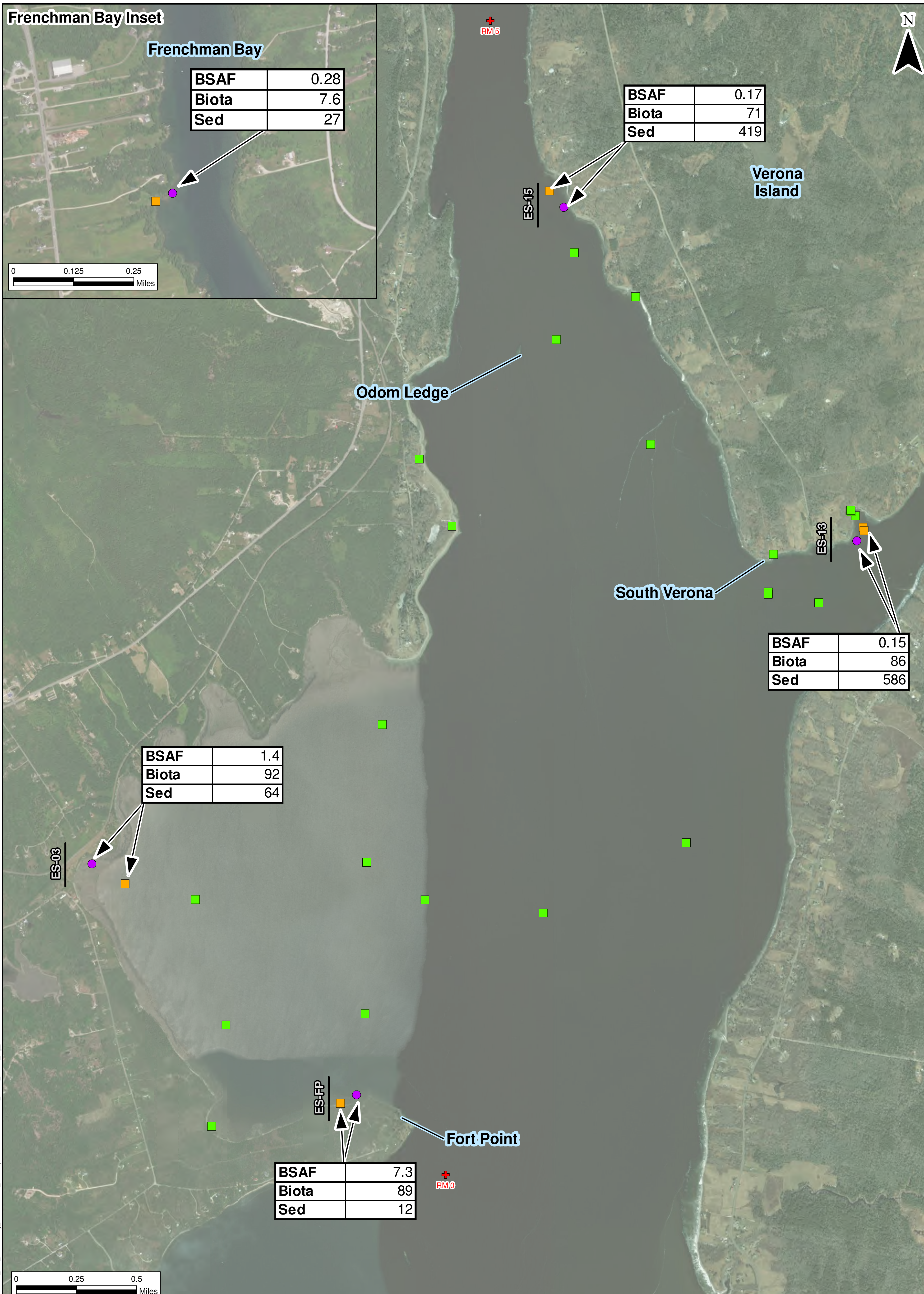

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Legend

- River Mile Marker
- Blue Mussel Sample
- Co-located Sediment Sample
- Sediment Sample Outside of Radius

W-17-N Sampling Location

Mendall Marsh Geographic Area Label

Notes:
Blue Mussel home range radius is 50 feet.

Collocated sediments that fell just outside of the home range radius were utilized in pairings due to proximity or initial collocated intent

Figure 12a
2017 Blue Mussel Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

amec foster wheeler

Project: 3616166052 | Prepared/Date: RD 2/1/2018 | Checked/Date: KPH 2/1/2018

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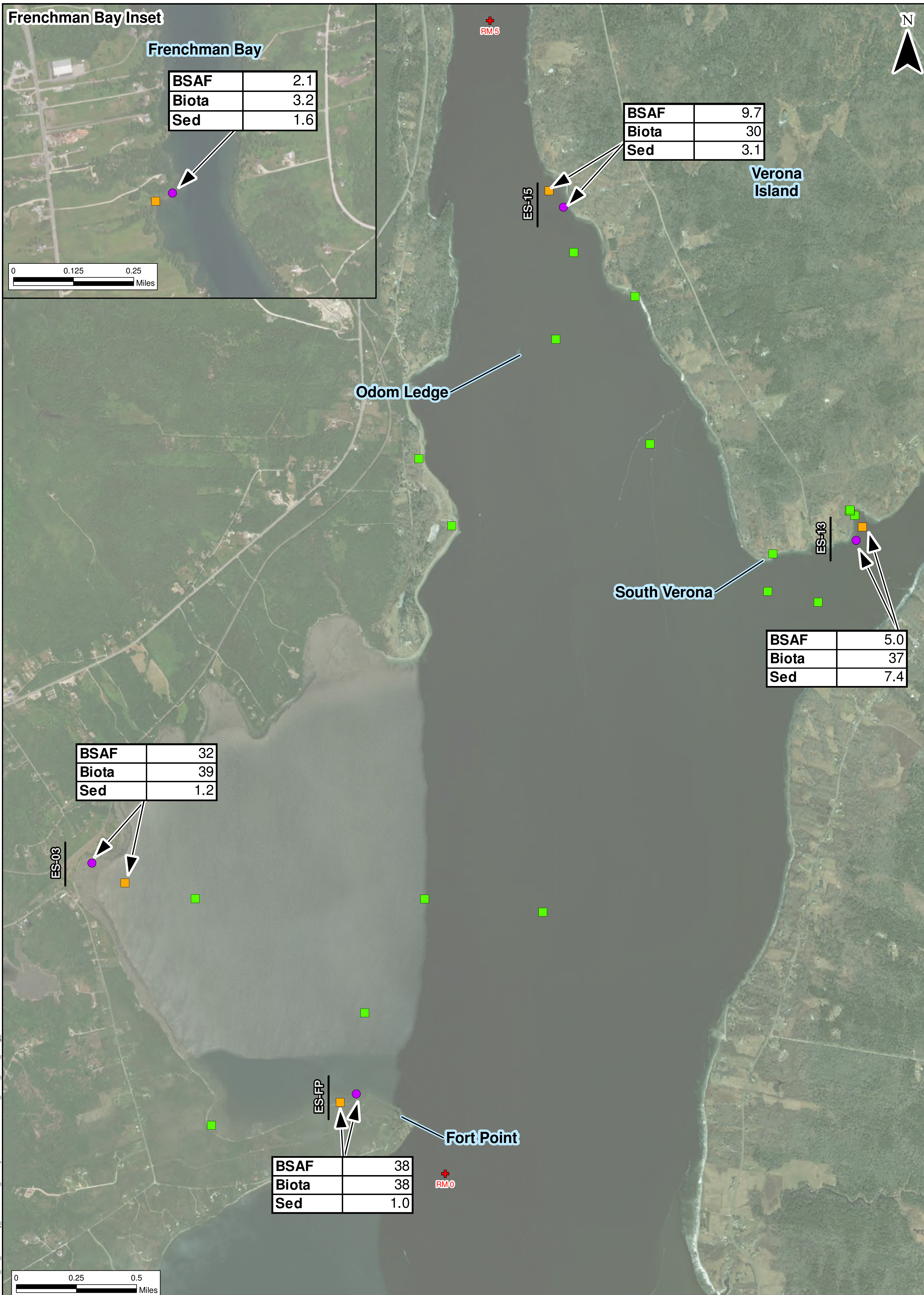

amec foster wheeler

BSAF	unitless
Biota	in ng/g
Sediment	in ng/g

Notes:
Blue Mussel home range radius is 50 feet.

Collocated sediments that fell just outside of the home range radius were utilized in pairings due to proximity or initial collocated intent

Legend

- River Mile Marker
- Blue Mussel Sample
- Co-located Sediment Sample
- Sediment Sample Outside of Radius
- W-17-N — Sampling Location
- Mendall Marsh — Geographic Area Label

Figure 12b
2017 Blue Mussel
Methyl Mercury BSAFs

Penobscot River Risk Assessment and
Preliminary Remediation Goal Development
Penobscot River Phase III Engineering Study

Project: 3616166052 | Prepared/Date: RD 2/1/2018 | Checked/Date: KPH 2/1/2018

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C-6

BAF Tables (2016-2017)

2016 BAF

2017 BAF

TABLE C-1

2016 TOTAL MERCURY BAF
BLACK DUCK BLOOD-BLUE MUSSEL ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Duck Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussel Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	377.0	143.6	15	179.9	59.4	12.6	40	15.8	6.35	3.47

Prepared by: JAW 06/13/17
Checked by: KPH 6/15/17

TABLE C-2

2016 METHYL MERCURY BAF
BLACK DUCK BLOOD-BLUE MUSSEL ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Duck Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussel Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	296.9	113.1	15	141.7	25.4	5.4	40	6.8	11.71	6.40

Notes:
Converts mercury concentrations to methyl mercury using a given percentage for each biota.

Prepared by: JAW 06/29/17
Checked by: KPH 07/17/17

TABLE C-3

2016 TOTAL MERCURY BAF
BLACK DUCK BLOOD-POLYCHAETE ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Duck Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaete Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	377.0	144.4	15	46.7	24.7	21.2	5	11.9	15.26	7.59
FRB-01	43.5	26.3	15	8.5	3.2	0.0	1	0.0	13.68	2.68
MMBKD-01	504.0	309.4	15	100.1	190.0	85.7	5	48.0	2.65	0.85

Prepared by: JAW 06/13/17
Checked by: KPH 6/15/17

TABLE C-4

2016 METHYL MERCURY BAF
BLACK DUCK BLOOD-POLYCHAETE ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Duck Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaete Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	296.9	113.9	15	36.9	2.4	1.3	4	0.8	123.70	43.23
FRB-01	34.3	20.1	15	6.5	NA	NA	NA	NA	NA	NA
MMBKD-01	396.9	243.7	15	78.8	9.9	3.7	5	2.1	40.09	11.55

Prepared by: KPH 07/17/17
Checked by: JAW 07/19/17

TABLE C-5

2016 TOTAL MERCURY BAF
BLACK DUCK TISSUE-BLUE MUSSEL ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Duck Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussel Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	441.0	157.6	5	88.3	59.4	12.6	40	2.5	7.42	1.52

Prepared by: JAW 06/13/17
Checked by: KPH 6/15/17

TABLE C-6

2016 METHYL MERCURY BAF
BLACK DUCK TISSUE-BLUE MUSSEL ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Duck Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussel Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	352.8	126.1	5	70.6	25.4	5.4	40	1.1	13.91	2.85

Notes:
Converts mercury concentrations to methyl mercury using a given percentage for each biota.

Prepared by: JAW 06/29/17
Checked by: KPH 07/17/17

TABLE C-7

2016 TOTAL MERCURY BAF

BLACK DUCK TISSUE-POLYCHAETE ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Location Name	Median Duck Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaete Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	441.0	160.4	5	89.9	24.7	21.5	5	12.1	17.85	9.44
FRB-01	44.8	14.5	5	8.1	3.2	0.0	1	0.0	14.00	2.53
MMBKD-01	177.0	276.6	5	155.0	190.0	86.9	5	48.7	0.93	0.85

Prepared by: JAW 06/13/17
Checked by: KPH 6/15/17

TABLE C-8

2016 METHYL MERCURY BAF
BLACK DUCK TISSUE-POLYCHAETE ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Duck Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaete Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	352.8	129.0	5	72.3	2.4	1.3	4	0.8	147.00	57.40
FRB-01	35.8	11.6	5	6.5	NA	NA	NA	NA	NA	NA
MMBKD-01	141.6	221.3	5	124.0	9.9	3.7	5	2.1	14.30	12.89

Prepared by: KPH 07/17/17
Checked by: JAW 07/19/17

TABLE C-9

2016 TOTAL MERCURY BAF
MUMMICHOG-TERRESTRIAL INSECT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insect Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	71.2	56.5	20	15.8	NA	NA	NA	NA	NA	NA
OB-05	89.1	18.8	20	5.3	NA	NA	NA	NA	NA	NA
OB-01	134.0	0.0	1	0.0	222.0	153.7	5	86.1	0.60	0.23
Mendall Marsh SE	158.5	56.5	4	35.4	222.0	153.7	5	86.1	0.71	0.32

Prepared By: KPH 07/18/17
Checked By: JAW 07/19/17

TABLE C-10

2016 METHYL MERCURY BAF
MUMMICHOG-TERRESTRIAL INSECT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insect Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	61.4	48.8	20	13.7	NA	NA	NA	NA	NA	NA
OB-05	76.8	16.2	77	2.3	NA	NA	NA	NA	NA	NA
OB-01	115.6	0.0	1	0.0	91.2	86.1	5	48.2	1.27	0.67
Mendall Marsh SE	136.8	48.8	4	30.5	91.2	86.1	5	48.2	1.50	0.86

Prepared By: KPH 07/18/17
Checked By: JAW 07/19/17

TABLE C-11

2016 TOTAL MERCURY BAF
MUMMICHOG-POLYCHAETE ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaete Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
FRB-01b	8.0	2.0	20	0.6	3.2	0.0	1	0.0	2.50	0.18
BO-04c	71.2	55.4	20	15.5	185.0	61.4	5	34.4	0.38	0.11

Prepared by: JAW 06/13/17
Checked by: KPH 6/15/17

TABLE C-12

2016 METHYL MERCURY BAF
MUMMICHOG-POLYCHAETE ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaete Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
FRB-01b	6.9	1.7	20	0.5	NA	NA	NA	NA	NA	NA
BO-04c	61.4	47.8	20	13.4	8.3	0.8	5	0.5	7.40	1.67

Prepared by: KPH 07/18/17
Checked by: JAW 07/19/17

TABLE C-13

2016 TOTAL MERCURY BAF
RAINBOW SMELT-MUMMICHOG ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13j	38.4	0.0	1	0.0	87.6	48.0	45	9.0	0.44	0.04
ES-FPb	55.4	24.6	20	6.9	95.8	39.9	25	10.0	0.58	0.09
FRB-01d	6.6	0.9	20	0.2	8.0	2.0	20	0.5	0.83	0.06
OB-01e	86.8	27.5	12	9.9	87.6	47.5	45	8.9	0.99	0.15
OB-05c	201.0	0.0	1	0.0	87.6	48.0	45	9.0	2.29	0.23
OB-05r	65.5	38.0	8	16.8	87.6	47.5	45	8.9	0.75	0.21

Prepared by: JAW 06/13/17
Checked by: KPH 06/15/17

TABLE C-14

2016 METHYL MERCURY BAF

RAINBOW SMELT-MUMMICHOG ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Location Name	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13j	30.3	0.0	1	0.0	75.6	41.4	45	7.7	0.40	0.04
ES-FPb	43.7	19.5	20	5.5	82.7	34.4	25	8.6	0.53	0.09
FRB-01d	5.2	0.7	20	0.2	6.9	1.7	20	0.5	0.76	0.06
OB-01e	68.6	21.7	12	7.9	75.6	41.0	45	7.7	0.91	0.14
OB-05c	158.8	0.0	1	0.0	75.6	41.4	45	7.7	2.10	0.21
OB-05r	51.7	30.0	8	13.3	75.6	41.0	45	7.7	0.68	0.19

Prepared by: KPH 7/17/17
Checked by: JAW 7/19/2017

TABLE C-15

2016 TOTAL MERCURY BAF
RAINBOW SMELT-POLYCHAETE ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaete Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13j	38.4	0.0	1	0.0	142.0	100.4	25	25.2	0.27	0.05
ES-FPb	55.4	24.6	20	6.9	70.6	96.5	20	27.0	0.78	0.32
FRB-01d	6.6	0.9	20	0.2	3.2	0.0	1	0.0	2.09	0.08
OB-01e	86.8	27.5	12	10.0	142.0	98.5	25	24.7	0.61	0.13
OB-05c	201.0	0.0	1	0.0	142.0	100.4	25	25.2	1.42	0.25
OB-05r	65.5	38.0	8	16.9	142.0	98.6	25	24.7	0.46	0.14

Prepared by: JAW 06/13/17
Checked by: KPH 06/15/17

TABLE C-16

2016 METHYL MERCURY BAF
RAINBOW SMELT-POLYCHAETE ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaete Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13j	30.3	0.0	1	0.0	8.3	4.1	23	1.1	3.65	0.47
ES-FPb	43.7	19.5	20	5.5	9.1	4.5	18	1.3	4.83	0.93
OB-01e	68.6	21.7	12	7.9	8.3	4.0	23	1.1	8.26	1.41
OB-05c	158.8	0.0	1	0.0	8.3	4.1	23	1.1	19.13	2.48
OB-05r	51.7	30.1	8	13.3	8.3	4.0	23	1.1	6.23	1.79

Prepared by: KPH 07/18/17
Checked by: JAW 07/19/17

TABLE C-17

2009 TOTAL MERCURY BAF
RAINBOW SMELT-SHRIMP ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Shrimp Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-02-E	147.5	84.2	20	23.6	73.7	15.7	35	3.3	2.00	0.33
ES-03	47.8	11.0	20	3.1	73.7	15.7	35	3.3	0.65	0.05
ES-04-W	39.4	11.8	20	3.3	67.3	16.5	24	4.2	0.59	0.06
ES-05-S	91.9	84.0	19	24.1	73.7	15.7	35	3.3	1.25	0.33
ES-06-S	132.5	43.4	6	22.2	73.7	15.7	35	3.3	1.80	0.31
ES-09	59.6	20.9	15	6.8	73.7	15.7	35	3.3	0.81	0.10
ES-10	45.5	6.1	12	2.2	67.3	16.5	24	4.2	0.68	0.05
ES-11-N	59.7	23.0	6	11.8	73.7	15.7	35	3.3	0.81	0.16
ES-12	62.1	14.6	4	9.1	73.7	15.7	35	3.3	0.84	0.13
ES-13	78.6	20.4	33	4.5	73.7	15.7	35	3.3	1.07	0.08
ES-14	30.9	8.8	12	3.2	67.3	16.5	24	4.2	0.46	0.06
ES-14-N	80.2	20.9	10	8.3	73.7	15.7	35	3.3	1.09	0.12
ES-15-S	76.4	24.3	7	11.5	73.7	15.7	35	3.3	1.04	0.16
ES-FP	54.6	13.9	20	3.9	73.7	15.7	35	3.3	0.74	0.06
OB-01	91.2	24.3	30	5.6	73.7	15.7	35	3.3	1.24	0.09
OB-02	60.9	19.6	3	14.2	73.7	15.8	35	3.3	0.83	0.20
OB-04	90.4	159.6	3	115.4	73.7	15.8	35	3.3	1.23	1.57

Prepared by: JAW 06/13/17
Checked by: KPH 06/15/17

TABLE C-18

2009 METHYL MERCURY BAF
RAINBOW SMELT-SHRIMP ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Shrimp Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-02-E	139.2	98.7	4	61.8	49.3	13.0	34	2.8	2.82	1.26
ES-03	39.0	11.8	4	7.4	49.3	13.0	34	2.8	0.79	0.16
ES-04-W	30.3	6.8	4	4.2	48.1	12.9	23	3.4	0.63	0.10
ES-05-S	56.5	24.1	4	15.1	49.3	13.0	34	2.8	1.15	0.31
ES-06-S	90.0	0.0	1	0.0	49.3	13.1	34	2.8	1.83	0.10
ES-09	56.9	2.4	3	1.7	49.3	13.0	34	2.8	1.15	0.07
ES-10	39.7	6.7	2	6.0	48.1	13.0	23	3.4	0.82	0.14
ES-11-N	43.2	0.0	1	0.0	49.3	13.1	34	2.8	0.88	0.05
ES-12	59.5	0.0	1	0.0	49.3	13.1	34	2.8	1.21	0.07
ES-13	51.4	20.7	7	9.8	49.3	13.0	34	2.8	1.04	0.21
ES-14	45.8	11.5	3	8.3	48.1	12.9	23	3.4	0.95	0.19
ES-14-N	32.4	6.1	2	5.4	49.3	13.1	34	2.8	0.66	0.12
ES-15-S	20.6	0.0	1	0.0	49.3	13.1	34	2.8	0.42	0.02
ES-FP	37.5	3.5	4	2.2	49.3	13.0	34	2.8	0.76	0.06
OB-01	81.5	21.6	7	10.2	49.3	13.0	34	2.8	1.65	0.23
OB-02	53.8	0.0	1	0.0	49.3	13.1	34	2.8	1.09	0.06
OB-04	301.0	0.0	1	0.0	49.3	13.1	34	2.8	6.11	0.35

Prepared by: JAW 06/13/17
Checked by: KPH 06/15/17

TABLE C-19

2016 TOTAL MERCURY BAF

RAINBOW SMELT-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Location Name	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13j	38.4	0.00	1	0.00	50	117.99	15	38.17	0.77	0.59
ES-FPb	55.4	24.65	20	6.91	50	114.18	15	36.94	1.11	0.83
OB-01e	86.8	27.54	12	9.96	50	114.31	15	36.98	1.74	1.30
OB-05c	201.0	0.00	1	0.00	50	117.99	15	38.17	4.02	3.07
OB-05r	65.5	38.11	8	16.88	50	114.47	15	37.03	1.31	1.03

Prepared by: JAW 06/13/17
Checked by: KPH 06/15/17

TABLE C-20

2016 METHYL MERCURY BAF
RAINBOW SMELT-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13j	30.3	0.00	1	0.00	33.5	60.65	15	19.62	0.91	0.53
ES-FPb	43.7	19.47	20	5.46	33.5	58.69	15	18.99	1.31	0.76
OB-01e	68.6	21.75	12	7.87	33.5	58.75	15	19.01	2.05	1.18
OB-05c	158.8	0.00	1	0.00	33.5	60.65	15	19.62	4.74	2.78
OB-05r	51.7	30.10	8	13.33	33.5	58.83	15	19.03	1.54	0.96

Prepared by: KPH 07/18/17
Checked by: JAW 07/19/17

TABLE C-21

2016 TOTAL MERCURY BAF
NELSONS SPARROW-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Sparrow Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD	467.0	140.4	11	53.0	16.8	23.0	5	12.9	27.80	21.57
MMSE	6130.0	1611.9	15	521.5	222.0	138.4	5	77.6	27.61	9.93
MMSW	5840.0	1301.7	11	491.8	47.5	8.7	5	4.9	122.95	16.33
W-17	5000.0	2879.6	15	931.6	30.4	89.1	5	49.9	164.47	271.85

Prepared by: JAW 06/13/17
Checked by: KPH 07/18/17

TABLE C-22

2016 METHYL MERCURY BAF
NELSONS SPARROW-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Sparrow Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD	446.1	134.1	11	50.7	18.6	10.0	5	5.6	23.99	7.72
MMSE	5856.0	1539.8	15	498.2	91.2	77.5	5	43.4	64.21	31.05
MMSW	5579.0	1243.5	11	469.8	26.8	9.2	5	5.2	208.17	43.85
W-17	4776.5	2750.9	15	890.0	56.7	34.5	5	19.3	84.24	32.70

Prepared by: KPH 07/18/17
Checked by: JAW 07/19/17

TABLE C-23

2016 TOTAL MERCURY BAF
NELSONS SPARROW-SPIDER ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Sparrow Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Spider Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD	467.0	140.4	11	53.0	31.4	7.4	5	4.2	14.87	2.59
MMSE	6130.0	1611.9	15	521.5	205.0	228.9	5	128.2	29.90	18.88
MMSW	5840.0	1301.7	11	491.8	219.0	38.2	5	21.4	26.67	3.44
W-17	5000.0	2879.6	15	931.6	263.0	101.7	5	57.0	19.01	5.43

Prepared by: JAW 06/13/17
Checked by: KPH 07/18/17

TABLE C-24

2016 METHYL MERCURY BAF
NELSONS SPARROW-SPIDER ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Sparrow Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Spider Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD	446.1	134.1	11	50.7	22.9	16.1	5	9.0	19.48	8.01
MMSE	5856.0	1539.8	15	498.2	174.0	35.6	5	20.0	33.66	4.81
MMSW	5579.0	1243.5	11	469.8	217.0	62.3	5	34.9	25.71	4.67
W-17	4776.5	2750.9	15	890.0	282.0	160.8	5	90.1	16.94	6.26

Prepared by: KPH 07/18/17
Checked by: JAW 07/19/17

TABLE C-25

2016 TOTAL MERCURY BAF
SPIDER-TERRESTRIAL INSECT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Spider Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insect Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD-01c	31.4	7.5	5	4.2	16.8	23.3	5	13.0	1.87	1.47
MMSE-1a	205.0	232.0	5	130.0	222.0	140.3	5	78.6	0.92	0.67
MMSW-Cb	219.0	38.6	5	21.6	47.5	8.8	5	4.9	4.61	0.66
W17-Nb	263.0	103.1	5	57.8	30.4	90.3	5	50.6	8.65	14.53

Prepared by: JAW 06/13/17
Checked by: KPH 06/15/17

TABLE C-26

2016 METHYL MERCURY BAF
SPIDER-TERRESTRIAL INSECT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Spider Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insect Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD-01c	22.9	16.3	5	9.2	18.6	10.1	5	5.7	1.23	0.62
MMSE-1a	174.0	36.1	5	20.2	91.2	78.6	5	44.0	1.91	0.95
MMSW-Cb	217.0	63.0	5	35.3	26.8	9.3	5	5.2	8.10	2.06
W17-Nb	282.0	163.0	5	91.3	56.7	34.9	5	19.6	4.97	2.35

Prepared by: JAW 06/13/17
Checked by: KPH 07/17/17

TABLE C-27

2016 TOTAL MERCURY BAF
ATLANTIC TOMCOD ACCUMULATION FACTOR EVALUATIONS
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Prey	Median Tomcod (ng/g)	Standard Deviation	Count	Standard Error	Median Prey Item (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
Riverwide										
Insects	154.5	72.0	54	12.3	50.0	118.0	15	38.2	3.09	2.37
Polychaetes	154.5	72.0	54	12.3	142.0	100.4	25	25.2	1.09	0.21
Lobster	154.5	72.0	54	12.3	176.0	188.7	100	23.7	0.88	0.14
Smelt	154.5	72.0	54	12.3	60.6	36.5	42	7.0	2.55	0.36
Mummichog	154.5	72.0	54	12.3	87.6	48.0	45	9.0	1.76	0.23
Forage Fish	154.5	72.0	54	12.3	78.4	45.0	87	6.0	1.97	0.22
Shrimp (2009)	113.0	113.0	113	13.3	73.7	15.9	35	3.4	1.53	0.19
Background (Frenchmans Bay)										
Insects	36.5	0.0	1	0.0	--	--	--	--	--	--
Polychaetes	36.5	0.0	1	0.0	--	--	--	--	--	--
Lobster	36.5	0.0	1	0.0	--	--	--	--	--	--
Smelt	36.5	0.0	1	0.0	6.6	0.9	20	0.2	5.50	0.21
Mummichog	36.5	0.0	1	0.0	8.0	2.0	20	0.6	4.59	0.32
Forage Fish	36.5	0.0	1	0.0	7.0	1.7	40	0.3	5.18	0.24
Shrimp (2009)	--	--	--	--	--	--	--	--	--	--

Prepared By: JPM 06/07/17
Checked By: KPH 06/07/17

TABLE C-28

2016 METHYL MERCURY BAF
ATLANTIC TOMCOD ACCUMULATION FACTOR EVALUATIONS
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Prey	Median Tomcod (ng/g)	Standard Deviation	Count	Standard Error	Median Prey Item (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
Riverwide										
Insects	122.9	57.3	54	9.8	33.5	60.6	15	19.6	3.67	2.17
Polychaetes	122.9	57.3	54	9.8	8.3	4.1	23	1.1	14.81	2.25
Lobster	122.9	57.3	54	9.8	137.8	147.7	100	18.5	0.89	0.14
Smelt	122.9	57.3	54	9.8	47.9	28.8	42	5.6	2.57	0.36
Mummichog	122.9	57.3	54	9.8	75.6	41.4	45	7.7	1.63	0.21
Forage Fish	122.9	57.3	54	9.8	64.7	38.8	87	5.2	1.90	0.21
Shrimp (2009)	89.9	89.9	113	10.6	49.3	13.1	34	2.8	1.82	0.24
Background (Frenchmans Bay)										
Insects	29.0	0.0	1	0.0	--	--	--	--	--	
Polychaetes	29.0	0.0	1	0.0	--	--	--	--	--	
Lobster	29.0	0.0	1	0.0	--	--	--	--	--	
Smelt	29.0	0.0	1	0.0	5.2	0.7	20	0.2	5.54	0.21
Mummichog	29.0	0.0	1	0.0	6.9	1.7	20	0.5	4.23	0.30
Forage Fish	29.0	0.0	1	0.0	5.8	1.5	40	0.3	4.99	0.26
Shrimp (2009)	--	--	--	--	--	--	--	--	--	

Prepared By: JPM 06/07/17
Checked By: KPH 06/07/17

TABLE C-29

2016 TOTAL MERCURY BAF
LOBSTER TAIL-BLUE MUSSEL ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Tail Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussel Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
L10-52	206.5	192.7	20	54.0	59.4	12.6	40	2.5	3.48	0.92
SVE-01	366.0	257.7	20	72.2	59.6	12.7	40	2.5	6.14	1.24
								Median:	**4.81**	**1.60**

Prepared by: JAW 08/16/17
Checked by: KPH 08/16/17

TABLE C-30

2016 METHYL MERCURY BAF
LOBSTER TAIL-BLUE MUSSEL ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Tail Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussel Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
L10-52	161.62755	150.8	20	42.3	25.35786	5.4	40	1.1	6.37	1.69
SVE-01	286.4682	201.7	20	56.5	25.44324	5.41E+00	40	1.07E+00	11.26	2.27
								Median:	**8.82**	**2.94**

Prepared by: JAW 08/16/17
Checked by: KPH 08/16/17

TABLE C-31

2016 TOTAL MERCURY BAF
LOBSTER TAIL-POLYCHAETE ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Tail Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaete Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
L10-52	206.5	193.6	20	54.2	24.7	21.2	5	11.9	8.36	4.58
SVE-01	366.0	257.7	20	72.2	24.7	21.2	5	11.9	14.82	7.70
								Median:	**11.59**	**8.75**

Prepared by: JAW 08/16/17
Checked by: KPH 08/23/17

TABLE C-32

2016 METHYL MERCURY BAF
LOBSTER TAIL-POLYCHAETE ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Tail Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaete Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
L10-52	161.6	151.5	20	42.5	2.4	1.4	4	0.9	67.34	30.78
SVE-01	286.5	201.7	20	56.5	2.4	1.4	4	0.9	119.36	50.48
								Median:	**93.35**	**58.13**

Notes:
Converts mercury concentrations to methyl mercury using a given percentage for each biota.

Prepared by: JAW 08/16/17
Checked by: KPH 08/23/17

TABLE C-33

2016 TOTAL MERCURY BAF
LOBSTER TAIL-RAINBOW SMELT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Tail Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
CPJL	179.5	73.6	20	20.6	55.35	24.6	20	6.9	3.24	0.55
L10-52	254	206.5	15	66.8	38.4	0.0	1	0.0	6.61	1.74
								Median:	**4.93**	**1.54**

Prepared by: JAW 08/16/17
Checked by: KPH 08/23/17

TABLE C-34

2016 METHYL MERCURY BAF
LOBSTER TAIL-RIANBOW SMELT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Tail Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
CPJL	140.49465	57.6	20	16.1	43.72	19.5	20	5.5	3.21	0.55
L10-52	198.8058	161.7	15	52.3	30.3	0.0	1	0.0	6.55	1.72
								Median:	**4.88**	**1.53**

Notes:
Converts mercury concentrations to methyl mercury using a given percentage for each biota.

Prepared by: JAW 08/16/17
Checked by: KPH 08/23/17

TABLE C-35

2015 TOTAL MERCURY AND METHYL MERCURY BAF
LOBSTER TAIL-ROCK CRAB ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Tail Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Rock Crab Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
Riverwide (THg)	145.0	230.9	175	21.9	143.0	116.7	161	11.5	1.09	0.19
Riverwide (MeHg)	113.5	180.7	175	17.1	129.7	105.8	161	10.4	0.94	0.16

Prepared by: JAW 08/16/17
Checked by: KPH 08/16/17

TABLE C-36

2016 TOTAL MERCURY BAF
EEL-INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
OB-01	394	0	1	0.0	50.00	118.0	15	38.2	7.88	6.02

Prepared by: JAW 12/05/17
Checked by: KPH 12/07/17

TABLE C-37

2016 METHYL MERCURY BAF
EEL-INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
OB-01	345	0	1	0.0	33.50	60.6	15	19.6	10.31	6.04

Notes:
Methyl mercury values for the Eels are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 12/05/17
Checked by: KPH 12/07/17

TABLE C-38

2016 TOTAL MERCURY BAF
EEL-MUMMICHOG ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	1370	0	1	0.0	71.15	56.5	20	15.8	19.26	4.29
OB-01	394	0	1	0.0	134.00	0	1	0.0	2.94	0.00
OB-05	461	71.0	5	39.8	89.05	18.8	20	5.3	5.18	0.54

Prepared by: JAW 12/01/17
Checked by: KPH 12/07/17

TABLE C-39

2016 METHYL MERCURY BAF
EEL-MUMMICHOG ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	1201	0	1	0.0	61.4	48.8	20	13.7	19.56	4.35
OB-01	345	0	1	0.0	115.6	0	1	0.0	2.99	0.00
OB-05	404	62.3	5	34.9	76.8	16.2	20	4.5	5.26	0.55

Notes:
Methyl mercury values for the biota are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 12/01/17
Checked by: KPH 12/07/17

TABLE C-40

2016 TOTAL MERCURY BAF
EEL-POLYCHAETES ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaetes Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	1370	0	1	0.0	185	68.3	5	38.3	7.41	1.53
OB-01	394	0	1	0.0	190	95	5	53.4	2.07	0.58
OB-05	461	71.0	5	39.8	215	16.2	5	9.1	2.14	0.21

Prepared by: JAW 12/05/17
Checked by: KPH 12/07/17

TABLE C-41

2016 METHYL MERCURY BAF
EEL-POLYCHAETES ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaetes Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	1201	0	1	0.0	8.3	0.9	5	0.5	144.66	9.23
OB-01	345	0	1	0.0	10	4	5	2.3	34.88	8.08
OB-05	404	62.3	5	34.9	12.7	0.8	5	0.5	31.81	2.98

Notes:
Methyl mercury values for the Eels are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 12/05/17
Checked by: KPH 12/07/17

TABLE C-42

2016 TOTAL MERCURY BAF
EEL-SMELT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	1370	0	1	0.0	201.0	0.0	1	0.0	6.82	0.00
OB-01	394	0	1	0.0	90.8	34.3	15	11.1	4.34	0.53
OB-05	461	71.0	5	39.8	201.0	0	1	0.0	2.29	0.20

Prepared by: JAW 12/05/17
Checked by: KPH 12/07/17

TABLE C-43

2016 METHYL MERCURY BAF
EEL-SMELT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	1201	0	1	0.0	158.8	0.0	1	0.0	7.56	0.00
OB-01	345	0	1	0.0	71.7	27.1	15	8.8	4.81	0.59
OB-05	404	62	5	34.9	158.8	0.0	1	0.0	2.54	0.22

Notes:
Methyl mercury values for the biota are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 12/05/17
Checked by: KPH 12/07/17

TABLE C-1
2017 TOTAL MERCURY BAF
AMERICAN BLACK DUCK BLOOD-MUSSELS ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median American Black Duck Blood Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussels Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	165	102	15	33	79	22	32	4.8	2.1	0.44
Reference										
FRB-01	56	18	15	5.9	7.6	2.2	20	0.61	7.4	0.98

Prepared by: RRP 2/28/18
Checked by: KPH 03/01/18

TABLE C-2
2017 METHYL MERCURY BAF
AMERICAN BLACK DUCK BLOOD-MUSSELS ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median American Black Duck Blood Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussels Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	130	80	15	26	34	9.3	32	2.1	3.8	0.81
Reference										
FRB-01	44	14	15	4.7	3.2	0.92	20	0.26	14	1.8

Note:
Methyl mercury values for biota are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: RRP 2/28/18
Checked by: KPH 03/01/18

TABLE C-3

2017 TOTAL MERCURY BAF

AMERICAN BLACK DUCK BLOOD-POLYCHAETES ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Location Name	Median American Black Duck Blood Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaetes Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
MMBKD	275	83.9	15	27.2	36.6	11.3	10	4.5	7.51	1.18
ES-13	165	102.1	15	33.0	23.8	8.3	20	2.3	6.95	1.55
Reference										
FRB-01	55.8	18.3	15	5.9	7.7	0.7	5	0.4	7.28	0.85

Prepared by: RRP 02/28/18
Checked by: KPH 03/01/18

TABLE C-4

2017 METHYL MERCURY BAF

AMERICAN BLACK DUCK BLOOD-POLYCHAETES ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Location Name	Median American Black Duck Blood Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaetes Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
MMBKD	217	66.1	15	21.4	7.6	2.9	10	1.1	28	5.1
ES-13	130	80.4	15	26.0	9.7	1.6	5	0.9	13	2.9
Reference										
FRB-01	43.9	14.4	15	4.7	NA	NA	NA	NA	NA	NA

Note:
Methyl mercury values for the duck are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: RRP 02/28/18
Checked by: KPH 03/01/18

TABLE C-5

2017 TOTAL MERCURY BAF

AMERICAN BLACK DUCK TISSUE-MUSSELS ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Location Name	Median American Black Duck Tissue Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussels Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	156	81	15	26	79	22	32	4.8	2.0	0.35
Reference										
FRB-01	69	15	15	4.7	7.6	2.2	20	0.61	9.2	0.97

Prepared by: KPH 03/01/18
Checked by: TAN 03/01/18

TABLE C-6
2017 METHYL MERCURY BAF
AMERICAN BLACK DUCK TISSUE-MUSSELS ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median American Black Duck Tissue Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussels Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13	125	65	15	21	34	9.3	32	2.1	3.7	0.66
Reference										
FRB-01	56	12	15	3.8	3.2	0.92	20	0.26	17	1.81

Note:
Methyl mercury values for biota are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: KPH 03/01/18
Checked by: TAN 03/01/18

TABLE C-7
2017 TOTAL MERCURY BAF
AMERICAN BLACK DUCK TISSUE-POLYCHAETES ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median American Black Duck Tissue Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaetes Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
MMBKD	244	67	15	22	37	11	10	4.5	6.7	1.0
ES-13	156	81	15	26	24	8.3	20	2.3	6.6	1.3
Reference										
FRB-01	69	15	15	4.7	7.7	0.7	5	0.37	9.1	0.75

Prepared by: KPH 03/01/18
Checked by: TAN 03/01/18

TABLE C-8
2017 METHYL MERCURY BAF
AMERICAN BLACK DUCK TISSUE-POLYCHAETES ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median American Black Duck Tissue Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaetes Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
MMBKD	195	53	15	17	7.6	2.9	10	1.1	26	4.4
ES-13	125	65	15	21	9.7	1.6	5	0.88	13	2.5
Reference										
FRB-01	56	12	15	3.8	NA	NA	NA	NA	NA	NA

Note:
Methyl mercury values for the duck are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: KPH 03/01/18
Checked by: TAN 03/01/18

TABLE C-9

2017 TOTAL MERCURY BAF
MUMMICHOG-INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
Mendall Marsh	109	48.7	19	14.0	22.7	27.3	5	15.3	4.80	3.29

Prepared by: JAW 12/06/17
Checked by: KPH 12/06/17

TABLE C-10

2017 METHYL MERCURY BAF
MUMMICHOG-INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
Mendall Marsh	94	42.0	19	12.1	21.2	22.8	5	12.8	4.44	2.74

Notes:
Methyl mercury values for the Mummichog are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 12/06/17
Checked by: KPH 12/06/17

TABLE C-11

2009 TOTAL MERCURY BAF
MUMMICHOG-SHRIMP ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	Shrimp Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
OB-05p	196	66.3	24	17.0	76.1	11.8	6	6.0	2.58	0.30
OB-01d	222	36.6	12	13.3	59.1	16.2	11	6.1	3.76	0.45

Prepared by: JAW 12/06/17
Checked by: KPH 12/06/17

TABLE C-12

2009 METHYL MERCURY BAF
MUMMICHOG-SHRIMP ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	Shrimp Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
OB-05p	177	54.9	4	34.4	58.3	11.6	6	5.9	3.04	0.67
OB-01d	204.5	21.0	2	18.6	51.55	12.4	10	4.9	3.97	0.52

Notes:
Distance for the OB-05p location was 0 ft. Distance for the OB-01d location was 842 ft.

Prepared by: JAW 12/06/17
Checked by: KPH 12/06/17

TABLE C-13

2017 TOTAL MERCURY BAF
SMELT-MUMMICHOG ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13_17SN001	37.8	17.7	20	5.0	97.2	46.1	54	7.9	0.39	0.06
ES-FP_17SN001	71.95	54.4	20	15.2	97.2	46.1	54	7.9	0.74	0.17
FRB-01_17SN001	11.35	5.9	20	1.6	6.495	1.1	20	0.3	1.75	0.27
OB-01_17SN001	46.7	10.1	20	2.8	94.4	46.0	55	7.8	0.49	0.05
OB-05_17SN001	83.5	11.0	5	6.2	94.4	46.1	55	7.8	0.88	0.10

Prepared by: JAW 11/27/17
Checked by: KPH 11/28/17

TABLE C-14

2017 METHYL MERCURY BAF
SMELT-MUMMICHOG ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ES-13_17SN001	29.9	14.0	20	3.9	83.9	39.7	54	6.8	0.36	0.05
ES-FP_17SN001	56.8	42.9	20	12.0	83.9	39.7	54	6.8	0.68	0.15
FRB-01_17SN001	9.0	4.6	20	1.3	5.6	0.9	20	0.3	1.60	0.24
OB-01_17SN001	36.9	8.0	20	2.2	81.4	39.7	55	6.7	0.45	0.05
OB-05_17SN001	66.0	8.7	5	4.9	81.4	39.8	55	6.7	0.81	0.09

Note:
Methyl mercury values for biota are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 11/27/17
Checked by: KPH 11/28/17

TABLE C-15

2017 TOTAL MERCURY BAF
NELSONS SPARROW-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Sparrow Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD-01	373	104.1	15	33.7	11.5	15.3	5	8.6	32.43	24.35
MMSE	2200	551.3	15	178.4	22.7	24.5	5	13.8	96.92	59.23
MMSW	2990	1053.0	15	340.7	34.3	31.7	5	17.8	87.17	46.27
W17	2465	1181.6	12	427.4	6.59	18.9	5	10.6	374.05	604.46

Prepared by: JAW 11/09/17
Checked by: KPH 11/10/17

TABLE C-16

2017 METHYL MERCURY BAF
NELSONS SPARROW-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Sparrow Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD-01	356.3	99.5	15	32.2	8.2	12.2	5	6.8	43.45	36.31
MMSE	2101.7	526.7	15	170.4	21.2	20.6	5	11.5	99.13	54.45
MMSW	2856.3	1006.0	15	325.5	27.1	15.7	5	8.8	105.40	36.18
W17	2354.8	1128.8	12	408.3	4.9	18.3	5	10.2	480.57	1007.21

Note:
Methyl mercury values for the Nelsons Sparrow are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 11/09/17
Checked by: KPH 11/10/17

TABLE C-17

2017 TOTAL MERCURY BAF
NELSONS SPARROW-SPIDER ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Sparrow Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Spider Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD-01	373	104.1	15	33.7	55	7.7	5	4.3	6.78	0.81
MMSE	2200	583.4	15	188.7	560	136.1	5	76.3	3.93	0.63
MMSW	2990	1050.4	15	339.8	315	46.6	5	26.1	9.49	1.34
W17	2465	1181.6	12	427.4	315	44.4	5	24.9	7.83	1.49

Prepared by: JAW 11/09/17
Checked by: KPH 11/10/17

TABLE C-18

2017 METHYL MERCURY BAF
NELSONS SPARROW-SPIDER INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Sparrow Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Spider Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD-01	356.3	99.5	15	32.2	58.5	8.4	5	4.7	6.09	0.74
MMSE	2101.7	557.3	15	180.3	544	161.2	5	90.3	3.86	0.72
MMSW	2856.3	1003.4	15	324.6	337	162.7	5	91.2	8.48	2.49
W17	2354.8	1128.8	12	408.3	323	27.9	5	15.6	7.29	1.31

Note:
Methyl mercury values for the Nelsons Sparrow are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 11/09/17
Checked by: KPH 11/10/17

TABLE C-19

2017 TOTAL MERCURY BAF

SPIDERS-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION

Penobscot River Phase III Engineering Study

Penobscot River Estuary, Maine

Location Name	Median Spider Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD-01	55	8.6	5	4.8	11.5	17.0	5	9.5	4.78	3.98
MMSE	402	175.4	2	155.4	23.7	1.3	2	1.2	17.00	6.63
MMSW	315	53.4	4	33.5	34.95	35.0	4	22.0	9.01	5.74
W17	315	44.4	5	24.9	6.59	20.9	5	11.7	47.80	85.23

Prepared by: JAW 11/09/17
Checked by: KPH 11/10/17

TABLE C-20

2017 METHYL MERCURY BAF
SPIDERS-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Spider Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
ADD-01	58.5	8.4	5	4.7	8.2	13.5	5	7.6	7.13	6.61
MMSE	403.5	152.0	2	134.7	21.35	0.2	2	0.2	18.90	6.31
MMSW	353.5	76.7	4	48.0	27.75	14.4	4	9.0	12.74	4.50
W17	323	27.9	5	15.6	4.9	20.2	5	11.3	65.92	152.68

Prepared by: JAW 11/09/17
Checked by: KPH 11/10/17

TABLE C-21

2017 TOTAL MERCURY BAF
ATLANTIC TOMCOD ACCUMULATION FACTOR EVALUATIONS
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Prey	Median Tomcod Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Prey Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
Riverwide										
Mummichog	137.5	95.9	60	15.5	94.4	46.4	55	7.8	1.46	0.20
Polychaete worms	137.5	95.9	60	15.5	25	12.0	55	2.0	5.50	0.77
Rainbow Smelt	137.5	95.9	60	15.5	46.5	37.4	65	5.8	2.96	0.50
Forage Fish	137.5	95.9	60	15.5	74.4	47.5	120	5.4	1.85	0.25

Prepared by: JAW 11/29/17
Checked by: KPH 11/29/17

TABLE C-22

2017 METHYL MERCURY BAF
ATLANTIC TOMCOD ACCUMULATION FACTOR EVALUATIONS
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Tomcod Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Prey Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
Riverwide										
Mummichog	109.4	76.3	60	12.3	81.4	40.1	55	6.8	1.34	0.19
Polychaete worms	109.4	76.3	60	12.3	9.5	3.5	30	0.8	11.51	1.63
Rainbow Smelt	109.4	76.3	60	12.3	36.7	29.5	65	4.6	2.98	0.50
Forage Fish	109.4	76.3	60	12.3	61.9	41.0	120	4.7	1.77	0.24

Notes:
Methyl mercury values for Tomcod, Mummichog, and Rainbow Smelt are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 11/29/17
Checked by: KPH 11/29/17

TABLE C-23

2017 TOTAL MERCURY BAF
LOBSTER-MUSSELS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussels Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
CJ_17LT004	577	352.4	2	312.3	89.3	37.8	20	10.6	6.46	3.58
FBJR	38.65	8.6	20	2.4	7.6	2.1	20	0.6	5.11	0.51
L10-52	239	346.7	20	97.1	79.1	21.5	32	4.8	3.02	1.24
SVE-01	290.5	129.5	20	36.3	79.1	21.5	32	4.8	3.67	0.51

Prepared by: JAW 11/27/17
Checked by: KPH 12/07/17

TABLE C-24

2017 METHYL MERCURY BAF
LOBSTER-MUSSELS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mussels Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
CJ_17LT004	451.6	275.8	2	244.4	38.1	16.1	20	4.5	11.85	6.57
FBJR	30.3	6.7	20	1.9	3.2	0.9	20	0.3	9.37	0.94
L10-52	187.1	271.3	20	76.0	33.8	9.2	32	2.0	5.54	2.28
SVE-01	227.4	101.4	20	28.4	33.8	9.2	32	2.0	6.73	0.93

Note:
Methyl mercury values for biota are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 11/27/17
Checked by: KPH 12/07/17

TABLE C-25

2017 TOTAL MERCURY BAF
LOBSTER-POLYCHAETES ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaetes Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
CJ	229	270.7	7	128.2	12.0	1.7	5	0.9	19.08	10.79
FBJR	38.65	8.7	20	2.4	7.7	0.6	5	0.3	5.05	0.38
L10-52	239	346.8	20	97.2	23.8	8.3	20	2.3	10.06	4.21
SVE-01	290.5	129.5	20	36.3	23.8	8.3	20	2.3	12.23	1.94

Prepared by: JAW 11/27/17
Checked by: KPH 12/07/17

TABLE C-26

2017 METHYL MERCURY BAF
LOBSTER-POLYCHAETES ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Polychaetes Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
CJ	--	--	--	--	--	--	--	--	--	--
FBJR	--	--	--	--	--	--	--	--	--	--
L10-52	187.1	272.5	20	76.3	9.7	1.4	5	0.8	19.29	8.03
SVE-01	227.4	99.3	20	27.8	9.7	1.4	5	0.8	23.44	3.45

Note:
Methyl mercury values for the Lobster are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 11/27/17
Checked by: KPH 12/07/17

TABLE C-27

2017 TOTAL MERCURY BAF
LOBSTER-SMELT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
CJ	222.5	189.4	20	53.1	71.95	54.4	20	15.2	3.09	0.99
FBJR	38.65	8.6	20	2.4	11.35	5.9	20	1.6	3.41	0.54
L10-52	239	346.8	20	97.2	37.8	17.7	20	5.0	6.32	2.70
SVE-01	290.5	126.4	20	35.4	37.8	17.7	20	5.0	7.69	1.38

Prepared by: JAW 11/27/17
Checked by: KPH 11/28/17

TABLE C-28

2017 METHYL MERCURY BAF
LOBSTER-SMELT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Lobster Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
CJ	174.2	148.3	20	41.5	56.8	43.0	20	12.0	3.06	0.98
FBJR	30.3	6.7	20	1.9	9.0	4.6	20	1.3	3.37	0.53
L10-52	187.1	271.5	20	76.1	29.9	14.0	20	3.9	6.27	2.68
SVE-01	227.4	98.9	20	27.7	29.9	14.0	20	3.9	7.62	1.36

Note:
Methyl mercury values for biota are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 11/27/17
Checked by: KPH 11/28/17

TABLE C-29

2017 TOTAL MERCURY BAF
EEL-MUMMICHOG ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	491	212.8	20	59.6	63.4	0.0	1	0.0	7.74	0.94
OB-05	201	75.8	9	31.7	76.7	22.5	20	6.3	2.62	0.47

Prepared by: JAW 11/29/17
Checked by: KPH 11/29/17

TABLE C-30

2017 METHYL MERCURY BAF
EEL-MUMMICHOG ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Mummichog Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	430.3	186.5	20	52.3	54.7	0.0	1	0.0	7.87	0.96
OB-05	176.2	66.5	9	27.8	66.2	19.4	20	5.4	2.66	0.47

Notes:
Methyl mercury values for the biota are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 11/29/17
Checked by: KPH 11/29/17

TABLE C-31

2009 TOTAL MERCURY BAF
EEL-SHRIMP ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Shrimp Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
OB-01d	389.5	178.1	20	49.9	59.1	16.2	11	6.1	6.59	1.08
OB-04	451	144.1	6	73.7	77.1	11.0	13	3.8	5.85	1.00
OB-05p	569	215.8	13	75.0	76.05	11.8	6	6.0	7.48	1.15

Prepared by: JAW 11/29/17
Checked by: KPH 11/30/17

TABLE C-32

2009 METHYL MERCURY BAF
EEL-SHRIMP ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Shrimp Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
OB-01d	326.5	167.6	20	46.9	51.55	12.1	10	4.8	6.33	1.08
OB-04	360	150.1	6	76.8	46.8	13.1	13	4.5	7.69	1.80
OB-05p	498	198.4	13	69.0	58.25	11.4	6	5.8	8.55	1.46

Prepared by: JAW 11/29/17
Checked by: KPH 11/30/17

TABLE C-33

2017 TOTAL MERCURY BAF
EEL-INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	491	212.8	20	59.6	6.59	20.9	5	11.7	74.51	133.02
OB-05	263	159.3	20	44.6	6.59	20.9	5	11.7	39.91	71.41
OV-04	168.5	80.9	6	41.4	6.59	20.9	5	11.7	25.57	45.98

Prepared by: JAW 12/01/17
Checked by: KPH 12/06/17

TABLE C-34

2017 METHYL MERCURY BAF
EEL-INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	430.3	186.5	20	52.3	4.9	20.2	5	11.3	87.82	203.64
OB-05	230.5	139.6	20	39.1	4.9	20.2	5	11.3	47.04	109.22
OV-04	147.7	70.9	6	36.3	4.9	20.2	5	11.3	30.14	70.18

Notes:
Methyl mercury values for the Eels are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 12/01/17
Checked by: KPH 12/06/17

TABLE C-35

2017 TOTAL MERCURY BAF
EEL-POLYCHAETES ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Polychaetes Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	491	212.8	20	59.6	30.60	2.5	5	1.4	16.05	2.08
OB-05	263	159.3	20	44.6	30.60	2.5	5	1.4	8.59	1.51
OV-04	169	80.9	6	41.4	30.60	2.5	5	1.4	5.51	1.38

Prepared by: JAW 12/06/17
Checked by: KPH 12/06/17

TABLE C-36

2017 METHYL MERCURY BAF
EEL-POLYCHAETES ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Polychaetes Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	430	186.5	20	52.3	10.40	2.1	5	1.2	41.38	6.85
OB-05	230	139.6	20	39.1	10.40	2.1	5	1.2	22.16	4.51
OV-04	148	70.9	6	36.3	10.40	2.1	5	1.2	14.20	3.84

Notes:
Methyl mercury values for the Eels are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 12/06/17
Checked by: KPH 12/06/17

TABLE C-37

2017 TOTAL MERCURY BAF
EEL-SMELT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	491	212.8	20	59.6	83.5	12.3	5	6.9	5.88	0.86
OB-05	263	159.3	20	44.6	83.5	12.3	5	6.9	3.15	0.59
OV-04	168.5	80.9	6	41.4	83.5	12.3	5	6.9	2.02	0.52

Prepared by: JAW 12/06/17
Checked by: KPH 12/06/17

TABLE C-38

2017 METHYL MERCURY BAF
EEL-SMELT ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Eel Concentration (ng/g)	Standard Deviation	Count	Standard Error	Smelt Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
BO-04	430	186	20	52.3	66.0	9.7	5	5.4	6.52	0.96
OB-05	230	140	20	39.1	66.0	9.7	5	5.4	3.49	0.66
OV-04	148	71	6	36.3	66.0	9.7	5	5.4	2.24	0.58

Notes:
Methyl mercury values for the biota are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 12/06/17
Checked by: KPH 12/06/17

TABLE C-39

2017 TOTAL MERCURY BAF
BLACKBIRD-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Blackbird Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
MMSW	5870	3179	4	1991.5	22.95	16	4	10.1	255.77	141.89
W17	3370	2220	2	1967.2	36.5	0	1	0.0	92.33	53.90

Prepared by: JAW 11/10/17
Checked by: KPH 11/13/17

TABLE C-40

2017 METHYL MERCURY BAF
BLACKBIRD-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Blackbird Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Insects Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
MMSW	5608	3037	4	1902.5	20.9	12	4	7.5	268.31	132.47
W17	3219	2121	2	1879.3	39.2	0	1	0.0	82.13	47.94

Note:
Methyl mercury values for the Blackbird are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 11/10/17
Checked by: KPH 11/13/17

TABLE C-41

2017 TOTAL MERCURY BAF
BLACKBIRD-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Blackbird Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Spiders Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
MMSW	6020	854	3	618.1	279	0	1	0.0	21.58	2.22

Prepared by: JAW 11/10/17
Checked by: KPH 11/13/17

TABLE C-42

2017 METHYL MERCURY BAF
BLACKBIRD-TERRESTRIAL INSECTS ACCUMULATION FACTOR EVALUATION
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Location Name	Median Blackbird Concentration (ng/g)	Standard Deviation	Count	Standard Error	Median Spiders Concentration (ng/g)	Standard Deviation	Count	Standard Error	BAF	Standard Error
MMSW	5750.906	816	3	590.5	337	0	1	0.0	17.07	1.75

Note:
Methyl mercury values for the Blackbird are converted utilizing the methyl mercury percentage to total mercury from historic sampling.

Prepared by: JAW 11/10/17
Checked by: KPH 11/13/17

C-7

R Code

```
########################################
#  (01)-BAF DATA CLEANING & PLOTTING  #
########################################

library(DescTools)
library(dplyr)
library(readxl)
library(stringr)



#Define data source(s)

sauce_0 <- "NESP BAF DATA_2016.xlsx"
sauce_1 <- "NESP BAF DATA_2017.xlsx"

#Get index of sheets by source

saucedir_0 <- excel_sheets(sauce_0) %>% print
saucedir_1 <- excel_sheets(sauce_1) %>% print

#Define Predator & Prey for Plotting & .csv's

PREDATOR <- "Smelt"
PREY <- "Mummichog"

#Read in appropriate sheets based on index

d0 <- as_tibble(read_excel(sauce_0, saucedir_0[7])) #2016
d1 <- as_tibble(read_excel(sauce_1, saucedir_1[6])) #2017

# Check for site loc factor name inconsistencies
levels(as.factor(d0$pred.site))
levels(as.factor(d1$pred.site))
levels(as.factor(d0$prey.site))
levels(as.factor(d1$prey.site))
levels(as.factor(d0$medn.locs))
levels(as.factor(d1$medn.locs))

#replace inconsitent locs
# d0$pred.site[str_which(d0$pred.site, "^bo05")] <- "bo04"
# d0$prey.site[str_which(d0$prey.site, "^bo05")] <- "bo04"
# d0$medn.locs[str_which(d0$medn.locs, "^bo05")] <- "bo04"

# d0$pred.site <- str_replace(d0$pred.site, "cpjl", "cj")
# d0$prey.site <- str_replace(d0$prey.site, "cpjl", "cj")
# d0$medn.locs <- str_replace(d0$medn.locs, "cpjl", "cj")


# Check for parameter factor inconsistencies
levels(as.factor(d0$parameter))
levels(as.factor(d1$parameter))
levels(as.factor(d0$PARAM_NAME))
levels(as.factor(d1$PARAM_NAME))
levels(as.factor(d0$PARAM_NAME__1))
levels(as.factor(d1$PARAM_NAME__1))


#replace inconsitent locs
d0$parameter[str_which(d0$parameter, "^methyl")] <- "Methyl Mercury"
# d1$parameter[str_which(d1$parameter, "^Methyl")] <- "Methyl Mercury"
d0$parameter[str_which(d0$parameter, "^mer")] <- "Mercury"
# d1$PARAM_NAME__1[str_which(d1$PARAM_NAME__1, "^Mer")] <- "Mercury"
#
#
# d0$PARAM_NAME[str_which(d0$PARAM_NAME, "^Methyl")] <- "Methyl Mercury"
# d1$PARAM_NAME[str_which(d1$PARAM_NAME, "^Methyl")] <- "Methyl Mercury"
# d0$PARAM_NAME[str_which(d0$PARAM_NAME, "^mer")] <- "Mercury"
# d1$PARAM_NAME[str_which(d1$PARAM_NAME, "^mer")] <- "Mercury"
```

```
#
# d0$PARAM_NAME__1[str_which(d0$PARAM_NAME__1, "^Methyl")] <- "Methyl Mercury"
# d1$PARAM_NAME__1[str_which(d1$PARAM_NAME__1, "^Methyl")] <- "Methyl Mercury"
# # d0$PARAM_NAME__1[str_which(d0$PARAM_NAME__1, "^mer")] <- "Mercury"
# d1$PARAM_NAME__1[str_which(d1$PARAM_NAME__1, "^mer")] <- "Mercury"


#Format date as DATE
d0$DATE <- as.Date(d0$DATE, format = "%m/%d/%Y")
# d0$Year <- as.numeric(substring(d0$DATE, 1, 4))
d1$DATE <- as.Date(d1$DATE, format = "%m/%d/%Y")
# d1$DATE__1 <- as.Date(d1$DATE__1, origin = "1899-12-30")


summary(d0)
summary(d1)


#replace erroneous pred.sites & prey.sites showing as w18 and greater [[for sparrow-ti & sparrow-spider]]
# d0$pred.site <- as.character(d0$pred.site)
# d0$pred.site[str_which(d0$pred.site, "^w")] <- "w17"
# d0$pred.site <- as.factor(d0$pred.site)
# levels(d0$pred.site)

#replace erroneous prey.site showing as bo05 and ob06 [[for polychaetes]]
# d0$prey.site <- as.character(d0$prey.site)
# d0$prey.site[str_which(d0$prey.site, "ob06")] <- "ob05"
# d0$prey.site[str_which(d0$prey.site, "bo05")] <- "bo04"
# d0$prey.site[str_which(d0$prey.site, "es14")] <- "es13"
# d0$prey.site <- as.factor(d0$prey.site)
# levels(d0$prey.site)


#Split d0 and d1 into three seperate tables

t.sed_1 <-
  d1 %>% #2017
  select(LOC_NAME:prey.medn) %>%
  filter(!is.na(LOC_NAME)) %>%
  mutate(Year = as.numeric("2017")) %>%
  print

t.sed1 <- d0 %>% #2016
  select(LOC_NAME:prey.medn) %>%
  filter(!is.na(LOC_NAME)) %>%
  mutate(Year = as.numeric("2016")) %>%
  print

t.sed_2 <- d1 %>% #2017
  select(LOC_NAME__1:pred.medn, -DATE__1) %>%
  filter(!is.na(LOC_NAME__1)) %>%
  mutate(Year = as.numeric("2017")) %>%
  print

t.sed2 <- d0 %>% #2016
  select(LOC_NAME__1:pred.medn, -DATE__1) %>%
  filter(!is.na(LOC_NAME__1)) %>%
  mutate(Year = as.numeric("2016")) %>%
  print

t.sed_3 <- d1 %>% #2017
  select(medn.locs:prey.median) %>%
  filter(!is.na(medn.locs)) %>%
  mutate(Year = as.numeric("2017")) %>%
  arrange(medn.locs) %>%
  print

t.sed3 <- d0 %>% #2016
```

```
  select(medn.locs:prey.median) %>%
  filter(!is.na(medn.locs)) %>%
  mutate(Year = as.numeric("2016")) %>%
  arrange(medn.locs) %>%
  print


#Append 2016 data to 2017 data
ti.sed1 <- union(t.sed_1, t.sed1)
ti.sed2 <- union(t.sed_2, t.sed2)
ti.sed3 <- union(t.sed_3, t.sed3)

#Set locations as factors & define order from N to S
ti.sed1$pred.site <- as.factor(ti.sed1$pred.site)
ti.sed2$prey.site <- as.factor(ti.sed2$prey.site)
ti.sed3$medn.locs <- as.factor(ti.sed3$medn.locs)
ti.sed1$pred.site <- factor(ti.sed1$pred.site, levels(ti.sed1$pred.site)[c(3, 6, 5, 4, 1, 2)] ) #Ordering sites from N to S
ti.sed2$prey.site <- factor(ti.sed2$prey.site, levels(ti.sed2$prey.site)[c(3, 6, 5, 4, 1, 2)] )
ti.sed3$medn.locs <- factor(ti.sed3$medn.locs, levels(ti.sed3$medn.locs)[c(3, 6, 5, 4, 1, 2)] )


# Calculate medians based on individual concentrations by location, parameter, and year to check against medians listed in ti.sed3
medians_check_1 <- ti.sed1 %>%
  group_by(pred.site, PARAM_NAME, Year) %>%
  summarise(pred.count = n(),
            pred.min = min(pred.conc),
            pred.max = max(pred.conc),
            pred.sd = sd(pred.conc),
            pred.median = median(pred.conc)) %>%
  print()

View(ti.sed3)


medians_check_2 <- ti.sed2 %>%
  group_by(prey.site,PARAM_NAME__1, Year) %>%
  summarise(prey.count = n(),
            prey.min = min(prey.conc),
            prey.max = max(prey.conc),
            prey.sd = sd(prey.conc),
            prey.median = median(prey.conc)) %>%
  print()



# Write clean data to csvs
medians <- left_join(medians_check_1, medians_check_2, by = c( "pred.site" = "prey.site", "PARAM_NAME" = "PARAM_NAME__1", "Year" = "Year" ))
rm(medians_check_1, medians_check_2)
write.csv(medians, paste(Sys.Date(), " 2016-2017 ", PREDATOR,"-", PREY, " Medians-cal.csv", sep = ""))
write.csv(ti.sed1, paste(Sys.Date(), " 2016-2017 ", PREDATOR,"-", PREY, " Predator_Conc.csv", sep = ""))
write.csv(ti.sed2, paste(Sys.Date(), " 2016-2017 ", PREDATOR,"-", PREY, " Prey_Conc.csv", sep = ""))
write.csv(ti.sed3, paste(Sys.Date(), " 2016-2017 ", PREDATOR,"-", PREY, " Median_Conc.csv", sep = ""))

#correct median sediment t.sed value for mmse 2017, mmsw 2017,
# ti.sed1$prey.medn[ti.sed1$Year == 2017 & ti.sed1$pred.site == "mmse"] <- as.numeric(medians_check_2[4,6])
# ti.sed3$prey.median[ti.sed3$Year == 2017 & ti.sed3$medn.locs == "mmse"] <- as.numeric(medians_check_2[4,6])
#
# ti.sed1$prey.medn[ti.sed1$Year == 2017 & ti.sed1$pred.site == "mmsw"] <-
```

```
as.numeric(medians_check_2[6,6])
# ti.sed3$prey.median[ti.sed3$Year == 2017 & ti.sed3$medn.locs == "mmsw"] <- as.numeric(medians_check_2[6,6])

#Error noted in the t.sed3$prey.median AND  t.sed1$prey.medn for W17[NSP].  Should be 476(calculated) instead of 828(provided)
# t.sed3$prey.median[t.sed3$medn.locs == "w17"] <- medians_check_2$prey.median[medians_check_2$prey.site == "w17"]
# t.sed1$prey.medn[t.sed1$pred.site == "w17"] <- medians_check_2$prey.median[medians_check_2$prey.site == "w17"]

#Set the color palatte for plotting
# pie(rep(1, 10), col = rainbow(10))
palette(rainbow(12)[c(1, 7, 5, 2, 8, 10, 12)]) # modified to accomodate ordering of locs from N to S.

############
### Plots ##
############

#Set analyte to either "Mercury" or "Methyl Mercury", re-run code below for both analytes
ANALYTE <- "Mercury"

# Subset based on analyte selection
ti.sed1_tmp <- ti.sed1[ti.sed1$PARAM_NAME == ANALYTE,]
ti.sed2_tmp <- ti.sed2[ti.sed2$PARAM_NAME__1 == ANALYTE,]
ti.sed3_tmp <- ti.sed3[ti.sed3$parameter == ANALYTE,]

# Change plotting device
pdf(paste(Sys.Date()," 2016 & 2017 ", PREDATOR, "-", PREY, " ", ANALYTE, " BAF.pdf", sep = ""), paper = "letter") #sauce_dir[3],


# Set plotting margins
op <- par(mar=c(8, 4.7, 4, 2) + 0.1)

# Initialize plot
plot(pred.conc ~ prey.medn, data = ti.sed1_tmp,
     col = as.numeric(ti.sed1_tmp$pred.site),
     ylim = c(0, 1.1 * max(ti.sed1_tmp$pred.conc, na.rm = T)), yaxs = "i",
     xlim = c(0, 1.1 * max(ti.sed2_tmp$prey.conc, na.rm = T)), xaxs = "i",
     pch = c(0,1)[as.factor(ti.sed1_tmp$Year)], tck = 0.015, las = 1,
     ylab = paste(PREDATOR,"\n", "Tissue (ng/g-predator)"), xlab = paste("Tissue (ng/g-prey)\n", PREY), cex = 0.5,
     main = paste("2016 & 2017 | ", PREDATOR, "-", PREY, " ",ANALYTE," BAF", sep = "")
     ) #, sauce_dir[2]

# add data to plot along x-axis
points(pred.medn ~ prey.conc, data = ti.sed2_tmp,
       col = as.numeric(as.factor(ti.sed2_tmp$prey.site)),
       pch = c(0,1)[as.factor(ti.sed2_tmp$Year)], cex = 0.5)

# Regression on median concentrations
mod1 <-lm(ti.sed3_tmp$pred.median ~ ti.sed3_tmp$prey.median-1)

modsum <- summary(mod1) %>% print


# Set up regression summary to be plotted
slope <- modsum$coefficients[1,1]
r2 <- modsum$adj.r.squared
pval <- modsum$coefficients[1,4]


t.sed_r2 <- list(bquote(y == .(format(slope, digits = 4)) * italic(x) ),
                 bquote(italic(Adj.~R)^2 == .(format(r2, digits = 2)) * "," ~~
                          italic(p) == .(format(pval, digits = 3))) )

#Plot abline
```

```
clip(0.7 * min(ti.sed1_tmp$prey.medn, na.rm = T),
     1.1 * max(ti.sed1_tmp$prey.medn, na.rm = T),
     0,
     1.1 * max(ti.sed2_tmp$pred.medn, na.rm = T))

abline(mod1, lty = 2, col = "darkgray", lwd = 2)

clip(-0.1 * min(ti.sed1_tmp$prey.medn, na.rm = T),
     1.1 * max(ti.sed1_tmp$prey.medn, na.rm = T),
     0,
     1.1 * max(ti.sed2_tmp$pred.medn, na.rm = T))

#Define legend
leg_sites <- read.csv("//ksw-fs1/transfer/LOuy/Penobscot/2017_11_XX BSAF PLOTS/replace.csv", as.is = TRUE)
site_ref <- levels(ti.sed1_tmp$pred.site)
leg_ref <- c(site_ref,
             palette()[1:length(site_ref)],
             c(1:as.numeric(length(site_ref))))

dim(leg_ref) <- c(length(site_ref),3)
leg_ref <- as_tibble(leg_ref)
leg_ref <- left_join(leg_ref, leg_sites, by="V1", n="") %>%
  arrange(V3.y) %>%
  print
rm(site_ref, leg_sites)

# Plot regression summary and legends
mtext(do.call(expression, t.sed_r2),
      side = 3, line=-c(1, 1.5), adj = 1,
      at=par("usr")[1]+0.95*diff(par("usr")[1:2]),
      cex = 0.7)


legend(x= ,"bottom",
       legend = leg_ref$V2.y,
       pch = 16, col = leg_ref$V2.x, cex = 0.6, xjust = 1, bty = "n",
       horiz = "TRUE",
       inset = c(0.0,-0.28),
       xpd = TRUE)

legend(x= ,"bottom",
       legend = c("2016 Data Point", "2017 Data Point", "2016 Median",  "2017 Median"),
       pch = c(0,1,24,25),
       cex = 0.6, xjust = 0.5, bty = "n",
       ncol = 2,
       inset = c(0.0,-0.34),
       xpd = TRUE)

legend(x= ,"bottom",
       legend = "Regression Line",
       lty = 2, col = "darkgray", lwd = 2,
       cex = 0.6, xjust = 0.5, bty = "n", horiz = "FALSE",
       inset = c(0.0,-0.37),
       xpd = TRUE)


# Wilcoxon Rank Sum test &
# Plotting of confidence intervals about the median
s.wt_1a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "frb01" & ti.sed2_tmp$Year == 2016], conf.int = T) %>% print()
arrows(x0 = s.wt_1a$conf.int[1], x1 = s.wt_1a$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "frb01" & ti.sed2_tmp$Year == 2016]),
       angle = 90, length = 0.05, code = 3, col = 1)

s.wt_1b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "frb01" & ti.sed2_tmp$Year == 2017], conf.int = T) %>% print()
arrows(x0 = s.wt_1b$conf.int[1], x1 = s.wt_1b$conf.int[2],
```

```
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "frb01" &
       ti.sed2_tmp$Year == 2017]),
       angle = 90, length = 0.05, code = 3, col = 1)


t.wt_1a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "frb01" &
ti.sed1_tmp$Year == 2016], conf.int = T) %>% print()
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "frb01" &
ti.sed1_tmp$Year == 2016]),
       y0 = t.wt_1a$conf.int[1], y1 = t.wt_1a$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 1)

t.wt_1b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "frb01" &
ti.sed1_tmp$Year == 2017], conf.int = T) %>% print()
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "frb01" &
ti.sed1_tmp$Year == 2017]),
       y0 = t.wt_1b$conf.int[1], y1 = t.wt_1b$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 1)


s.wt_2a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob05" &
ti.sed2_tmp$Year == 2016], conf.int = T) %>% print()
arrows(x0 = s.wt_2a$conf.int[1], x1 = s.wt_2a$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob05"&
       ti.sed2_tmp$Year == 2016]),
       angle = 90, length = 0.05, code = 3, col = 2)

s.wt_2b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob05"&
ti.sed2_tmp$Year == 2017], conf.int = T) %>% print()
arrows(x0 = s.wt_2b$conf.int[1], x1 = s.wt_2b$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob05"&
       ti.sed2_tmp$Year == 2017]),
       angle = 90, length = 0.05, code = 3, col = 2)

t.wt_2a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob05" &
ti.sed1_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob05" &
ti.sed1_tmp$Year == 2016]),
       y0 = t.wt_2a$conf.int[1], y1 = t.wt_2a$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 2)

t.wt_2b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob05" &
ti.sed1_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob05" &
ti.sed1_tmp$Year == 2017]),
       y0 = t.wt_2b$conf.int[1], y1 = t.wt_2b$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 2)


s.wt_3a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob04" &
ti.sed2_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = s.wt_3a$conf.int[1], x1 = s.wt_3a$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob04" &
       ti.sed2_tmp$Year == 2016]),
       angle = 90, length = 0.05, code = 3, col = 3)

s.wt_3b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob04" &
ti.sed2_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = s.wt_3b$conf.int[1], x1 = s.wt_3b$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob04" &
       ti.sed2_tmp$Year == 2017]),
       angle = 90, length = 0.05, code = 3, col = 3)

t.wt_3a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob04" &
ti.sed1_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob04" &
ti.sed1_tmp$Year == 2016]),
       y0 = t.wt_3a$conf.int[1], y1 = t.wt_3a$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 3)
```

```
t.wt_3b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob04" &
ti.sed1_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob04" &
ti.sed1_tmp$Year == 2017]),
       y0 = t.wt_3b$conf.int[1], y1 = t.wt_3b$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 3)

s.wt_4a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob01" &
ti.sed2_tmp$Year == 2016], conf.int = T) %>% print()
arrows(x0 = s.wt_4a$conf.int[1], x1 = s.wt_4a$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob01" &
       ti.sed2_tmp$Year == 2016]),
       angle = 90, length = 0.05, code = 3, col = 4)

s.wt_4b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob01" &
ti.sed2_tmp$Year == 2017], conf.int = T) %>% print()
arrows(x0 = s.wt_4b$conf.int[1], x1 = s.wt_4b$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob01" &
       ti.sed2_tmp$Year == 2017]),
       angle = 90, length = 0.05, code = 3, col = 4)

t.wt_4a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob01" &
ti.sed1_tmp$Year == 2016], conf.int = T) %>% print()
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob01" &
ti.sed1_tmp$Year == 2016]),
       y0 = t.wt_4a$conf.int[1], y1 = t.wt_4a$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 4)

t.wt_4b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob01" &
ti.sed1_tmp$Year == 2017], conf.int = T) %>% print()
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob01" &
ti.sed1_tmp$Year == 2017]),
       y0 = t.wt_4b$conf.int[1], y1 = t.wt_4b$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 4)

s.wt_5a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "es13" &
ti.sed2_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = s.wt_5a$conf.int[1], x1 = s.wt_5a$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "es13" &
       ti.sed2_tmp$Year == 2016]),
       angle = 90, length = 0.05, code = 3, col = 5)

s.wt_5b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "es13" &
ti.sed2_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = s.wt_5b$conf.int[1], x1 = s.wt_5b$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "es13" &
       ti.sed2_tmp$Year == 2017]),
       angle = 90, length = 0.05, code = 3, col = 5)

t.wt_5a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "es13" &
ti.sed1_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "es13" &
ti.sed1_tmp$Year == 2016]),
       y0 = t.wt_5a$conf.int[1], y1 = t.wt_5a$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 5)

t.wt_5b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "es13" &
ti.sed1_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "es13" &
ti.sed1_tmp$Year == 2017]),
       y0 = t.wt_5b$conf.int[1], y1 = t.wt_5b$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 5)

s.wt_6a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "esfp" &
ti.sed2_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = s.wt_6a$conf.int[1], x1 = s.wt_6a$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "esfp" &
       ti.sed2_tmp$Year == 2016]),
```

```
        angle = 90, length = 0.05, code = 3, col = 6)

s.wt_6b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "esfp" & ti.sed2_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = s.wt_6b$conf.int[1], x1 = s.wt_6b$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "esfp" & ti.sed2_tmp$Year == 2017]),
       angle = 90, length = 0.05, code = 3, col = 6)

t.wt_6a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "esfp" & ti.sed1_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "esfp" & ti.sed1_tmp$Year == 2016]),
       y0 = t.wt_6a$conf.int[1], y1 = t.wt_6a$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 6)

t.wt_6b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "esfp" & ti.sed1_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "esfp" & ti.sed1_tmp$Year == 2017]),
       y0 = t.wt_6b$conf.int[1], y1 = t.wt_6b$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 6)

# Add points for median concentrations
points(pred.median ~ prey.median, data = ti.sed3_tmp,
       pch = c(24,25)[as.factor(ti.sed3_tmp$Year)], col = "black",
       cex = 1)

par(op)

# Reset plotting device
dev.off()
```

```
###########################################
#  (02)-BAF REGRESSION & WILCOXON SUMMARY  #
###########################################



# LO 2017-12-14 version0
# LO 2017-12-18 version1  {updated to include confidence level associated with wilcoxon signed rank tests}



library(tidyverse)
library(stringr)
library(broom)
# library(lubridate)

setwd("\\\\ksw-fs1/transfer/Town Point/KP Haywood/Penobscot River/Graph Data/2016-2017 BAF Plots/_data/Pairwise Individual")

pred.list <- list.files(path= ".", pattern='*Predator_Conc.csv')
prey.list <- list.files(path= ".", pattern='*Prey_Conc.csv')
medi.list <- list.files(path= ".", pattern='*Median_Conc.csv')


names(pred.list) <- pred.list %>%
  str_sub(start = str_locate(pred.list, "[:alpha:]")[,1],
          end = str_locate(pred.list, "Predator_Conc")[,1] -1)

names(prey.list) <- prey.list %>%
  str_sub(start = str_locate(prey.list, "[:alpha:]")[,1],
          end = str_locate(prey.list, "Prey_Conc")[,1] -1)

names(medi.list) <- medi.list %>%
  str_sub(start = str_locate(medi.list, "[:alpha:]")[,1],
          end = str_locate(medi.list, "Median_Conc")[,1] -1)



BAF_pred_list <- map_df(pred.list, read_csv,
                        col_names = c("X1","LOC_NAME", "pred.site", "MED_T", "ID", "DATE", "MEDIA",
                                      "PARAM_NAME", "pred.conc", "RESULT_UOM", "prey.medn", "Year"),
                        cols_only(LOC_NAME = "c",
                                  pred.site = "c",
                                  MED_T = "c",
                                  ID = "c",
                                  DATE = "c",
                                  MEDIA = "c",
                                  PARAM_NAME = "c",
                                  pred.conc = "d",
                                  RESULT_UOM = "c",
                                  prey.medn = "d",
                                  Year = "n"
                        ),
                        skip = 1,
                        .id = "PAIR") %>%
  mutate( PAIR = as.factor(PAIR),
          pred.site = as.factor(pred.site),
          DATE = as.Date(DATE),
          PARAM_NAME = as.factor(PARAM_NAME),
          parameter_plot = as.factor(PARAM_NAME),
          MED_prey = str_sub(PAIR,
                             start = str_locate(PAIR, regex("-(?!w)"))[,1]+1,
                             end = -1L)
  ) %>%
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  filter( !(MED_T == "American Black Duck" & Year == 2017) )
```

```
BAF_prey_list <- map_df(prey.list, read_csv,
                        col_names = c("X1","LOC_NAME__1", "prey.site", "ID__1", "MEDIA__1",
                                      "PARAM_NAME__1", "prey.conc", "RESULT_UOM__1", "pred.medn", "Year"),
                        cols_only(LOC_NAME__1 = "c",
                                  prey.site = "c",
                                  ID__1 = "c",
                                  MEDIA__1 = "c",
                                  PARAM_NAME__1 = "c",
                                  prey.conc = "d",
                                  RESULT_UOM__1 = "c",
                                  pred.medn = "d",
                                  Year = "n"
                        ),
                        skip = 1,
                        .id = "PAIR") %>%
  mutate( PAIR = as.factor(PAIR),
          prey.site = as.factor(prey.site),
          PARAM_NAME__1 = as.factor(PARAM_NAME__1)
  ) %>%
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  filter( !(PAIR %in% c("DuckB -Mussel ", "DuckB -Polychaete ", "DuckT -Mussel ", "DuckT -Polychaete ")
            & Year == 2017)
  )



BAF_median_list <- map_df(medi.list, read_csv,
                          col_names = c("X1", "medn.locs", "parameter", "pred.median", "prey.median", "Year"),
                          cols_only(medn.locs = "c",
                                    parameter = "c",
                                    pred.median = "d",
                                    prey.median = "d",
                                    Year = "n"),
                          skip = 1,
                          .id = "PAIR") %>%
  mutate( PAIR = as.factor(PAIR),
          medn.locs = as.factor(medn.locs),
          parameter = as.factor(parameter)) %>%
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  filter( !(PAIR %in% c("DuckB -Mussel ", "DuckB -Polychaete ", "DuckT -Mussel ", "DuckT -Polychaete ")
            & Year == 2017)
  )


########
# Set-up for and perform regression on pred-prey medians
########

nREG_BAF_median_list <- BAF_median_list %>%
  group_by(PAIR, parameter) %>%
  nest()

REG_mod <- function(df){
  lm(pred.median ~ prey.median -1, data = df)
}

REG_BAF_median_list <- nREG_BAF_median_list %>%
  mutate(model = map(data, REG_mod),
         coeff_info = map(model, tidy),
         model_info = map(model, glance))

REG_BAF_median_summ <- REG_BAF_median_list %>%
```

```
  unnest(coeff_info, model_info) %>%
  ungroup() %>%
  select(PAIR, parameter, estimate, std.error, statistic, p.value, r.squared,
  adj.r.squared)


########
# Set-up for and perform pred.conc Wilcoxon Signed Rank Test | One-Sample, Unpaired
########

nWSR_BAF_pred_list <- BAF_pred_list %>%
  select(PAIR, pred.site, PARAM_NAME, Year, pred.conc) %>%
  group_by(PAIR, pred.site, PARAM_NAME, Year) %>%
  nest(pred.conc)

WSR_FUN_pred <- function(data){
  wilcox.test(data$pred.conc, conf.int = T)
}


WSR_BAF_pred_summ <- nWSR_BAF_pred_list %>%
  mutate(WSR_MOD = map(data, WSR_FUN_pred),
         conf.level = map_dbl(
           map(WSR_MOD, "conf.int"),
           attr_getter("conf.level")
         ),
         WSR_COEF = map(WSR_MOD, tidy)) %>%
  unnest(WSR_COEF) %>%
  select(PAIR:Year, estimate:conf.high, conf.level, method:alternative) %>%
  arrange(PAIR, Year, pred.site, PARAM_NAME)


########
# Set-up for and perform prey.conc Wilcoxon Signed Rank Test
########

nWSR_BAF_prey_list <- BAF_prey_list %>%
  select(PAIR, prey.site, PARAM_NAME__1, Year, prey.conc) %>%
  group_by(PAIR, prey.site, PARAM_NAME__1, Year) %>%
  nest(prey.conc)

WSR_FUN_prey <- function(data){
  wilcox.test(data$prey.conc, conf.int = T)
}


WSR_BAF_prey_summ <- nWSR_BAF_prey_list %>%
  mutate(WSR_MOD = map(data, WSR_FUN_prey),
         conf.level = map_dbl(
           map(WSR_MOD, "conf.int"),
           attr_getter("conf.level")
         ),
         WSR_COEF = map(WSR_MOD, tidy)) %>%
  unnest(WSR_COEF) %>%
  select(PAIR:Year, estimate:conf.high, conf.level, method:alternative) %>%
  arrange(PAIR, Year, prey.site, PARAM_NAME__1)

# WSR_BAF_prey_summ <- nWSR_BAF_prey_list %>%
#   mutate(WSR_MOD = map(data, WSR_FUN_prey),
#          WSR_COEF = map(WSR_MOD, tidy)) %>%
#   # WSR_MODSUM = map(WSR_MOD[["result"]], tidy))
#   # WSR_MODSUM2 = map(WSR_MOD, glance)) %>%
#   select(-data, -WSR_MOD) %>%
#   unnest(WSR_COEF)


#######
# Write summaries to csvs
#######
```

```
setwd("\\\\ksw-fs1/transfer/Town Point/KP Haywood/Penobscot River/Graph Data/2016-2017 BAF Plots")
write.csv(REG_BAF_median_summ, paste(Sys.Date(), "BAF Regression Summary.csv"))
write.csv(WSR_BAF_pred_summ, paste(Sys.Date(), "BAF WSR Predator Conc. Summary.csv"))
write.csv(WSR_BAF_prey_summ, paste(Sys.Date(), "BAF WSR Prey Conc. Summary.csv"))
```

```
#############################################
#  (03)-BSAF REGRESSION & WILCOXON SUMMARY  #
#            EXTREME VALUE REMOVAL          #
#############################################

library(tidyverse)
library(stringr)
library(broom)


setwd("//ksw-fs1/transfer/Town Point/KP Haywood/Penobscot River/Graph Data/2016-2017 BSAF Plots/_data")


sediment.list <- list.files(path= ".", pattern='*Sed_Conc.csv') %>% print()
tissue.list <- list.files(path= ".", pattern='*Tis_Conc.csv') %>% print()
medians.list <- list.files(path= ".", pattern='*Median_Conc.csv') %>% print()

names(sediment.list) <- sediment.list %>%
  str_sub(start = str_locate(sediment.list, "[:alpha:]")[,1],
          end = str_locate(sediment.list, "Sed_Conc")[,1] -1)

names(tissue.list) <- tissue.list %>%
  str_sub(start = str_locate(tissue.list, "[:alpha:]")[,1],
          end = str_locate(tissue.list, "Tis_Conc")[,1] -1)

names(medians.list) <- medians.list %>%
  str_sub(start = str_locate(medians.list, "[:alpha:]")[,1],
          end = str_locate(medians.list, "Median_Conc")[,1] -1
  ) %>%
  print()

BSAF_tis_list <- map_df(tissue.list, read_csv,
                        col_names = c("X1","LOC_NAME", "tissue.site", "MED_T", "ID", "DATE", "MEDIA",
                                      "PARAM_NAME", "tissue.conc", "RESULT_UOM", "sed.medn", "Year"),
                        cols_only(LOC_NAME = "c",
                                  tissue.site = "c",
                                  MED_T = "c",
                                  ID = "c",
                                  DATE = "c",
                                  MEDIA = "c",
                                  PARAM_NAME = "c",
                                  tissue.conc = "d",
                                  RESULT_UOM = "c",
                                  sed.medn = "d",
                                  Year = "n"
                        ),
                        skip = 1,
                        .id = "PAIR") %>%
  mutate( PAIR = as.factor(trimws(PAIR)),
          tissue.site = as.factor(tissue.site),
          DATE = as.Date(DATE),
          PARAM_NAME = as.factor(PARAM_NAME)
  ) %>%
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  filter( !(MED_T == "American Black Duck" & Year == 2017) )

BSAF_sed_list <- map_df(sediment.list, read_csv,
                        col_names = c("X1","LOC_NAME__1", "sed.site", "ID__1", "MEDIA__1",
                                      "PARAM_NAME__1", "sed.conc", "RESULT_UOM__1", "tissue.medn", "Year"),
                        cols_only(LOC_NAME__1 = "c",
                                  sed.site = "c",
                                  ID__1 = "c",
                                  MEDIA__1 = "c",
                                  PARAM_NAME__1 = "c",
```

```
                                  sed.conc = "d",
                                  RESULT_UOM__1 = "c",
                                  tissue.medn = "d",
                                  Year = "n"
                        ),
                        skip = 1,
                        .id = "PAIR") %>%
  mutate( PAIR = as.factor(trimws(PAIR)),
          sed.site = as.factor(sed.site),
          PARAM_NAME__1 = as.factor(PARAM_NAME__1)
  ) %>%
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  filter( !(PAIR %in% c("DuckB -Mussel ", "DuckB -Polychaete ", "DuckT -Mussel ", "DuckT -Polychaete ")
            & Year == 2017)
  )


BSAF_median_list <- map_df(medians.list, read_csv,
                          col_names = c("X1", "medn.locs", "parameter", "tis.median", "sed.median", "Year"),
                          cols_only(medn.locs = "c",
                                    parameter = "c",
                                    tis.median = "d",
                                    sed.median = "d",
                                    Year = "n"),
                          skip = 1,
                          .id = "PAIR") %>%
  mutate( PAIR = as.factor(trimws(PAIR)),
          medn.locs = as.factor(medn.locs),
          parameter = as.factor(parameter))
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  # filter( !(PAIR %in% c("DuckB -Mussel ", "DuckB -Polychaete ", "DuckT -Mussel ", "DuckT -Polychaete ")
  #           & Year == 2017)
  # )


###
#  Filter for BSAF Sed-Biota Pairs with OUTLIERS (Smelt, Terrestrial Insects, and Eel)
###

table(BSAF_median_list$PAIR)

BSAF_median_outliers_present <- BSAF_median_list %>%
  filter(PAIR %in% c("Terrestrial Insects", "Smelt", "Eel")) %>%
  arrange(PAIR, parameter, Year, medn.locs) %>%
  print() #Should have dimension 47 x 6

table(BSAF_median_outliers_present$PAIR)

BSAF_median_outliers <- BSAF_median_outliers_present %>%
  mutate( B_LOC_YEAR = str_c(PAIR, medn.locs, Year, sep = "-")) %>%
  filter( B_LOC_YEAR %in% c("Smelt-ob05-2016",
                            "Eel-bo04-2016",
                            "Terrestrial Insects-mmse-2016"))  # Should have dimension 6 x 7

BSAF_median_outliers_removed <- BSAF_median_outliers_present %>%
  mutate( B_LOC_YEAR = str_c(PAIR, medn.locs, Year, sep = "-")) %>%
  filter( !B_LOC_YEAR %in% c("Smelt-ob05-2016",
                            "Eel-bo04-2016",
                            "Terrestrial Insects-mmse-2016"))  # Should have dimension 47-6 x 7



BSAF_sed_list_no_outliers <- BSAF_sed_list %>%
  filter(PAIR %in% c("Terrestrial Insects", "Smelt", "Eel")) %>%
```

```
  mutate(B_LOC_YEAR = str_c(PAIR, sed.site, Year, sep = "-")) %>%
  filter(!B_LOC_YEAR %in% c("Smelt-ob05-2016",
                            "Eel-bo04-2016",
                            "Terrestrial Insects-mmse-2016"))


BSAF_tis_list_no_outliers <- BSAF_tis_list %>%
  filter(PAIR %in% c("Terrestrial Insects", "Smelt", "Eel")) %>%
  mutate(B_LOC_YEAR = str_c(PAIR, tissue.site, Year, sep = "-")) %>%
  filter(!B_LOC_YEAR %in% c("Smelt-ob05-2016",
                            "Eel-bo04-2016",
                            "Terrestrial Insects-mmse-2016"))

setwd("//ksw-fs1/transfer/Town Point/KP Haywood/Penobscot River/Graph Data/2016-2017 BSAF Plots/2018_01 Outlier Removal Regression QC/Plots")
write_csv(BSAF_median_outliers_removed, paste( Sys.Date(), "ExtremeVal-Free BSAF Medians.csv"))
write_csv(BSAF_sed_list_no_outliers, paste( Sys.Date(), "ExtremeVal-Free BSAF Sediment Conc.csv"))
write_csv(BSAF_tis_list_no_outliers, paste( Sys.Date(), "ExtremeVal-Free BSAF Tissue Conc.csv"))

setwd("//ksw-fs1/transfer/Town Point/KP Haywood/Penobscot River/Graph Data/2016-2017 BSAF Plots/2018_01 Outlier Removal Regression QC")

#############
##  Perform regression on outlier free medians
#############


nREG_BSAF_list <- BSAF_median_outliers_removed %>%
  group_by(PAIR, parameter) %>%
  nest()

REG_mod <- function(df){
  lm(tis.median ~ sed.median -1, data = df)
}

REG_BSAF_modlist <- nREG_BSAF_list %>%
  mutate(model = map(data, REG_mod),
         coeff_info = map(model, tidy),
         model_info = map(model, glance))

REG_BSAF_modsumm <- REG_BSAF_modlist %>%
  unnest(coeff_info, model_info) %>%
  ungroup() %>%
  select(PAIR, parameter, estimate, std.error, statistic, p.value, r.squared, adj.r.squared)


######
# EXPORT CSVs for QC
#####

setwd("//ksw-fs1/transfer/Town Point/KP Haywood/Penobscot River/Graph Data/2016-2017 BSAF Plots/2018_01 Outlier Removal Regression QC")

write_csv(BSAF_median_outliers_present, paste(Sys.Date(), "2016-2017 Select BSAF Data [w. outliers].csv"))
write_csv(BSAF_median_outliers, paste(Sys.Date(), "2016-2017 BSAF Outliers for Removal.csv"))
write_csv(BSAF_median_outliers_removed, paste(Sys.Date(), "2016-2017 Select BSAF Data [outliers rm].csv"))
write_csv(REG_BSAF_modsumm, paste(Sys.Date(), "2016-2017 Select BSAF LM Model Results [outliers rm].csv"))
```

```
############################################
#  (03)-BAF REGRESSION & WILCOXON SUMMARY  #
#           EXTREME VALUE REMOVAL          #
############################################

# LO 2017-12-14 version0
# LO 2017-12-18 version1  {updated to include confidence level associated with wilcoxon signed rank tests}
# LO 2018-01-22 version2  {modified to remove samples comprising one or more extreme median value}


library(tidyverse)
library(stringr)
library(broom)
# library(lubridate)

setwd("\\\\ksw-fs1/transfer/Town Point/KP Haywood/Penobscot River/Graph Data/2016-2017 BAF Plots/_data/Pairwise Individual")

pred.list <- list.files(path= ".", pattern='*Predator_Conc.csv') %>% print()
prey.list <- list.files(path= ".", pattern='*Prey_Conc.csv') %>% print()
medi.list <- list.files(path= ".", pattern='*Median_Conc.csv') %>% print()


names(pred.list) <- pred.list %>%
  str_sub(start = str_locate(pred.list, "[:alpha:]")[,1],
          end = str_locate(pred.list, "Predator_Conc")[,1] -1)

names(prey.list) <- prey.list %>%
  str_sub(start = str_locate(prey.list, "[:alpha:]")[,1],
          end = str_locate(prey.list, "Prey_Conc")[,1] -1)

names(medi.list) <- medi.list %>%
  str_sub(start = str_locate(medi.list, "[:alpha:]")[,1],
          end = str_locate(medi.list, "Median_Conc")[,1] -1)



BAF_pred_list <- map_df(pred.list, read_csv,
                        col_names = c("X1","LOC_NAME", "pred.site", "MED_T", "ID", "DATE", "MEDIA",
                                      "PARAM_NAME", "pred.conc", "RESULT_UOM", "prey.medn", "Year"),
                        cols_only(LOC_NAME = "c",
                                  pred.site = "c",
                                  MED_T = "c",
                                  ID = "c",
                                  DATE = "c",
                                  MEDIA = "c",
                                  PARAM_NAME = "c",
                                  pred.conc = "d",
                                  RESULT_UOM = "c",
                                  prey.medn = "d",
                                  Year = "n"
                        ),
                        skip = 1,
                        .id = "PAIR") %>%
  mutate( PAIR = as.factor(PAIR),
          pred.site = as.factor(pred.site),
          DATE = as.Date(DATE),
          PARAM_NAME = as.factor(PARAM_NAME),
          parameter_plot = as.factor(PARAM_NAME),
          MED_prey = str_sub(PAIR,
                             start = str_locate(PAIR, regex("-(?!w)"))[,1]+1,
                             end = -1L)
  ) %>%
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  filter( !(MED_T == "American Black Duck" & Year == 2017) )
```

```
BAF_prey_list <- map_df(prey.list, read_csv,
                        col_names = c("X1","LOC_NAME__1", "prey.site", "ID__1",
                        "MEDIA__1",
                                      "PARAM_NAME__1", "prey.conc", "RESULT_UOM__1",
                                      "pred.medn", "Year"),
                        cols_only(LOC_NAME__1 = "c",
                                  prey.site = "c",
                                  ID__1 = "c",
                                  MEDIA__1 = "c",
                                  PARAM_NAME__1 = "c",
                                  prey.conc = "d",
                                  RESULT_UOM__1 = "c",
                                  pred.medn = "d",
                                  Year = "n"
                        ),
                        skip = 1,
                        .id = "PAIR") %>%
  mutate( PAIR = as.factor(PAIR),
          prey.site = as.factor(prey.site),
          PARAM_NAME__1 = as.factor(PARAM_NAME__1)
  ) %>%
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  filter( !(PAIR %in% c("DuckB -Mussel ", "DuckB -Polychaete ", "DuckT -Mussel ",
  "DuckT -Polychaete ")
            & Year == 2017)
  )



BAF_median_list <- map_df(medi.list, read_csv,
                          col_names = c("X1", "medn.locs", "parameter", "pred.median",
                          "prey.median", "Year"),
                          cols_only(medn.locs = "c",
                                    parameter = "c",
                                    pred.median = "d",
                                    prey.median = "d",
                                    Year = "n"),
                          skip = 1,
                          .id = "PAIR") %>%
  mutate( PAIR = as.factor(PAIR),
          medn.locs = as.factor(medn.locs),
          parameter = as.factor(parameter)) %>%
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  filter( !(PAIR %in% c("DuckB -Mussel ", "DuckB -Polychaete ", "DuckT -Mussel ",
  "DuckT -Polychaete ")
            & Year == 2017)
  )


#################
#  REMOVAL of OUTLIERS
#################

BAF_median_list <- BAF_median_list %>%
  mutate(PREY = str_sub(PAIR,
                            start = str_locate(PAIR, regex("-(?!w)"))[,1]+1,
                            end = -1L),
         PRED = str_sub(PAIR,
                        end = str_locate(PAIR, regex("-(?!w)"))[,1]-1)
         )

setwd("//ksw-fs1/transfer/Town Point/KP Haywood/Penobscot River/Graph Data/2016-2017
BAF Plots/2018_01 Outlier Removal Regression QC")

out_index <- read_csv("2018-01-19 2016-2017 Penobscot BAF Outlier Index.csv")

out_index <- out_index %>%
```

```
  mutate( MED_T = as.factor(MED_T),
          PARAM_NAME = as.factor(MED_T),
          ALT_LOC = as.factor(ALT_LOC),
          LOC_YEAR = as.factor(LOC_YEAR))

# Predator Data Set of Outliers
pred_w_outlier <-
  BAF_pred_list %>%
  filter( ID %in% out_index$ID)

list_pred_w_outlier <-
  pred_w_outlier %>%
  select(PAIR)

# Prey Data Set of Outliers
prey_w_outlier <-
  BAF_prey_list %>%
  filter( ID__1 %in% out_index$ID)

list_prey_w_outlier <-
  prey_w_outlier %>%
  select(PAIR)

# Index of BAF PAIRS w. Outliers
OUTLIER_PAIR_INDEX <- bind_rows(list_pred_w_outlier,  list_prey_w_outlier) %>%
  unique()

# Write csvs of outlier data set
write_csv(OUTLIER_PAIR_INDEX, paste( Sys.Date(), "INDEX OF BAF PAIRS W. OUTLIERS.csv"))
write_csv(pred_w_outlier, paste( Sys.Date(), "2016-2017 BAF Outlier Predator Data.csv"))
write_csv(prey_w_outlier, paste( Sys.Date(), "2016-2017 BAF Outlier Prey Data.csv"))

rm(list = c("pred_w_outlier", "list_pred_w_outlier", "prey_w_outlier",
"list_prey_w_outlier"))

# Predator & Prey Data Set w.out Outliers (OLD PREY/PRED MEDIAN STILL PRESENT)
PRED_list <-
  BAF_pred_list %>%
  filter( !(ID %in% out_index$ID))

PREY_list <-
  BAF_prey_list %>%
  filter( !(ID__1 %in% out_index$ID)) %>%
  mutate(MED_pred = str_sub(PAIR,
                            end = str_locate(PAIR, regex("-(?!w)"))[,1]-1)
  )


# Calculate NEW MEDIANS
PRED_list_medians <-
  PRED_list %>%
  filter(PAIR %in% OUTLIER_PAIR_INDEX$PAIR) %>%
  rename(medn.locs = pred.site,
         parameter = PARAM_NAME) %>%
  group_by(PAIR, MED_prey,medn.locs, parameter, Year) %>%
  summarize(pred.median = median(pred.conc)) %>%
  droplevels()

PREY_list_medians <-
  PREY_list %>%
  filter(PAIR %in% OUTLIER_PAIR_INDEX$PAIR) %>%
  rename(medn.locs = prey.site,
         parameter = PARAM_NAME__1) %>%
  group_by(PAIR, MED_pred, medn.locs, parameter, Year) %>%
  summarize(prey.median = median(prey.conc)) %>%
  droplevels()

BAF_median_list_full <- full_join(PRED_list_medians, PREY_list_medians) %>%  # full
list shows locs that will be removed due to outlier removals
```

```
  filter(PAIR %in% OUTLIER_PAIR_INDEX$PAIR) %>%
  select(PAIR, parameter, medn.locs, Year, MED_pred, pred.median, MED_prey, prey.median) %>%
  droplevels()

BAF_median_list <- BAF_median_list_full %>% # this list shows that available medians after outlier removal
  drop_na()


write_csv(BAF_median_list_full, paste( Sys.Date(), "2016-2017 BAF Medians (no outliers with NA).csv"))
rm(BAF_median_list_full)
write_csv(BAF_median_list, paste( Sys.Date(), "2016-2017 BAF Medians (no outliers).csv"))


PRED_list <- PRED_list %>%
  filter(PAIR %in% OUTLIER_PAIR_INDEX$PAIR) %>%
  select(-prey.medn)

PRED_list <- left_join(PRED_list, PREY_list_medians,
                         by = c("PAIR" = "PAIR",
                                "pred.site" = "medn.locs",
                                "PARAM_NAME" = "parameter",
                                "Year" = "Year")
)


PREY_list <- PREY_list %>%
  filter( PAIR %in% OUTLIER_PAIR_INDEX$PAIR) %>%
  select(-pred.medn)

PREY_list <- left_join(PREY_list, PRED_list_medians,
                       by = c("PAIR" = "PAIR",
                              "prey.site" = "medn.locs",
                              "PARAM_NAME__1" = "parameter",
                              "Year" = "Year")
)

write_csv(PRED_list, paste( Sys.Date(), "BAF 2016-2017 BAF Predator Data (no outliers).csv"))
write_csv(PREY_list, paste( Sys.Date(), "BAF 2016-2017 BAF Prey Data (no outliers).csv"))





########
# Set-up for and perform regression on pred-prey medians on outlier-free medians
########

nREG_BAF_median_list_outfree <- BAF_median_list %>%
  group_by(PAIR, parameter) %>%
  nest()

REG_mod <- function(df){
  lm(pred.median ~ prey.median -1, data = df)
}

REG_BAF_median_list_outfree <- nREG_BAF_median_list_outfree %>%
  mutate(model = map(data, REG_mod),
         coeff_info = map(model, tidy),
         model_info = map(model, glance))

REG_BAF_median_summ <- REG_BAF_median_list_outfree %>%
  unnest(coeff_info, model_info) %>%
  ungroup() %>%
  select(PAIR, parameter, estimate, std.error, statistic, p.value, r.squared, adj.r.squared)
```

```
write_csv(REG_BAF_median_summ, paste(Sys.Date(), "BAF Regression Summary [outlier
rm].csv"))
```

```
#########################################
#  (01)-BSAF DATA CLEANING & PLOTTING  #
#########################################

library(DescTools)
library(dplyr)
library(readxl)
library(stringr)



#Define data source(s)

sauce_0 <- "NESP BAF DATA_2016.xlsx"
sauce_1 <- "NESP BAF DATA_2017.xlsx"

#Get index of sheets by source

saucedir_0 <- excel_sheets(sauce_0) %>% print
saucedir_1 <- excel_sheets(sauce_1) %>% print

#Define Predator & Prey for Plotting & .csv's

PREDATOR <- "Smelt"
PREY <- "Mummichog"

#Read in appropriate sheets based on index

d0 <- as_tibble(read_excel(sauce_0, saucedir_0[7])) #2016
d1 <- as_tibble(read_excel(sauce_1, saucedir_1[6])) #2017

# Check for site loc factor name inconsistencies
levels(as.factor(d0$pred.site))
levels(as.factor(d1$pred.site))
levels(as.factor(d0$prey.site))
levels(as.factor(d1$prey.site))
levels(as.factor(d0$medn.locs))
levels(as.factor(d1$medn.locs))

#replace inconsitent locs
# d0$pred.site[str_which(d0$pred.site, "^bo05")] <- "bo04"
# d0$prey.site[str_which(d0$prey.site, "^bo05")] <- "bo04"
# d0$medn.locs[str_which(d0$medn.locs, "^bo05")] <- "bo04"

# d0$pred.site <- str_replace(d0$pred.site, "cpjl", "cj")
# d0$prey.site <- str_replace(d0$prey.site, "cpjl", "cj")
# d0$medn.locs <- str_replace(d0$medn.locs, "cpjl", "cj")


# Check for parameter factor inconsistencies
levels(as.factor(d0$parameter))
levels(as.factor(d1$parameter))
levels(as.factor(d0$PARAM_NAME))
levels(as.factor(d1$PARAM_NAME))
levels(as.factor(d0$PARAM_NAME__1))
levels(as.factor(d1$PARAM_NAME__1))


#replace inconsitent locs
d0$parameter[str_which(d0$parameter, "^methyl")] <- "Methyl Mercury"
# d1$parameter[str_which(d1$parameter, "^Methyl")] <- "Methyl Mercury"
d0$parameter[str_which(d0$parameter, "^mer")] <- "Mercury"
# d1$PARAM_NAME__1[str_which(d1$PARAM_NAME__1, "^Mer")] <- "Mercury"
#
#
# d0$PARAM_NAME[str_which(d0$PARAM_NAME, "^Methyl")] <- "Methyl Mercury"
# d1$PARAM_NAME[str_which(d1$PARAM_NAME, "^Methyl")] <- "Methyl Mercury"
# d0$PARAM_NAME[str_which(d0$PARAM_NAME, "^mer")] <- "Mercury"
# d1$PARAM_NAME[str_which(d1$PARAM_NAME, "^mer")] <- "Mercury"
```

```
#
# d0$PARAM_NAME__1[str_which(d0$PARAM_NAME__1, "^Methyl")] <- "Methyl Mercury"
# d1$PARAM_NAME__1[str_which(d1$PARAM_NAME__1, "^Methyl")] <- "Methyl Mercury"
# # d0$PARAM_NAME__1[str_which(d0$PARAM_NAME__1, "^mer")] <- "Mercury"
# d1$PARAM_NAME__1[str_which(d1$PARAM_NAME__1, "^mer")] <- "Mercury"


#Format date as DATE
d0$DATE <- as.Date(d0$DATE, format = "%m/%d/%Y")
# d0$Year <- as.numeric(substring(d0$DATE, 1, 4))
d1$DATE <- as.Date(d1$DATE, format = "%m/%d/%Y")
# d1$DATE__1 <- as.Date(d1$DATE__1, origin = "1899-12-30")


summary(d0)
summary(d1)


#replace erroneous pred.sites & prey.sites showing as w18 and greater [[for sparrow-ti & sparrow-spider]]
# d0$pred.site <- as.character(d0$pred.site)
# d0$pred.site[str_which(d0$pred.site, "^w")] <- "w17"
# d0$pred.site <- as.factor(d0$pred.site)
# levels(d0$pred.site)

#replace erroneous prey.site showing as bo05 and ob06 [[for polychaetes]]
# d0$prey.site <- as.character(d0$prey.site)
# d0$prey.site[str_which(d0$prey.site, "ob06")] <- "ob05"
# d0$prey.site[str_which(d0$prey.site, "bo05")] <- "bo04"
# d0$prey.site[str_which(d0$prey.site, "es14")] <- "es13"
# d0$prey.site <- as.factor(d0$prey.site)
# levels(d0$prey.site)


#Split d0 and d1 into three seperate tables

t.sed_1 <-
  d1 %>% #2017
  select(LOC_NAME:prey.medn) %>%
  filter(!is.na(LOC_NAME)) %>%
  mutate(Year = as.numeric("2017")) %>%
  print

t.sed1 <- d0 %>% #2016
  select(LOC_NAME:prey.medn) %>%
  filter(!is.na(LOC_NAME)) %>%
  mutate(Year = as.numeric("2016")) %>%
  print

t.sed_2 <- d1 %>% #2017
  select(LOC_NAME__1:pred.medn, -DATE__1) %>%
  filter(!is.na(LOC_NAME__1)) %>%
  mutate(Year = as.numeric("2017")) %>%
  print

t.sed2 <- d0 %>% #2016
  select(LOC_NAME__1:pred.medn, -DATE__1) %>%
  filter(!is.na(LOC_NAME__1)) %>%
  mutate(Year = as.numeric("2016")) %>%
  print

t.sed_3 <- d1 %>% #2017
  select(medn.locs:prey.median) %>%
  filter(!is.na(medn.locs)) %>%
  mutate(Year = as.numeric("2017")) %>%
  arrange(medn.locs) %>%
  print

t.sed3 <- d0 %>% #2016
```

```
  select(medn.locs:prey.median) %>%
  filter(!is.na(medn.locs)) %>%
  mutate(Year = as.numeric("2016")) %>%
  arrange(medn.locs) %>%
  print


#Append 2016 data to 2017 data
ti.sed1 <- union(t.sed_1, t.sed1)
ti.sed2 <- union(t.sed_2, t.sed2)
ti.sed3 <- union(t.sed_3, t.sed3)

#Set locations as factors & define order from N to S
ti.sed1$pred.site <- as.factor(ti.sed1$pred.site)
ti.sed2$prey.site <- as.factor(ti.sed2$prey.site)
ti.sed3$medn.locs <- as.factor(ti.sed3$medn.locs)
ti.sed1$pred.site <- factor(ti.sed1$pred.site, levels(ti.sed1$pred.site)[c(3, 6, 5, 4, 1, 2)] ) #Ordering sites from N to S
ti.sed2$prey.site <- factor(ti.sed2$prey.site, levels(ti.sed2$prey.site)[c(3, 6, 5, 4, 1, 2)] )
ti.sed3$medn.locs <- factor(ti.sed3$medn.locs, levels(ti.sed3$medn.locs)[c(3, 6, 5, 4, 1, 2)] )


# Calculate medians based on individual concentrations by location, parameter, and year to check against medians listed in ti.sed3
medians_check_1 <- ti.sed1 %>%
  group_by(pred.site, PARAM_NAME, Year) %>%
  summarise(pred.count = n(),
            pred.min = min(pred.conc),
            pred.max = max(pred.conc),
            pred.sd = sd(pred.conc),
            pred.median = median(pred.conc)) %>%
  print()

View(ti.sed3)


medians_check_2 <- ti.sed2 %>%
  group_by(prey.site,PARAM_NAME__1, Year) %>%
  summarise(prey.count = n(),
            prey.min = min(prey.conc),
            prey.max = max(prey.conc),
            prey.sd = sd(prey.conc),
            prey.median = median(prey.conc)) %>%
  print()



# Write clean data to csvs
medians <- left_join(medians_check_1, medians_check_2, by = c( "pred.site" = "prey.site", "PARAM_NAME" = "PARAM_NAME__1", "Year" = "Year" ))
rm(medians_check_1, medians_check_2)
write.csv(medians, paste(Sys.Date(), " 2016-2017 ", PREDATOR,"-", PREY, " Medians-cal.csv", sep = ""))
write.csv(ti.sed1, paste(Sys.Date(), " 2016-2017 ", PREDATOR,"-", PREY, " Predator_Conc.csv", sep = ""))
write.csv(ti.sed2, paste(Sys.Date(), " 2016-2017 ", PREDATOR,"-", PREY, " Prey_Conc.csv", sep = ""))
write.csv(ti.sed3, paste(Sys.Date(), " 2016-2017 ", PREDATOR,"-", PREY, " Median_Conc.csv", sep = ""))

#correct median sediment t.sed value for mmse 2017, mmsw 2017,
# ti.sed1$prey.medn[ti.sed1$Year == 2017 & ti.sed1$pred.site == "mmse"] <- as.numeric(medians_check_2[4,6])
# ti.sed3$prey.median[ti.sed3$Year == 2017 & ti.sed3$medn.locs == "mmse"] <- as.numeric(medians_check_2[4,6])
#
# ti.sed1$prey.medn[ti.sed1$Year == 2017 & ti.sed1$pred.site == "mmsw"] <-
```

```
as.numeric(medians_check_2[6,6])
# ti.sed3$prey.median[ti.sed3$Year == 2017 & ti.sed3$medn.locs == "mmsw"] <- as.numeric(medians_check_2[6,6])

#Error noted in the t.sed3$prey.median AND  t.sed1$prey.medn for W17[NSP].  Should be 476(calculated) instead of 828(provided)
# t.sed3$prey.median[t.sed3$medn.locs == "w17"] <- medians_check_2$prey.median[medians_check_2$prey.site == "w17"]
# t.sed1$prey.medn[t.sed1$pred.site == "w17"] <- medians_check_2$prey.median[medians_check_2$prey.site == "w17"]

#Set the color palatte for plotting
# pie(rep(1, 10), col = rainbow(10))
palette(rainbow(12)[c(1, 7, 5, 2, 8, 10, 12)]) # modified to accomodate ordering of locs from N to S.

############
### Plots ##
############

#Set analyte to either "Mercury" or "Methyl Mercury", re-run code below for both analytes
ANALYTE <- "Mercury"

# Subset based on analyte selection
ti.sed1_tmp <- ti.sed1[ti.sed1$PARAM_NAME == ANALYTE,]
ti.sed2_tmp <- ti.sed2[ti.sed2$PARAM_NAME__1 == ANALYTE,]
ti.sed3_tmp <- ti.sed3[ti.sed3$parameter == ANALYTE,]

# Change plotting device
pdf(paste(Sys.Date()," 2016 & 2017 ", PREDATOR, "-", PREY, " ", ANALYTE, " BAF.pdf", sep = ""), paper = "letter") #sauce_dir[3],


# Set plotting margins
op <- par(mar=c(8, 4.7, 4, 2) + 0.1)

# Initialize plot
plot(pred.conc ~ prey.medn, data = ti.sed1_tmp,
     col = as.numeric(ti.sed1_tmp$pred.site),
     ylim = c(0, 1.1 * max(ti.sed1_tmp$pred.conc, na.rm = T)), yaxs = "i",
     xlim = c(0, 1.1 * max(ti.sed2_tmp$prey.conc, na.rm = T)), xaxs = "i",
     pch = c(0,1)[as.factor(ti.sed1_tmp$Year)], tck = 0.015, las = 1,
     ylab = paste(PREDATOR,"\n", "Tissue (ng/g-predator)"), xlab = paste("Tissue (ng/g-prey)\n", PREY), cex = 0.5,
     main = paste("2016 & 2017 | ", PREDATOR, "-", PREY, " ",ANALYTE," BAF", sep = "")
     ) #, sauce_dir[2]

# add data to plot along x-axis
points(pred.medn ~ prey.conc, data = ti.sed2_tmp,
       col = as.numeric(as.factor(ti.sed2_tmp$prey.site)),
       pch = c(0,1)[as.factor(ti.sed2_tmp$Year)], cex = 0.5)

# Regression on median concentrations
mod1 <-lm(ti.sed3_tmp$pred.median ~ ti.sed3_tmp$prey.median-1)

modsum <- summary(mod1) %>% print


# Set up regression summary to be plotted
slope <- modsum$coefficients[1,1]
r2 <- modsum$adj.r.squared
pval <- modsum$coefficients[1,4]


t.sed_r2 <- list(bquote(y == .(format(slope, digits = 4)) * italic(x) ),
                 bquote(italic(Adj.~R)^2 == .(format(r2, digits = 2)) * "," ~~
                            italic(p) == .(format(pval, digits = 3))) )

#Plot abline
```

```
clip(0.7 * min(ti.sed1_tmp$prey.medn, na.rm = T),
     1.1 * max(ti.sed1_tmp$prey.medn, na.rm = T),
     0,
     1.1 * max(ti.sed2_tmp$pred.medn, na.rm = T))

abline(mod1, lty = 2, col = "darkgray", lwd = 2)

clip(-0.1 * min(ti.sed1_tmp$prey.medn, na.rm = T),
     1.1 * max(ti.sed1_tmp$prey.medn, na.rm = T),
     0,
     1.1 * max(ti.sed2_tmp$pred.medn, na.rm = T))

#Define legend
leg_sites <- read.csv("//ksw-fs1/transfer/LOuy/Penobscot/2017_11_XX BSAF
PLOTS/replace.csv", as.is = TRUE)
site_ref <- levels(ti.sed1_tmp$pred.site)
leg_ref <- c(site_ref,
             palette()[1:length(site_ref)],
             c(1:as.numeric(length(site_ref))))

dim(leg_ref) <- c(length(site_ref),3)
leg_ref <- as_tibble(leg_ref)
leg_ref <- left_join(leg_ref, leg_sites, by="V1", n="") %>%
  arrange(V3.y) %>%
  print
rm(site_ref, leg_sites)

# Plot regression summary and legends
mtext(do.call(expression, t.sed_r2),
      side = 3, line=-c(1, 1.5), adj = 1,
      at=par("usr")[1]+0.95*diff(par("usr")[1:2]),
      cex = 0.7)


legend(x= ,"bottom",
       legend = leg_ref$V2.y,
       pch = 16, col = leg_ref$V2.x, cex = 0.6, xjust = 1, bty = "n",
       horiz = "TRUE",
       inset = c(0.0,-0.28),
       xpd = TRUE)

legend(x= ,"bottom",
       legend = c("2016 Data Point", "2017 Data Point", "2016 Median",  "2017 Median"),
       pch = c(0,1,24,25),
       cex = 0.6, xjust = 0.5, bty = "n",
       ncol = 2,
       inset = c(0.0,-0.34),
       xpd = TRUE)

legend(x= ,"bottom",
       legend = "Regression Line",
       lty = 2, col = "darkgray", lwd = 2,
       cex = 0.6, xjust = 0.5, bty = "n", horiz = "FALSE",
       inset = c(0.0,-0.37),
       xpd = TRUE)


# Wilcoxon Rank Sum test &
# Plotting of confidence intervals about the median
s.wt_1a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "frb01" &
ti.sed2_tmp$Year == 2016], conf.int = T) %>% print()
arrows(x0 = s.wt_1a$conf.int[1], x1 = s.wt_1a$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "frb01" &
       ti.sed2_tmp$Year == 2016]),
       angle = 90, length = 0.05, code = 3, col = 1)

s.wt_1b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "frb01" &
ti.sed2_tmp$Year == 2017], conf.int = T) %>% print()
arrows(x0 = s.wt_1b$conf.int[1], x1 = s.wt_1b$conf.int[2],
```

```
        y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "frb01" &
        ti.sed2_tmp$Year == 2017]),
        angle = 90, length = 0.05, code = 3, col = 1)
t.wt_1a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "frb01" &
ti.sed1_tmp$Year == 2016], conf.int = T) %>% print()
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "frb01" &
ti.sed1_tmp$Year == 2016]),
        y0 = t.wt_1a$conf.int[1], y1 = t.wt_1a$conf.int[2],
        angle = 90, length = 0.05, code = 3, col = 1)
t.wt_1b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "frb01" &
ti.sed1_tmp$Year == 2017], conf.int = T) %>% print()
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "frb01" &
ti.sed1_tmp$Year == 2017]),
        y0 = t.wt_1b$conf.int[1], y1 = t.wt_1b$conf.int[2],
        angle = 90, length = 0.05, code = 3, col = 1)
s.wt_2a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob05" &
ti.sed2_tmp$Year == 2016], conf.int = T) %>% print()
arrows(x0 = s.wt_2a$conf.int[1], x1 = s.wt_2a$conf.int[2],
        y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob05"&
        ti.sed2_tmp$Year == 2016]),
        angle = 90, length = 0.05, code = 3, col = 2)
s.wt_2b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob05"&
ti.sed2_tmp$Year == 2017], conf.int = T) %>% print()
arrows(x0 = s.wt_2b$conf.int[1], x1 = s.wt_2b$conf.int[2],
        y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob05"&
        ti.sed2_tmp$Year == 2017]),
        angle = 90, length = 0.05, code = 3, col = 2)
t.wt_2a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob05" &
ti.sed1_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob05" &
ti.sed1_tmp$Year == 2016]),
        y0 = t.wt_2a$conf.int[1], y1 = t.wt_2a$conf.int[2],
        angle = 90, length = 0.05, code = 3, col = 2)
t.wt_2b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob05" &
ti.sed1_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob05" &
ti.sed1_tmp$Year == 2017]),
        y0 = t.wt_2b$conf.int[1], y1 = t.wt_2b$conf.int[2],
        angle = 90, length = 0.05, code = 3, col = 2)
s.wt_3a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob04" &
ti.sed2_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = s.wt_3a$conf.int[1], x1 = s.wt_3a$conf.int[2],
        y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob04" &
        ti.sed2_tmp$Year == 2016]),
        angle = 90, length = 0.05, code = 3, col = 3)
s.wt_3b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob04" &
ti.sed2_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = s.wt_3b$conf.int[1], x1 = s.wt_3b$conf.int[2],
        y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob04" &
        ti.sed2_tmp$Year == 2017]),
        angle = 90, length = 0.05, code = 3, col = 3)
t.wt_3a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob04" &
ti.sed1_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob04" &
ti.sed1_tmp$Year == 2016]),
        y0 = t.wt_3a$conf.int[1], y1 = t.wt_3a$conf.int[2],
        angle = 90, length = 0.05, code = 3, col = 3)
```

```
t.wt_3b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob04" & ti.sed1_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob04" & ti.sed1_tmp$Year == 2017]),
       y0 = t.wt_3b$conf.int[1], y1 = t.wt_3b$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 3)

s.wt_4a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob01" & ti.sed2_tmp$Year == 2016], conf.int = T) %>% print()
arrows(x0 = s.wt_4a$conf.int[1], x1 = s.wt_4a$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob01" & ti.sed2_tmp$Year == 2016]),
       angle = 90, length = 0.05, code = 3, col = 4)

s.wt_4b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "ob01" & ti.sed2_tmp$Year == 2017], conf.int = T) %>% print()
arrows(x0 = s.wt_4b$conf.int[1], x1 = s.wt_4b$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "ob01" & ti.sed2_tmp$Year == 2017]),
       angle = 90, length = 0.05, code = 3, col = 4)

t.wt_4a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob01" & ti.sed1_tmp$Year == 2016], conf.int = T) %>% print()
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob01" & ti.sed1_tmp$Year == 2016]),
       y0 = t.wt_4a$conf.int[1], y1 = t.wt_4a$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 4)

t.wt_4b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "ob01" & ti.sed1_tmp$Year == 2017], conf.int = T) %>% print()
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "ob01" & ti.sed1_tmp$Year == 2017]),
       y0 = t.wt_4b$conf.int[1], y1 = t.wt_4b$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 4)

s.wt_5a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "es13" & ti.sed2_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = s.wt_5a$conf.int[1], x1 = s.wt_5a$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "es13" & ti.sed2_tmp$Year == 2016]),
       angle = 90, length = 0.05, code = 3, col = 5)

s.wt_5b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "es13" & ti.sed2_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = s.wt_5b$conf.int[1], x1 = s.wt_5b$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "es13" & ti.sed2_tmp$Year == 2017]),
       angle = 90, length = 0.05, code = 3, col = 5)

t.wt_5a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "es13" & ti.sed1_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "es13" & ti.sed1_tmp$Year == 2016]),
       y0 = t.wt_5a$conf.int[1], y1 = t.wt_5a$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 5)

t.wt_5b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "es13" & ti.sed1_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "es13" & ti.sed1_tmp$Year == 2017]),
       y0 = t.wt_5b$conf.int[1], y1 = t.wt_5b$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 5)

s.wt_6a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "esfp" & ti.sed2_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = s.wt_6a$conf.int[1], x1 = s.wt_6a$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "esfp" & ti.sed2_tmp$Year == 2016]),
```

```
       angle = 90, length = 0.05, code = 3, col = 6)

s.wt_6b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "esfp" &
ti.sed2_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = s.wt_6b$conf.int[1], x1 = s.wt_6b$conf.int[2],
       y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "esfp" &
       ti.sed2_tmp$Year == 2017]),
       angle = 90, length = 0.05, code = 3, col = 6)

t.wt_6a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "esfp" &
ti.sed1_tmp$Year == 2016], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "esfp" &
ti.sed1_tmp$Year == 2016]),
       y0 = t.wt_6a$conf.int[1], y1 = t.wt_6a$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 6)

t.wt_6b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "esfp" &
ti.sed1_tmp$Year == 2017], conf.int = T) %>% print
arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "esfp" &
ti.sed1_tmp$Year == 2017]),
       y0 = t.wt_6b$conf.int[1], y1 = t.wt_6b$conf.int[2],
       angle = 90, length = 0.05, code = 3, col = 6)
#
# s.wt_7a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "es13" &
ti.sed2_tmp$Year == 2016], conf.int = T) %>% print
# arrows(x0 = s.wt_7a$conf.int[1], x1 = s.wt_7a$conf.int[2],
#        y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "es13" &
ti.sed2_tmp$Year == 2016]),
#        angle = 90, length = 0.05, code = 3, col = 7)
#
# s.wt_7b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "es13" &
ti.sed2_tmp$Year == 2017], conf.int = T) %>% print
# arrows(x0 = s.wt_7b$conf.int[1], x1 = s.wt_7b$conf.int[2],
#        y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "es13" &
ti.sed2_tmp$Year == 2017]),
#        angle = 90, length = 0.05, code = 3, col = 7)
#
# t.wt_7a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "es13" &
ti.sed1_tmp$Year == 2016], conf.int = T) %>% print
# arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "es13" &
ti.sed1_tmp$Year == 2016]),
#        y0 = t.wt_7a$conf.int[1], y1 = t.wt_7a$conf.int[2],
#        angle = 90, length = 0.05, code = 3, col = 7)
#
# t.wt_7b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "es13" &
ti.sed1_tmp$Year == 2017], conf.int = T) %>% print
# arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "es13" &
ti.sed1_tmp$Year == 2017]),
#        y0 = t.wt_7b$conf.int[1], y1 = t.wt_7b$conf.int[2],
#        angle = 90, length = 0.05, code = 3, col = 7)
#
# s.wt_8a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "sve02" &
ti.sed2_tmp$Year == 2016], conf.int = T) %>% print
# arrows(x0 = s.wt_8a$conf.int[1], x1 = s.wt_8a$conf.int[2],
#        y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "sve02" &
ti.sed2_tmp$Year == 2016]),
#        angle = 90, length = 0.05, code = 3, col = 8)
#
# s.wt_8b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "sve02" &
ti.sed2_tmp$Year == 2017], conf.int = T) %>% print
# arrows(x0 = s.wt_8b$conf.int[1], x1 = s.wt_8b$conf.int[2],
#        y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "sve02" &
ti.sed2_tmp$Year == 2017]),
#        angle = 90, length = 0.05, code = 3, col = 8)
#
# t.wt_8a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "sve02" &
ti.sed1_tmp$Year == 2016], conf.int = T) %>% print
# arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "sve02" &
ti.sed1_tmp$Year == 2016]),
```

```
#        y0 = t.wt_8a$conf.int[1], y1 = t.wt_8a$conf.int[2],
#        angle = 90, length = 0.05, code = 3, col = 8)
#
# t.wt_8b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "sve02" & ti.sed1_tmp$Year == 2017], conf.int = T) %>% print
# arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "sve02" & ti.sed1_tmp$Year == 2017]),
#        y0 = t.wt_8b$conf.int[1], y1 = t.wt_8b$conf.int[2],
#        angle = 90, length = 0.05, code = 3, col = 8)
#
# s.wt_9a <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "esfp" & ti.sed2_tmp$Year == 2016], conf.int = T) %>% print
# arrows(x0 = s.wt_9a$conf.int[1], x1 = s.wt_9a$conf.int[2],
#        y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "esfp" & ti.sed2_tmp$Year == 2016]),
#        angle = 90, length = 0.05, code = 3, col = 9)
#
# s.wt_9b <- wilcox.test(ti.sed2_tmp$prey.conc[ti.sed2_tmp$prey.site == "esfp" & ti.sed2_tmp$Year == 2017], conf.int = T) %>% print
# arrows(x0 = s.wt_9b$conf.int[1], x1 = s.wt_9b$conf.int[2],
#        y0 = unique(ti.sed2_tmp$pred.medn[ti.sed2_tmp$prey.site == "esfp" & ti.sed2_tmp$Year == 2017]),
#        angle = 90, length = 0.05, code = 3, col = 9)
#
# t.wt_9a <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "esfp" & ti.sed1_tmp$Year == 2016], conf.int = T) %>% print
# arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "esfp" & ti.sed1_tmp$Year == 2016]),
#        y0 = t.wt_9a$conf.int[1], y1 = t.wt_9a$conf.int[2],
#        angle = 90, length = 0.05, code = 3, col = 9)
#
# t.wt_9b <- wilcox.test(ti.sed1_tmp$pred.conc[ti.sed1_tmp$pred.site == "esfp" & ti.sed1_tmp$Year == 2017], conf.int = T) %>% print
# arrows(x0 = unique(ti.sed1_tmp$prey.medn[ti.sed1_tmp$pred.site == "esfp" & ti.sed1_tmp$Year == 2017]),
#        y0 = t.wt_9b$conf.int[1], y1 = t.wt_9b$conf.int[2],
#        angle = 90, length = 0.05, code = 3, col = 9)

# Add points for median concentrations
points(pred.median ~ prey.median, data = ti.sed3_tmp,
       pch = c(24,25)[as.factor(ti.sed3_tmp$Year)], col = "black",
       cex = 1)

par(op)

# Reset plotting device
dev.off()
```

```r
################################
#      BAF AND BSAF BIOTA      #
#    EXTREME VALUE SCREENING   #
################################

library(tidyverse)
library(car)


penob_median_extreme_values <- read_csv("2018-01-22 2016-2017 Select Biota Data with Extreme Values.csv") %>% print()

summary(penob_median_extreme_values)
str(penob_median_extreme_values)

penob_median_extreme_values <-
  penob_median_extreme_values %>%
  mutate(MED_T = as.factor(MED_T),
         PARAM_NAME = as.factor(PARAM_NAME),
         LOC_YEAR = as.factor(LOC_YEAR)) %>%
  print()

str(penob_median_extreme_values)


################################################################################
# GENERATE BOX & WHISKER PLOTS AND QQ-PLOTS TO IDENTIFY EXTREME MEDIAN VALUES #
################################################################################

pdf(paste(Sys.Date(), "2016-2017 Terrestrial Insect Tissue Medians (w. extreme value) Plots.pdf"), paper = "US")

Boxplot(median ~ PARAM_NAME, data = penob_median_extreme_values[penob_median_extreme_values$MED_T == "Terrestrial Insect",],
        labels. = paste(LOC_YEAR), boxwex = 0.4,
        main = "Terrestrial Insect (2016-2017)",
        xlab = "Parameter",
        ylab = "Median Tissue Concentration (ng/g)"
        )  # MMSE-2016 identified as extreme value

qqnorm(penob_median_extreme_values$median[penob_median_extreme_values$MED_T == "Terrestrial Insect" & penob_median_extreme_values$PARAM_NAME == "Mercury" ],
       main = "Normal QQ-Plot of Terrestrial Insect (2016-2017)",
       ylab = "Median Hg Tissue Sample Quantiles",
       ylim = c(0, 250))

qqline(penob_median_extreme_values$median[penob_median_extreme_values$MED_T == "Terrestrial Insect" & penob_median_extreme_values$PARAM_NAME == "Mercury"])

qqnorm(penob_median_extreme_values$median[penob_median_extreme_values$MED_T == "Terrestrial Insect" & penob_median_extreme_values$PARAM_NAME == "Methyl mercury" ],
       main = "Normal QQ-Plot of Terrestrial Insect (2016-2017)",
       ylab = "Median MeHg Tissue Sample Quantiles",
       ylim = c(0, 250))

qqline(penob_median_extreme_values$median[penob_median_extreme_values$MED_T == "Terrestrial Insect" & penob_median_extreme_values$PARAM_NAME == "Methyl mercury"])

dev.off()


pdf(paste(Sys.Date(), "2016-2017 Rainbow Smelt Tissue Medians (w. extreme value) Plots.pdf"), paper = "US")

Boxplot(median ~ PARAM_NAME, data = penob_median_extreme_values[penob_median_extreme_values$MED_T == "Rainbow Smelt",],
        labels. = paste(LOC_YEAR), boxwex = 0.4,
        main = "Rainbow Smelt (2016-2017)",
        xlab = "Parameter",
```

```
        ylab = "Median Tissue Concentration (ng/g)"
        )  # OB-05 2016 identified as extremem value

qqnorm(penob_median_extreme_values$median[penob_median_extreme_values$MED_T == "Rainbow Smelt" & penob_median_extreme_values$PARAM_NAME == "Mercury" ],
       main = "Normal QQ-Plot of Rainbow Smelt (2016-2017)",
       ylab = "Median Hg Tissue Sample Quantiles",
       ylim = c(0, 250))

qqline(penob_median_extreme_values$median[penob_median_extreme_values$MED_T == "Rainbow Smelt" & penob_median_extreme_values$PARAM_NAME == "Mercury"])

dev.off()


pdf(paste(Sys.Date(), "2016-2017 Eel Tissue Medians (w. extreme value) Plots.pdf"), paper = "US")

Boxplot(median ~ PARAM_NAME, data = penob_median_extreme_values[penob_median_extreme_values$MED_T == "Eel",],
        labels. = paste(LOC_YEAR), boxwex = 0.4,
        main = "Eel (2016-2017)",
        xlab = "Parameter",
        ylab = "Median Tissue Concentration (ng/g)"
        )  #BO-04 2016 identified as extremem value

qqnorm(penob_median_extreme_values$median[penob_median_extreme_values$MED_T == "Eel" & penob_median_extreme_values$PARAM_NAME == "Mercury" ],
       main = "Normal QQ-Plot of Eel (2016-2017)",
       ylab = "Median Hg Tissue Sample Quantiles",
       ylim = c(0, 1500))

qqline(penob_median_extreme_values$median[penob_median_extreme_values$MED_T == "Eel" & penob_median_extreme_values$PARAM_NAME == "Mercury"])

dev.off()


###############################################
# FILTER OUT EXTREME VALUE AND REVIEW QQ-PLOT #
###############################################


## Terrestrial Insect

terrestrial_insect_extreme_val_removed <- penob_median_extreme_values %>%
  filter(MED_T == "Terrestrial Insect",
         LOC_YEAR != "MMSE- 2016")

pdf(paste(Sys.Date(), "2016-2017 Terrestrial Insect Tissue Medians (w.out extreme value) Plots.pdf"), paper = "US")

Boxplot(median ~ PARAM_NAME, data = terrestrial_insect_extreme_val_removed,
        labels. = paste(LOC_YEAR), boxwex = 0.4,
        main = "Terrestrial Insect (2016-2017)",
        xlab = "Parameter\n
        (MMSE-2016 removed)",
        ylab = "Median Tissue Concentration (ng/g)"
)

qqnorm(terrestrial_insect_extreme_val_removed$median[terrestrial_insect_extreme_val_removed$PARAM_NAME == "Mercury"],
       main = "Normal QQ-Plot of Terrestrial Insect (2016-2017)",
       ylab = "Median Hg Tissue Sample Quantiles",
       xlab = "Theoretical Quantiles",
       sub ="(MMSE-2016 removed)",
       ylim = c(0, 250))

qqline(terrestrial_insect_extreme_val_removed$median[terrestrial_insect_extreme_val_remov
```

```
ed$PARAM_NAME == "Mercury"])

qqnorm(terrestrial_insect_extreme_val_removed$median[terrestrial_insect_extreme_val_removed$PARAM_NAME == "Methyl mercury"],
       main = "Normal QQ-Plot of Terrestrial Insect (2016-2017)",
       ylab = "Median MeHg Tissue Sample Quantiles",
       sub = "(MMSE-2016 removed)",
       ylim = c(0, 250))

qqline(terrestrial_insect_extreme_val_removed$median[terrestrial_insect_extreme_val_removed$PARAM_NAME == "Methyl mercury"])

dev.off()

## Smelt

pdf(paste(Sys.Date(), "2016-2017 Rainbow Smelt Tissue Medians (w.out extreme value) Plots.pdf"), paper = "US")

smelt_extreme_val_removed <- penob_median_extreme_values %>%
  filter(MED_T == "Rainbow Smelt",
         LOC_YEAR != "OB-05 2016")

Boxplot(median ~ PARAM_NAME, data = smelt_extreme_val_removed,
        labels. = paste(LOC_YEAR), boxwex = 0.4,
        main = "Rainbow Smelt (2016-2017)",
        xlab = "Parameter\n
        (OB-05 2016 removed)",
        ylab = "Median Tissue Concentration (ng/g)"
)

qqnorm(smelt_extreme_val_removed$median,
       main = "Normal QQ-Plot of Rainbow Smelt (2016-2017)",
       ylab = "Median Hg Tissue Sample Quantiles",
       xlab = "Theoretical Quantiles",
       sub ="(OB-05 removed)",
       ylim = c(0, 250))

qqline(smelt_extreme_val_removed$median)

dev.off()

## Eel

pdf(paste(Sys.Date(), "2016-2017 Eel Tissue Medians (w.out extreme value) Plots.pdf"), paper = "US")

eel_extreme_val_removed <- penob_median_extreme_values %>%
  filter(MED_T == "Eel",
         LOC_YEAR != "BO-04 2016")

Boxplot(median ~ PARAM_NAME, data = eel_extreme_val_removed,
        labels. = paste(LOC_YEAR), boxwex = 0.4,
        main = "Eel (2016-2017)",
        xlab = "Parameter\n
        (BO-04 2016 removed)",
        ylab = "Median Tissue Concentration (ng/g)"
)

qqnorm(eel_extreme_val_removed$median,
       main = "Normal QQ-Plot of Rainbow eel (2016-2017)",
       ylab = "Median Hg Tissue Sample Quantiles",
       xlab = "Theoretical Quantiles",
       sub ="(OB-05 removed)",
       ylim = c(0, 1500))

qqline(eel_extreme_val_removed$median)

dev.off()
```

```
############################################
#  (02)-BSAF REGRESSION & WILCOXON SUMMARY  #
############################################

# LO 2017-12-14 version0
# LO 2017-12-18 version1  {updated to include confidence level associated with wilcoxon signed rank tests}



library(tidyverse)
library(stringr)
library(broom)
# library(lubridate)

setwd("\\\\ksw-fs1/transfer/Town Point/KP Haywood/Penobscot River/Graph Data/2016-2017 BAF Plots/_data/Pairwise Individual")

pred.list <- list.files(path= ".", pattern='*Predator_Conc.csv')
prey.list <- list.files(path= ".", pattern='*Prey_Conc.csv')
medi.list <- list.files(path= ".", pattern='*Median_Conc.csv')


names(pred.list) <- pred.list %>%
  str_sub(start = str_locate(pred.list, "[:alpha:]")[,1],
          end = str_locate(pred.list, "Predator_Conc")[,1] -1)

names(prey.list) <- prey.list %>%
  str_sub(start = str_locate(prey.list, "[:alpha:]")[,1],
          end = str_locate(prey.list, "Prey_Conc")[,1] -1)

names(medi.list) <- medi.list %>%
  str_sub(start = str_locate(medi.list, "[:alpha:]")[,1],
          end = str_locate(medi.list, "Median_Conc")[,1] -1)



BAF_pred_list <- map_df(pred.list, read_csv,
                        col_names = c("X1","LOC_NAME", "pred.site", "MED_T", "ID", "DATE", "MEDIA",
                                      "PARAM_NAME", "pred.conc", "RESULT_UOM", "prey.medn", "Year"),
                        cols_only(LOC_NAME = "c",
                                  pred.site = "c",
                                  MED_T = "c",
                                  ID = "c",
                                  DATE = "c",
                                  MEDIA = "c",
                                  PARAM_NAME = "c",
                                  pred.conc = "d",
                                  RESULT_UOM = "c",
                                  prey.medn = "d",
                                  Year = "n"
                        ),
                        skip = 1,
                        .id = "PAIR") %>%
  mutate( PAIR = as.factor(PAIR),
          pred.site = as.factor(pred.site),
          DATE = as.Date(DATE),
          PARAM_NAME = as.factor(PARAM_NAME),
          parameter_plot = as.factor(PARAM_NAME),
          MED_prey = str_sub(PAIR,
                             start = str_locate(PAIR, regex("-(?!w)"))[,1]+1,
                             end = -1L)
  ) %>%
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  filter( !(MED_T == "American Black Duck" & Year == 2017) )


```

```r
BAF_prey_list <- map_df(prey.list, read_csv,
                        col_names = c("X1","LOC_NAME__1", "prey.site", "ID__1", "MEDIA__1",
                                      "PARAM_NAME__1", "prey.conc", "RESULT_UOM__1", "pred.medn", "Year"),
                        cols_only(LOC_NAME__1 = "c",
                                  prey.site = "c",
                                  ID__1 = "c",
                                  MEDIA__1 = "c",
                                  PARAM_NAME__1 = "c",
                                  prey.conc = "d",
                                  RESULT_UOM__1 = "c",
                                  pred.medn = "d",
                                  Year = "n"
                        ),
                        skip = 1,
                        .id = "PAIR") %>%
  mutate( PAIR = as.factor(PAIR),
          prey.site = as.factor(prey.site),
          PARAM_NAME__1 = as.factor(PARAM_NAME__1)
  ) %>%
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  filter( !(PAIR %in% c("DuckB -Mussel ", "DuckB -Polychaete ", "DuckT -Mussel ", "DuckT -Polychaete ")
            & Year == 2017)
  )



BAF_median_list <- map_df(medi.list, read_csv,
                          col_names = c("X1", "medn.locs", "parameter", "pred.median", "prey.median", "Year"),
                          cols_only(medn.locs = "c",
                                    parameter = "c",
                                    pred.median = "d",
                                    prey.median = "d",
                                    Year = "n"),
                          skip = 1,
                          .id = "PAIR") %>%
  mutate( PAIR = as.factor(PAIR),
          medn.locs = as.factor(medn.locs),
          parameter = as.factor(parameter)) %>%
  #Remove pairs with 2017 ABD and 2017 XYZ (should be 2016 XYZ or 2018)
  filter( !(PAIR %in% c("DuckB -Mussel ", "DuckB -Polychaete ", "DuckT -Mussel ", "DuckT -Polychaete ")
            & Year == 2017)
  )


########
# Set-up for and perform regression on pred-prey medians
########

nREG_BAF_median_list <- BAF_median_list %>%
  group_by(PAIR, parameter) %>%
  nest()

REG_mod <- function(df){
  lm(pred.median ~ prey.median -1, data = df)
}

REG_BAF_median_list <- nREG_BAF_median_list %>%
  mutate(model = map(data, REG_mod),
         coeff_info = map(model, tidy),
         model_info = map(model, glance))

REG_BAF_median_summ <- REG_BAF_median_list %>%
  unnest(coeff_info, model_info) %>%
  ungroup() %>%
```

```
  select(PAIR, parameter, estimate, std.error, statistic, p.value, r.squared,
  adj.r.squared)


########
# Set-up for and perform pred.conc Wilcoxon Signed Rank Test | One-Sample, Unpaired
########

nWSR_BAF_pred_list <- BAF_pred_list %>%
  select(PAIR, pred.site, PARAM_NAME, Year, pred.conc) %>%
  group_by(PAIR, pred.site, PARAM_NAME, Year) %>%
  nest(pred.conc)

WSR_FUN_pred <- function(data){
  wilcox.test(data$pred.conc, conf.int = T)
}


WSR_BAF_pred_summ <- nWSR_BAF_pred_list %>%
  mutate(WSR_MOD = map(data, WSR_FUN_pred),
         conf.level = map_dbl(
           map(WSR_MOD, "conf.int"),
           attr_getter("conf.level")
         ),
         WSR_COEF = map(WSR_MOD, tidy)) %>%
  unnest(WSR_COEF) %>%
  select(PAIR:Year, estimate:conf.high, conf.level, method:alternative) %>%
  arrange(PAIR, Year, pred.site, PARAM_NAME)


########
# Set-up for and perform prey.conc Wilcoxon Signed Rank Test
########

nWSR_BAF_prey_list <- BAF_prey_list %>%
  select(PAIR, prey.site, PARAM_NAME__1, Year, prey.conc) %>%
  group_by(PAIR, prey.site, PARAM_NAME__1, Year) %>%
  nest(prey.conc)

WSR_FUN_prey <- function(data){
  wilcox.test(data$prey.conc, conf.int = T)
}


WSR_BAF_prey_summ <- nWSR_BAF_prey_list %>%
  mutate(WSR_MOD = map(data, WSR_FUN_prey),
         conf.level = map_dbl(
           map(WSR_MOD, "conf.int"),
           attr_getter("conf.level")
         ),
         WSR_COEF = map(WSR_MOD, tidy)) %>%
  unnest(WSR_COEF) %>%
  select(PAIR:Year, estimate:conf.high, conf.level, method:alternative) %>%
  arrange(PAIR, Year, prey.site, PARAM_NAME__1)

# WSR_BAF_prey_summ <- nWSR_BAF_prey_list %>%
#   mutate(WSR_MOD = map(data, WSR_FUN_prey),
#          WSR_COEF = map(WSR_MOD, tidy)) %>%
#   # WSR_MODSUM = map(WSR_MOD[["result"]], tidy))
#   # WSR_MODSUM2 = map(WSR_MOD, glance)) %>%
#   select(-data, -WSR_MOD) %>%
#   unnest(WSR_COEF)


#######
# Write summaries to csvs
#######

setwd("\\\\ksw-fs1/transfer/Town Point/KP Haywood/Penobscot River/Graph Data/2016-2017
```

```
BAF Plots")
write.csv(REG_BAF_median_summ, paste(Sys.Date(), "BAF Regression Summary.csv"))
write.csv(WSR_BAF_pred_summ, paste(Sys.Date(), "BAF WSR Predator Conc. Summary.csv"))
write.csv(WSR_BAF_prey_summ, paste(Sys.Date(), "BAF WSR Prey Conc. Summary.csv"))
```

APPENDIX D

PRG Calculations

Appendix D

Sediment PRG Computation Approach

For the purposes of developing long-term remediation options, risk-based sediment preliminary remediation goals (PRGs) for mercury were developed. The PRGs were based on food web modeling and bioaccumulation modeling, using target tissue levels for both human and ecological receptors. Sediment PRGs were calculated using multiple lines of evidence. Sediment PRGs were calculated using three different approaches, the food web approach, BSAF tissue-based approach, and dietary approach.

Food web modeling tissue-based approach were calculated using the target tissue level (termed PRG_{TIS} in equation below) and estimated exposure using the following equation:

$$PRG_{SED}\left(\frac{ng}{g}\right) = \frac{PRG_{TIS}\left(\frac{ng}{g}\right)}{\sum_{p}^{n=p} BSAF_p \times \left(BAF_p \times DC_p\right)}$$

Where:

- PRG_{SED} = Sediment PRG (ng/g, dry weight [dw])
- PRG_{TIS} = Tissue PRG (ng/g)
- $BSAF_P$ = Species-specific BSAF (unitless) of a prey item
- BAF_P = Species-specific BAF (unitless) of a prey item
- DC_P = Dietary Composition (% as a decimal number) of a prey item

Biota-sediment accumulation factor (BSAF) tissue-based approach is based on the target tissue level (termed PRG_{TIS} in equation below) and estimated exposure using the following equation:

$$PRG_{SED}\left(\frac{ng}{g}\right) = \frac{PRG_{TIS}\left(\frac{ng}{g}\right)}{BSAF}$$

Where:

- PRG_{SED} = Sediment PRG (ng/g, dw)
- PRG_{TIS} = Tissue PRG (ng/g)
- BSAF = Species-specific BSAF (unitless)

Food web modeling dietary-based approach is based on the standard food chain model equation:

$$PRG_{SED}\ (\frac{ng}{g}) = \frac{TRV}{SFF \times IR_F \times EF \times \left(\frac{1}{BW}\right) \times \left((IR_{SED} \times P_{SED}) + \sum_{P}^{n=P} BSAF_p \times DC_p\right)}$$

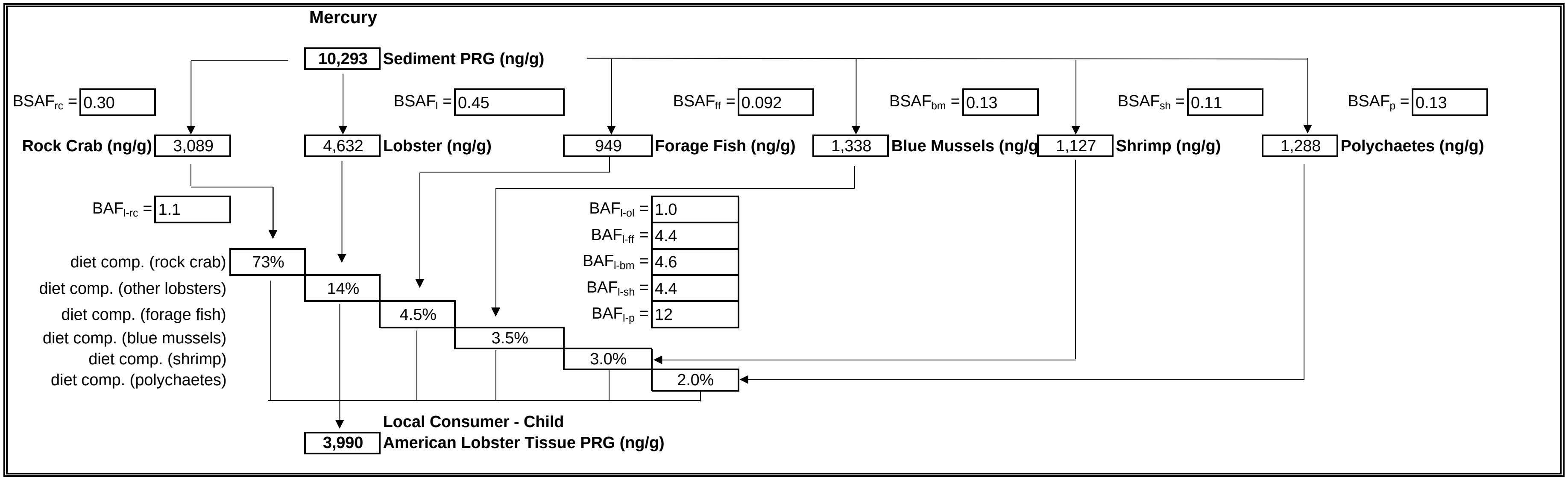
Where:

- PRG_{SED} = Sediment PRG (ng/g, dw)
- TRV = Toxicity Reference Value (ng/g bw/day)
- SFF = Site Foraging Frequency (unitless)
- EF = Exposure Frequency (unitless)
- IR_F = Daily food intake rate (kg/day, wet weight)
- BW = Body Weight (kg)
- IR_S = Sediment ingestion rate (kg/day, dw)
- P_{SED} = Proportion of diet comprised of sediment (unitless)
- $BSAF_P$ = Specific-specific BSAF (unitless) of a prey item
- DC_P = Dietary Composition (% as a decimal number) of a prey item

Sediment PRGs were calculated for human health using food web modeling and BSAF tissue-based approaches. Human health-based sediment PRGs were also calculated for two different scenarios—the local consumer and the MeCDC fish tissue action level for finfish consumption. Sediment PRGs were calculated for ecological receptors using food web modeling and BSAF tissue-based approaches, as well as the dietary-based approach. The sediment PRGs were developed for total mercury and methyl mercury using site-specific and species-specific BSAFs (i.e., ratio of biota tissue to sediment mercury concentrations) and biota-biota (i.e., ratio of prey to predator mercury concentrations) accumulation factors (BAFs). The BSAF is a parameter describing the bioaccumulation of sediment-associated compounds into tissues of ecological receptors. In contrast, the BAF describes the bioaccumulation of a compound in prey tissue to predator tissue via dietary exposure. In addition, sediment PRGs were developed for all of the biota types evaluated in the human health and ecological risk assessments in order to provide a range of potential sediment PRGs that would be protective of human health and ecological receptors. The proposed sediment PRGs are applicable to sediments within the bioactive zone for estuarine environments.

TABLE D-1

LOBSTER FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (CHILD)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



<u>Notes:</u>
Sediment in dry weight; tissue in wet weight.

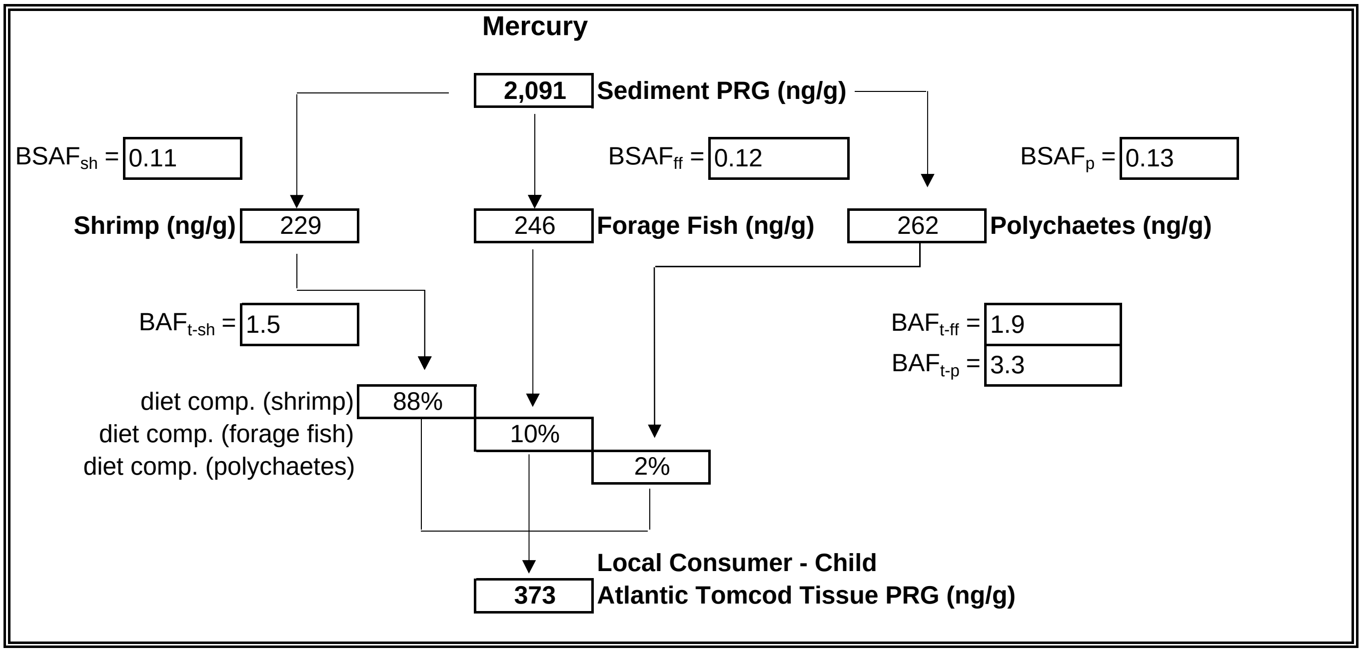
Prepared by: <u>IMR 08/15/18</u>
Checked by: <u>NSR 08/15/18</u>

<u>Abbreviations:</u>
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{rc}$	Sediment to rock crab BSAF
$BSAF_{l}$	Sediment to lobster BSAF
$BSAF_{ff}$	Sediment to forage fish (smelt) BSAF
$BSAF_{bm}$	Sediment to blue mussel BSAF
$BSAF_{sh}$	Sediment to shrimp BSAF
$BSAF_{p}$	Sediment to polychaete BSAF
$BAF_{l\text{-}rc}$	Rock crab to lobster BAF
$BAF_{l\text{-}ol}$	Lobster to other lobster BAF (1:1 ratio assumed)
$BAF_{l\text{-}ff}$	Forage fish (smelt) to lobster BAF
$BAF_{l\text{-}bm}$	Blue mussel to lobster BAF
$BAF_{l\text{-}sh}$	Shrimp to lobster BAF; no lobster-shrimp pairings and statistical analysis of 2009 smelt and 2009 shrimp data indicated no significant difference for the river
$BAF_{l\text{-}p}$	Polychaete to lobster BAF

TABLE D-2

ATLANTIC TOMCOD FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (CHILD)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

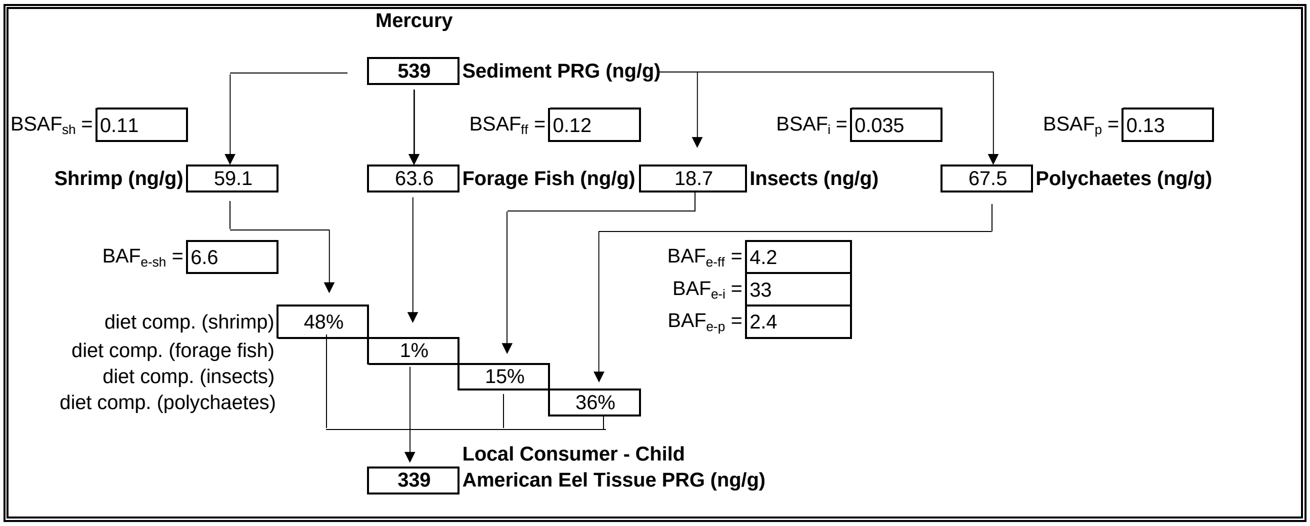
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{sh}$	Sediment to shrimp BSAF
$BSAF_{ff}$	Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{p}$	Sediment to polychaete BSAF
BAF_{t-sh}	Shrimp to tomcod BAF
BAF_{t-ff}	Forage fish (smelt + mummichog) to tomcod BAF
BAF_{t-p}	Polychaete to tomcod BAF

TABLE D-3

AMERICAN EEL FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (CHILD)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

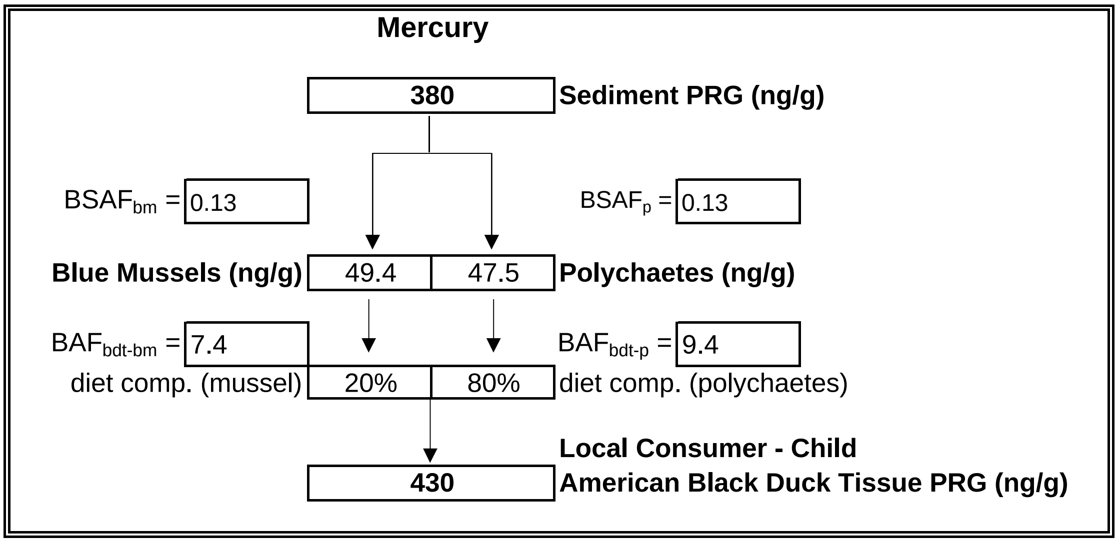
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{sh}$	Sediment to shrimp BSAF
$BSAF_{ff}$	Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{i}$	Sediment to insect BSAF
$BSAF_{p}$	Sediment to polychaete BSAF
$BAF_{e\text{-}sh}$	Shrimp to eel BAF
$BAF_{e\text{-}ff}$	Forage fish (smelt + mummichog) to eel BAF
$BAF_{e\text{-}i}$	Insect to eel BAF
$BAF_{e\text{-}p}$	Polychaete to eel BAF

TABLE D-4

BLACK DUCK FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (CHILD)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

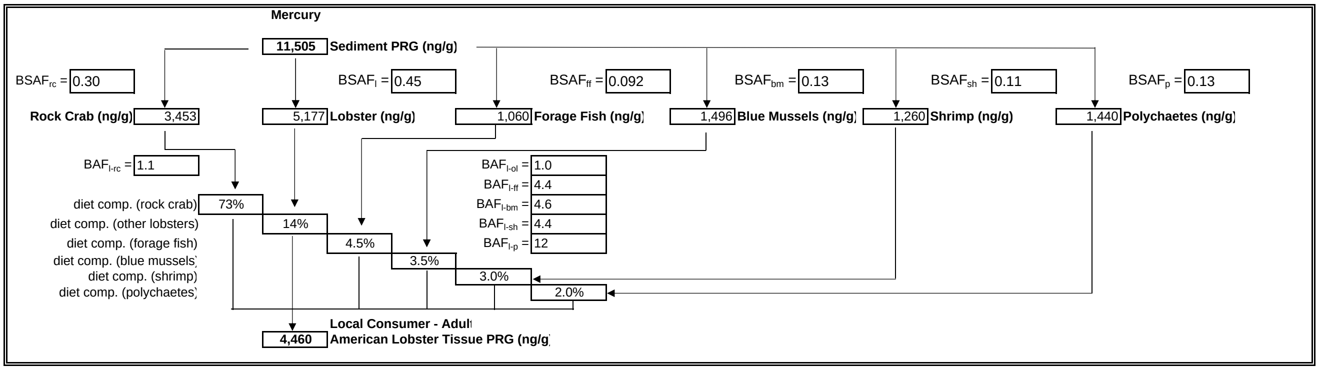
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{p}$	Sediment to polychaete BSAF
$BSAF_{bm}$	Sediment to blue mussel BSAF
BAF_{bdt-p}	Polychaete to black duck blood BAF
BAF_{bdt-bm}	Blue mussel to black duck blood BAF

TABLE D-5

LOBSTER FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (ADULT)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

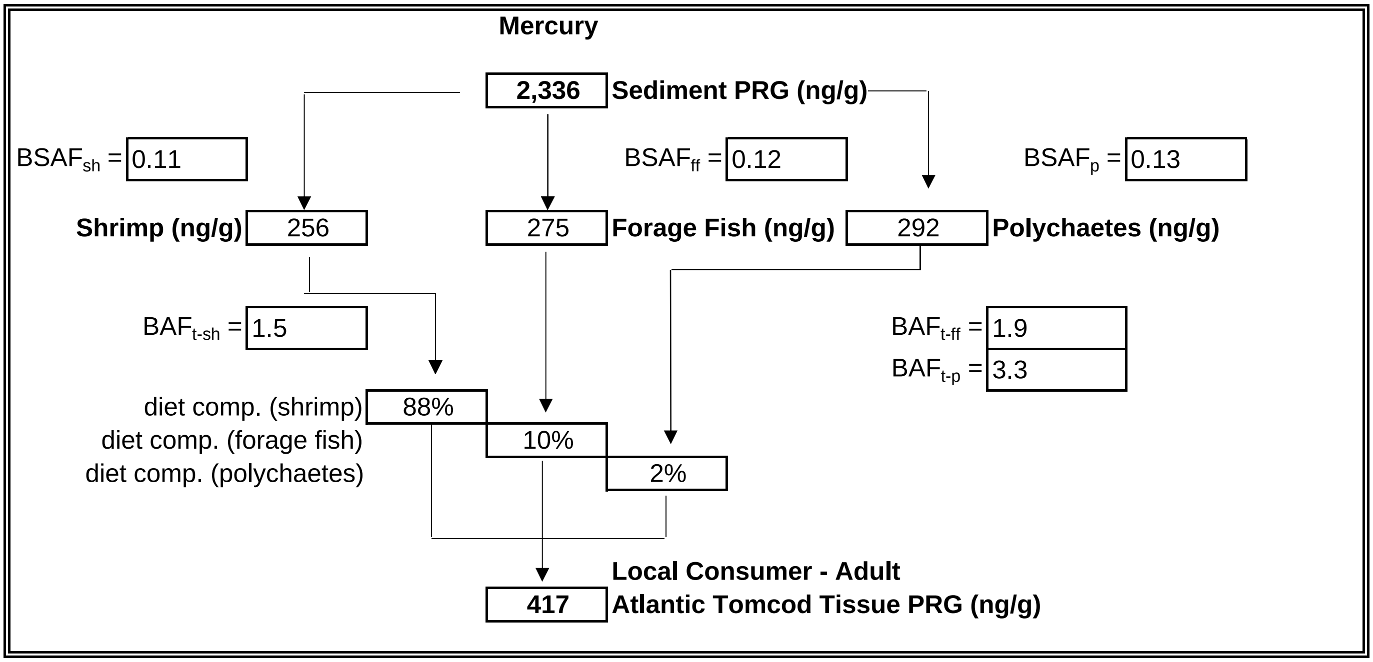
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_{rc}$	Sediment to rock crab BSAF
BSAF$_{l}$	Sediment to lobster BSAF
BSAF$_{ff}$	Sediment to forage fish (smelt) BSAF
BSAF$_{bm}$	Sediment to blue mussel BSAF
BSAF$_{sh}$	Sediment to shrimp BSAF
BSAF$_{p}$	Sediment to polychaete BSAF
BAF$_{l\text{-}rc}$	Rock crab to lobster BAF
BAF$_{l\text{-}ol}$	Lobster to other lobster BAF (1:1 ratio assumed)
BAF$_{l\text{-}ff}$	Forage fish (smelt) to lobster BAF
BAF$_{l\text{-}bm}$	Blue mussel to lobster BAF
BAF$_{l\text{-}sh}$	Shrimp to lobster BAF; no lobster-shrimp pairings and statistical analysis of 2009 smelt and 2009 shrimp data indicated no significant difference for the river
BAF$_{l\text{-}p}$	Polychaete to lobster BAF

TABLE D-6

ATLANTIC TOMCOD FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (ADULT)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



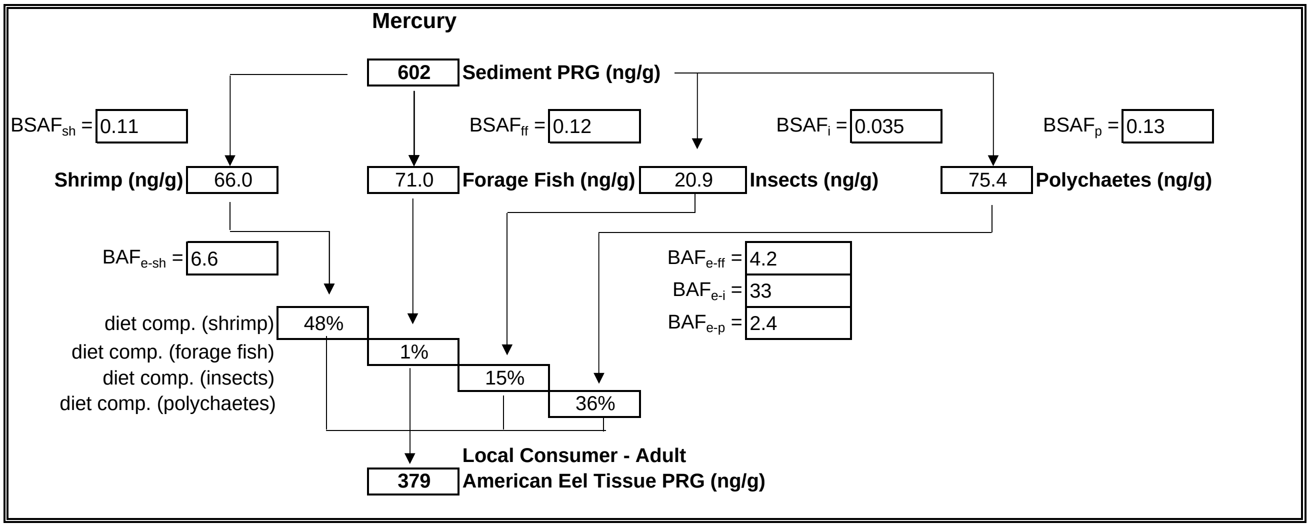
Notes:
Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal
$BSAF_{sh}$ Sediment to shrimp BSAF
$BSAF_{ff}$ Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{p}$ Sediment to polychaete BSAF
$BAF_{t\text{-}sh}$ Shrimp to tomcod BAF
$BAF_{t\text{-}ff}$ Forage fish (smelt + mummichog) to tomcod BAF
$BAF_{t\text{-}p}$ Polychaete to tomcod BAF

TABLE D-7

AMERICAN EEL FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (ADULT)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

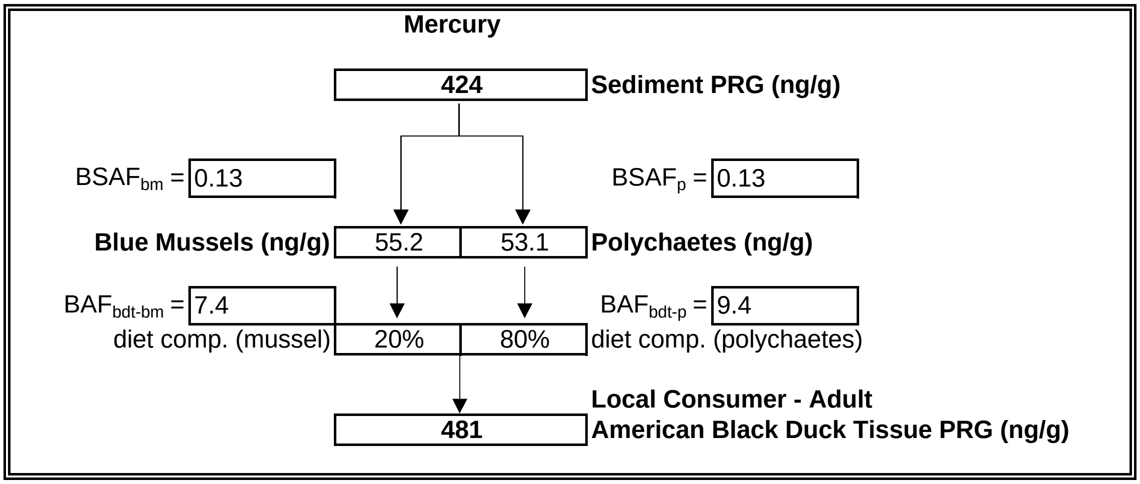
Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_{sh}$	Sediment to shrimp BSAF
BSAF$_{ff}$	Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
BSAF$_{i}$	Sediment to insect BSAF
BSAF$_{p}$	Sediment to polychaete BSAF
BAF$_{e-sh}$	Shrimp to eel BAF
BAF$_{e-ff}$	Forage fish (smelt + mummichog) to eel BAF
BAF$_{e-i}$	Insect to eel BAF
BAF$_{e-p}$	Polychaete to eel BAF

TABLE D-8

BLACK DUCK FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (ADULT)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

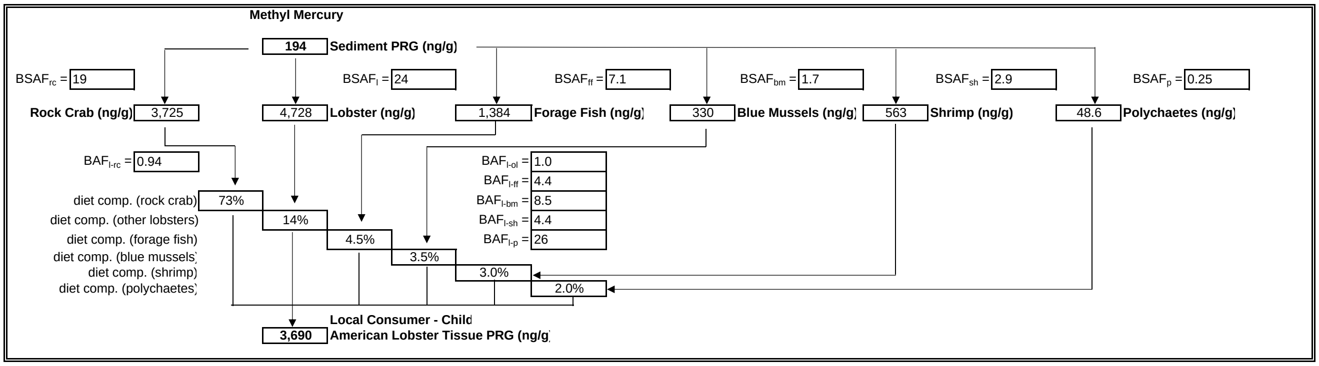
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_p$	Sediment to polychaete BSAF
$BSAF_{bm}$	Sediment to blue mussel BSAF
BAF_{bdt-p}	Polychaete to black duck blood BAF
BAF_{bdt-bm}	Blue mussel to black duck blood BAF

TABLE D-9

LOBSTER FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (CHILD)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight

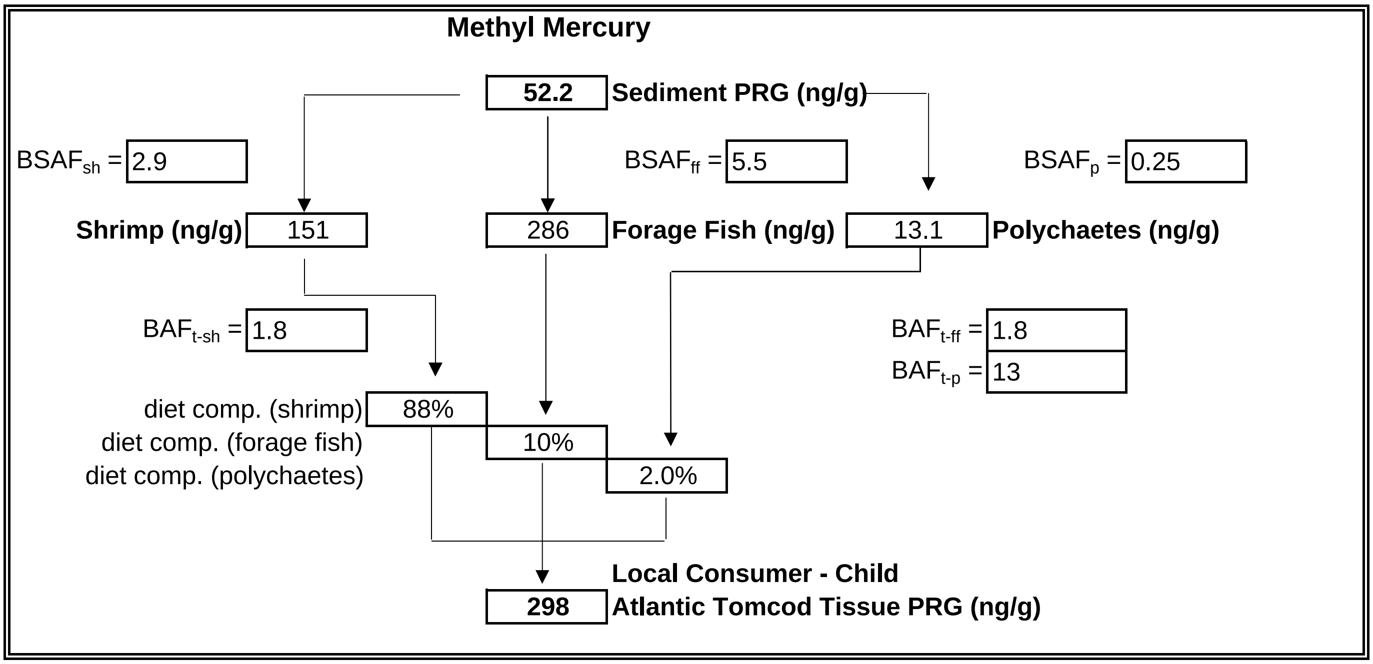
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{rc}$	Sediment to rock crab BSAF
$BSAF_{l}$	Sediment to lobster BSAF
$BSAF_{ff}$	Sediment to forage fish (smelt) BSAF
$BSAF_{bm}$	Sediment to blue mussel BSAF
$BSAF_{sh}$	Sediment to shrimp BSAF
$BSAF_{p}$	Sediment to polychaete BSAF
$BAF_{l\text{-}rc}$	Rock crab to lobster BAF
$BAF_{l\text{-}ol}$	Lobster to other lobster BAF (1:1 ratio assumed)
$BAF_{l\text{-}ff}$	Forage fish (smelt) to lobster BAF
$BAF_{l\text{-}bm}$	Blue mussel to lobster BAF
$BAF_{l\text{-}sh}$	Shrimp to lobster BAF; no lobster-shrimp pairings and statistical analysis of 2009 smelt and 2009 shrimp data indicated no significant difference for the river
$BAF_{l\text{-}p}$	Polychaete to lobster BAF

TABLE D-10

ATLANTIC TOMCOD FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (CHILD)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

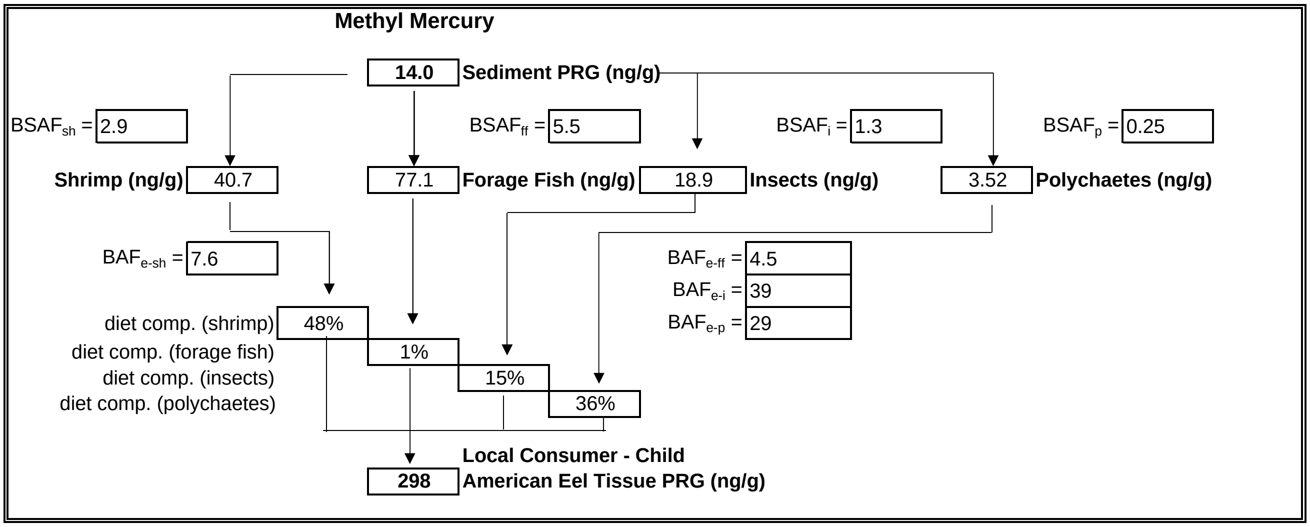
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{sh}$ Sediment to shrimp BSAF
$BSAF_{ff}$ Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{p}$ Sediment to polychaete BSAF
$BAF_{t\text{-}sh}$ Shrimp to tomcod BAF
$BAF_{t\text{-}ff}$ Forage fish (smelt + mummichog) to tomcod BAF
$BAF_{t\text{-}p}$ Polychaete to tomcod BAF

TABLE D-11

AMERICAN EEL FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (CHILD)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

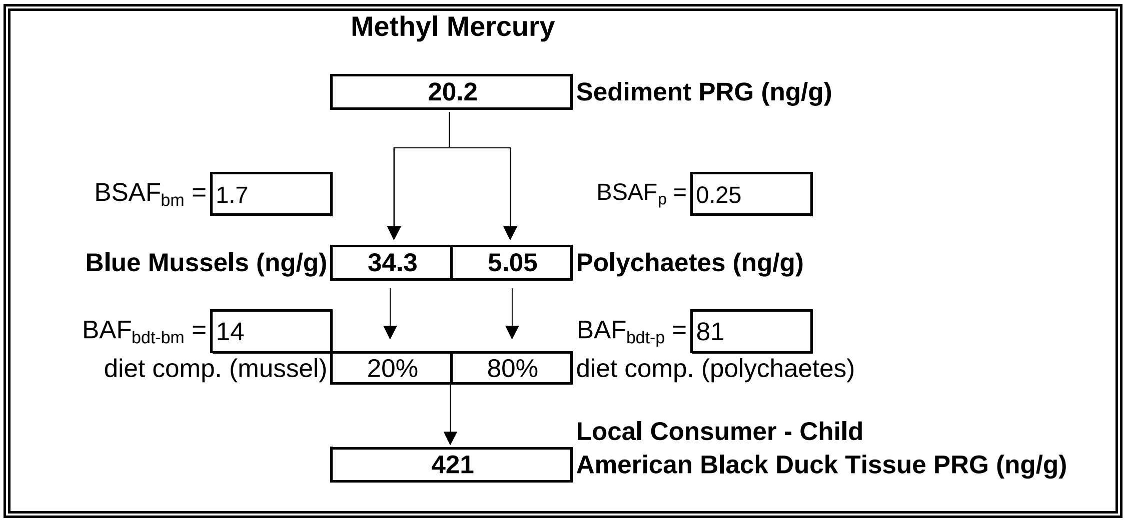
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{sh}$	Sediment to shrimp BSAF
$BSAF_{ff}$	Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{i}$	Sediment to insect BSAF
$BSAF_{p}$	Sediment to polychaete BSAF
$BAF_{e\text{-}sh}$	Shrimp to eel BAF
$BAF_{e\text{-}ff}$	Forage fish (smelt + mummichog) to eel BAF
$BAF_{e\text{-}i}$	Insect to eel BAF
$BAF_{e\text{-}p}$	Polychaete to eel BAF

TABLE D-12

BLACK DUCK FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (CHILD)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



<u>Notes:</u>
Sediment in dry weight; tissue in wet weight.

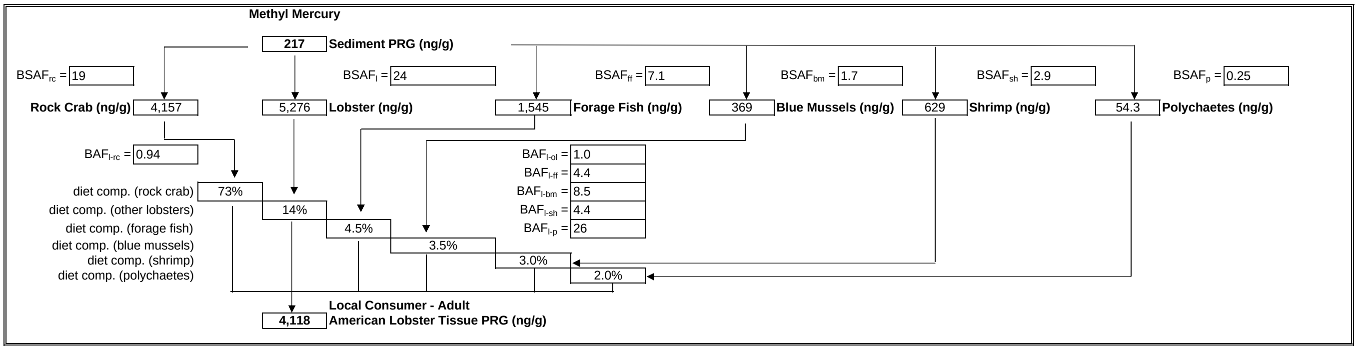
Prepared by: <u>IMR 02/01/18</u>
Checked by: <u>NSR 02/01/18</u>

<u>Abbreviations:</u>
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{p}$	Sediment to polychaete BSAF
$BSAF_{bm}$	Sediment to blue mussel BSAF
$BAF_{bdt\text{-}p}$	Polychaete to black duck blood BAF
$BAF_{bdt\text{-}bm}$	Blue mussel to black duck blood BAF

TABLE D-13

LOBSTER FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (ADULT)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

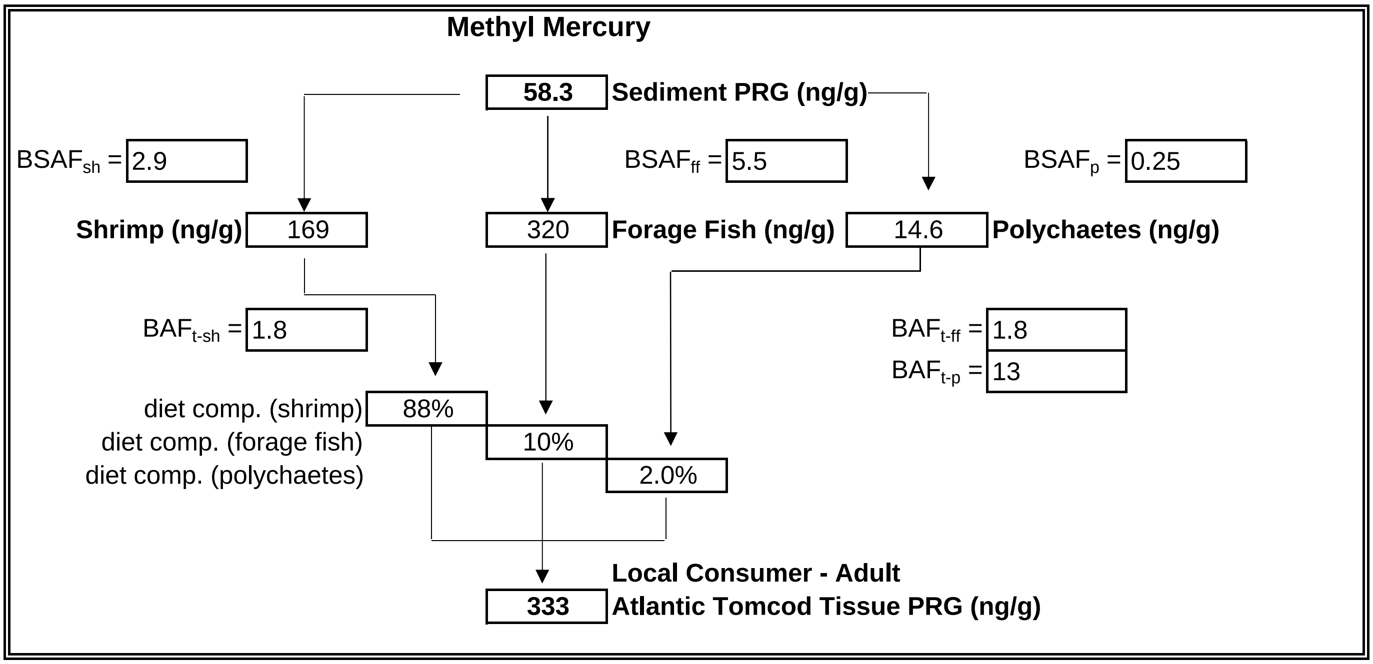
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_{rc}$	Sediment to rock crab BSAF
BSAF$_{l}$	Sediment to lobster BSAF
BSAF$_{ff}$	Sediment to forage fish (smelt) BSAF
BSAF$_{bm}$	Sediment to blue mussel BSAF
BSAF$_{sh}$	Sediment to shrimp BSAF
BSAF$_{p}$	Sediment to polychaete BSAF
BAF$_{l\text{-}rc}$	Rock crab to lobster BAF
BAF$_{l\text{-}ol}$	Lobster to other lobster BAF (1:1 ratio assumed)
BAF$_{l\text{-}ff}$	Forage fish (smelt) to lobster BAF
BAF$_{l\text{-}bm}$	Blue mussel to lobster BAF
BAF$_{l\text{-}sh}$	Shrimp to lobster BAF; no lobster-shrimp pairings and statistical analysis of 2009 smelt and 2009 shrimp data indicated no significant difference for the river
BAF$_{l\text{-}p}$	Polychaete to lobster BAF

TABLE D-14

ATLANTIC TOMCOD FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (ADULT)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



<u>Notes:</u>
Sediment in dry weight; tissue in wet weight.

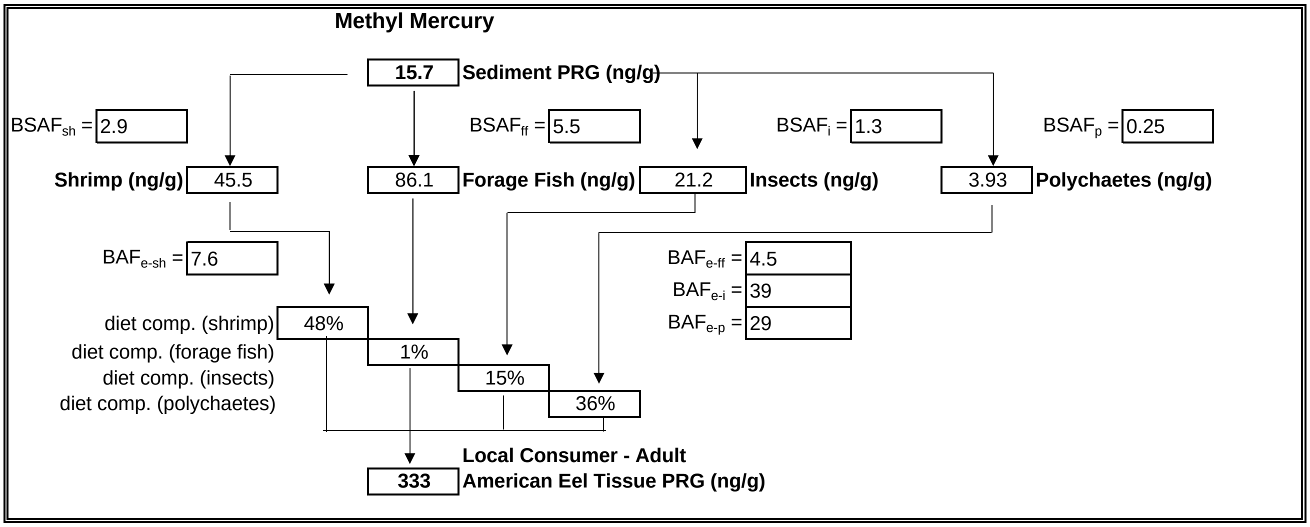
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

<u>Abbreviations:</u>
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_{sh}$	Sediment to shrimp BSAF
BSAF$_{ff}$	Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
BSAF$_{p}$	Sediment to polychaete BSAF
BAF$_{t\text{-}sh}$	Shrimp to tomcod BAF
BAF$_{t\text{-}ff}$	Forage fish (smelt + mummichog) to tomcod BAF
BAF$_{t\text{-}p}$	Polychaete to tomcod BAF

TABLE D-15

AMERICAN EEL FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (ADULT)
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

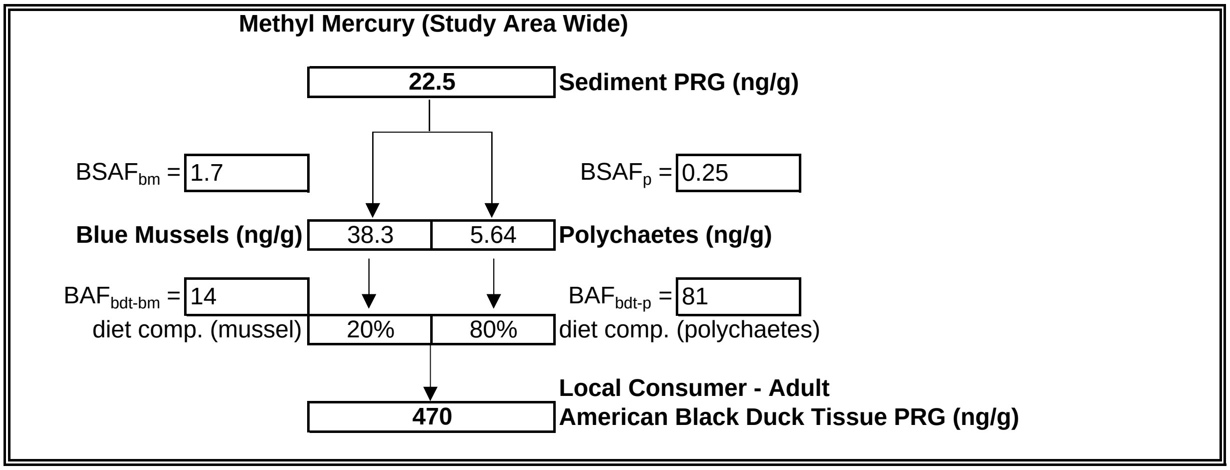
Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{sh}$	Sediment to shrimp BSAF
$BSAF_{ff}$	Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{i}$	Sediment to insect BSAF
$BSAF_{p}$	Sediment to polychaete BSAF
$BAF_{e\text{-}sh}$	Shrimp to eel BAF
$BAF_{e\text{-}ff}$	Forage fish (smelt + mummichog) to eel BAF
$BAF_{e\text{-}i}$	Insect to eel BAF
$BAF_{e\text{-}p}$	Polychaete to eel BAF

TABLE D-16

BLACK DUCK FOOD WEB RISK-BASED SEDIMENT PRG - LOCAL CONSUMER (ADULT)

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

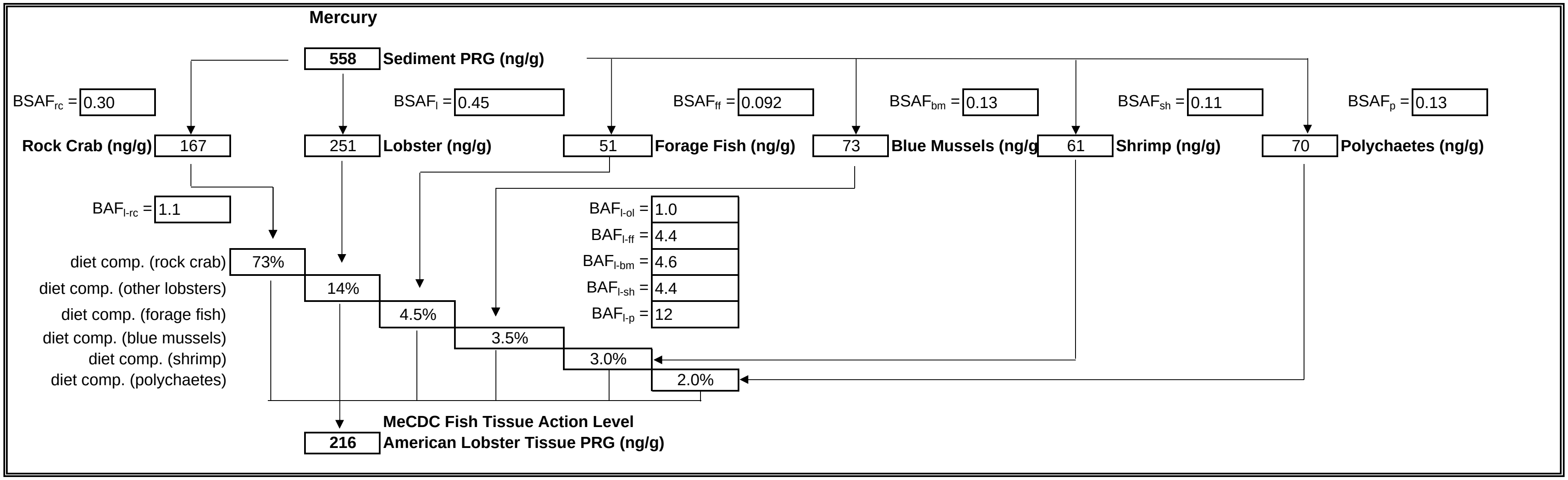
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_{p}$	Sediment to polychaete BSAF
BSAF$_{bm}$	Sediment to blue mussel BSAF
BAF$_{bdt\text{-}p}$	Polychaete to black duck blood BAF
BAF$_{bdt\text{-}bm}$	Blue mussel to black duck blood BAF

TABLE D-17

AMERICAN LOBSTER FOOD WEB TISSUE-BASED SEDIMENT PRG - MECDC FISH TISSUE ACTION LEVEL
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 01/31/18
Checked by: NSR 02/01/18

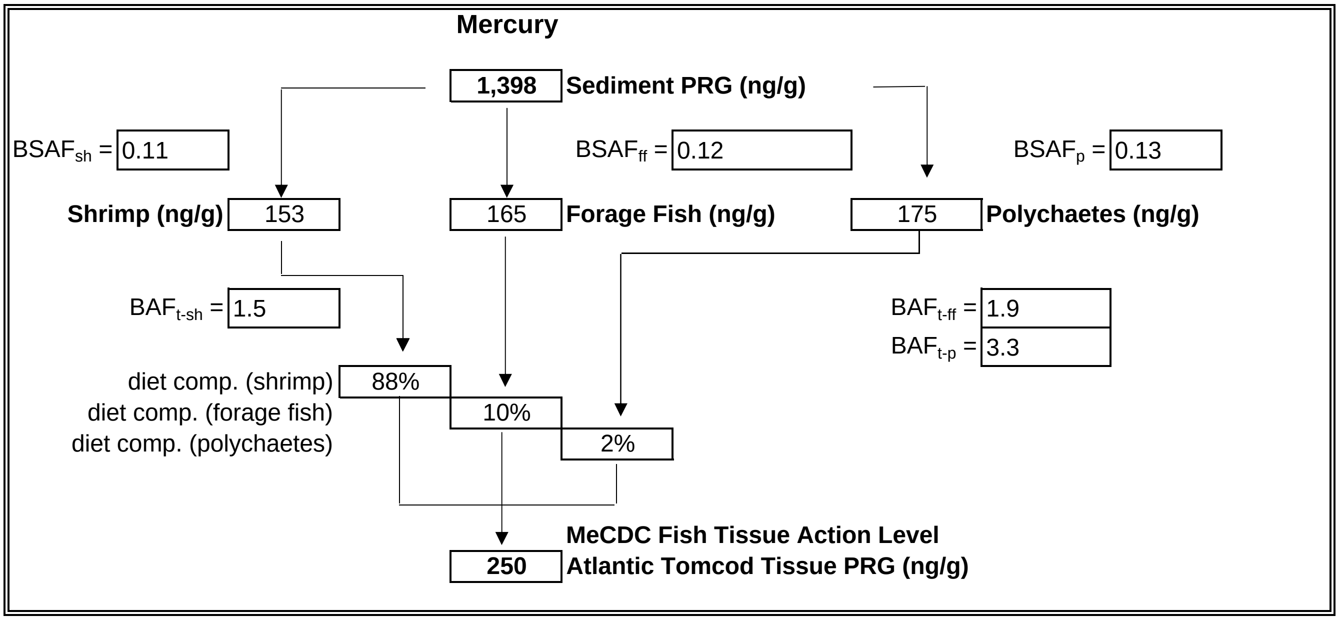
Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{rc}$	Sediment to rock crab BSAF
$BSAF_{l}$	Sediment to lobster BSAF
$BSAF_{ff}$	Sediment to forage fish (smelt) BSAF
$BSAF_{bm}$	Sediment to blue mussel BSAF
$BSAF_{sh}$	Sediment to shrimp BSAF
$BSAF_{p}$	Sediment to polychaete BSAF
BAF_{l-rc}	Rock crab to lobster BAF
BAF_{l-ol}	Lobster to other lobster BAF (1:1 ratio assumed)
BAF_{l-ff}	Forage fish (smelt) to lobster BAF
BAF_{l-bm}	Blue mussel to lobster BAF
BAF_{l-sh}	Shrimp to lobster BAF; no lobster-shrimp pairings and statistical analysis of 2009 smelt and 2009 shrimp data indicated no significant difference for the river
BAF_{l-p}	Polychaete to lobster BAF

TABLE D-18

ATLANTIC TOMCOD FOOD WEB TISSUE-BASED SEDIMENT PRG - MECDC FISH TISSUE ACTION LEVEL

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



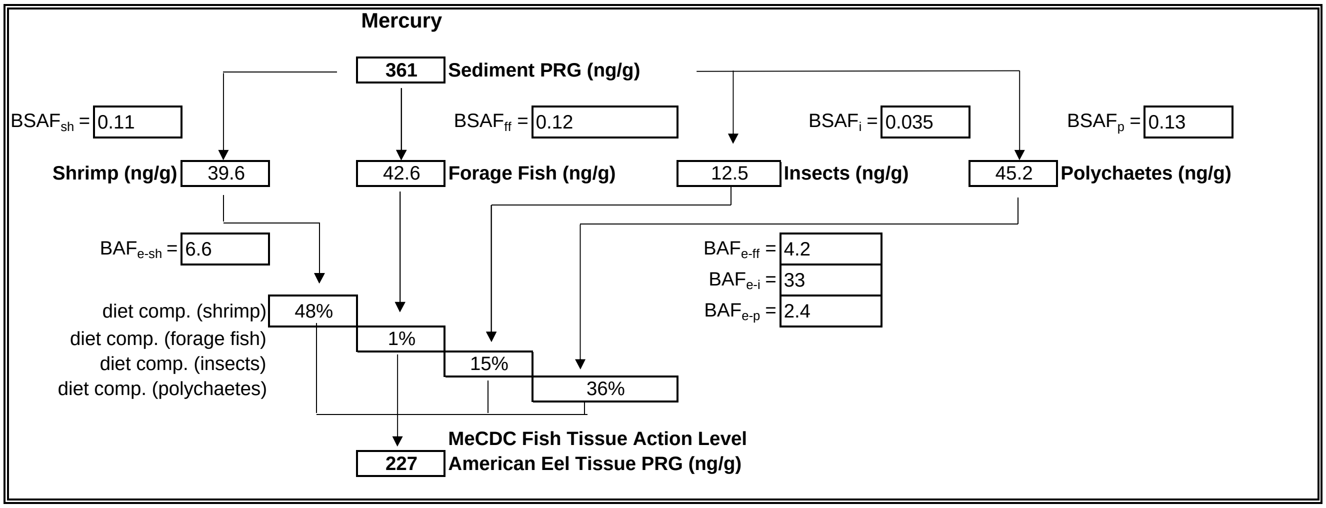
Notes:
Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 01/31/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal
BSAF$_{sh}$ Sediment to shrimp BSAF
BSAF$_{ff}$ Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
BSAF$_{p}$ Sediment to polychaete BSAF
BAF$_{t-sh}$ Shrimp to tomcod BAF
BAF$_{t-ff}$ Forage fish (smelt + mummichog) to tomcod BAF
BAF$_{t-p}$ Polychaete to tomcod BAF

TABLE D-19

AMERICAN EEL FOOD WEB TISSUE-BASED SEDIMENT PRG - MECDC FISH TISSUE ACTION LEVEL
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 01/31/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal
$BSAF_{sh}$ Sediment to shrimp BSAF
$BSAF_{ff}$ Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{i}$ Sediment to insect BSAF
$BSAF_{p}$ Sediment to polychaete BSAF
$BAF_{e\text{-}sh}$ Shrimp to eel BAF
$BAF_{e\text{-}ff}$ Forage fish (smelt + mummichog) to eel BAF
$BAF_{e\text{-}i}$ Insect to eel BAF
$BAF_{e\text{-}p}$ Polychaete to eel BAF

TABLE D-20

BLACK DUCK FOOD WEB TISSUE-BASED SEDIMENT PRG - MECDC FISH TISSUE ACTION LEVEL

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Mercury

181 **Sediment PRG (ng/g)**

$BSAF_{bm}$ = 0.13 | $BSAF_{p}$ = 0.13

	Blue Mussels	Polychaetes	
Blue Mussels (ng/g)	23.5	22.6	**Polychaetes (ng/g)**
BAF_{bdt-bm} = 7.4			BAF_{bdt-p} = 9.4
diet comp. (mussel)	20%	80%	diet comp. (polychaetes)

205 **MeCDC Fish Tissue Action Level American Black Duck Tissue PRG (ng/g)**

Notes:
Sediment in dry weight; tissue in wet weight.

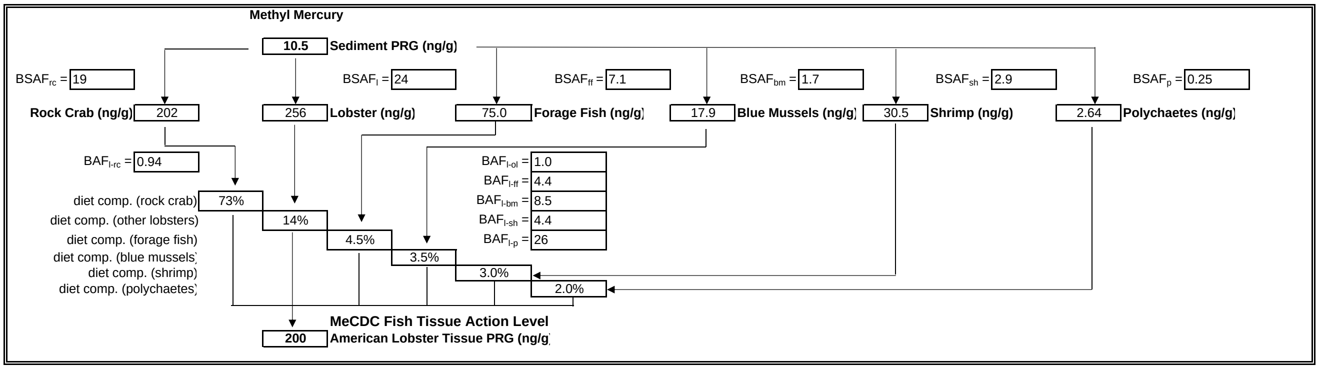
Prepared by: IMR 01/31/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{p}$	Sediment to polychaete BSAF
$BSAF_{bm}$	Sediment to blue mussel BSAF
BAF_{bdt-p}	Polychaete to black duck blood BAF
BAF_{bdt-bm}	Blue mussel to black duck blood BAF

TABLE D-21

AMERICAN LOBSTER FOOD WEB TISSUE-BASED SEDIMENT PRG - MECDC FISH TISSUE ACTION LEVEL
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight

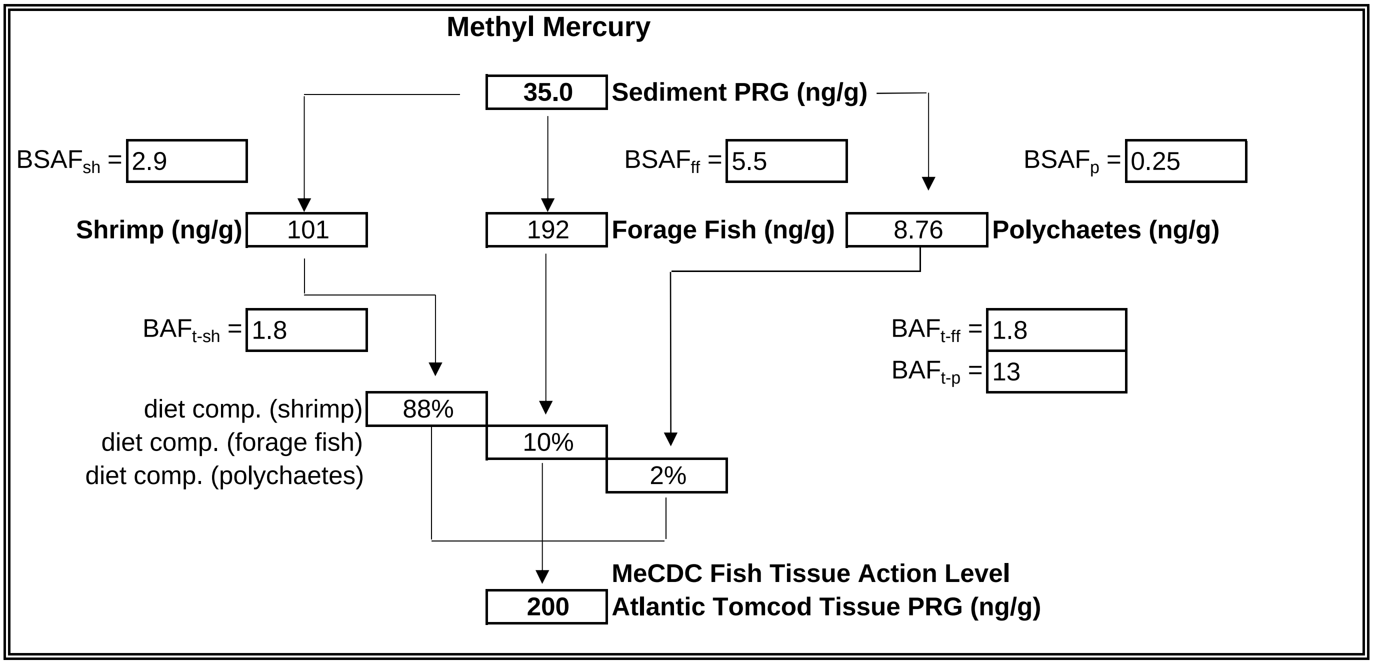
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_{rc}$	Sediment to rock crab BSAF
BSAF$_{l}$	Sediment to lobster BSAF
BSAF$_{ff}$	Sediment to forage fish (smelt) BSAF
BSAF$_{bm}$	Sediment to blue mussel BSAF
BSAF$_{sh}$	Sediment to shrimp BSAF
BSAF$_{p}$	Sediment to polychaete BSAF
BAF$_{l-rc}$	Rock crab to lobster BAF
BAF$_{l-ol}$	Lobster to other lobster BAF (1:1 ratio assumed)
BAF$_{l-ff}$	Forage fish (smelt) to lobster BAF
BAF$_{l-bm}$	Blue mussel to lobster BAF
BAF$_{l-sh}$	Shrimp to lobster BAF; no lobster-shrimp pairings and statistical analysis of 2009 smelt and 2009 shrimp data indicated no significant difference for the river
BAF$_{l-p}$	Polychaete to lobster BAF

TABLE D-22

ATLANTIC TOMCOD FOOD WEB TISSUE-BASED SEDIMENT PRG - MECDC FISH TISSUE ACTION LEVEL
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



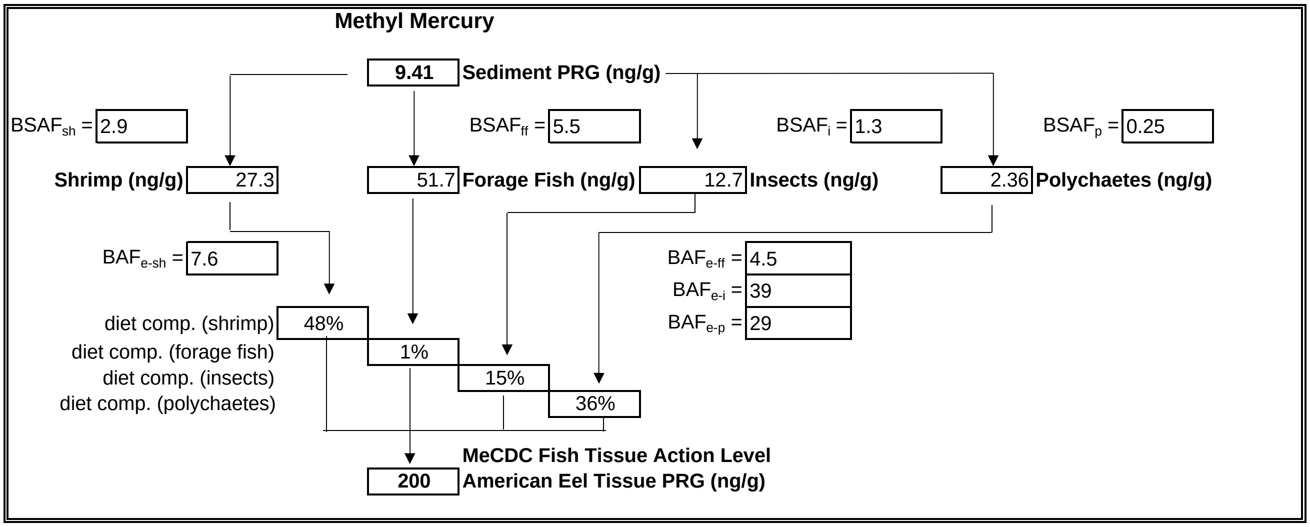
Notes:
Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal
$BSAF_{sh}$ Sediment to shrimp BSAF
$BSAF_{ff}$ Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{p}$ Sediment to polychaete BSAF
$BAF_{t\text{-}sh}$ Shrimp to tomcod BAF
$BAF_{t\text{-}ff}$ Forage fish (smelt + mummichog) to tomcod BAF
$BAF_{t\text{-}p}$ Polychaete to tomcod BAF

TABLE D-23

AMERICAN EEL FOOD WEB TISSUE-BASED SEDIMENT PRG - MECDC FISH TISSUE ACTION LEVEL
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



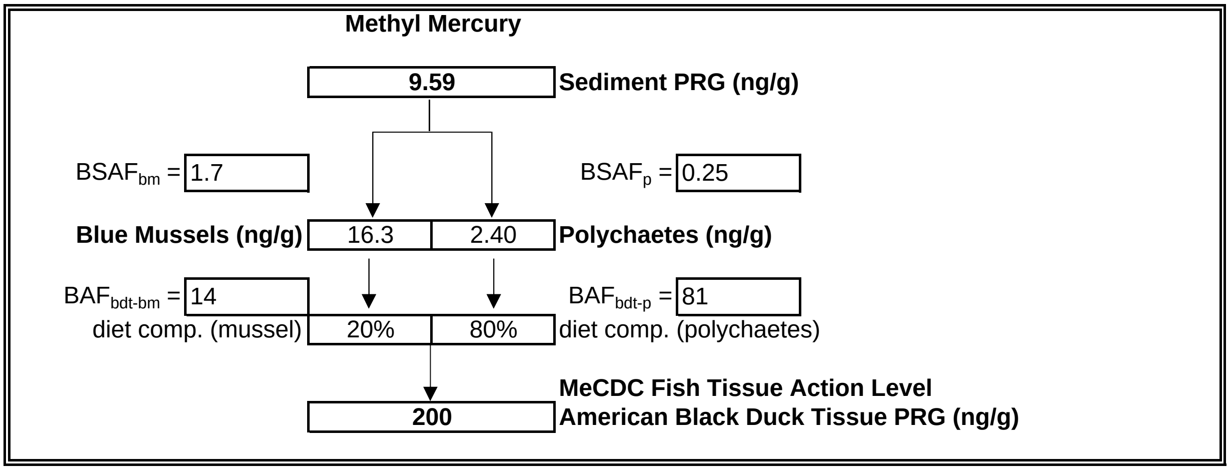
Notes:
Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal
$BSAF_{sh}$ Sediment to shrimp BSAF
$BSAF_{ff}$ Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{i}$ Sediment to insect BSAF
$BSAF_{p}$ Sediment to polychaete BSAF
$BAF_{e\text{-}sh}$ Shrimp to eel BAF
$BAF_{e\text{-}ff}$ Forage fish (smelt + mummichog) to eel BAF
$BAF_{e\text{-}i}$ Insect to eel BAF
$BAF_{e\text{-}p}$ Polychaete to eel BAF

TABLE D-24

BLACK DUCK FOOD WEB TISSUE-BASED SEDIMENT PRG - MECDC FISH TISSUE ACTION LEVEL
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_p$	Sediment to polychaete BSAF
$BSAF_{bm}$	Sediment to blue mussel BSAF
BAF_{bdt-p}	Polychaete to black duck blood BAF
BAF_{bdt-bm}	Blue mussel to black duck blood BAF

TABLE D-25

HUMAN HEALTH BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR LOBSTER
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Lobster $BSAF_L$	Lobster EPC[2] (EPC_{SM}), ng/g wet wt.	Lobster Tisue PRG (ng/g)	Hazard Quotient[4] (unitless)	Lobster PRG[5] (ng/kg dry wt.)
Local Consumer - Child						
Mercury	8,867	0.45	3,990	3,990	1.00	8,867
Methyl Mercury	152	24	3,690	3,690	1.00	152
Local Consumer - Adult						
Mercury	9,911	0.45	4,460	4,460	1.00	9,911
Methyl Mercury	169	24	4,120	4,120	1.00	169
MeCDC Fish Tissue Action Level						
Mercury	481	0.45	216	216	1.00	481
Methyl Mercury	8.22	24	200	200	1.00	8.22

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Smelt:

$$\text{PRG (Sediment) (ng/g)} = \frac{\text{PRG (Tissue)}}{\text{BSAF}}$$

Prepared By: IMR 01/31/18
Checked by: NSR 02/01/18

TABLE D-26

HUMAN HEALTH BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR ATLANTIC TOMCOD
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Tomcod $BSAF_T$	Tomcod EPC[2] (EPC_T), ng/g wet wt.	Tomcod Tisue PRG (ng/g)	Hazard Quotient[4] (unitless)	Tomcod Sediment PRG[5] (ng/kg dry wt.)
Local Consumer - Child						
Mercury	1,660	0.22	373	373	1.00	1,660
Methyl Mercury	16.8	18	298	298	1.00	16.8
Local Consumer - Adult						
Mercury	1,855	0.22	417	417	1.00	1,855
Methyl Mercury	18.8	18	333	333	1.00	18.8
MeCDC Fish Tissue Action Level						
Mercury	1,113	0.22	250	250	1.00	1,113
Methyl Mercury	11.3	18	200	200	1.00	11.3

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Tomcod:

$$\text{PRG (Sediment) (ng/g)} = \frac{\text{PRG (Tissue)}}{\text{BSAF}}$$

Prepared By: IMR 01/31/18
Checked by: NSR 02/01/18

TABLE D-27

HUMAN HEALTH BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR AMERICAN EEL
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Eel $BSAF_E$	Eel EPC[2] (EPC_E), ng/g wet wt.	Eel Tisue PRG (ng/g)	Hazard Quotient[4] (unitless)	Eel Sediment PRG[5] (ng/kg dry wt.)
Local Consumer - Child						
Mercury	694	0.49	339	339	1.00	694
Methyl Mercury	4.81	62	298	298	1.00	4.81
Local Consumer - Adult						
Mercury	776	0.49	379	379	1.00	776
Methyl Mercury	5.38	62	333	333	1.00	5.38
MeCDC Fish Tissue Action Level						
Mercury	465	0.49	227	227	1.00	465
Methyl Mercury	3.23	62	200	200	1.00	3.23

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Eel:

$$\text{PRG (Sediment) (ng/g)} = \frac{\text{PRG (Tissue)}}{\text{BSAF}}$$

Prepared By: IMR 01/31/18
Checked by: NSR 02/01/18

TABLE D-28

HUMAN HEALTH BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR AMERICAN BLACK DUCK
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Black Duck $BSAF_D$	Black Duck EPC[2] (EPC_D), ng/g wet wt.	Black Duck Tisue PRG (ng/g)	Hazard Quotient[4] (unitless)	Black Duck Sediment PRG[5] (ng/kg dry wt.)
Local Consumer - Child						
Mercury	936	0.46	430	430	1.00	936
Methyl Mercury	13.6	31	421	421	1.00	13.6
Local Consumer - Adult						
Mercury	1,045	0.46	481	481	1.00	1,045
Methyl Mercury	15.2	31	470	470	1.00	15.2
MeCDC Fish Tissue Action Level						
Mercury	445	0.46	205	205	1.00	445
Methyl Mercury	6.45	31	200	200	1.00	6.45

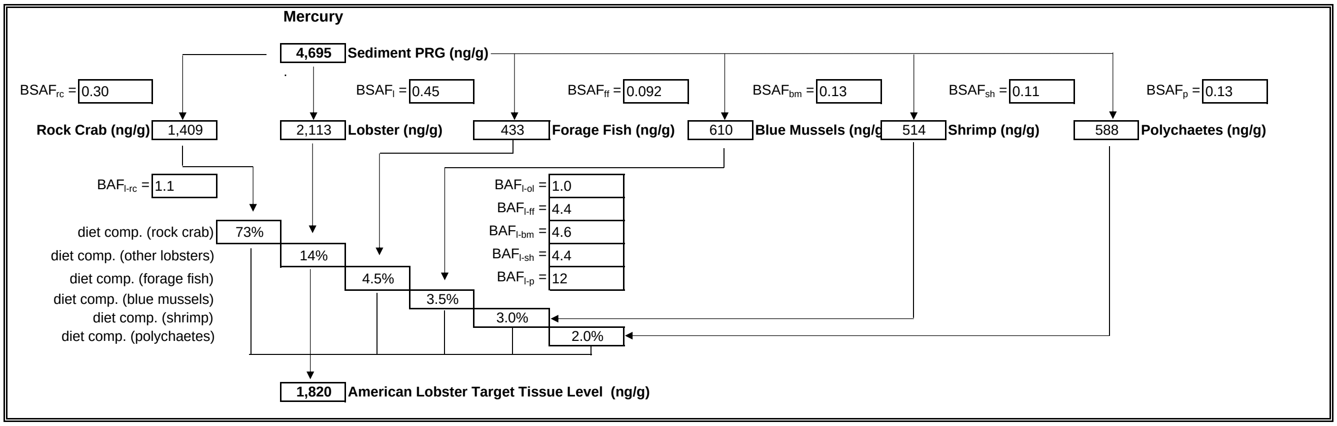
Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Black Duck:

$$\text{PRG (Sediment) (ng/g)} = \frac{\text{PRG (Tissue)}}{\text{BSAF}}$$

Prepared By: IMR 01/31/18
Checked by: NSR 02/01/18

TABLE D-29

LOBSTER FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

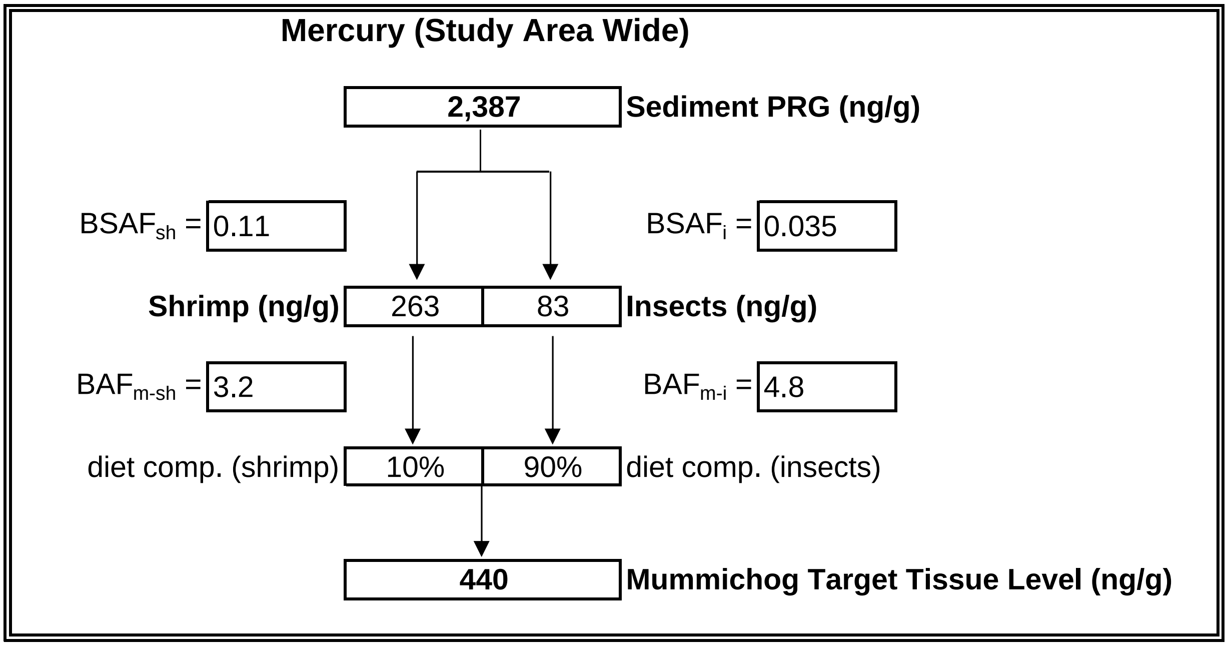
Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{rc}$	Sediment to rock crab BSAF
$BSAF_{l}$	Sediment to lobster BSAF
$BSAF_{ff}$	Sediment to forage fish (smelt) BSAF
$BSAF_{bm}$	Sediment to blue mussel BSAF
$BSAF_{sh}$	Sediment to shrimp BSAF
$BSAF_{p}$	Sediment to polychaete BSAF
$BAF_{l\text{-}rc}$	Rock crab to lobster BAF
$BAF_{l\text{-}ol}$	Lobster to other lobster BAF (1:1 ratio assumed)
$BAF_{l\text{-}ff}$	Forage fish (smelt) to lobster BAF
$BAF_{l\text{-}bm}$	Blue mussel to lobster BAF
$BAF_{l\text{-}sh}$	Shrimp to lobster BAF; no lobster-shrimp pairings and statistical analysis of 2009 smelt and 2009 shrimp data indicated no significant difference for the river
$BAF_{l\text{-}p}$	Polychaete to lobster BAF

TABLE D-30

MUMMICHOG FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

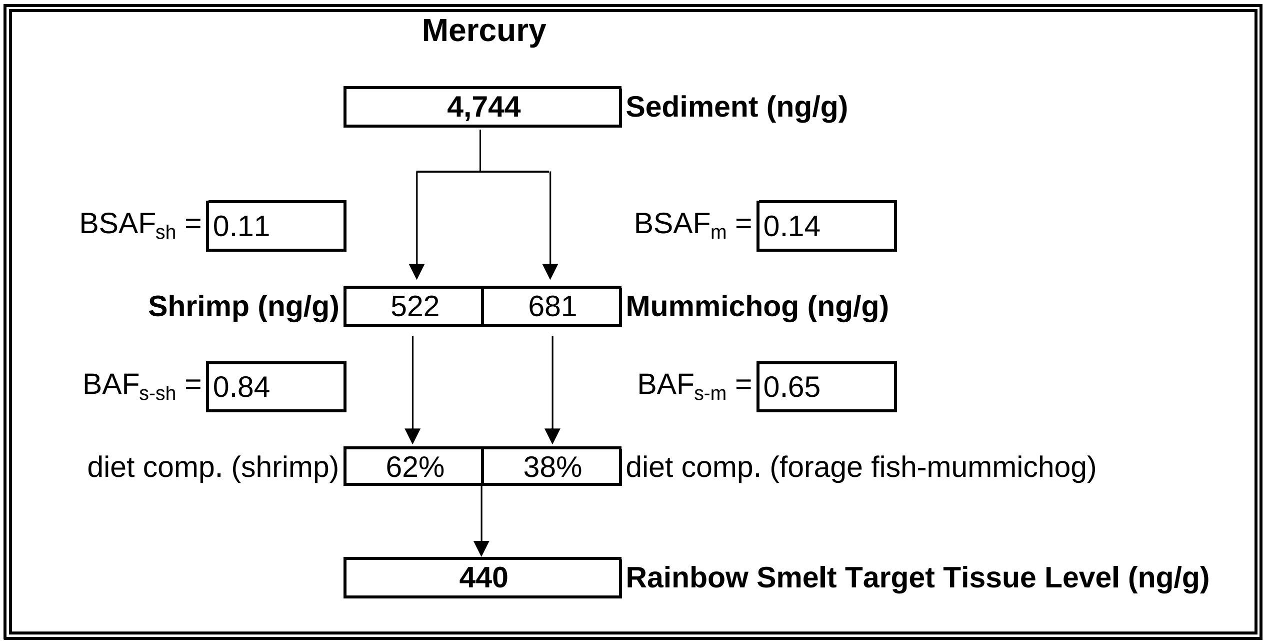
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_{sh}$	Sediment to shrimp BSAF
BSAF$_{i}$	Sediment to insect BSAF
BAF$_{m-sh}$	Shrimp to mummichog BAF
BAF$_{m-i}$	Insect to mummichog BAF

TABLE D-31

RAINBOW SMELT FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

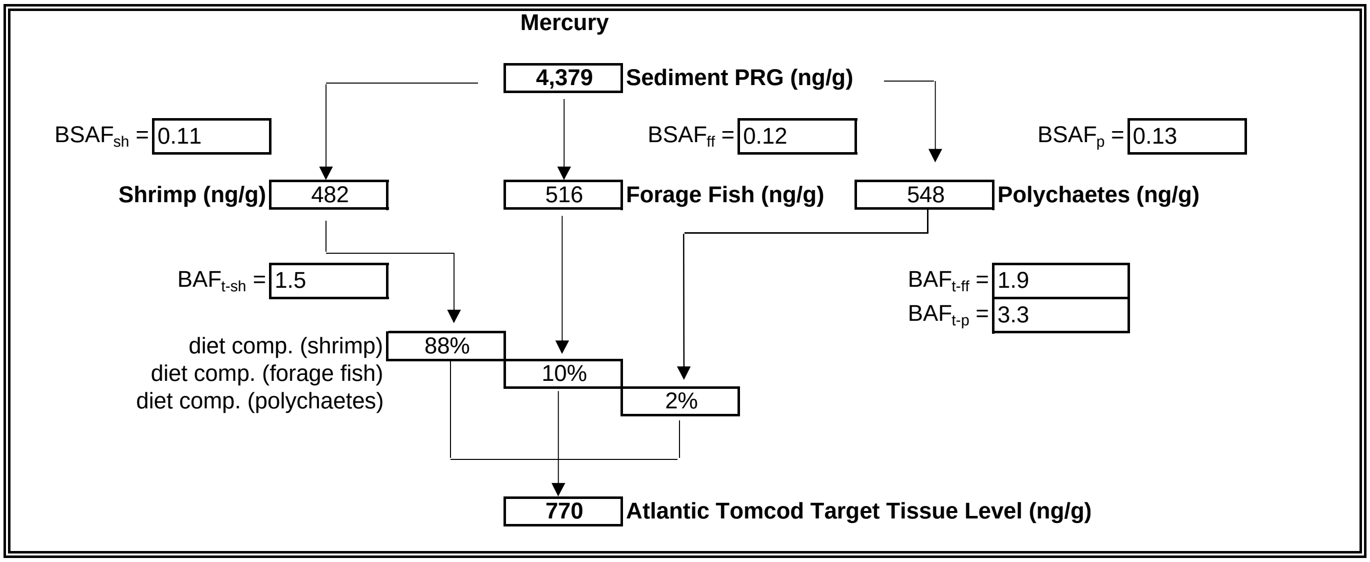
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{sh}$	Sediment to shrimp BSAF
$BSAF_{m}$	Sediment to mummichog BSAF
BAF_{s-sh}	Shrimp to smelt BAF
BAF_{s-m}	Mummichog to smelt BAF

TABLE D-32

ATLANTIC TOMCOD FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



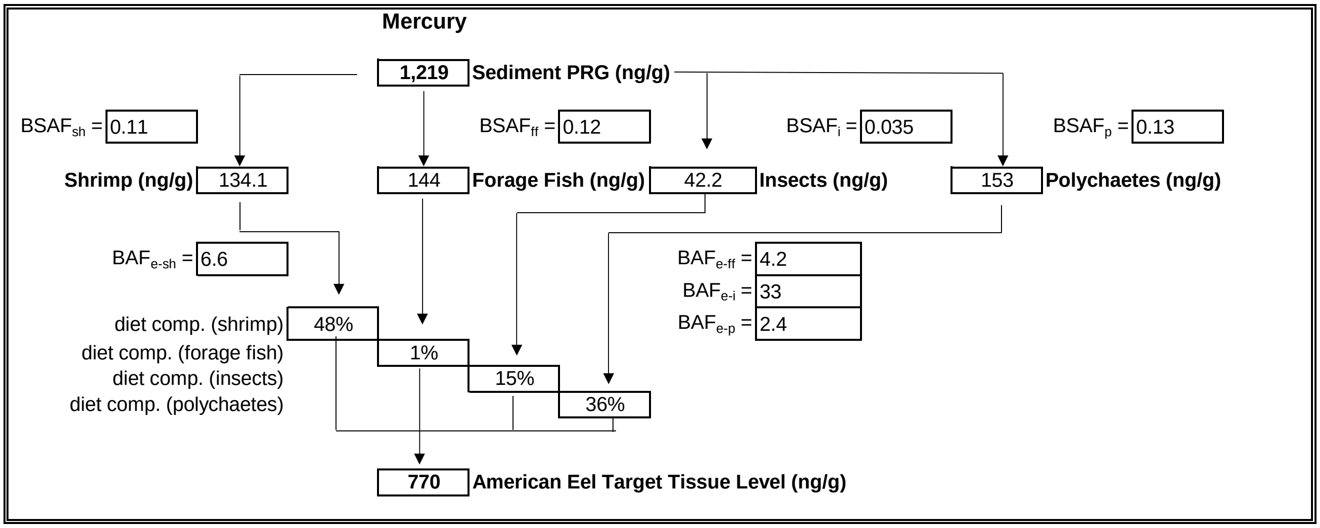
Notes:
Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal
$BSAF_{sh}$ Sediment to shrimp BSAF
$BSAF_{ff}$ Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{p}$ Sediment to polychaete BSAF
$BAF_{t\text{-}sh}$ Shrimp to tomcod BAF
$BAF_{t\text{-}ff}$ Forage fish (smelt + mummichog) to tomcod BAF
$BAF_{t\text{-}p}$ Polychaete to tomcod BAF

TABLE D-33

AMERICAN EEL FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

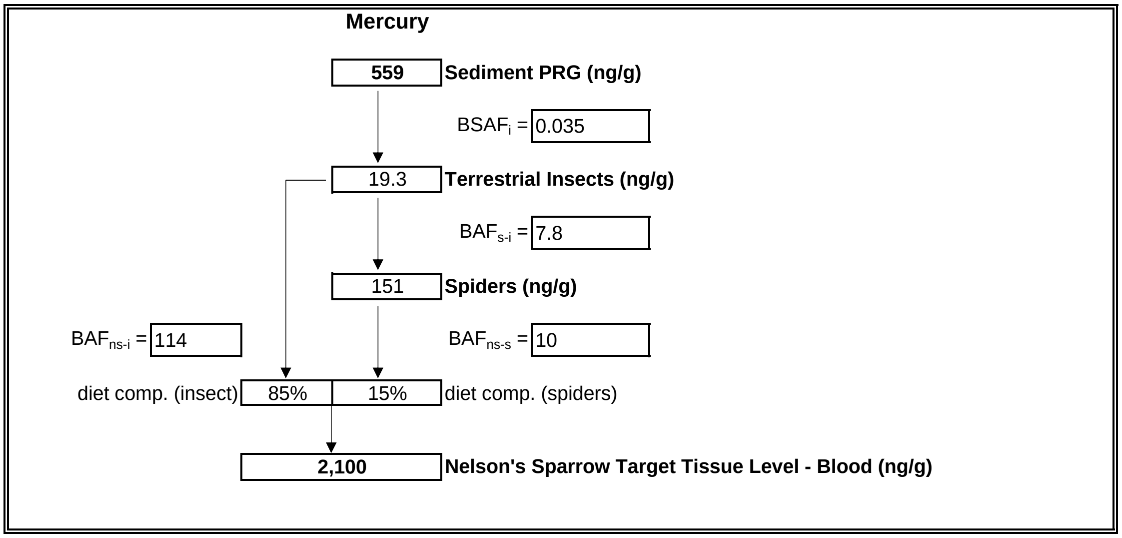
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{sh}$	Sediment to shrimp BSAF
$BSAF_{ff}$	Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{i}$	Sediment to insect BSAF
$BSAF_{p}$	Sediment to polychaete BSAF
BAF_{e-sh}	Shrimp to eel BAF
BAF_{e-ff}	Forage fish (smelt + mummichog) to eel BAF
BAF_{e-i}	Insect to eel BAF
BAF_{e-p}	Polychaete to eel BAF

TABLE D-34

NELSON'S SPARROW FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

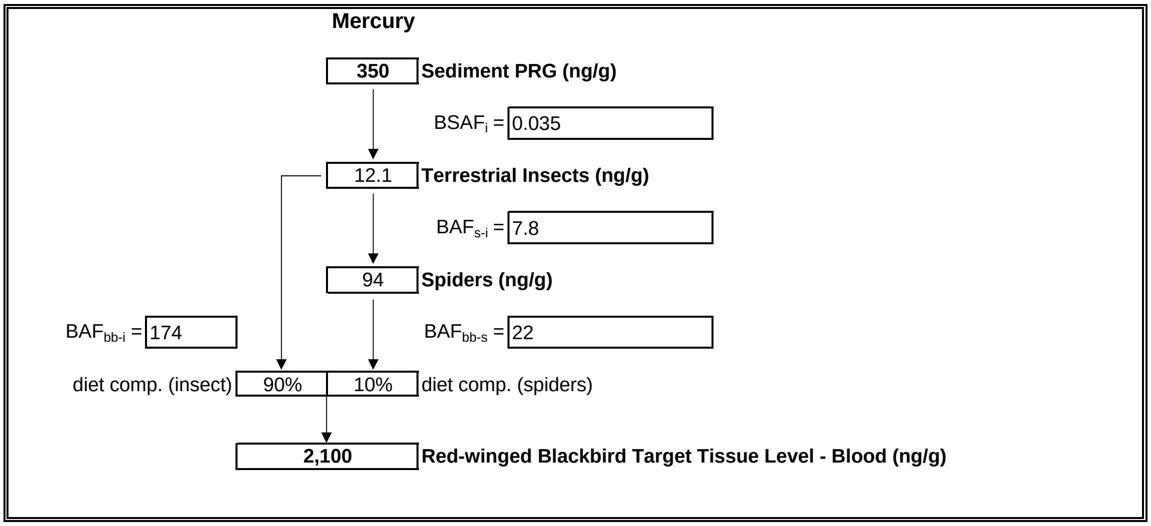
Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_i$	Sediment to insect BSAF
BAF_{s-i}	Spider to insect BAF
BAF_{ns-s}	Spider to Nelson's sparrow BAF
BAF_{ns-i}	Insect to Nelson's sparrow BAF

TABLE D-35

RED-WINGED BLACKBIRD FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

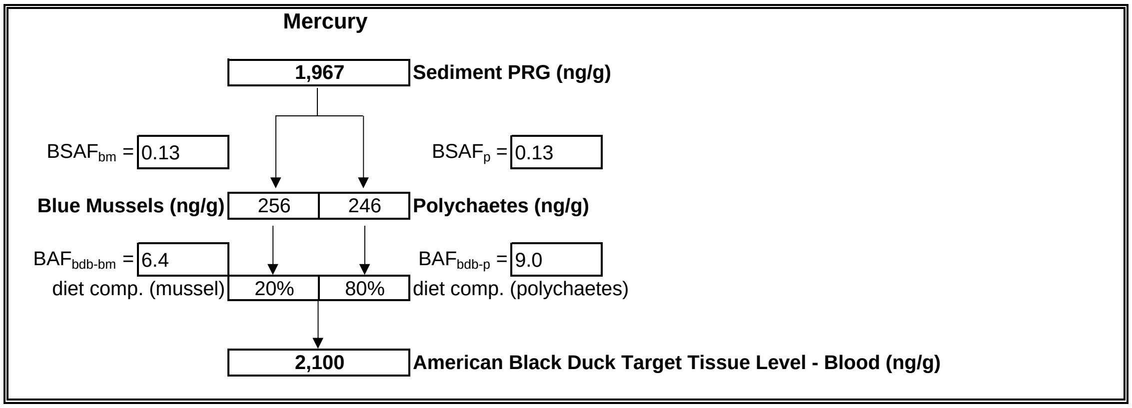
Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_i$	Sediment to insect BSAF
BAF$_{s-i}$	Insect to spider BAF
BAF$_{bb-s}$	Spider to red-winged blackbird BAF
BAF$_{bb-i}$	Insect to red-winged blackbird BAF

TABLE D-36

BLACK DUCK FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

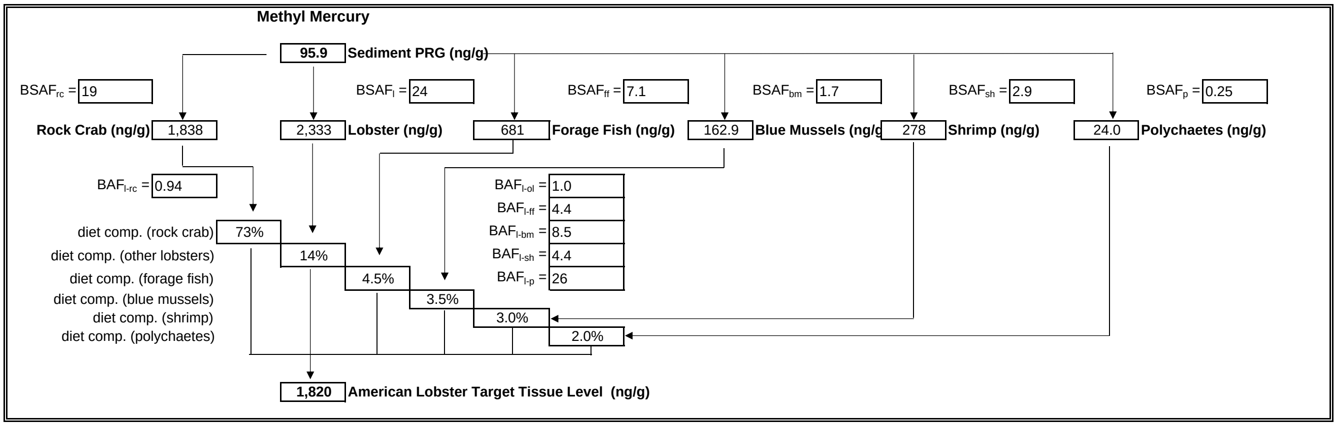
Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{p}$	Sediment to polychaete BSAF
$BSAF_{bm}$	Sediment to blue mussel BSAF
BAF_{bdt-p}	Polychaete to black duck blood BAF
BAF_{bdt-bm}	Blue mussel to black duck blood BAF

TABLE D-37

LOBSTER FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

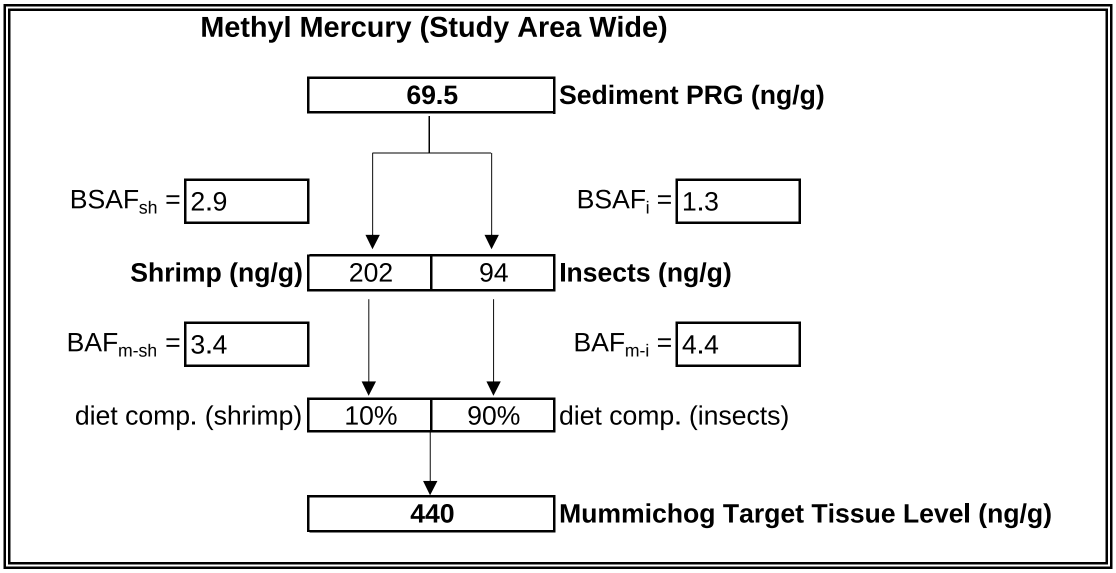
Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_{rc}$	Sediment to rock crab BSAF
BSAF$_{l}$	Sediment to lobster BSAF
BSAF$_{ff}$	Sediment to forage fish (smelt) BSAF
BSAF$_{bm}$	Sediment to blue mussel BSAF
BSAF$_{sh}$	Sediment to shrimp BSAF
BSAF$_{p}$	Sediment to polychaete BSAF
BAF$_{l\text{-}rc}$	Rock crab to lobster BAF
BAF$_{l\text{-}ol}$	Lobster to other lobster BAF (1:1 ratio assumed)
BAF$_{l\text{-}ff}$	Forage fish (smelt) to lobster BAF
BAF$_{l\text{-}bm}$	Blue mussel to lobster BAF
BAF$_{l\text{-}sh}$	Shrimp to lobster BAF; no lobster-shrimp pairings and statistical analysis of 2009 smelt and 2009 shrimp data indicated no significant difference for the river
BAF$_{l\text{-}p}$	Polychaete to lobster BAF

TABLE D-38

MUMMICHOG FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:

Notes:

Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

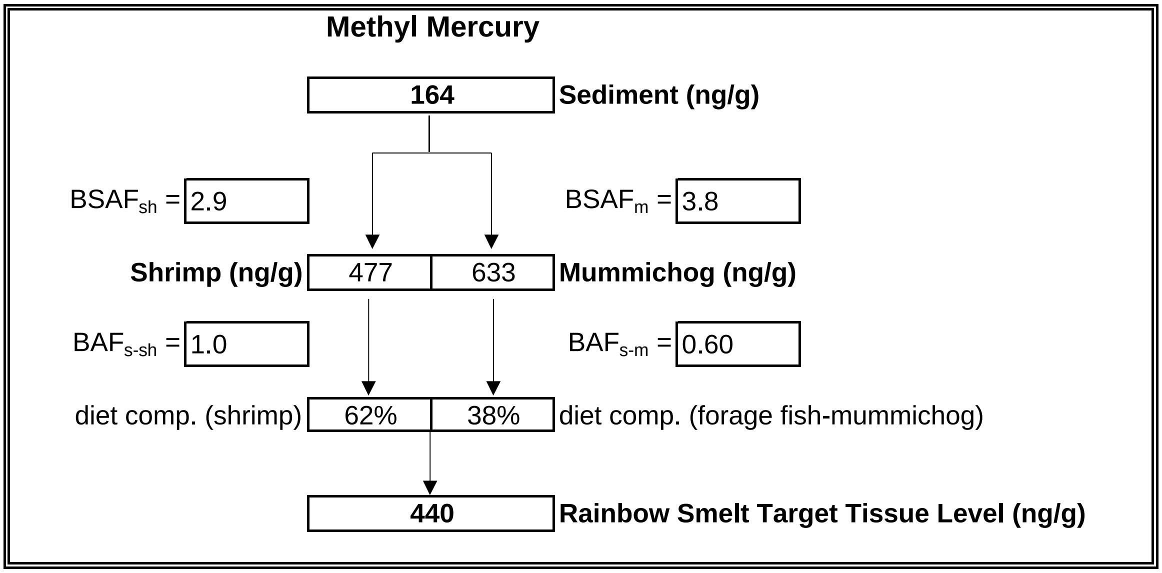
Abbreviations:

ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_{sh}$	Sediment to shrimp BSAF
$BSAF_{i}$	Sediment to insect BSAF
$BAF_{m\text{-}sh}$	Shrimp to mummichog BAF
$BAF_{m\text{-}i}$	Insect to mummichog BAF

TABLE D-39

RAINBOW SMELT FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

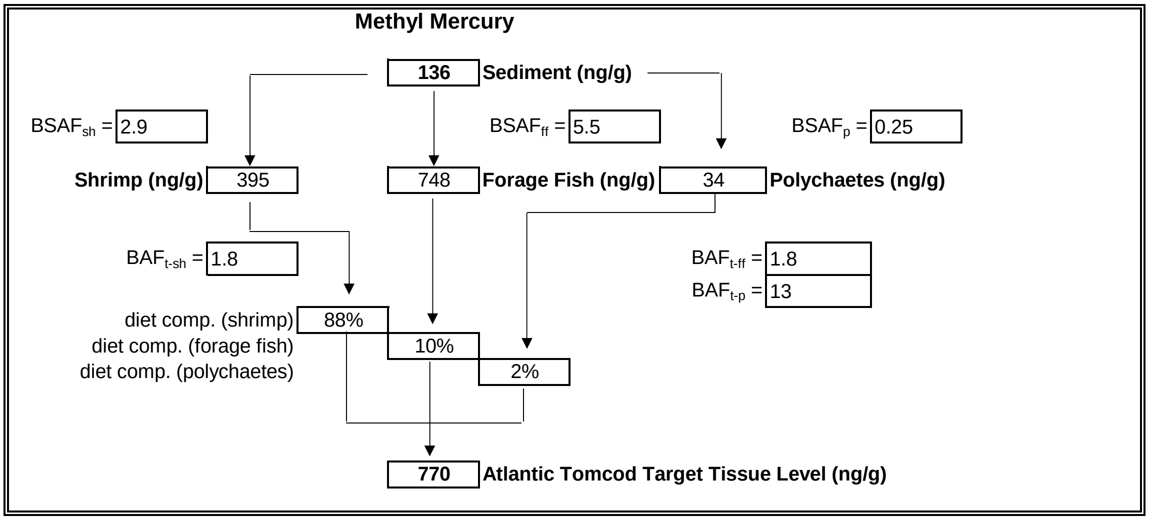
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_{sh}$	Sediment to shrimp BSAF
BSAF$_{m}$	Sediment to mummichog BSAF
BAF$_{s-sh}$	Shrimp to smelt BAF
BAF$_{s-m}$	Mummichog to smelt BAF

TABLE D-40

ATLANTIC TOMCOD FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

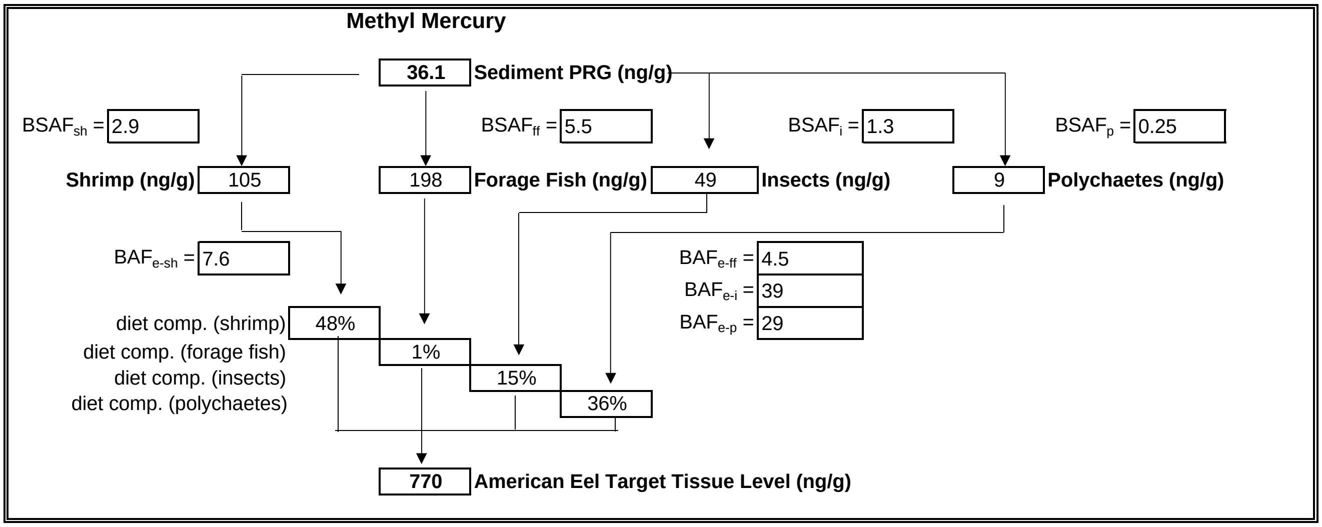
Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_{sh}$	Sediment to shrimp BSAF
BSAF$_{ff}$	Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
BSAF$_{p}$	Sediment to polychaete BSAF
BAF$_{t\text{-}sh}$	Shrimp to tomcod BAF
BAF$_{t\text{-}ff}$	Forage fish (smelt + mummichog) to tomcod BAF
BAF$_{t\text{-}p}$	Polychaete to tomcod BAF

TABLE D-41

AMERICAN EEL FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



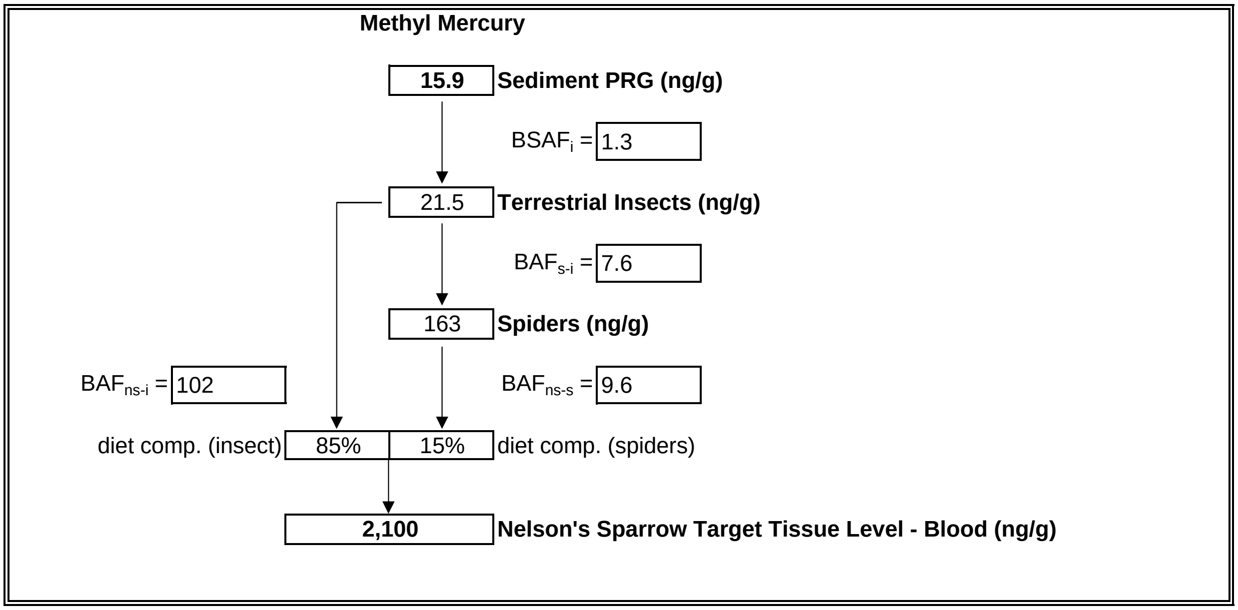
Notes:
Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 02/01/18
Checked by: NSR 02/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal
$BSAF_{sh}$ Sediment to shrimp BSAF
$BSAF_{ff}$ Sediment to forage fish BSAF (assumes 50-50 of smelt and mummichog BSAFs)
$BSAF_{i}$ Sediment to insect BSAF
$BSAF_{p}$ Sediment to polychaete BSAF
$BAF_{e\text{-}sh}$ Shrimp to eel BAF
$BAF_{e\text{-}ff}$ Forage fish (smelt + mummichog) to eel BAF
$BAF_{e\text{-}i}$ Insect to eel BAF
$BAF_{e\text{-}p}$ Polychaete to eel BAF

TABLE D-42

NELSON'S SPARROW FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

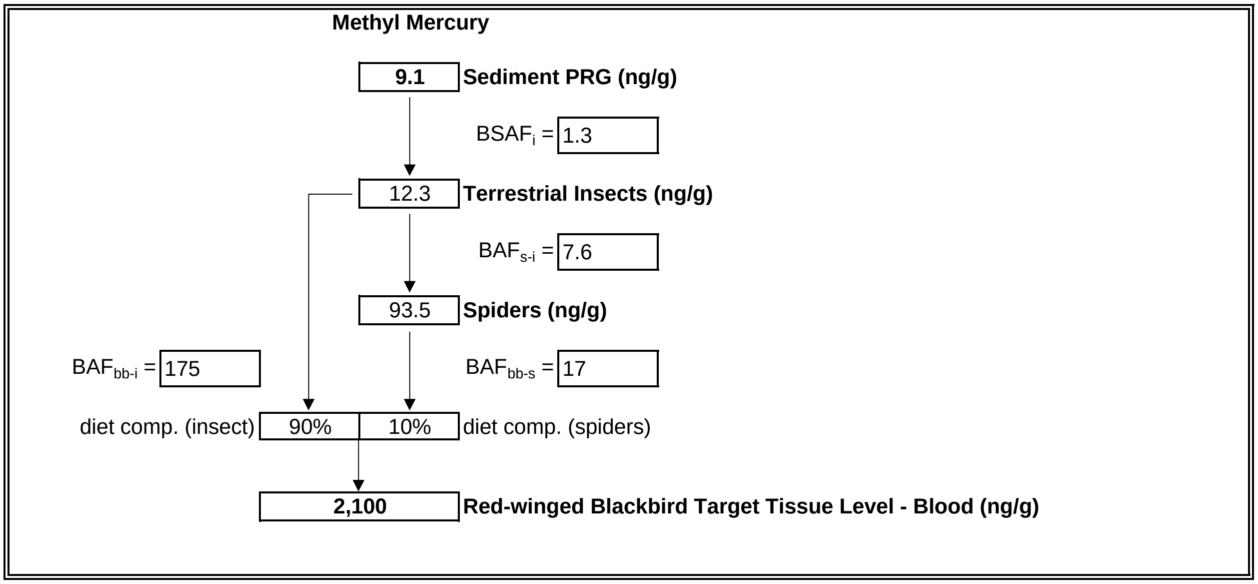
Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_i$	Sediment to insect BSAF
BAF_{s-i}	Spider to insect BAF
BAF_{ns-s}	Spider to Nelson's sparrow BAF
BAF_{ns-i}	Insect to Nelson's sparrow BAF

TABLE D-43

RED-WINGED BLACKBIRD FOOD WEB TISSUE-BASED SEDIMENT PRG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

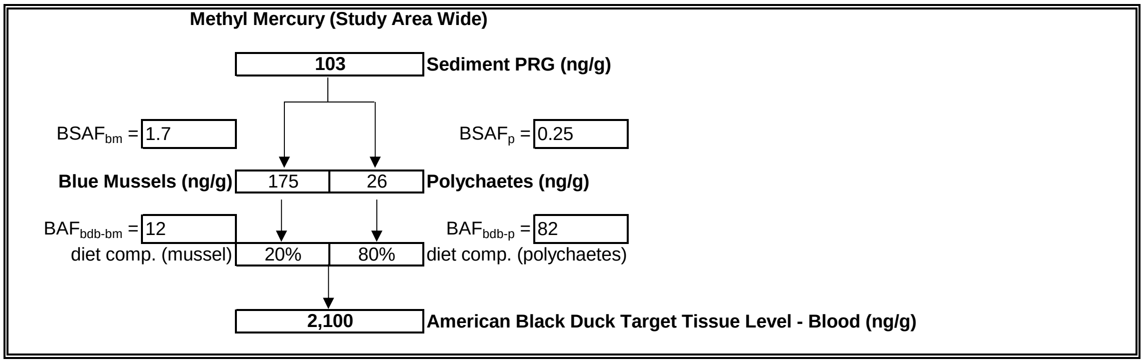
Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

$BSAF_i$	Sediment to insect BSAF
BAF_{s-i}	Insect to spider BAF
BAF_{bb-s}	Spider to red-winged blackbird BAF
BAF_{bb-i}	Insect to red-winged blackbird BAF

TABLE D-44

BLACK DUCK FOOD WEB TISSUE-BASED SEDIMENT PRG

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine



Notes:
Sediment in dry weight; tissue in wet weight.

Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

Abbreviations:
ng/g = nanograms per gram
PRG = preliminary remediation goal

BSAF$_{p}$	Sediment to polychaete BSAF
BSAF$_{bm}$	Sediment to blue mussel BSAF
BAF$_{bdt-p}$	Polychaete to black duck blood BAF
BAF$_{bdt-bm}$	Blue mussel to black duck blood BAF

TABLE D-45

DIETARY-BASED SEDIMENT PRG CALCULATION FOR MUMMICHOG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAFs (wet wt. tissue/dry wt. sediment)[1] Shrimp $BSAF_S$	Insect $BSAF_I$	Shrimp EPC[2] (EPC_S), ng/g wet wt.	Insect EPC[2] (EPC_I), ng/g wet wt.	Mummichog TRV (ng/g bw-day)	Mummichog Intake[3] (ng/g bw-day)	Hazard Quotient[4] (unitless)	Mummichog Sediment PRG[5] (ng/g dry wt.)
Metals									
Mercury	17,088	0.11	0.035	1,871	591	51.8	51.8	1.00	17,088
Methyl Mercury	478	2.9	1.3	1,387	645	51.8	51.8	1.00	478

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
3. Intake for Mummichog:

Prepared By: IMR 02/01/18
Checked by: NSR 02/01/18

$$\text{Intake (ng/g bw-day)} = \frac{SFF*IRf*EF*[(EPC_I*P_I)+(EPC_S*P_S)]}{BW}$$

4. HQ = Intake/TRV
5. Sediment PRG for Mummichog:

$$\text{PRG (ng/g)} = \frac{TRV}{SFF*IRf*EF*(1/BW)*[(BSAF_I*P_I)+(BSAF_S*P_S)]}$$

Where:

SFF = Site Foraging Frequency	1.00
IRf = Daily Food Intake Rate (kg/day) wet wt.	0.00036
EF = Exposure Frequency (unitless)	1.00
BW = Body Weight (kg)	0.0050
EPC_S = EPC for Shrimp (ng/g)	Chemical-specific
P_S = Proportion of Diet Comprised of Shrimp (unitless)	0.10
EPCI = EPC for Insect (ng/g)	Chemical-specific
P_I = Proportion of Diet Comprised of Insects (unitless)	0.90

TABLE D-46

DIETARY-BASED SEDIMENT PRG CALCULATION FOR RAINBOW SMELT
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAFs (wet wt. tissue/dry wt. sediment)[1] Mummichog $BSAF_M$	Shrimp $BSAF_S$	Forage Fish EPC[2] (EPC_F), ng/g wet wt.	Shrimp EPC[2] (EPC_S), ng/g wet wt.	Smelt TRV (ng/g bw-day)	Smelt Intake[3] (ng/g bw-day)	Hazard Quotient[4] (unitless)	Smelt Sediment PRG[5] (ng/g dry wt.)
Metals									
Mercury	3,846	0.14	0.11	552	421	51.8	51.8	1.00	3,846
Methyl Mercury	144	3.8	2.9	556	419	51.8	51.8	1.00	144

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
3. Intake for Smelt:

$$\text{Intake (ng/g bw-day)} = \frac{SFF*IRf*EF*[(EPC_M*P_M)+(EPC_S*P_S)]}{BW}$$

4. HQ = Intake/TRV
5. Sediment PRG for Smelt:

$$\text{PRG (ng/g)} = \frac{TRV}{SFF*IRf*EF*(1/BW)*[(BSAF_M*P_M)+(BSAF_S*P_S)]}$$

Prepared By: IMR 02/01/18
Checked by: NSR 02/01/18

Where:

SFF = Site Foraging Frequency	1.00
IRf = Daily Food Intake Rate (kg/day) wet wt.	0.00132
EF = Exposure Frequency (unitless)	1.00
BW = Body Weight (kg)	0.012
EPC_M = EPC for Mummichog (ng/g)	Chemical-specific
P_M = Proportion of Diet Comprised of Mummichog (unitless)	0.38
EPCS = EPC for Shrimp (ng/g)	Chemical-specific
P_S = Proportion of Diet Comprised of Shrimp (unitless)	0.62

TABLE D-47

DIETARY-BASED SEDIMENT PRG CALCULATION FOR ATLANTIC TOMCOD
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAFs (wet wt. tissue/dry wt. sediment)[1]			Forage Fish EPC[2] (EPC_F), ng/g wet wt.	Polychaete EPC[2] (EPC_P), ng/g wet wt.	Shrimp EPC[2] (EPC_S), ng/g wet wt.	Tomcod TRV (ng/g bw-day)	Tomcod Intake[3] (ng/g bw-day)	Hazard Quotient[4] (unitless)	Tomcod Sediment PRG[5] (ng/g dry wt.)
		Forage Fish $BSAF_F$	Polychaete $BSAF_P$	Shrimp $BSAF_S$							
Metals											
Mercury	44,863	0.12	0.13	0.11	5,288	5,614	4,913	139	139	1.00	44,863
Methyl Mercury	1,598	5.5	0.25	2.9	8,771	400	4,635	139	139	1.00	1,598

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
3. Intake for Tomcod:

$$\text{Intake (ng/g bw-day)} = \frac{SFF*IRf*EF*[(EPC_F*P_F)+(EPC_P*P_P)+(EPC_S*P_S)]}{BW}$$

4. HQ = Intake/TRV
5. Sediment PRG for Tomcod:

$$\text{PRG (ng/g)} = \frac{TRV}{SFF*IRf*EF*(1/BW)*[(BSAF_F*P_F)+(BSAF_P*P_P)+(BSAF_S*P_S)]}$$

Prepared By: IMR 02/01/18
Checked by: NSR 02/01/18

Where:

SFF = Site Foraging Frequency	1.0
IRf = Daily Food Intake Rate (kg/day) wet wt.	0.00098
EF = Exposure Frequency (unitless)	1.0
BW = Body Weight (kg)	0.035
EPC_F = EPC for Forage Fish (ng/g)	Chemical-specific
P_F = Proportion of Diet Comprised of Forage Fish (unitless)	0.10
EPCS = EPC for Shrimp (ng/g)	Chemical-specific
P_S = Proportion of Diet Comprised of Shrimp (unitless)	0.88
EPCP = EPC for Polychaetes (ng/g)	Chemical-specific
P_P = Proportion of Diet Comprised of Polychaetes (unitless)	0.02

TABLE D-48

DIETARY-BASED SEDIMENT PRG CALCULATION FOR AMERICAN EEL
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAFs (wet wt. tissue/dry wt. sediment)[1] Forage Fish $BSAF_F$	Polychaetes $BSAF_P$	Insect $BSAF_I$	Shrimp $BSAF_S$	Forage Fish EPC[2] (EPC_F), ng/g wet wt.	Polychaete EPC[2] (EPC_P), ng/g wet wt.	Insect EPC[2] (EPC_I), ng/g wet wt.	Shrimp EPC[2] (EPC_S), ng/g wet wt.	Eel TRV (ng/g bw-day)	Eel Intake[3] (ng/g bw-day)	Hazard Quotient[4] (unitless)	Eel Sediment PRG[5] (ng/g dry wt.)
Metals													
Mercury	13,368	0.12	0.13	0.035	0.11	1,576	1,673	463	1,464	139	139	1.00	13,368
Methyl Mercury	799	5.5	0.25	1.3	2.9	4,385	200	1,078	2,318	139	139	1.00	799

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
3. Intake for Eel:

$$\text{Intake (ng/g bw-day)} = \frac{SFF*IRf*EF*[(EPC_F*P_F)+(EPC_P*P_P)+(EPC_I*P_I)+(EPC_S*P_S)]}{BW}$$

4. HQ = Intake/TRV
5. Sediment PRG for Eel:

$$\text{PRG (ng/g)} = \frac{TRV}{SFF*IRf*EF*(1/BW)*[(BSAF_F*P_F)+(BSAF_P*P_P)+(BSAF_I*P_I)+(BSAF_S*P_S)]}$$

Prepared By: IMR 02/01/18
Checked by: NSR 02/01/18

Where:

SFF = Site Foraging Frequency	1.0
IRf = Daily Food Intake Rate (kg/day) wet wt.	0.00694
EF = Exposure Frequency (unitless)	1.0
BW = Body Weight (kg)	0.0694
EPCF = EPC for Forage Fish (ng/g)	Chemical-specific
P_F = Proportion of Diet Comprised of Forage Fish (unitless)	0.01
EPCS = EPC for Shrimp (ng/g)	Chemical-specific
P_S = Proportion of Diet Comprised of Shrimp (unitless)	0.48
EPCI = EPC for Insects (ng/g)	Chemical-specific
P_I = Proportion of Diet Comprised of Insects (unitless)	0.15
EPCP = EPC for Polychaetes (ng/g)	Chemical-specific
P_P = Proportion of Diet Comprised of Polychaetes (unitless)	0.36

TABLE D-49

DIETARY-BASED SEDIMENT PRG CALCULATION FOR NELSON'S SPARROW
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAFs (wet wt. tissue/dry wt. sediment)[1]		Insect EPC[2] (EPC_I), ng/g wet wt.	Spider EPC[2] (EPC_S), ng/g wet wt.	Sparrow TRV (ng/g bw-day)	Sparrow Intake[3] (ng/g bw-day)	Hazard Quotient[4] (unitless)	Sparrow Sediment PRG[5] (ng/g dry wt.)
		Insect $BSAF_I$	Spider $BSAF_S$						
Metals									
Mercury	6,186	0.035	0.48	214	2,966	260	260	1.00	6,186
Methyl Mercury	283	1.3	7.2	382	2,041	260	260	1.00	283

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
3. Intake for Sparrow:

$$\text{Intake (ng/g bw-day)} = \frac{SFF*IRf*EF*[(EPC_I*P_I)+(EPC_S*P_S)+(C_s*IRs*P_{SED})]}{BW}$$

4. HQ = Intake/TRV
5. Sediment PRG for Sparrow:

$$\text{PRG (ng/g)} = \frac{TRV}{SFF*IRf*EF*(1/BW)*[(BSAF_I*P_I)+(BSAF_S*P_S)+(IRs*P_{SED})]}$$

Prepared By: IMR 02/01/18
Checked by: NSR 02/01/18

Where:

SFF = Site Foraging Frequency	1.0
IRf = Daily Food Intake Rate (kg/day) wet wt.	0.014
IRs = Sediment ingestion rate (kg/day, dw)	0.00436
P_{SED} = Proportion of Diet Comprised of Sediment (unitless)	0.17
EF = Exposure Frequency (unitless)	0.50
BW = Body Weight (kg)	0.017
EPC_I= EPC for Insect (ng/g)	Chemical-specific
P_I = Proportion of Diet Comprised of Insects (unitless)	0.85
EPC_S = EPC for Spider (ng/g)	Chemical-specific
P_S = Proportion of Diet Comprised of Spiders (unitless)	0.15
C_S = Concentration in sediment (ng/g, dw)	Chemical-specific

TABLE D-50

DIETARY-BASED SEDIMENT PRG CALCULATION FOR RED-WINGED BLACKBIRD
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAFs (wet wt. tissue/dry wt. sediment)[1]		Insect EPC[2] (EPC_I), ng/g wet wt.	Spider EPC[2] (EPC_S), ng/g wet wt.	Blackbird TRV (ng/g bw-day)	Blackbird Intake[3] (ng/g bw-day)	Hazard Quotient[4] (unitless)	Blackbird Sediment PRG[5] (ng/g dry wt.)
		Insect $BSAF_I$	Spider $BSAF_S$						
Metals									
Mercury	10,550	0.035	0.48	365	5,058	260	260	1.00	10,550
Methyl Mercury	432	1.3	7.2	582	3,108	260	260	1.00	432

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
3. Intake for Blackbird:

$$\text{Intake (ng/g bw-day)} = \frac{SFF*IRf*EF*[(EPC_I*P_I)+(EPC_S*P_S)+(C_S*IRs*P_{SED})]}{BW}$$

4. HQ = Intake/TRV
5. Sediment PRG for Blackbird:

$$\text{PRG (ng/g)} = \frac{TRV}{SFF*IRf*EF*(1/BW)*[(BSAF_I*P_I)+(BSAF_S*P_S)+(IRs*P_{SED})]}$$

Prepared By: IMR 02/01/18
Checked by: NSR 02/01/18

Where:

SFF = Site Foraging Frequency	1.0
IRf = Daily Food Intake Rate (kg/day) wet wt.	0.0252
IRs = Sediment ingestion rate (kg/day, dw)	0.00874
P_{SED} = Proportion of Diet Comprised of Sediment (unitless)	0.005
EF = Exposure Frequency (unitless)	0.58
BW = Body Weight (kg)	0.047
EPC_I= EPC for Insect (ng/g)	Chemical-specific
P_I = Proportion of Diet Comprised of Insects (unitless)	0.90
EPC_S = EPC for Spider (ng/g)	Chemical-specific
P_S = Proportion of Diet Comprised of Spiders (unitless)	0.10
C_S = Concentration in sediment (ng/g, dw)	Chemical-specific

TABLE D-51

DIETARY-BASED SEDIMENT PRG CALCULATION FOR AMERICAN BLACK DUCK
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAFs (wet wt. tissue/dry wt. sediment)[1] Polychaete $BSAF_P$	Mussel $BSAF_M$	Polychaete EPC[2] (EPC_P), ng/g wet wt.	Mussel EPC[2] (EPC_M), ng/g wet wt.	Duck TRV (ng/g bw-day)	Duck Intake[3] (ng/g bw-day)	Hazard Quotient[4] (unitless)	Duck Sediment PRG[5] (ng/g dry wt.)
Metals									
Mercury	10,514	0.13	0.13	1,316	1,367	95	95	1.00	10,514
Methyl Mercury	2,472	0.25	1.7	619	4,203	95	95	1.00	2,472

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
3. Intake for Duck:

$$\text{Intake (ng/g bw-day)} = \frac{SFF*IRf*EF*[(EPC_P*P_P)+(EPC_M*P_M)+(C_S*IRs*P_{SED})]}{BW}$$

4. HQ = Intake/TRV
5. Sediment PRG for Duck:

$$\text{PRG (ng/g)} = \frac{TRV}{SFF*IRf*EF*(1/BW)*[(BSAF_P*P_P)+(BSAF_M*P_M)+(IRs*P_{SED})]}$$

Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

Where:

SFF = Site Foraging Frequency	1.0
IRf = Daily Food Intake Rate (kg/day) wet wt.	0.193
IRs = Sediment ingestion rate (kg/day, dw)	0.0618
P_{SED} = Proportion of Diet Comprised of Sediment (unitless)	0.020
EF = Exposure Frequency (unitless)	0.50
BW = Body Weight (kg)	1.36
EPC_P= EPC for Polychaetes (ng/g)	Chemical-specific
P_P = Proportion of Diet Comprised of Polychaetes (unitless)	0.80
EPC_M = EPC for Mussels (ng/g)	Chemical-specific
P_M = Proportion of Diet Comprised of Mussels (unitless)	0.20
C_S = Concentration in sediment (ng/g, dw)	Chemical-specific

TABLE D-52

DIETARY-BASED SEDIMENT PRG CALCULATION FOR BELTED KINGFISHER
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAFs (wet wt. tissue/dry wt. sediment)[1] Forage Fish $BSAF_{FF}$	Forage Fish EPC[2] (EPC_{FF}), ng/g wet wt.	Belted Kingfisher TRV (ng/g bw-day)	Belted Kingfisher Intake[3] (ng/g bw-day)	Hazard Quotient[4] (unitless)	Belted Kingfisher Sediment PRG[5] (ng/g dry wt.)
Metals							
Mercury	1,998	0.12	236	59.0	59	1.00	1,998
Methyl Mercury	43.0	5.5	236	59.0	59	1.00	43.0

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
3. Intake for Kingfisher:

$$\text{Intake (ng/g bw-day)} = \frac{SFF*IRf*EF*[(EPC_{FF}*P_{FF})+(C_s*IRs*P_{SED})]}{BW}$$

4. HQ = Intake/TRV
5. Sediment PRG for Kingfisher:

$$\text{PRG (ng/g)} = \frac{TRV}{SFF*IRf*EF*(1/BW)*[(BSAF_{FF}*P_{FF})+(IRs*P_{SED})]}$$

Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

Where:

SFF = Site Foraging Frequency	1.0
IRf = Daily Food Intake Rate (kg/day) wet wt.	0.075
IRs = Sediment ingestion rate (kg/day, dw)	0.024
P_{SED} = Proportion of Diet Comprised of Sediment (unitless)	0.010
EF = Exposure Frequency (unitless)	0.50
BW = Body Weight (kg)	0.15
EPC_{FF}= EPC for Forage Fish (ng/g)	Chemical-specific
P_{FF} = Proportion of Diet Comprised of Forage Fish (unitless)	1.00
C_S = Concentration in sediment (ng/g, dw)	Chemical-specific

TABLE D-53

DIETARY-BASED SEDIMENT PRG CALCULATION FOR AMERICAN BALD EAGLE
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAFs (wet wt. tissue/dry wt. sediment)[1] Forage Fish $BSAF_{FF}$	Predatory Fish $BSAF_{PF}$	Forage Fish EPC[2] (EPC_{FF}), ng/g wet wt.	Predatory Fish EPC[2] (EPC_{PF}), ng/g wet wt.	Bald Eagle TRV (ng/g bw-day)	Bald Eagle Intake[3] (ng/g bw-day)	Hazard Quotient[4] (unitless)	Bald Eagle Sediment PRG[5] (ng/g dry wt.)
Metals									
Mercury	2,917	0.12	0.36	344	1,050	59.0	59.0	1.00	2,917
Methyl Mercury	39.7	5.5	40	218	1,587	59.0	59.0	1.00	39.7

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
3. Intake for Eagle:

$$\text{Intake (ng/g bw-day)} = \frac{SFF*IRf*EF*[(EPC_{FF}*P_{FF})+(EPC_{PF}*P_{PF})+(C_s*IRs*P_{SED})]}{BW}$$

4. HQ = Intake/TRV
5. Sediment PRG for Eagle:

$$\text{PRG (ng/g)} = \frac{TRV}{SFF*IRf*EF*(1/BW)*[(BSAF_{FF}*P_{FF})+(BSAF_{PF}*P_{PF})+(IRs*P_{SED})]}$$

Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

Where:

SFF = Site Foraging Frequency	1.0
IRf = Daily Food Intake Rate (kg/day) wet wt.	0.552
IRs = Sediment ingestion rate (kg/day, dw)	0.228
P_{SED} = Proportion of Diet Comprised of Sediment (unitless)	0.010
EF = Exposure Frequency (unitless)	1.00
BW = Body Weight (kg)	4.60
EPC_{FF}= EPC for Forage Fish (ng/g)	Chemical-specific
P_{FF} = Proportion of Diet Comprised of Forage Fish (unitless)	0.80
EPC_{PF} = EPC for Predatory Fish (ng/g)	Chemical-specific
P_{PF} = Proportion of Diet Comprised of Predatory Fish (unitless)	0.20
C_S = Concentration in sediment (ng/g, dw)	Chemical-specific

TABLE D-54

DIETARY-BASED SEDIMENT PRG CALCULATION FOR MINK
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Forage Fish $BSAF_{FF}$	Forage Fish EPC[2] (EPC_{FF}), ng/g wet wt.	Mink TRV (ng/g bw-day)	Mink Intake[3] (ng/g bw-day)	Hazard Quotient[4] (unitless)	Mink Sediment PRG[5] (ng/g dry wt.)
Metals							
Mercury	7,591	0.12	895	121	121	1.00	7,591
Methyl Mercury	164	5.5	900	121	121	1.00	164

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
3. Intake for Mink:

Prepared By: IMR 02/01/18
Checked by: NSR 02/01/18

$$\text{Intake (ng/g bw-day)} = \frac{SFF*IRf*EF*[(EPC_{FF}*P_{FF})+(C_S*IRs*P_{SED})]}{BW}$$

4. HQ = Intake/TRV
5. Sediment PRG for Mink:

$$\text{PRG (ng/g)} = \frac{TRV}{SFF*IRf*EF*(1/BW)*[(BSAF_{FF}*P_{FF})+(IRs*P_{SED})]}$$

Where:

SFF = Site Foraging Frequency	1.0
IRf = Daily Food Intake Rate (kg/day) wet wt.	0.114
IRs = Sediment ingestion rate (kg/day, dw)	0.035
P_{SED} = Proportion of Diet Comprised of Sediment (unitless)	0.020
EF = Exposure Frequency (unitless)	1.00
BW = Body Weight (kg)	0.85
EPC_{FF}= EPC for Forage Fish (ng/g)	Chemical-specific
P_{FF} = Proportion of Diet Comprised of Forage Fish (unitless)	1.00
C_S = Concentration in sediment (ng/g, dw)	Chemical-specific

TABLE D-55

ECOLOGICAL BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR AMERICAN LOBSTER
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Lobster $BSAF_L$	Lobster EPC[2] (EPC_{SM}), ng/g wet wt.	Lobster TRV (ng/g)	Hazard Quotient[4] (unitless)	Lobster PRG[5] (ng/kg dry wt.)
Metals						
Mercury	4,044	0.45	1,820	1,820	1.00	4,044
Methyl Mercury	74.8	24	1,820	1,820	1.00	74.8

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Smelt:

$$PRG\ (ng/g) = \frac{TRV}{BSAF}$$

Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

TABLE D-56

ECOLOGICAL DIETARY-BASED SEDIMENT PRG CALCULATION FOR BLUE MUSSEL
Penobscot River Phase III Engineering Study
Penobscot River

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry) Mussel $BSAF_{BM}$	Mussel EPC[2] (EPC_{BM}), ng/g wet wt.	Mussel TRV (ng/g)	Hazard Quotient[4] (unitless)	Mussel Sediment PRG[5] (ng/kg dry wt.)
Metals						
Mercury	731	0.13	95	95	1.00	731
Methyl Mercury	55.9	1.7	95	95	1.00	55.9

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Tomcod:

$$PRG\ (ng/g) = \frac{TRV}{BSAF}$$

Prepared By: IMR 08/13/18
Checked by: LO 08/14/18

TABLE D-57

ECOLOGICAL BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR MUMMICHOG
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Mummichog $BSAF_M$	Mummichog EPC[2] (EPC_M), ng/g wet wt.	Forage Fish Tissue TRV (ng/g)	Hazard Quotient[4] (unitless)	Mummichog Sediment PRG[5] (ng/kg dry wt.)
Metals						
Mercury	3,065	0.14	440	440	1.00	3,065
Methyl Mercury	114	3.8	440	440	1.00	114

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Mummichog:

$$PRG\ (ng/g) = \frac{TRV}{BSAF}$$

Prepared By: IMR 02/01/18
Checked by: NSR 02/01/18

TABLE D-58

ECOLOGICAL BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR RAINBOW SMELT
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Smelt $BSAF_{SM}$	Smelt EPC[2] (EPC_{SM}), ng/g wet wt.	Forage Fish Tissue TRV (ng/g)	Hazard Quotient[4] (unitless)	Smelt Sediment PRG[5] (ng/kg dry wt.)
Metals						
Mercury	4,774	0.092	440	440	1.00	4,774
Methyl Mercury	61.8	7.1	440	440	1.00	61.8

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Smelt:

$$PRG\ (ng/g) = \frac{TRV}{BSAF}$$

Prepared By: IMR 02/01/18
Checked by: NSR 02/01/18

TABLE D-59

ECOLOGICAL BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR ATLANTIC TOMCOD
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Tomcod $BSAF_T$	Tomcod EPC[2] (EPC_T), ng/g wet wt.	Predatory Fish Tissue TRV (ng/g)	Hazard Quotient[4] (unitless)	Tomcod Sediment PRG[5] (ng/kg dry wt.)
Metals						
Mercury	3,427	0.22	770	770	1.00	3,427
Methyl Mercury	43.4	18	770	770	1.00	43.4

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Tomcod:

$$\text{PRG (ng/g)} = \frac{\text{TRV}}{\text{BSAF}}$$

Prepared By: IMR 02/01/18
Checked by: NSR 02/01/18

TABLE D-60

ECOLOGICAL BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR AMERICAN EEL
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Eel $BSAF_E$	Eel EPC[2] (EPC_E), ng/g wet wt.	Predatory Fish Tissue TRV (ng/g)	Hazard Quotient[4] (unitless)	Eel Sediment PRG[5] (ng/kg dry wt.)
Metals						
Mercury	1,577	0.49	770	770	1.00	1,577
Methyl Mercury	12.4	62	770	770	1.00	12.4

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Eel:

$$PRG\ (ng/g) = \frac{TRV}{BSAF}$$

Prepared By: IMR 02/01/18
Checked by: NSR 02/01/18

TABLE D-61

ECOLOGICAL BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR NELSON'S SPARROW
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Sparrow $BSAF_{SP}$	Sparrow EPC[2] (EPC_{SP}), ng/g wet wt.	Marsh Avian Blood TRV (ng/g)	Hazard Quotient[4] (unitless)	Sparrow Sediment PRG[5] (ng/kg dry wt.)
Metals						
Mercury	349	6.0	2,100	2,100	1.00	349
Methyl Mercury	6.84	307	2,100	2,100	1.00	6.84

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Sparrow:

$$PRG\ (ng/g) = \frac{TRV}{BSAF}$$

Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

TABLE D-62

ECOLOGICAL BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR RED-WINGED BLACKBIRD
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Blackbird $BSAF_B$	Blackbird EPC[2] (EPC_B), ng/g wet wt.	Marsh Avian Blood TRV (ng/g)	Hazard Quotient[4] (unitless)	Blackbird Sediment PRG[5] (ng/kg dry wt.)
Metals						
Mercury	482	4.4	2,100	2,100	1.00	482
Methyl Mercury	9.0	233	2,100	2,100	1.00	9.0

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Blackbird:

$$PRG\ (ng/g) = \frac{TRV}{BSAF}$$

Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

TABLE D-63

ECOLOGICAL BSAF TISSUE-BASED SEDIMENT PRG CALCULATION FOR AMERICAN BLACK DUCK
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Parameter	Maximum Allowable Sediment EPC (Cs), ng/g dry wt.	BSAF (wet wt. tissue/dry wt. sediment)[1] Black Duck $BSAF_D$	Black Duck EPC[2] (EPC_D), ng/g wet wt.	Aquatic Avian Blood TRV (ng/g)	Hazard Quotient[4] (unitless)	Black Duck Sediment PRG[5] (ng/kg dry wt.)
Metals						
Mercury	3,684	0.57	2,100	2,100	1.00	3,684
Methyl Mercury	38.2	55	2,100	2,100	1.00	38.2

Notes:
1. Refer to Table IV.1-3.
2. EPC = Sediment concentration (dry weight) x BSAF.
4. HQ = EPC/TRV
5. Sediment PRG for Black Duck:

$$PRG\ (ng/g) = \frac{TRV}{BSAF}$$

Prepared by: IMR 08/01/18
Checked by: LO 08/01/18

APPENDIX E

Statistical Evaluation

APPENDIX E-1

SUMMARY OF DUCK BLOOD MERCURY CONCENTRATION COMPARISONS
HUMAN HEALTH RISK ASSESSMENT
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Factor	Grouping	Number of Data Points	Group Mean (ng/g)	Group Median (ng/g)	Scheirer-Ray-Hare (non-parametric 2-way ANOVA)	Dunn's Test of Multiple Comparisons Result*
Location	ES13	62	212	150	Significantly Different ($p < 0.001$)	a
	FRB	59	66.8	62.7		b
	MM	54	505	369		c
Year	2011	19	453	186	Significantly Different ($p = 0.002$)	a
	2012	22	349	154		a
	2014	44	129	93.4		b
	2017	45	321	310		a
	2018	45	176	165		ab
Interaction of Location and Year	NA	NA	NA	NA	No Interaction ($p = 0.089$)	NA
Location by Year	ES13 2011	3	488	299	Significantly Different ($p < 0.001$)	ab
	ES13 2012	8	139	138		ac
	ES13 2014	21	103	97.3		c
	ES13 2017	15	380	377		b
	ES13 2018	15	180	165		ac
	FRB 2011	8	82.6	81.2	Significantly Different ($p = 0.001$)	ab
	FRB 2012	6	106	101		a
	FRB 2014	15	68.1	67.2		ab
	FRB 2017	15	53.3	43.5		b
	FRB 2018	15	54.9	55.8		b
	MM 2011	8	811	936	Significantly Different ($p = 0.012$)	a
	MM 2012	8	741	515		a
	MM 2014	8	314	242		a
	MM 2017	15	529	504		a
	MM 2018	15	292	275		a

Notes:
ANOVA = Analysis of Variance
*Bonferroni adjustment used for multiple comparisons
Groups sharing a letter are not signficantly different; Letters not comparable across factors (e.g., the *a* for Location in 2011 is not the same *a* as the *a* in the year comparisons: 2011, 2012, etc.)
MM = Mendall Marsh, FRB = Frenchman Bay, ES13 = South Verona
ng/g = nanogram per gram

Prepared by/Date: LO 8/16/18
Checked by/Date: LSV 8/16/18

APPENDIX E-2

SUMMARY OF ESTIMATED TO ACTUAL DUCK MUSCLE TISSUE MERCURY CONCENTRATION COMPARISONS
HUMAN HEALTH RISK ASSESSMENT
Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Factor	Grouping	Number of Data Points	Group Mean (ng/g)	Group Median (ng/g)	Scheirer-Ray-Hare (non-parametric 2-way ANOVA)	Dunn's Test of Multiple Comparisons Result*
Location	ES13*	52	180	129	Significantly Different ($p < 0.001$)	a
	FRB*	35	76.8	74.9		b
	MM*	40	503	377		c
Year	2011*	22	472	283	Significantly Different ($p = 0.029$)	a
	2012*	20	331	140		ab
	2014*	25	145	103		b
	2017	15	274	177		ab
	2018*	45	165	156		ab
Interaction of Location and Year	NA	NA	NA	NA	No Interaction ($p = 0.13$)	NA
Location by Year	ES13 2011*	3	413	263	Significantly Different ($p < 0.001$)	a
	ES13 2012*	8	135	135		ab
	ES13 2014*	21	107	102		b
	ES13 2017	5	456	441		a
	ES13 2018*	15	168	156		ab
	FRB 2011*	8	90.8	89.6	Significantly Different ($p < 0.001$)	ab
	FRB 2012*	6	109	106		a
	FRB 2014	1	85.3	85.3		abc
	FRB 2017	5	38.1	44.8		c
	FRB 2018*	15	68.8	69.4		bc
	MM 2011	11	765	747	Significantly Different ($p < 0.001$)	a
	MM 2012	6	815	772		a
	MM 2014	3	432	430		ab
	MM 2017	5	329	177		ab
	MM 2018*	15	258	244		b

Notes:
*Muscle concentrations estimated from blood concentrations using a significant, positive correlation between blood and muscle tissue mercury concentrations that was developed for black duck in the 2016 Biota Monitoring Report (Amec Foster Wheeler 2017a).
ANOVA = Analysis of Variance
*Bonferroni adjustment used for multiple comparisons
Groups sharing a letter are not signficantly different; Letters not comparable across factors (e.g., the *a* for Location in 2011 is not the same *a* as the *a* in the year comparisons: 2011, 2012, etc.)
MM = Mendall Marsh, FRB = Frenchman Bay, ES13 = South Verona
ng/g = nanogram per gram

Prepared by/Date: LO 8/16/18
Checked by/Date: LSV 8/16/18

APPENDIX E-3

Supporting Data for ED_{20} Calculation for American Black Duck - Probit Procedure for Methyl Mercury Toxicity 4-week Surviving Ducks

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Analysis based on Finley and Stendell (1978) study data

Several SAS/STAT procedures can be used for statistical modeling of the dose-response data including logistic, genmod, probit and catmod. The procedure for estimating toxicology endpoint from dose-response curves used in this report follows the probit procedure in SAS. The probit procedure calculates the maximum likelihood estimates of regression parameters β and C of probit equation from the natural or threshold response rate for quantal response data from MeHg dose-response data. The parameter estimation follows a modified Newton-Raphson algorithm. When the Y is binary, with values 0 and 1, the probit equation is given as:

$$p = P_r(Y = 0) = C + (1 - C)F(x'\beta)$$

where:

β	is the vector of the parameter estimates
F	is the cumulative frequency function (logistic in this case)
x	is the vector of the explanatory variables
p	is the probability of the response
C	is the natural or threshold response rate

(where " $P_r(Y = 0)$" is the probability of having zero or no response to a dosage.)

The dosage levels of methylmercury in feed (ppm) and the 4-week duckling survival response data for two consecutive seasons (1973 and 1974) are presented below:

Dose (mg/kg), ppm	Trials	Replicates	Response
0	2	1	1
2.92	2	1	0.097
3.41	2	1	0.212

The Model

The Proc Pobit procedure of SAS Workstation (version 9.4, 2013) was used with the logistic option which fits the logistic model is as follows:

APPENDIX E-3

Supporting Data for ED_{20} Calculation for American Black Duck - Probit Procedure for Methyl Mercury Toxicity 4-week Surviving Ducks

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

```
data ducks_surviving_1973;
        input dose n y;
        logdose = log(dose);
        datalines;
0       1       1
3       1       0.097
3       1       0.212
;
proc probit log10 plot=predpplot;
  model y/n=dose / d=logistic inversecl;
  output out=B p=Prob std=std xbeta=xbeta;
run;
```

The estimated exposure concentration which affected 20% of the population is 0.74 ppm in dry weight (for the two seasons in 1973 and 1974) for 4 weeks - no. of ducks surviving.

Algorithm converged.

Type III Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
Log10(dose)	1	0.194	0.6596

Analysis of Maximum Likelihood Parameter Estimates							
Parameter	DF	Estimate	Standard Error	95% Confidence Limits		Chi-Square	Pr > ChiSq
Intercept	1	0.7452	5.6233	-10.2762	11.7667	0.02	0.8946
Log10(dose)	1	-4.8906	11.1047	-26.6555	16.8743	0.19	0.6596

Probit Model in Terms of Tolerance Distribution	
MU	SIGMA
0.15237983	0.2044747

APPENDIX E-3

Supporting Data for ED_{20} Calculation for American Black Duck - Probit Procedure for Methyl Mercury Toxicity 4-week Surviving Ducks

Penobscot River Phase III Engineering Study
Penobscot River Estuary, Maine

Estimated Covariance Matrix for Tolerance Parameters		
	MU	SIGMA
MU	0.694863	-0.340508
SIGMA	-0.340508	0.215563

Probit Analysis on dose			
Probability	dose	95% Fiducial Limits	
0.1	3.99629	.	.
0.2	2.72798	.	.
0.3	2.11656	.	.
0.4	1.71904	.	.
0.5	1.4203	.	.
0.6	1.17347	.	.
0.7	0.95308	.	.
0.8	0.73947	.	.
0.9	0.50478	.	.

The following graph represents a plot of the response expressed as the cumulative predicted probability of effect (i.e. duckling survival) at a given dosage of methylmercury (in ppm).