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Memorandum

~~March 18, 2022~~July 8, 2022

To: Eva DeMaria, U.S. Environmental Protection Agency

From: Nathan Soccorsy and Greg Brunkhorst, Anchor QEA, LLC

Re: Bremerton Gas Works Superfund Site: ~~Anthropogenic~~ Site-Specific Background Study Results

1 Introduction

Cascade Natural Gas Corporation (CNGC) is conducting a Remedial Investigation (RI) and Feasibility Study (FS) at the Bremerton Gas Works (BGW) Superfund Site (Site) under the direction of EPA in accordance with the Administrative Settlement Agreement and Order on Consent (CERCLA Docket No. 10-2013-0104). As part of the RI/FS process, ~~this~~this ~~Anthropogenic~~Site-specific Background study was performed within Port Washington Narrows (PWN) in accordance with the EPA-approved Third and Fourth Sampling and Quality Assurance Project Plans (SQAPP Addenda; Anchor QEA 2020a, 2021). This memorandum summarizes the study design and implementation, identifies the ~~Anthropogenic~~Site-specific Background dataset, and calculates summary statistics for selected contaminants of potential concern. The rest of this memorandum contains the following sections:

- **Section 2. Study Objectives and Sediment Sampling Design.** Summarizes the study design, the objectives for the study, and the sediment sampling design.
- **Section 3. Port Washington Narrows Conceptual Site Model.** Discusses the aquatic setting for PWN, including sediment sources and characteristics.
- **Section 4. Data Evaluation.** Evaluates data in a manner consistent with the methods described in guidance (e.g., EPA 2002a, 2002b, 2006), including statistical distribution characteristics, physical characteristics of the PWN sediments, and potential statistical outliers.
- **Section 5. Summary and Conclusions.** Provides summary statistics for data retained from the data evaluation for use in the BGW RI.

The following attachments are also included:

- **Attachment A.** SQAPP Addenda (A.1 Third SQAPP Addendum; A.2 Fourth SQAPP Addendum)
- **Attachment B.** 700-Series Results Table
- **Attachment C.** Field Forms (including grab collection forms, daily logs, and chain-of-custody forms)
- **Attachment D.** Laboratory Reports (D.1) and Data Validation Reports (D.2)
- **Attachment E.** ~~Anthropogenic~~Site-specific Background Study Data
- **Attachment F.** EPA Memoranda (F.1 and F.2)

2 Study Objectives and Sediment Sampling Design

2.1 Purpose

CERCLA guidance describes the importance of measuring background concentrations for chemicals of concern for risk characterization and risk communication (EPA 1989, 2002a, 2002b). EPA's 1989 guidance defines two background concepts as follows:

- ***Natural Background:*** *Substances present in the environment in forms that have not been influenced by human activity.*
- ***Anthropogenic Background:*** *Natural and human-made substances present in the environment as a result of human activities (not specifically related to the CERCLA release in question).*

Natural Background has been operationally defined in Puget Sound using the results of an interagency sediment survey of central Puget Sound areas (the BOLD Survey; USACE 2009). ~~However, t~~The concentrations of carcinogenic polycyclic aromatic hydrocarbons (PAHs) in PWN are elevated above Natural Background as defined by other EPA sites in the region (EPA 2014) due to the location within the city of Bremerton, the presence of combined sewer overflows (CSOs) and stormwater outfalls, and historical development activities. The purpose of this study is to estimate Anthropogenic Background concentrations for PWN, which are referred to as Site-specific Background in this memorandum.

Sediments adjacent to the historical BGW ~~plant~~ have been extensively studied, as documented in the following reports:

- RI/FS Work Plan (Aspect and Anchor QEA 2017)
- Work Plan Addendum (Aspect and Anchor QEA 2019)
- Risk Assessment Technical Memorandum (Anchor QEA and Aspect 2020a)
- Remedial Investigation Data Report (Aspect and Anchor QEA 2021)

Characterization data to calculate PWN ~~Anthropogenic~~Site-specific Background were collected in two phases with EPA oversight. The initial data acquired to characterize ~~Anthropogenic~~Site-specific Background were collected in August 2020 in accordance with the Third SQAPP Addendum (Attachment A.1). The initial results were the product of a relatively small sample size in relation to the statistically highly skewed distribution,[1] resulting in ~~Anthropogenic~~Site-specific Background estimates with large confidence intervals (high uncertainty on the estimate).

Following consultation with EPA, a Fourth SQAPP Addendum (Attachment A.2) was prepared with a study design that relied upon the existing data and analysis to develop the Data Quality Objectives to complete the ~~Anthropogenic~~Site-specific Background study. The overall objective of the Fourth

[1] For example, the benzo(a)pyrene skewness coefficient is 3.4.

SQAPP Addendum was to narrow the confidence intervals on statistical estimates by acquiring a large number of samples throughout PWN (115 total sediment samples).

2.2 Sediment Sampling

This section provides additional detail on the two rounds of ~~Anthropogenic~~Site-specific Background sampling. Following coordination and consultation with EPA in summer 2020, EPA approved the Third SQAPP Addendum in August 2020. The first round of samples were collected from August 17, 2020, through August 19, 2020. Twenty-nine samples were collected (the 600-series samples), including six samples within the initial study area (ISA; ISA-SS600-series) and 23 outside of the ISA (PWN-SS600-series). Twenty samples were taken from intertidal sediments (PWN-SS600 through PWN-SS620) and nine samples from subtidal sediments (PWN/ISA-SS622 through PWN/ISA-SS630). Samples were acquired and immediately submitted for grain size, total organic carbon (TOC), and PAHs using Method 8270D with alkyl groups. Following the first round of sampling, a draft data memorandum (Anchor QEA 2021) was submitted to EPA, which was followed by a series of meetings with EPA and CNGC to evaluate the data. These evaluations were used to identify the number of samples and the sample locations for the second round of sampling, as described in Section 2.3.

In July 2021, EPA approved the Fourth SQAPP Addendum for the collection of an additional 85 samples (the 700-series samples), including 67 from intertidal sediments (labeled PWN-700 through PWN-767) and 18 from subtidal sediments (labeled PWN-768 through PWN-785). This second round of samples were collected in late July and early August 2021 and immediately submitted for analysis for the same constituents as the first round of analyses (i.e., grain size, TOC, and PAHs). There were no deviations from the sampling plan other than ~~offsetting~~ moving sample location~~s 738~~ ~~and~~ PWN-746 due to the presence of concrete/riprap piles. Location PWN-746 was moved from between PWN-745 and PWN-747 to the location southeast of PWN-741 along the shoreline grid spacing (about 1,000 feet to the southeast). As-collected sediment locations are depicted in Figure 2-1.

2.2.1 Testing Results and Data Quality Assessment

The tabulated results of the 2021 data acquisition are presented in Attachment B. Supporting information such as field forms is included in Attachment C. Laboratory and third-party data validation reports are presented in Attachments D.1 and D.2, respectively.

Chemical testing was performed by Analytical Resources, Inc., in Tukwila, Washington. Data validations of the chemistry results were performed in accordance with EPA guidelines as outlined in the ~~Marine~~ SQAPP, the SQAPP Addenda, and the EPA National Functional Guidelines for Data Review. All analyses conformed to procedures described in the approved Marine SQAPP and SQAPP Addenda.

No samples were rejected. Validation qualifiers were added by the independent validator, Laboratory Data Consultants of Carlsbad, California, and the data can be used as qualified.

2.3 Sample Locations

Both rounds of sampling targeted a 1.6-mile stretch of PWN generally centered on the ISA (Figure 2-1). For the purpose of this memorandum, we refer to this collectively as the PWN Study Area.

The first round of sampling, conducted in August 2020 in accordance with the Third SQAPP Addendum, included samples that were roughly 500 feet apart. Ten intertidal samples on the southern shore of PWN stretched approximately 3,000 feet to the east and west of the ISA (PWN-SS611 through PWN-SS620), and 10 intertidal samples on the northern shore of PWN stretched along the entire 1.6-mile segment of the PWN Study Area (PWN-SS600 through PWN-SS610). Nine subtidal samples were collected near the border of the ISA (PWN/ISA-SS622 through PWN/ISA-SS630).

Following the first round of sampling and analysis, modifications to the ~~Anthropogenic~~Site-specific Background dataset were made in consultation with EPA based on the data evaluation. ~~Seven~~ Five subtidal samples within the ISA from the first round of sampling were removed from the ~~Anthropogenic~~Site-specific Background dataset due to proximity to the Site (PWN/ISA-SS624 through PWN/ISA-SS627 and PWN/ISA-SS630), and ~~eight~~ six subtidal samples collected in 2017 were added to the ~~Anthropogenic~~Site-specific Background dataset because they were farther from Site sources and did not have evidence for Site impacts (ISA-SS01, ISA-SS03, ISA-SS04, ISA-SS08, PWN-SS09, and PWN-SS14). These data were referenced in the Fourth SQAPP Addendum as the 1000+ dataset.

The second round of sampling, conducted in July and August 2021 in accordance with the Fourth SQAPP Addendum, greatly increased the number of samples. In the intertidal, 67 samples were placed on an approximately 150-foot spacing, filling in gaps from the first round of sampling. Locations within 50 feet of the first round sample locations were skipped. Consistent with the grid-spacing methodology, the intertidal samples varied in their proximity to outfalls (from approximately 10 to approximately 1,000 feet from the closest mapped outfall); however, no samples acquired were observed to be directly proximal to outfall(s). Eighteen subtidal samples were targeted on a grid spacing of approximately 450 feet. The intent of the grid spacing was to provide a representative population of the various conditions in PWN subtidal areas similar to the physical conditions of the ISA.

After the two rounds of sampling and consultation with EPA, the resulting ~~Anthropogenic~~Site-specific Background dataset consisted of 115 samples (85 intertidal and 30 subtidal; Figure 2-1).

3 Port Washington Narrows Conceptual Site Model

3.1 Setting

PWN is a 3.5-mile-long channel that connects Sinclair Inlet (connected to the main body of Puget Sound) with Dyes Inlet on the Kitsap Peninsula. The segment targeted for the ~~Anthropogenic~~Site-specific Background Study extends 1.6 miles and has a channel width ranging from 1,000 to 1,800 feet. Due to the large tidal fluctuations within the narrow channel, high tidal current velocities are observed during ebb and flood tides, which reverse directions twice daily. The predominance of gravel in the PWN is the result of these high current velocities. A tidal velocity report is provided in Appendix E of the RI Data Report (Anchor QEA and Aspect 2021).

Bremerton is the largest city on the Kitsap peninsula (40,681 people based on the 2019 census) and home to Puget Sound Naval Shipyard (a sediment cleanup site) in Sinclair Inlet and the Bremerton Annex of Naval Kitsap Base in Dyes Inlet. PWN is located within Bremerton, with residences as the primary waterfront land use along both shores of the PWN. The gravel beaches along PWN are open to the public and can be accessed from public parks (Lions Park located on the north shore of PWN, and Lillian A. & James Walker Park on the south shore) from roads that terminate at the PWN, and from houses and condominiums along the shore. Nonresidential land uses are also present along the PWN waterfront, including Bridgeview Marina just west of the former Gas Works property. Warren Avenue Bridge connecting East Bremerton and Central Bremerton runs over PWN to the east of the ISA. The former Gas Works property is one of several former industrial properties along PWN.

3.2 Outfalls

Because of its central location at the base of both Central Bremerton and East Bremerton, PWN is the receiving water for the majority of CSOs in the Bremerton wastewater system and numerous stormwater outfalls that service a large portion of Bremerton.

3.2.1 Combined Sewer Overflows

Ten CSO outfalls are located in the 1.6-mile PWN Study Area (Figure 3-1; City of Bremerton 2021). On the southern shoreline of PWN, two CSO outfalls are located west of the ISA (OF-8 and OF-9); three are located within the ISA (OF-10, OF-11, and OF-12); and one is located to the east (OF-13). The East Plant sewage treatment plant is located across PWN from the ISA, along with four CSO outfalls (OF-6, OF-1, OF-2, and OF-3 from west to east). These 10 CSOs service six drainage basins (Tracyton Beach, Pine Road, Stevens Canyon, Cherry Avenue, Warren Avenue, and Anderson Cove) for a combined area of 2,300 acres.

Under the NPDES permit for the sewage treatment plant, CSOs are allowed an average of one discharge event per year over a 20-year period. Most of the major CSO system upgrades were completed in 2009. Since that time (i.e., from 2010 through 2021~~0~~~~[2]~~), all CSOs have discharged less

~~[2] Reporting for 2021 has not been compiled at the time of writing.~~

than once per year with the exception of OF-11 and OF-17. The 10 CSOs in the PWN Study Area have averaged a combined 4.2 overflow events per year. Based on the 2020 CSO Report, OF-11 is expected to come into compliance following the completion of a pump station in 2020 (City of Bremerton 2021).

CSO outfall receiving sediments were sampled in 2018 under the sewage treatment plant's NPDES permit (Cosmopolitan Marine Engineering 2018). Three CSO outfalls within PWN were sampled (OF-~~-~~-6, OF-12, and OF-13) for metals and PAHs and compared to Washington State Sediment Management Standards criteria. These samples contained detectable concentrations of PAHs at magnitudes similar to the concentrations observed in this study. ~~For example, the average~~The six ~~benzo(a)pyrene concentration~~ samples collected outside of the ISA (three samples each collected near outfalls OF-6 and OF-13) contained benzo(a)pyrene at concentrations that range from 10 ~~was 32~~ ~~micrograms per kilogram~~ (µg/kg~~)~~ ~~for locations outside of the ISA (OF-6 and OF-13), ranging from nondetected~~ to 68 µg/kg with a mean of 32 µg/kg. In comparison, the final Site-specific Background dataset contained benzo(a)pyrene concentrations that range from nondetect to 267 µg/kg with a mean of 21 µg/kg (see Section 5). The 2018 outfall samples were not included in the Site-specific Background dataset because they targeted CSO receiving sediments, rather than samples located based on a grid approach.

3.2.2 Stormwater

CSO events are periodic and contribute relatively low volumes of discharges to the PWN. However, stormwater discharges occur throughout the year (depending on daily precipitation) and result in a relatively larger volume of inputs to PWN. Nine of the 10 CSO outfalls located within the PWN Study Area service stormwater in addition to CSO events. Moreover, at least 12 additional stormwater outfalls are located in the 1.6-mile PWN Study Area (Figure 3-1). Less is known about these outfalls compared to the CSOs because they are not consolidated under a single permit. The total drainage area of the storm drain network discharging to PWN is not known.

3.3 Sediment Physical Characteristics

The sediment physical characteristics in the PWN Study Area are generally similar to those observed within the ISA, consisting primarily of coarse-grained gravels with low TOC concentrations. However, the ISA had higher TOC concentrations related to Site impacts, as illustrated by the following summary statistics:

Percentile	TOC (percent)		Total Fines (percent)	
	Surface Sediment Site Data (190 samples)	**~~Anthropogenic~~Site-specific Background Dataset (115 samples)**	**Surface Sediment Site Data (84 samples)**	**~~Anthropogenic~~Site-specific Background Dataset (115 samples)**
10%	0.17	0.064	0.1	~~1.7~~0.1

Percentile	TOC (percent)		Total Fines (percent)	
	Surface Sediment Site Data (190 samples)	~~Anthropogenic~~Site-specific Background Dataset (115 samples)	Surface Sediment Site Data (84 samples)	~~Anthropogenic~~Site-specific Background Dataset (115 samples)
50%	0.55	0.15	3.0~~1~~	~~4.0~~3.0
90%	4.0	0.38	50	~~10~~9.9

3.4 Summary

PWN has distinct characteristics compared to other areas of Puget Sound. High current velocities inhibit the settling of fine-grained particles and organic matter, resulting in sediments that are mostly gravel and have low organic carbon content (and associated organic contaminant concentrations). However, a high density of active CSOs and stormwater outfalls results in substantial anthropogenic inputs to the PWN compared to the size of the waterbody, resulting in higher concentrations of organic contaminants heterogeneously distributed throughout the area. These counteracting effects can be observed in the data, as discussed in the following section.

4 Data Evaluation

4.1 Contaminant Selection

~~Anthropogenic Background~~Background is used to delineate site areas and establish cleanup levels for chemicals that have low risk-based threshold concentrations[3] because cleanup levels are not typically established below background levels. ~~Anthropogenic Background is~~Background is not relevant for chemicals that do not contribute to Site risk above regulatory thresholds (i.e., chemicals with less than 10^{-6} excess cancer risk). Therefore, a relevant subset of chemicals was retained for this evaluation based on the relative contribution to Site risk described in the Draft Risk Assessment Technical Memorandum (Anchor QEA 2020a). The other chemicals (i.e., those chemicals for which ~~Anthropogenic~~Site-specific Background is unlikely to be relevant) are retained in the ~~Anthropogenic~~Site-specific Background dataset (Attachment E) but are not evaluated in detail for this study.

Based on the draft risk assessments, the seven ~~carcinogenic PAHs (~~cPAHs~~)~~ including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-c,d)pyrene together contribute >99% of the excess cancer risk from all PAHs. Of these, benzo(a)pyrene alone contributes 72% of total PAH risk. Based on this

[3] A risk-based threshold concentration is the average sediment concentration that is estimated to achieve a risk target (for example, the estimated sediment concentration that would achieve 1×10^{-6} excess cancer risk).

information, the individual cPAHs are retained for evaluation in this report, and total PAHs are presented for informational purposes, resulting in the following list:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(a,h)anthracene
- Indeno(1,2,3-c,d)pyrene
- Total cPAH ~~toxic equivalent (TEQ; EPA 1993) (U = 1/2)~~TEQ
- Total PAH (16) (U = 0)
- Total Benzofluoranthenes (U = 1/2)

Maps of the ~~Anthropogenic~~Site-specific Background sample locations and concentrations for these chemicals are presented in Figures 4-1a through 4-1~~i~~j. If later refinements to the risk assessments indicate other contaminants exceed thresholds, the ~~Anthropogenic~~Site-specific Background calculations can be conducted on the ~~Anthropogenic~~Site-specific Background dataset as part of the RI/FS process.

4.2 Statistical Distributions

4.2.1 Histograms

Figures 4-2a through 4-2~~i~~j show histograms of concentrations for the chemicals included in the analysis. The histograms are plotted with the probability of occurrence on the y-axis (with all bars of the histogram summing to 1.0) with 50 ~~bins~~ bars distributed along the x-axis for each chemical. Histograms were used to make visual observations to inform subsequent distribution and outlier analyses.

All PAH concentration distributions were highly skewed, with the majority of probability in the lowest concentration samples~~, indicating that most locations in PWN have concentrations similar to Natural Background~~. However, all PAHs included some samples with higher concentrations, consistent with diffuse anthropogenic sources. As discussed in Section 3.4, the low concentration samples were likely due to scour of fine-grained material from tidal currents, and the higher concentrations were likely due to diffuse inputs from the high number of outfalls that convey nonpoint sources to the PWN (see Section 3).

4.2.2 Distribution Comparison Tests

The data were compared to common statistical distributions to assess the potential use of parametric tests and methods. Concentration distributions were compared to common theoretical parametric distributions (normal, lognormal, and gamma) using the EPA statistics tool ProUCL. ProUCL algorithms can provide estimates that account for samples with nondetect results. Nondetect sample concentrations are reported as unknown values between zero and the detection limit. The detection limit is the lowest concentration that a laboratory procedure can reliably detect. The Site-specific Background dataset had a relatively high fraction of nondetect results, ranging from 24% (benzo(b)fluoranthene and chrysene) to 63% (dibenzo(a,h)anthracene). Because detection limits can skew the results of a distribution comparison test, these tests are performed on detected values only. Statistical methods are then used to estimate population distribution parameters in consideration of both detect and nondetect values. Note that sample population distribution parameters can be highly sensitive by nondetect treatment, particularly for lognormal distributions.

Table 4-1 presents the distribution choice using the ProUCL algorithm, which runs multiple tests in a step-wise fashion. All distributions are far from normally distributed, and were all classified as lognormally distributed with the exception of dibenzo(a,h)anthracene, which fit a gamma distribution based on the ProUCL algorithm. These results are consistent with the visual observations for the histograms.

Figures 4-3a through 4-3j~~i~~ show the probability plots (i.e., Q-Q plots) for the PAHs for the selected distribution in each case for detected values only. The diagonal lines on the plots show the theoretical distribution fit: If the data fit a theoretical distribution, they appear on the line. Consistent with the distribution comparisons and the histograms, the probability plots show qualitatively that the PAHs are well represented by the lognormal (or gamma) distribution.

4.3 Evaluation of Potential Outliers

Outliers are very high or very low values that have the potential to result in unrepresentative statistics and data comparisons. EPA guidance defines outliers as measurements that are unusually larger or smaller than the remaining data, and which are not representative of the sample population from which they were drawn (EPA 2002a). Geiselbrecht et al. (2019) distinguish between false outliers and true outliers as follows:

> ***False outliers.*** *Measurements that are very large or small relative to the rest of the data but represent true extreme values of a distribution and indicate more variability in the population than was expected (USEPA 2006).*
>
> ***True outliers.*** *Measurements that are very large or small relative to the rest of the data but are a result of transcription errors, data-coding errors, or measurement system problems (USEPA 2006).* (Geiselbrecht et al. 2019)

Based on the ~~Anthropogenic~~Site-specific Background study sampling design process, field sampling methods, and laboratory data validation procedures used in this study, there is no evidence for "true outliers" in the data. The retained samples are broadly representative of the dynamic conditions within PWN.

Therefore, this analysis focuses on the so-called "false outliers," or the extreme values in the dataset that may result in unrepresentative statistics. These are values that were observed in the ~~Anthropogenic~~Site-specific Background study, but which are not expected to be observed in the future. In this context, the purpose of the outlier evaluation is to identify aberrant values that would not be observed in the future.

As noted in statistical guidance, the application of outlier tests to remove outliers requires caution:

> *If no error can be detected and corrected, outliers should not be discarded based solely on the fact that they appear unusual. Outliers are often discarded in order to make the data fit nicely to a preconceived theoretical distribution. There is no reason to suppose that they should! The entire dataset may arise from a skewed distribution, and taking logarithms or some other transformation may produce quite symmetrical data. Even if no transformation achieves symmetry, outliers need not be discarded.* (Helsel 2020)

The outlier evaluation was performed in the following three steps:

1. Potential outliers were identified graphically. Consistent with standard statistical practice, potential outliers were visually evaluated by looking for high concentration samples that appear to the upper left of the diagonal line on the appropriate (lognormal or gamma) probability plot.
2. Walsh's outlier test was performed on potential outliers. Walsh's test is a nonparametric test that is identified by EPA guidance (EPA 2006) for non-normally distributed datasets where n is greater than 50 and multiple false outliers may be present. The more common Rosner test assumes normality after outlier removal, which is not the case in this dataset based on ProUCL evaluations. Therefore, the Rosner test is not applicable for these data.
3. For any sample identified by Walsh's test, a sensitivity analysis was performed to compare the impact of removing the sample(s).

Identified sample~~s~~ values were then considered for removal from the dataset based on the statistical tests in the context of the conceptual site model.

4.3.1 Outlier Evaluation Results

Table 4-2 presents data for the outlier evaluation. Potential outliers were identified graphically by evaluating concentrations on appropriate QQ plots based on the distribution fitted for each chemical. Only one sample, for dibenzo(a,h)anthracene (station BGW-PWN-752), was identified as a potential outlier based on the visual evaluation. Walsh's test also identified the visual sample as an outlier.

As an additional check, Walsh's test was run on the upper 5% of all samples for all chemicals for a comparison to the visual evaluation. The test identified a group of three potential outliers (stations BGW-PWN-777, BGW-PWN-752, and BGW-PWN-604) based on the concentration difference between the third highest and the fourth highest concentration samples in the indeno(1,2,3-c,d)pyrene dataset. Statistics are presented for these chemicals with the highest value(s) removed for comparison in Table 4-2.

4.3.2 Outlier Evaluation Summary

Potential outliers were considered for removal from the ~~Anthropogenic~~Site-specific Background dataset based on the statistical evaluation and in light of the conceptual site model. No identified samples were removed from the dataset, primarily because they are consistent with the conceptual site model of conditions in PWN and therefore consistent with conditions that are expected to persist into the future due to diffuse stormwater inputs.

For indeno(1,2,3-c,d)pyrene, the ~~highest~~ three highest concentration samples were identified ~~as outliers~~by the Walsh's test, solely because of the concentration difference between ~~them~~ those samples and the next highest ~~sample~~ concentration samples. The TOC content and percent fines were typical for PWN for the three locations. All three of the samples are considered representative of sediments in PWN.

Dibenzo(a,h)anthracene has a unique distribution compared to the other chemicals in the evaluation. It was the only chemical that was closest to a gamma distribution, and it had the ~~most~~ fewest detections~~nondetects~~ compared to the other chemicals. ~~(Table 4-2). Because~~ As shown in Table 4-2, the temporary removal of the identified sample (BGW-PWN-752) does not impact the statistics for the chemical, due to ~~of~~ the size and characteristics of the dataset. This further confirms that removing the sample from the dataset is not warranted because the sample does not unduly impact summary statistics.~~, the removal of the identified sample does not impact the statistics for the chemical~~.

EPA independently performed an outlier analysis on the dataset, supporting the conclusion that there are no outliers in the dataset (Attachment F.1).

5 Summary and Conclusions

The ~~Anthropogenic~~Site-specific Background dataset consists of 115 samples (Section 2.3). The PAH distributions of the 115 samples were skewed due to the dynamic tidal conditions and configuration of the PWN, combined with a large number of stormwater outfalls and CSOs. An outlier evaluation was performed on the PAHs of interest to identify any samples that are unrepresentative of the population of samples from PWN. No samples were identified as potentially unrepresentative. Summary statistics for the resulting ~~Anthropogenic~~Site-specific Background dataset using statistical methods selected by EPA (Attachment F.2) are presented in Table 5-1 and summarized as follows:

Chemical	UCL95 (µg/kg)	95/95 UTL (µg/kg)
Benzo(a)anthracene	27	150
Benzo(a)pyrene	33	125
Benzo(b)fluoranthene	26	99

Chemical	UCL95 (µg/kg)	95/95 UTL (µg/kg)
Benzo(k)fluoranthene	18	66
Chrysene	44	162
Dibenzo(a,h)anthracene	4.1	17
Indeno(1,2,3-c,d)pyrene	23	84
Total cPAH TEQ (EPA 1993)	49	183
Total PAH (16)	458	3,277
Total Benzofluoranthenes	72	261

The additional sample collection in the second round of the study ~~successfully~~ significantly reduced the uncertainty in the evaluation. For benzo(a)pyrene, the upper confidence interval on the mean is 11.5 µg/kg (upper confidence limit [UCL]) 95 minus the measured mean), compared to 23 µg/kg for the 1000+ dataset. The upper confidence interval on the 95th percentile (95/95 upper tolerance limit [UTL] minus the measured 95th percentile) is 7 µg/kg compared to 44 µg/kg for the 1000+ dataset. These statistics highlight the importance of large datasets for evaluating skewed data. ~~In the RI/FS, the 95/95 UTL will be used to develop the Site area, and the UCL95 on the mean will be used in developing preliminary remediation goals for the Site.~~

6 References

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Tables

Figures

Attachment A.1
Third SQAPP Addendum

Attachment A.2
Fourth SQAPP Addendum

Attachment B
700-Series Results Table

Attachment C

Field Forms

Attachment D.1
Laboratory Reports

Provided as a separate PDF due to file size

Attachment D.2
Data Validation Reports

Provided as a separate PDF due to file size

Attachment E

~~Anthropogenic~~ Site-Specific Background Study Data

Attachment F.1

~~Anthropogenic~~ Site-Specific Background Outlier Evaluation and Discussion of Upper Bounds for Establishing Background Levels

Attachment F.2

~~Anthropogenic~~ Site-Specific Background Upper Tolerance Limit for Establishing Background Levels