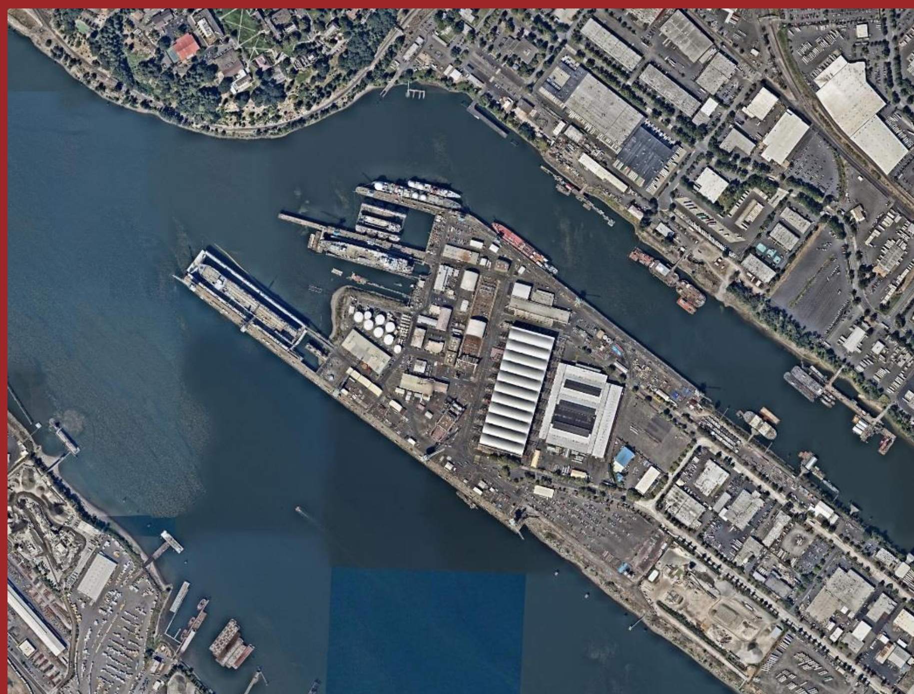
Vigor Shipyards

Final Monitoring, Performance Evaluation, and Contingency Plan



Prepared for

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LIMITATIONS

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The interpretations and conclusions contained in this report are based in part on site characterization data collected by others and provided by Vigor Industrial LLC. Floyd|Snider cannot assure the accuracy of this information.

Final Monitoring, Performance Evaluation, and Contingency Plan

This document was prepared for
Vigor Industrial LLC
under the supervision of:

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Date: August 20, 2018

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
1200-Z Permit	1200-Z General Industrial Stormwater Permit
BMP	Best management practice
City	City of Portland
COI	Contaminant of interest
CUL	Cleanup level
DMR	Discharge Monitoring Report
DQO	Data quality objective
EC	Electrocoagulation
gpm	Gallon(s) per minute

Acronym/ Abbreviation	Definition
ID	Sample identification code
JSCS	Joint Source Control Strategy
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LOE	Line of evidence
MDL	Method detection limit
µg/L	Micrograms per liter
MPECP	Monitoring, Performance Evaluation, and Contingency Plan
MS	Matrix spike
MSD	Matrix spike duplicate
NPDES	National Pollutant Discharge Elimination System
ODEQ	Oregon Department of Environmental Quality
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PQL	Practical quantitation limit
QA	Quality assurance
QC	Quality control
ROD	Record of Decision
RPD	Relative percent difference
SCM	Source control measure
SLV	Screening level value
SOP	Standard operating procedure
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
Vigor	Vigor Industrial LLC
WOE	Weight-of-evidence

1.0 Introduction

This Final Monitoring, Performance Evaluation, and Contingency Plan (MPECP) was prepared by Floyd|Snider on behalf of Vigor Industrial LLC (Vigor) for its Portland facility (the facility), located on Swan Island at 5555 North Channel Avenue in Portland, Oregon (Figure 1.1). This report has been prepared in accordance with the Order on Consent (Consent Order) issued by the Oregon Department of Environmental Quality (ODEQ) on December 19, 2016 (DEQ No. OPV-NWR-16-05). The Consent Order requires Vigor to prepare and submit a Final MPECP after receipt of ODEQ and U.S. Environmental Protection Agency (USEPA) comments on the Draft MPECP. The Draft MPECP was submitted to ODEQ on February 19, 2018, and Vigor received ODEQ comments on June 22, 2018. This Final MPECP has been revised to address ODEQ and USEPA comments on the Draft MPECP.

1.1 BACKGROUND AND PURPOSE OF PLAN

The Consent Order requires the implementation of stormwater source control measures (SCMs) to control stormwater as a potential contaminant pathway to the Willamette River. The objectives of the stormwater SCMs are to prevent sediment recontamination and to prevent unacceptable risk to in-water receptors posed by facility contaminants of interest (COIs)—including arsenic, cadmium, copper, lead, mercury, zinc, polycyclic aromatic hydrocarbons (PAHs), phthalate esters, tributyltin, and polychlorinated biphenyls (PCBs)—in stormwater discharging to the Willamette River and to the Swan Island Lagoon. The stormwater SCMs implemented at the facility, as described in the Stormwater SCM Revised Final Design Report (referred to as the Revised Final Design Report; Floyd|Snider 2018), include a 400 gallons per minute (gpm) electrocoagulation stormwater treatment system (EC system), media filtration systems installed in catch basins, downspout treatment measures, and best management practices (BMPs). Vigor completed installation of the stormwater SCMs in June 2017. The locations of the primary SCMs and their associated stormwater basins and outfalls are shown on Figure 1.2.

The primary objectives of this MPECP, as defined in the Consent Order, are the following:

- Monitoring variations in stormwater quality at the facility
- Monitoring contaminant concentrations in stormwater
- Evaluating the effectiveness of stormwater SCMs
- Evaluating the effectiveness of operational stormwater treatment systems in attaining the stormwater SCM objectives.

To achieve these objectives, the stormwater SCMs will be evaluated as described in this MPECP and in accordance with Vigor's National Pollutant Discharge Elimination System (NPDES) 1200-Z General Industrial Stormwater Permit (1200-Z Permit) and the *Portland Harbor Joint Source Control Strategy* (JSCS) guidance (ODEQ and USEPA 2005). This MPECP also proposes contingency measures to be implemented in the event that the stormwater SCM objectives are not being achieved during the monitoring and performance evaluation program.

Additional information describing facility operations and activities, stormwater management systems, and primary stormwater SCMs is provided in the Stormwater SCM Work Plan Rev 1 (referred to as the Work Plan; ERM 2017a), the Preliminary Design Report (ERM 2017b), and the Revised Final Design Report (Floyd|Snider 2018), which includes an Operations and Maintenance Plan (referred to as the O&M Plan) for the stormwater SCMs. As described in the Work Plan, the performance goals for the stormwater SCMs (i.e., target design criteria) include screening criteria required for source control. The screening criteria for evaluating stormwater for source control include the cleanup levels (CULs) specified in the 2017 Portland Harbor Record of Decision (ROD; USEPA 2017) and the JSCS Table 3-1 Screening Level Values (SLVs) for contaminants without CULs. The screening criteria are presented in Table 1.1.

1.2 DOCUMENT ORGANIZATION

This MPECP is organized as follows:

- **Section 2.0 – Project Team and Responsibilities.** This section describes the various management responsibilities and field and laboratory quality assurance (QA) responsibilities of key project personnel.
- **Section 3.0 – Performance Monitoring of Stormwater Source Control Measures.** This section provides an overview of the primary stormwater SCMs that have been implemented at the facility, the proposed monitoring locations, the monitoring parameters, and the frequency and duration of monitoring periods.
- **Section 4.0 – Sampling and Analysis Protocols.** This section describes the sample collection procedures, techniques, and equipment and identifies the analytical methods and reporting protocols for the stormwater sampling results.
- **Section 5.0 – Quality Assurance/Quality Control Procedures.** This section describes the field and analytical QA and quality control (QC) procedures.
- **Section 6.0 – Data Reduction, Validation, and Reporting.** This section describes the initial data reduction, validation, and reporting to be performed the laboratory.
- **Section 7.0 – Corrective Actions.** This section describes the corrective actions and responsibilities related to field sampling and the laboratory to ensure compliance with the MPECP.
- **Section 8.0 – Data Reporting and Evaluation Procedures.** This section describes the data evaluation that will be performed after each sampling event, as well as the associated documentation and reporting procedures. It also describes the evaluation of data for trend analysis, for achievement of the stormwater SCM objectives and criteria, and to determine whether there is a need to implement contingency SCMs or modify the long-term stormwater monitoring plan.

- **Section 9.0 – Conclusions and Schedule**. This section provides a conclusion and schedule for MPECP finalization and implementation.
- **Section 10 – References.** This section provides the facts of publication for the sources of information cited in this plan.

2.0 Project Team and Responsibilities

Vigor will perform field sampling activities associated with the stormwater SCM performance monitoring. Specialty Analytical in Portland, Oregon, will be the primary analytical laboratory, performing all chemical analyses on samples that are collected and submitted.

The various management responsibilities and field and laboratory QA responsibilities of key project personnel are defined in this section.

2.1 MANAGEMENT RESPONSIBILITIES

2.1.1 Gordon Erickson—Vigor Project Manager

Gordon Erickson is Vigor's Point of Contact and Project Manager for this project. He will oversee all aspects of the project planning and implementation.

2.1.2 Corey Wilson—Floyd|Snider Project Manger

Corey Wilson will have overall responsibility for project implementation. As Project Manager, he will be responsible for the overall QA on this project to ensure that the technical and contractual requirements are met. He will report directly to Vigor's Project Manager and be responsible for technical quality control (QC) and project oversight.

2.2 QUALITY ASSURANCE RESPONSIBILITIES

2.2.1 Adia Jumper—Floyd|Snider QA Manager

The Floyd|Snider QA Manager will report directly to the Floyd|Snider Project Manager and will be responsible for ensuring that all QA/QC procedures for the project are being followed. The Floyd|Snider QA Manager will be responsible for laboratory coordination and management of data validation for all sample results from the analytical laboratory.

2.2.2 Chell Black—Floyd|Snider Data Manager

The Floyd|Snider Data Manager will be responsible for data validation of all sample results from the analytical laboratory and will enter the data into a database. The Data Manager will also: review all laboratory reports, provide advice related to data corrective action procedures, perform QA/QC on analytical data reports, and oversee the database management and queries

2.3 LABORATORY RESPONSIBILITIES

Specialty Analytical will provide all chemical analytical services in support of the SCM performance monitoring activities.

2.3.1 Specialty Analytical Project Manager

The Specialty Analytical Project Manager will report directly to the Floyd|Snider QA Manager and will be responsible for ensuring that all resources of the laboratory are available, advising Floyd|Snider on the status of analytical reports, reviewing and approving final analytical reports, coordinating internal laboratory analyses and in-house chain-of-custody procedures, and overseeing the data review.

2.4 FIELD RESPONSIBILITIES

2.4.1 Harrison Holzgang—Vigor Field QA Officer

The Vigor Field QA Officer will be responsible for leading and coordinating the day-to-day field activities. The Field QA Officer will report directly to the Vigor Project Manager and will provide overall direction related to the field sampling in terms of logistics, personnel assignments, and field operations. He will supervise the collection of the field samples and will be responsible for: recording sample locations and identification; ensuring conformance with the sampling and handling requirements, including field decontamination procedures; physical evaluation and logging of the samples; and ensuring an appropriate chain-of-custody for the samples.

3.0 Performance Monitoring of Stormwater Source Control Measures

This section provides an overview of the primary stormwater SCMs that have been implemented at the facility, the proposed monitoring locations, the frequency and duration of monitoring periods, and the analytical parameters to be analyzed.

3.1 STORMWATER SOURCE CONTROL MEASURES

Vigor has implemented four types of stormwater SCMs to prevent sediment recontamination and unacceptable risk to in-water receptors posed by the COIs in stormwater discharging from the facility to the Swan Island Lagoon and the Willamette River. The facility stormwater SCMs are described in detail in the Revised Final Design Report (Floyd|Snider 2018). An overview of the stormwater SCMs at the facility is provided in Sections 3.1.1 through 3.1.4, and their locations are shown on Figure 1.2.

3.1.1 Electrocoagulation System

Stormwater from drainage basins E, F, Q, S, and S1 (totaling 12.4 acres) is collected and pumped by means of lift stations to a 1,000,000-gallon detention tank before being conveyed to the EC system for treatment and discharge. The EC system, which has an operating capacity of 400 gpm, treats stormwater by applying an electrical current to generate flocculants and then physically (by density driven settling or filtration) removes contaminants from the stormwater. Treated stormwater is discharged to the Willamette River through Outfall BWTP-1 (Figure 1.2).

3.1.2 Media Filtration Systems

Four types of media filtration systems have been installed in the catch basins: (1) catch basin retrofits; (2) catch basin fabric filter inserts with media (fabric filters); (3) in-line media filters (referred to as storm drain filter socks in the Preliminary Design Report (ERM 2017b); and (4) media bags. Stormwater media filtration systems contain APTsorb, a peat-based filter media. The peat media is a fine-grained, highly porous material that is rich in carbon, which is effective at removing metals, PCBs, PAHs, and phthalates in stormwater by adsorption processes. Media filtration systems are used in catch basins to passively treat contaminants in stormwater drainage as it enters the catch basin. As stormwater flows through the filter media, particulate and dissolved contaminants are removed by physical and chemical processes. In general, the media filtration systems are used in drainage basins that discharge directly to the Swan Island Lagoon or the Willamette River, rather than conveying the flow to the EC system.

3.1.3 Downspout Treatment Measures

Downspout treatment measures have been installed at roof drain downspouts to treat roof runoff. They include Grattix boxes and 55-gallon drum retrofits. The Grattix boxes contain a bioretention soil mix (i.e., sand and compost mix) for contaminant removal by filtration and adsorption. The 55-gallon drum retrofits are used where space limitations do not permit Grattix box installations. The 55-gallon drum retrofits contain APTSorb for contaminant removal. As an adaptive management measure, half of the 55-gallon drum retrofits installed at Building 72 in drainage basin R and at Building 50 in drainage basin T have been amended with biochar. Effluent discharges from downspout treatment measures are reconnected to downspouts or discharged to the ground surface and allowed to drain to nearby catch basins as sheet flow.

3.1.4 Best Management Practices

BMPs have been implemented across the facility and overwater structures where central conveyance systems are not present or media filtration systems are infeasible. The BMPs currently include weekly regenerative air sweeping, bi-annual crane rail cleaning, quarterly catch basin cleaning, and project-specific cleanup and control (i.e., preventative maintenance, sweeping, and increased frequency of catch basin clean outs during and after the completion of specific project activities). Vigor uses a high-efficiency filtration sweeper in high-traffic areas and storage areas to trap fine particulates and reduce these sources of stormwater contaminants. Vigor conducts monthly stormwater inspections of areas where industrial materials or activities are exposed to stormwater.

3.2 PROPOSED MONITORING LOCATIONS

The facility consists of a 64-acre parcel and 4.9 acres of overwater structures that discharge stormwater through 51 private outfalls and two City of Portland (City) outfalls to the Swan Island Lagoon and the Willamette River. Five of these outfalls typically do not discharge stormwater but rather serve as overflows during storm events that exceed the design storm flows for drainage basins whose discharge is typically conveyed to the EC system. In 2016 and 2017, Vigor completed a substantially similar effluent evaluation under the facility’s 1200-Z Permit that grouped drainage basins together based on the industrial activities and processes, stored materials, stormwater management practices, and flow characteristics. In its initial analysis submitted to ODEQ prior to issuance of its 1200-Z Permit, Vigor identified seven representative groups of drainage basins for stormwater sampling. Vigor subsequently identified two additional representative drainage basin groups, Pier C and Pier D, for source control monitoring. Stormwater sampling will be conducted in the N-series basins to evaluate stormwater SCMs installed in the basins. The substantially similar effluent evaluation considered the various types of stormwater SCMs and treatment systems at the facility; therefore, similar stormwater basin groups are appropriate for use in this MPECP for the evaluation of the effectiveness of the stormwater SCMs and treatment systems across the drainage basins. The substantially similar drainage basins and outfalls are shown on Figure 3.1. Drainage basin characteristics including their sizes, substantially similar outfalls and representative sampling point, and primary and contingency stormwater SCMs are presented in Table 3.1.

Specific locations that are proposed for monitoring by means of stormwater grab samples and composite sampling are identified in Sections 3.2.1 and 3.2.2, respectively. Additional performance monitoring locations for evaluating the removal efficiency and performance of the EC system, media filtration systems, and downspout treatment measures are discussed in Section 3.2.3.

3.2.1 Stormwater Grab Sampling and Monitoring Locations

Stormwater grab samples will be collected to characterize the nature of stormwater discharge at a particular point in time for a storm event. Concentrations of COIs in stormwater grab samples can vary depending on the time of sample collection during a storm event, the frequency and magnitude of the storm, and the daily, weekly, or monthly variations in industrial activities conducted in a drainage basin. Grab samples will be used to determine concentrations or a concentration range of the COIs in stormwater. The proposed stormwater grab sampling locations are shown on Figure 1.2. These locations are consistent with the sampling locations that are required by the 1200-Z Permit. For the nine drainage basin groups, one representative outfall or monitoring location will be used for the stormwater grab sampling:

- **Group G** – Group G makes up approximately 6.40 acres of the facility and consists of the north side laydown area including smaller drainage basins A, B, C, D, G, H, I, J, J1-B, J2, and J3. The Group G drainage basins discharge to the Swan Island Lagoon. Each drainage basin has between one and four catch basins that drain to a single outfall. Activities in these basins include equipment and material storage, roadway use, and parking. The stormwater SCMs implemented in Group G consist of catch basin retrofits, fabric filters installed in catch basins, and BMPs. The monitoring location for Group G is Outfall G.
- **Group LD1-B** – Group LD1-B makes up approximately 8.45 acres of the facility and consists of laydown areas LD1-A through LD7-B along the southern portion of the facility, which discharge to the Willamette River. Each laydown area drains to a single catch basin and outfall. Activities in these basins include equipment and material storage, roadway use, and parking. The stormwater SCMs implemented in Group LD1-B include catch basin retrofits and BMPs. The monitoring location for Group LD1-B is Outfall LD1-B.
- **Group M** – Group M makes up more than 17.4 acres of the facility and consists of larger drainage basins M and O, which provide production support for vessel construction. Building 4 occupies approximately 7.8 acres of drainage basins M and O. Both drainage basin conveyance lines connect to the City’s stormwater conveyance system. Drainage basin M ultimately discharges to the Swan Island Lagoon, and drainage basin O discharges to the Willamette River. The stormwater SCMs implemented in Group M consist of all four types of media filtration systems, downspout treatment measures at Building 4, and BMPs. The monitoring location for Group M is the location in drainage basin M where Vigor’s conveyance system discharges to the City’s conveyance system along North Lagoon Avenue.
- **Group M1** – Group M1 makes up approximately 6.05 acres of the facility and consists of larger drainage basins L, L1, M1, and N, which discharge to the Swan Island Lagoon. The stormwater SCMs implemented in Group L include catch basin retrofits, fabric filters, and BMPs. The monitoring location for Group M1 is Outfall M1.
- **Group N-Series** – The Group N-Series makes up approximately 2.67 acres of the facility and consists of basins N1, N2, N3, N4, N5, and N6, which are used for laydown

material storage. Each drainage basin consists of a single catch basin and outfall that discharge to the Swan Island Lagoon. The stormwater SCMs implemented in the Group N-Series basins consist of catch basin fabric filters and BMPs. Outfalls for the Group N-Series basins are generally submerged and inaccessible from the upland portion of the facility. Vigor is currently evaluating sampling locations to select a representative location of effluent from the stormwater SCMs in one of the N-series drainage areas. The catch basin in the N5 Basin is identified as the tentative sampling location for the N-series basins. The monitoring location for Group N-Series will be documented in the Monitoring and Performance Evaluation Report.

- **Group P** – Group P makes up approximately 8.46 acres of the facility and consists of drainage basin P, which is used for employee parking and laydown material storage. Stormwater from drainage basin P is discharged to the Willamette River. The stormwater SCMs implemented in Group P consist of fabric filters installed in catch basins and BMPs. The monitoring location for Group P is Outfall P.
- **Group Q** – Group Q makes up more than 12.4 acres of the facility and consists of drainage basins E, F, Q, S, and S1, which include the outdoor buildway and production support. Stormwater from these drainage basins is pumped and treated at the EC system and discharged to the Willamette River through Outfall BWTP-1. The monitoring location for Group Q is the effluent sampling port at the EC system.
- **Group R** – Group R makes up approximately 3.80 acres of the facility and primarily consists of roof drainages in areas K, R, R1, J1-A, and T. Potential contaminants in stormwater in this group originate primarily from roof top sources. The stormwater SCMs implemented in Group R drainage basins consist of downspout treatment measures and media filtration systems. The monitoring location for Group R is Outfall R.
- **Group Pier C** – Pier C makes up approximately 1.31 acres of the facility and consists of an overwater structure that supports dry dock activities in the western portion of the facility, at the transition between the Swan Island Lagoon and the Willamette River. Stormwater is collected by scuppers that discharge directly to the receiving water. The stormwater SCMs implemented along Pier C consist of BMPs. The monitoring location is a scupper centrally located on Pier C.
- **Group Pier D** – Pier D makes up approximately 4.59 acres and consists of three overwater structures (Berths 312 through 314) that span the length of the facility at its southern boundary. Stormwater is collected by catch basins and discharged through more than 40 outfalls to the Willamette River. There are three catch basins per outfall along Berth 312 and two catch basins per outfall along Berths 313 and 314. The stormwater SCMs implemented along Pier D consist of BMPs. The monitoring location for Pier D is the outfall located on Berth 313.

Visual monitoring will also be conducted at the stormwater SCMs installed in the drainage basins described above. Overflow occurrences at the media filtration systems will be documented during the sampling events to evaluate changes in treatment system capacity and flow-through rates. Lift stations 1 through 3 are equipped with alarm systems to notify the Vigor Field QA Officer of overflow events, and alarms triggered due to high flows will be documented in the field forms. Operation and maintenance of the SCMs and BMPs is documented in the O&M Plan submitted as an appendix in the Revised Final Design Report (Floyd|Snider 2018). Occurrences of overflow at the media filtration systems and lift stations will be evaluated against rainfall data to determine whether the storm event was greater than the approved water quality design storm. Visual monitoring will be included in the weight-of-evidence (WOE) evaluations as described in Section 8.2.2.

3.2.2 Stormwater Composite Sampling Locations

As described in the JSCS, composite samples typically characterize stormwater quality during a longer period of runoff. Vigor will attempt to conduct one stormwater composite sampling event at each of the locations described in Section 3.2.1. The composite sampling event will occur during one of the four grab sampling events at each location. For media filtration systems and downspout treatment measures with the potential for overflow during periods of high flow in a storm event, composite sampling captures both treated water during no overflow and untreated and treated water during overflow. If access constraints and storm drain configurations at the grab sampling locations described in Section 3.2.1 prevent installing composite sampling equipment, the composite sampling will be performed at the stormwater collection structure (i.e., catch basin or manhole) farthest downstream, as close as possible to the point of discharge at which the grab samples are collected. Any adjustments to the composite sampling locations or reasons for failed attempts to collect composite samples will be documented in the Monitoring and Performance Evaluation Report.

Time-weighted composite sampling has been selected for implementation due to the challenges associated with flow-weighted composite sampling, including location restrictions for flowmeter installation, accurately predicting flow-weighted sampling intervals, power sources, and cost. Time-weighted composite samples will be compared to grab samples to help assess variability of COI concentrations in stormwater.

3.2.3 Additional Sampling Locations for Stormwater SCM Performance Monitoring

The samples collected at the locations described in Sections 3.2.1 and 3.2.2 will evaluate stormwater SCMs on a drainage basin-wide and site-wide basis. Additional sampling locations have been selected to evaluate the performance of individual stormwater SCMs: the EC system, media filtration systems, downspout treatment measures, and BMPs. This performance monitoring will consist of the collection of grab samples at influent (and in some cases effluent) locations for the stormwater SCMs. Paired influent and effluent samples will provide data for calculating media removal efficiencies, contribute information related to operation and maintenance requirements and media replacement frequencies, and potentially identify contributing sources of the COIs in stormwater. Performance monitoring points are shown on Figure 1.2.

Influent grab samples will be collected from the EC system to evaluate removal efficiency and treatment performance. The results from influent grab sample will be compared to those from the grab sample collected at the effluent port (refer to Section 3.2.1).

Influent grab samples will be collected from the catch basin retrofits in drainage basins G and LD1-B drainage basin to provide performance data for catch basin retrofits in drainage basins of varying size and stormwater flows. The results from the influent grab samples will be compared with those of the effluent samples collected from the outfalls (refer to Section 3.2.1) to assess the removal efficiency of the catch basin retrofits.

Collection of performance monitoring samples at locations Q, G, and LD1-B will be timed such that influent and effluent treatment system samples will be collected during the same storm event and at approximately the same time for each treatment system.

Influent and effluent grab samples will be collected at a Grattix box at Building 4 in drainage basin M and from a Grattix box and 55-gallon drum retrofit at Building 72 in drainage basin R. These grab samples will allow an assessment of the removal efficiency of each stormwater SCM and a comparison of the performance of the two types of downspout treatment measures.

As described in Section 3.1.3, the basins that are currently being adaptively managed (roof barrels for Building 50 in the T Basin and Building 72 in the R Basin) will be evaluated during the first two storm events. If the media amendment with biochar demonstrates enhanced removal efficiencies, all other media filtration SCMs that have not met CULs/SLVs will be amended with biochar as a contingency measure for the remainder of the MPECP monitoring events.

Because of the nature of the installation configurations of catch basin fabric filters, in-line media filters, and media bags, influent and effluent sampling is infeasible. The performance of these systems will be evaluated using the grab sampling results from the representative outfall for the drainage basins in which they are installed (e.g., samples from Groups M1, M, and P).

Visual monitoring will also be conducted at the media filtration systems and Grattix boxes to evaluate overflow occurrences and assess changes in treatment system capacity and flow-through rates. Occurrences of overflow at the media filtration systems will be evaluated against rainfall data to determine whether the storm event was greater than the approved water quality design storm.

3.3 PROPOSED MONITORING FREQUENCY AND DURATION

3.3.1 Stormwater Grab Sampling Frequency

Per the guidance in the Portland Harbor JSCS (ODEQ and USEPA 2005), a minimum of four separate storm events at each location will be sampled for stormwater parameters described in Section 4.4. As discussed with ODEQ during development of the Consent Order, the low frequency of qualifying “first flush” events (i.e., sampling within the first 30 minutes of stormwater discharges) may hinder Vigor’s efforts to collect stormwater grab samples during sufficient events to meet the objectives of this MPECP. Vigor will plan and strive to conduct two sampling events at each sampling location during representative "first flush" conditions; however, due to the variability in storm event predictions versus actual conditions, timing at the start of precipitation, and required antecedent dry periods, sampling during "first flush" may not be practicable. For the other two events, Vigor will plan to collect samples within the first 3 hours of stormwater discharge, to the extent practicable. Unavoidable deviations from the storm criteria and protocols will be described in the Monitoring and Performance Evaluation Report. Although the intent of this MPECP is to collect four samples, if the COI concentrations area spread over a sizable range, it may be appropriate to collect additional samples to strengthen the dataset.

Additional information describing comparison of sampling results to screening criteria is discussed in Section 8.0.

3.3.2 Stormwater Composite Sampling Frequency and Duration

During the implementation of this MPECP, one composite sample will be collected at or near each of the grab sampling locations, as described in Section 3.2.2. The composite sampling event will occur during one of the four grab sampling events at each location. The composite samples will be collected on a time-weighted average basis throughout the duration of the storm event to assess variability of COI concentrations in stormwater, relative to grab sampling events collected simultaneously with the composite sample. Additional composite sampling may be conducted after the results from the composite samples and grab samples have been reviewed.

3.3.3 Stormwater SCM Sampling Frequency and Duration

During the first year of monitoring, influent and effluent samples will be collected quarterly to evaluate the performance of the individual stormwater SCMs described in Section 3.2.3. After the first year of monitoring, samples will be collected on an as-needed basis to assess the needs for maintenance and media replacement.

3.4 ANALYTICAL PARAMETERS FOR STORMWATER

The data gaps investigation (ERM 2014) and ODEQ determinations identified the need for site-wide SCMs for arsenic, copper, lead, zinc, cadmium, mercury, PAHs, phthalate esters, tribuyltin, and PCBs (Table 1.1). These parameters are considered contaminants in stormwater, and are COIs for the facility. Total suspended solids (TSS) and pH will be measured in stormwater samples collected during grab and composite sampling events. The sampling techniques and analytical methods for the stormwater samples are described in Section 4.0.

4.0 Sampling and Analysis Protocols

This section describes the sample collection procedures, sampling techniques, and sampling equipment; identifies the analytical methods to be used on the stormwater samples, and discusses the reporting protocols for the stormwater sampling results.

4.1 SAMPLE COLLECTION PROCEDURES AND TECHNIQUES

In order to perform the stormwater sampling, the following conditions must be met:

- Ideally, the sampling events will be conducted when the National Weather Service website (http://www.wrh.noaa.gov/pqr/) or a comparable source of weather information predicts at least 0.2 inches of rain over a storm duration of at least 3 hours. Samples may be collected under conditions outside of these parameters if necessary because of weather patterns and limited daylight hours. However, the conditions must be recorded in the field notes.

  The sampling events will be timed to occur when there has been less than 0.1 inches of rainfall at U.S. Geological Services (USGS) Station 204 (Swan Island) over the previous 24 hours. Rainfall data for this station is available on the USGS website: http://or.water.usgs.gov/non-usgs/bes/raingage_info/clickmap.html.

- Samples will be collected only during daylight hours and during Vigor's normal business hours, when conditions are safe. Examples of known location-specific safety concerns that would prevent sampling are listed below.
  - Samples will not be collected from location M during high-flow events (e.g., when the water level in the manhole exceeds approximately 9 inches). High-flow events prevent secure dry-land footing for sampling personnel.
  - Collection of samples from location LD1-B requires water-side access. Samples will not be collected unless (1) the location can be safely accessed by boat or (2) the water level is low enough that sampling personnel can access the location on foot without wading in the river. During sampling events, Vigor will begin tracking river stage using the USGS river gage on the Willamette River at the Broadway Bridge (gage 14211720) to develop a better understanding of the optimal river stage range for sampling.

- Samples will not be collected from outfalls when the Willamette River stage height results in infiltration of surface water into the stormwater system. If this condition is encountered, it will be noted on the field form to allow the development of a relationship between surface water infiltration and the gage height measured at USGS gage 14211720. River gage information is available on the USGS website: https://waterdata.usgs.gov/nwis/uv?cb_00060=on&cb_00065=on&format=gif_default&site_no=14211720&period=&begin_date=2017-11-27&end_date=2017-12-04.

Vigor will document information related to each of these criteria for each completed stormwater sampling event in the Monitoring and Performance Evaluation Report. Due to variability in forecasts and storm events, some sampling events may not meet the storm criteria for total rainfall or duration. This information will be included in the data report prepared after each sampling event (refer to Section 8.1).

Regardless of the sample type, the following information will be recorded on a field form at the time of sample collection:

- Sampled location
- Sample collection date and time
- Sampler(s)
- Weather conditions
- Whether the sample was collected within the first 30 minutes or 3 hours of the stormwater discharge event; or an explanation of why a sample could not be collected within this time frame. If it is unknown whether the sample was collected within the first flush or first 3 hours of the storm, the sampler will provide an explanation of why.
- Unusual discharge conditions (e.g., odor, color, or visible turbidity)
- Any observed overflow at a stormwater SCM
- Any observed conditions that could affect sampling results (e.g., increased site activity, on-site construction activities, or inadequate housekeeping practices)
- Any unsafe conditions that prevented sampling and stage gage information

Specific sample collection procedures at each sampling location will vary according to the sample type (i.e., grab or composite sample) and location type (i.e., outfall, sampling port, catch basin, or manhole). The sample collection procedures are described in Section 4.1.1 for grab samples and Section 4.1.2 for composite samples; detailed sampling protocols are provided in Appendix A.

4.1.1 Grab Sample Collection Equipment and Procedures

The grab samples collected from locations R, LD1-B, G, L, P, and the outfall located on Berth 313 (Figure 1.2) will be collected from discharging outfalls.

Outfalls for the Group N-Series basins are generally submerged and inaccessible from the upland portion of the facility. Vigor is currently evaluating sampling locations to select a representative location of effluent from the stormwater SCMs in one of the N-series drainage areas. The catch basin in the N3 Basin is identified as the tentative sampling location for the N-series basins. The monitoring location for Group N-Series will be documented in the Monitoring and Performance Evaluation Report.

The proposed sampling location representing Group Q is the effluent sampling port at the EC system. Grab samples collected from a sampling port are collected following the same procedure as for samples collected from an outfall. At Location Q, Vigor will collect grab samples both before treatment (representing influent conditions) and after treatment (representing effluent or discharge conditions). The collection of pretreatment and posttreatment samples will enable Vigor to determine the removal efficiency of the EC system and other treatment systems for each COI. Grab samples collected from outfalls and sampling ports will be collected according to Standard Operating Procedure (SOP) 1 (in Appendix A). Boat access considerations related to sample collection from location LD1-B are specified in SOP 2 (in Appendix A).

Grab samples representing Group M will be collected from manhole 7 within the stormwater conveyance system, rather than an outfall or sampling port. The manhole is located where Vigor's conveyance system discharges to the City's conveyance system along North Lagoon Avenue (Figure 3.1). If field conditions are safe, sampling personnel will enter the manhole and collect the grab samples according to SOP 3 (in Appendix A). Alternatively, samples may be collected from the ground surface using weighted disposable bailers or a hand pump. Before either of these alternative procedures is implemented, SOP 3 will be updated to describe the revised sample collection procedure.

Influent grab samples from catch basin retrofits in drainage area G and LD-1B will be collected in accordance with SOP 4. Influent and effluent grab samples from downspout treatment measures in drainage areas M and R will be collected in accordance with SOP 5.

Regardless of the sample collection method, care should be taken to limit contact of the sampling container with the sides or bottom of the manhole, outfall, or sampling port. Contact with these surfaces disturbs settled sediment or contamination present on these surfaces and can result in artificially elevated contaminant concentrations.

Samples from all the locations will be analyzed for the parameters listed in Table 4.1. The appropriate sample container type and size, sample preservation requirements, and the specified holding times for the analytical method are indicated in Table 4.1. The pH measurement will be taken in the field with an OakTon pHTestr 30 or equivalent instrument that has been calibrated within 24 hours prior to the beginning of each sampling event. SOPs 6 and 7 for pH field measurements are included in Appendix A.

4.1.2 Composite Sample Collection Equipment and Procedures

Composite sampling will be performed with a Global Water WS750 Sampler (or similar style instrument from another manufacturer). The sampler consists of a programmable peristaltic pump and Teflon tubing used to collect a specified sample volume based on predetermined time or flow volume intervals. The Teflon tubing is placed in the upstream direction of flow and pumps the specified sample volume from the stormwater as it flows over the tubing opening. The tube will be affixed to the side of the drainage structure or to a weighted device and will be positioned in the water column of the flowing stormwater. Procedures for programming the sampler are presented in SOP 8 (in Appendix A).

Time-weighted composite sampling is proposed. The composite sampler will be programmed to collect one sample every 20 minutes for the duration of the storm. The aliquot volume will be programmed to ensure the collection of sufficient sample volume to perform all the planned analyses (Table 4.1). Because of the number of parameters and the different types of sample containers, the samples will be accumulated in a 5.5-gallon glass carboy during the duration of the storm. At the completion of the sampling event, the stormwater in the carboy will be homogenized and distributed to the various sample containers.

4.2 SAMPLE HANDLING PROCEDURES AND CUSTODY DOCUMENTATION

4.2.1 Sample Handling

The sample handling procedures to be used during sample collection are described in Appendix A. The samples will be kept in sight of the sampling crew or in a secure, locked vehicle at all times.

All samples will be assigned a unique alphanumeric identification code (ID; e.g., Q-010118-EFF), which will consist of a unique location code (i.e., Q), followed by the date of collection in MMDDYY format. For samples from Location Q or other stormwater treatment system performance monitoring locations, the identification code will be appended with the designation “EFF” to represent effluent samples or “INF” to represent influent samples.

Each sample container will be labeled in waterproof ink on a water-resistant label with the sample identification code, company name, project code, sampler’s initials, sampling date, collection time, and parameter to be analyzed. If water-resistant ink and labels are not available, the sample labels may be taped to the container or otherwise protected from precipitation and moisture.

Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analysis, to the time the sample results are reported. Field logbook and Chain-of-Custody Form entries will be completed for each sample collected.

At the conclusion of sampling, the samples will be submitted to a laboratory accredited by ODEQ to perform stormwater analysis. The samples will be transported to the laboratory as soon as possible (within the holding time specified for the analytical method). If the samples must be held overnight before transport, they must be kept in a cool, secure, locked location at all times.

4.2.2 Sample Chain-of-Custody

Technical field staff will be responsible for all sample tracking and custody procedures in the field, and the chain-of-custody procedures will be strictly followed. The Field QA Officer will be responsible for final sample inventory and maintenance of the sample custody documentation.

At the end of each day, each sample will be recorded on the Chain-of-Custody Form in indelible ink. All sample information (i.e., sample IDs, sampling date/time, sample matrix, number of sample containers, analytical methods, and notes) will be recorded on the Chain-of-Custody Form before formal transfer of the sample containers to the analytical laboratory. The sampler will place the original Chain-of Custody Form in a clear plastic bag inside the sample cooler with the samples.

The samples will be considered to be in custody if one of the following conditions is maintained:

- The samples are in someone's physical possession.
- The samples are in someone's view.
- The samples are secured in a locked container or vehicle or otherwise sealed so that any tampering would be evident.
- The samples are kept in a secured area, restricted to authorized personnel only.

Any time possession of the samples is transferred, the individuals relinquishing and receiving the samples will sign, date, and note the time of transfer on the Chain-of-Custody Form. This form also documents the transfer of custody of samples from the sampler to the laboratory. Each transfer of sample coolers will be accompanied by the Chain-of-Custody Forms.

Copies of all forms will be retained as appropriate and included as appendices to QA/QC reports submitted to management.

4.2.3 Sample Transport

Before transport, the field technician will wrap the sample containers and securely pack them inside the cooler with ice packs or crushed ice. The original signed Chain-of-Custody Forms will be transferred with the cooler. The coolers containing the samples will be delivered to the laboratory under chain-of-custody protocol after completion of sampling activities on the day of sample collection or the following day depending on the duration of the field sampling event, or couriered, shipped, or otherwise delivered directly to the laboratory, if appropriate.

4.2.4 Sample Receipt

The designated sample receiver at the laboratory will accept custody of the samples and verify that the Chain-of-Custody Forms match the samples received. The Specialty Analytical Project Manager and/or sample receiver will ensure that the Chain-of-Custody Forms are properly signed upon receipt of the samples and will note questions or observations concerning sample integrity on the Chain-of-Custody Forms. Upon receipt, the laboratory will contact the Data QA Manager or the Floyd|Snider Project Manager immediately if discrepancies between the Chain-of-Custody Forms and the sample shipment are noted. The Specialty Analytical Project Manager, or designee, will specifically note any coolers that do not contain ice packs or are not sufficiently cold upon receipt.

4.3 EQUIPMENT DECONTAMINATION

The field sampling equipment for composite sampling will use disposable Teflon tubing that will be replaced after each sampling event. The glass carboys used to accumulate the stormwater for the composite samples will be cleaned by the laboratory after each sampling event. A rinsate sample will be collected from the cleaned glass carboy and analyzed for all parameters listed in Table 1.1.

4.4 PROPOSED ANALYTICAL METHODS

The samples will be analyzed for the COIs using the recommended methods and reporting limits in Table 1.1. These analytical methods conform with the latest revision of the Guidelines Establishing Test Procedures for the Analysis of Pollutants (Code of Federal Regulation, Title 40, Part 136). Alternative methods capable of achieving the specified reporting limits are acceptable if they have been approved by ODEQ.

5.0 Quality Assurance/Quality Control Procedures

The field and analytical QA/QC procedures in place at the Vigor facility have been developed in accordance with ODEQ and USEPA guidance (USEPA 2001; ODEQ 2013).

This MPECP establishes the QC procedures and QA criteria developed to meet the data quality objectives (DQOs) established for the field activities associated with the stormwater monitoring and SCM performance evaluation. The overall QA objective is to specify laboratory procedures for ensuring that data quality is maintained throughout field sampling, sample custody and transfers of custody, laboratory analyses, and data reporting.

5.1 FIELD QA/QC PROCEDURES

Vigor will obtain new sample containers from the laboratory before each sampling event. Unused bottles will be returned to the laboratory at the conclusion of each sampling event; if samples were not collected within 30 days of receipt of the sample containers (i.e., the event was a false start), all containers will be returned to the laboratory to limit the potential for container contamination resulting from storage on-site.

Field personnel who are collecting samples will put on a new pair of disposable gloves before collecting samples at each sampling location. If the gloves become contaminated during the course of sample collection at any location, a new pair of uncontaminated gloves will be put on. To ensure collection of representative samples, field personnel will prevent the disturbance of sediment in the manhole during sampling, prevent contact of the sampling container with the outfall features, and will not sample from stagnant water, to the extent practicable.

Disposable personal protective equipment and other waste generated during the sampling activities will be placed in a trash bag and disposed of in a municipal waste bin for transport to a municipal landfill, along with any other trash that may be generated during the course of sampling.

The pH meter will be calibrated according to the manufacturer's calibration procedures immediately prior to or at the beginning of each stormwater sampling event. Calibration standards will be used to perform the calibration, and the results of the calibration for each event will be recorded in the field logbook.

To ensure that samples are representative of the stormwater at the facility, QC samples (i.e., field duplicates) will be collected in the field. For each round of sampling at all locations, one blind field duplicate sample (four total) will be collected and analyzed for the full suite of parameters listed in Table 1.1. Field duplicates will be collected by filling two sample bottles for the suite of parameters and labeling them as two different samples.

5.2 LABORATORY QUALITY ASSURANCE OBJECTIVES

The analytical DQOs include the generation of data that are technically sound and properly documented, having been evaluated against established criteria for the principal data quality indicators (i.e., precision, accuracy, representativeness, completeness, and comparability) as defined in USEPA guidance (USEPA 2002). The QA criteria for data are presented in Table 5.1.

The quality of analytical data is assessed by the frequency and type of internal QC checks developed for analysis type and method. The quality of the analytical data will be evaluated by reviewing the analytical results for method blanks, matrix spikes (MSs), duplicate samples, laboratory control samples (LCSs), calibrations, performance evaluation samples, and interference checks as specified by the specific analytical methods.

5.2.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, precision is a quantitative measure of the variability of a group of measurements compared to their average values. Analytical precision is measured through MS/matrix spike duplicate (MSD) samples for organic analysis and through laboratory duplicate samples for inorganic analyses.

Analytical precision measurements will be carried out on project-specific samples at a minimum frequency of one sample per laboratory analysis group or one sample per event, whichever is more frequent. Analytical precision will be evaluated against quantitative relative percent difference (RPD) performance criteria.

Field precision will be evaluated by the collection of blind field duplicates at a minimum frequency of one sample per event, which will be analyzed for metals. Currently, no performance criteria have been established for field duplicates. Field duplicate precision will therefore be screened against a RPD of 75 percent for all samples. However, no data will be qualified based solely on field duplicate precision.

Precision measurements can be affected by the nearness of a chemical concentration to the method detection limit (MDL), where the percent error (expressed as RPD) increases. The equation used to express precision is as follows:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

Where:

C_1 = larger of the two observed values

C_2 = smaller of the two observed values

RPD = relative percent difference

5.2.2 Accuracy

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Analytical accuracy may be assessed by analyzing "spiked" samples with known standards (surrogates, LCSs, and/or MS) and measuring the percent recovery. Accuracy measurements on MS samples will be carried out at a minimum frequency of 1 in 20 samples. Because MS/MSDs measure the effects of potential matrix interferences of a specific matrix, the laboratory will perform MS/MSDs only on samples from this investigation and not from other projects. Surrogate recoveries will be determined for every sample analyzed for organics.

Laboratory accuracy will be evaluated against quantitative LCS, MS, and surrogate spike recoveries using limits for each applicable analyte. Accuracy can be expressed as a percentage of the true or reference value, or as a percent recovery in those analyses where reference materials are unavailable and spiked samples are analyzed. The equation used to express accuracy is as follows:

$$\%R = 100\% \times (S-U)/C_{sa}$$

Where:

%R = percent recovery

C_{sa} = actual concentration of spike added

S = measured concentration in the spiked aliquot

U = measured concentration in the unspiked aliquot

5.2.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. The sampling program has been designed carefully to ensure that the sampling locations are properly selected, sufficient numbers of samples are collected to accurately reflect conditions at the location(s), and samples are representative of the sampling location(s). A sufficient volume of sample will be collected at each sampling location to minimize bias or errors associated with sample particle size and heterogeneity.

5.2.4 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as follows:

$$C = \frac{\text{(Number of acceptable data points)} \times 100}{\text{(Total number of data points)}}$$

The DQO for completeness for all components of this project is 95 percent. Data that are qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that are qualified as rejected will not be considered valid for the purpose of assessing completeness.

5.2.5 Laboratory Quality Control Procedures

Results of the QC samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine whether control limits were exceeded. If control limits are exceeded in the sample group, corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

All primary chemical standards and standard solutions used in this project will be traceable to documented and reliable commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities identified in the standard will be documented.

The following sections summarize the procedures that will be used to assess data quality throughout sample analysis.

Analytical Duplicates. Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates are subsamples of the original sample that are prepared and analyzed as a separate sample. A minimum of 1 duplicate will be analyzed per sample group or for every 20 samples, whichever is more frequent.

Matrix Spikes and Matrix Spike Duplicates. Analysis of MS samples provides information on the extraction efficiency of the method on the sample matrix. By performing MSD analyses, information on the precision of the method is also provided for organic analyses. A minimum of 1 MS/MSD will be analyzed for every sample group or for every 20 samples, whichever is more frequent. MS/MSD analyses will be performed on project-specific samples (i.e., batch QC using samples from other projects is not permitted).

Laboratory Control Samples. An LCS is a method blank sample carried throughout the same process as the samples to be analyzed, with a known amount of standard added. The blank spike compound recovery assesses analytical accuracy in the absence of any sample heterogeneity or matrix effects.

Surrogate Spikes. All project samples analyzed for organic compounds will be spiked with appropriate surrogate compounds as defined in the analytical methods. Surrogate recoveries will be reported by the laboratory; however, no sample result will be corrected for recovery using these values.

Method Blanks. Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. A minimum of 1 method blank will be analyzed for every extraction batch or for every 20 samples, whichever is more frequent.

6.0 Data Reduction, Validation, and Reporting

Initial data reduction, evaluation, and reporting at the laboratory will be carried out as described in the appropriate analytical protocols and the laboratory's QA Manual. QC data resulting from the methods and procedures described in this MPECP will also be reported.

Monitoring data that are not of acceptable quality for use will be reported to ODEQ; however, the failure of the data to meet QA/QC requirements will be clearly noted. Data that do not meet the QA/QC requirements will not be used in any calculations or in determinations of compliance with a pollutant limit. The data report will include a note about the QA/QC failure and the corrective actions that have been or will be taken. When possible, Vigor will resample in a timely manner for parameters failing the QA/QC requirements, analyze the samples, and report the results.

During data quality review, laboratory-provided data qualifiers may be modified for consistency with the ODEQ discharge monitoring report (DMR) reporting requirements. Specifically, results that are less than the practical quantitation limit (PQL) will be reported as follows:

- Results at or less than the MDL will be reported as less than the specified detection limit. For example, if the detection limit is 2.0 micrograms per liter (µg/L) and the result is non-detect, the result will be reported as "<2.0 µg/L."
- Results greater than the MDL but less than the PQL will be reported as the detection limit preceded by the ODEQ data code "e." This code identifies the result as being between the MDL and the PQL. For example, if the MDL is 2.0 µg/L and the PQL is 10.0 µg/L and the sample result is 4.0 µg/L, the result will be reported as "e2.0 µg/L."

6.1 DATA REDUCTION AND REPORTING

The laboratory will be responsible for internal checks on data reporting and the correction of errors identified during the QA review. The laboratory will maintain close contact with the Floyd|Snider QA Manager to resolve any QC problems in a timely manner. The analytical laboratory will be required, where applicable, to provide the following:

- **Project Narrative.** This summary, in the form of a cover letter, will discuss problems, if any, encountered during any aspect of analysis. It should discuss, but not be limited to, QC, sample shipment, sample storage, and analytical difficulties. Any problems encountered (actual or perceived) and their resolutions will be documented in as much detail as necessary.
- **Sample Identification Codes.** Records will be produced that clearly match all blind duplicate QA samples with laboratory sample identification codes (IDs).
- **Chain-of-Custody Records.** Legible copies of the custody forms will be provided as part of the data package. This documentation will include the time of receipt and condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented.

- **Sample Results.** The data package will summarize the results for each sample analyzed and include the following information when applicable:
    - Field sample ID and the corresponding laboratory identification code
    - Sample matrix
    - Date of sample extraction
    - Date and time of analysis
    - Weight and/or volume of the sample used for analysis
    - Final dilution volumes or concentration factor for the sample
    - Identification of the instrument used for analysis
    - Method reporting and quantitation limits
    - Analytical results reported with reporting units identified
    - All data qualifiers and their definitions
    - Electronic data deliverables
- **Quality Assurance/Quality Control Summaries.** The results of all QA/QC procedures will be provided. Each QA/QC sample analysis will be documented with the same information required for the sample results (refer to above). No recovery or blank corrections will be made by the laboratory.
- **Method Blank Analysis.** The method blank analyses associated with each sample and the concentration of all compounds of interest identified in these blanks will be reported.
- **Surrogate Spike Recovery.** All surrogate spike recovery data for organic compounds will be reported. The names and concentrations of all compounds added, their percent recoveries, and the range of recoveries will be listed.
- **Matrix Spike Recovery.** All MS recovery data for metals and organic compounds will be reported. The names and concentrations of all compounds added, their percent recoveries, and the range of recoveries will be listed. The RPD for all duplicate analyses will be reported.
- **Matrix Duplicate.** The RPD for all matrix duplicate analyses will be reported.
- **Laboratory Control Samples and Laboratory Control Sample Duplicates.** All LCSs and laboratory control sample duplicates (LCSDs) for metals and organic compounds will be reported. The RPD for all duplicate analyses will be reported.
- **Blind Duplicates.** Blind duplicates will be reported in the same format as any other sample. RPDs will be calculated for duplicate samples and evaluated as part of the data quality review.

6.2 DATA VALIDATION

A compliance screening (Stages 1 and 2A) will be performed on all data. The laboratory reports will be reviewed for internal consistency, transmittal errors, laboratory protocols, and adherence to the DQOs, as specified in this MPECP.

A data quality review of the analytical data will follow the USEPA National Functional Guidelines (USEPA 2016a, 2016b). All chemical data will be reviewed with regard to the following:

- Chain-of-custody/documentation
- Sample preservation and holding times
- Method blanks
- Reporting limits
- Surrogate recoveries
- MS/MSD recoveries and RPDs
- LCS/LCSD recoveries and RPDs
- Laboratory and field duplicate RPDs
- Field blanks
- Initial calibration and continuing calibration

Data usability, conformance with the DQOs, and any deviations that may have affected the quality of the data, as well as the basis for the application of data qualifiers, will be included in the final report of the data. Any required corrective actions based on the evaluation of the analytical data will be determined by the laboratory Project Manager in consultation with the Floyd|Snider QA Manager and may include data qualification.

7.0 Corrective Actions

The corrective action procedures related to field sampling and laboratory analysis are described in this section.

7.1 CORRECTIVE ACTION FOR FIELD SAMPLING

The Field QA Officer will be responsible for correcting field errors in sampling or documentation of equipment malfunctions during the field sampling effort. The Vigor project manager, along with the Field QA Officer, will be responsible for resolving situations in the field that may result in noncompliance with the MPECP. All corrective measures will be immediately documented in the field logbook.

7.2 CORRECTIVE ACTION FOR LABORATORY ANALYSES

The laboratory must comply with its own SOPs. The Specialty Analytical Project Manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this MPECP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

If the concentration in any QC sample exceeds the project-specified control limits, the laboratory analyst will identify and correct the anomaly before continuing with the sample analysis. The laboratory analyst will document the implemented corrective action in a memorandum submitted to the Floyd|Snider QA Manager. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, and/or reextraction) will be submitted with the data package.

8.0 Data Reporting and Evaluation Procedures

This section describes the monitoring data reporting and performance evaluation that will be included in the Monitoring and Performance Evaluation Report. It also describes the decision making criteria that will be considered in evaluating changes and trends in stormwater quality; whether stormwater SCM objectives and criteria have been met; whether implementation of contingency SCMs is warranted; and whether modifications to the long-term stormwater monitoring program are warranted.

8.1 DATA REPORTING AND DOCUMENTATION PROTOCOLS

In accordance with the Consent Order, Vigor will prepare a Monitoring and Performance Evaluation Report to present the stormwater data collected during implementation of this MPECP and serve as a performance evaluation of the stormwater SCMs and BMPs at the facility. The Monitoring and Performance Evaluation Report will be submitted 2 months after the validated analytical data results are received for the fourth sampling event at all locations. If received in sufficient time, ODEQ comments on the Monitoring and Performance Evaluation Report will be incorporated into the Tier II Report, which is required by the 1200-Z Permit and is due on December 31, 2019.

Interim stormwater data results will be submitted to ODEQ in the Quarterly Progress Reports.

The Monitoring and Performance Evaluation Report will be organized as follows:

- **Section 1 – Introduction/Background.** This section will give a general facility overview and background of stormwater SCM objectives.
- **Section 2 – Summary of Monitoring Events.** This section will describe the sampling activities and any deviations from the MPECP. It will include a hydrograph, i.e. a graph of the rainfall distribution (inches per hour) for the timeframe that begins 24 hours prior to the storm event and covers the entire storm event. The time when sampling took place for each sample will be indicated on this hydrograph.
- **Section 3 – Summary of Monitoring Results.** This section will include a summary and data tables for validated analytical results. COIs with concentrations that exceed the screening criteria will be discussed. The summary data tables will be modeled after the tables in Appendix D of ODEQ's 2010 *Guidance for Evaluating the Stormwater Pathway at Upland Sites* (referred to as ODEQ's 2010 Guidance) and include the date of the sampling event, sampling locations, detected results, units, laboratory MDLs and PQLs, screening criteria, and results that exceed the screening criteria.

  This section will also include a summary table of the facility's 1200-Z Permit stormwater results dating back to 2006 to evaluate trends in COI concentrations after implementation of the BMPs. Methods for evaluating trends in stormwater quality are described in Section 8.2.1.

- **Section 4 – Performance Evaluation.** This section will present a WOE evaluation for all contaminants that exceed the Portland Harbor CUL/SLVs, consistent with the JSCS. The performance evaluation will evaluate the magnitude of the exceedances and discuss whether these results are representative of typical discharge conditions using the WOE evaluation described in Section 8.2.2. The results will be described relative to typical industrial concentrations, using the tool provided in Appendix E of ODEQ's 2010 Guidance (ODEQ 2009). The rank order curves from ODEQ's 2010 Guidance are provided in Appendix B of this MPECP.
- **Section 5 – Contingency SCMs.** If contingency SCMs are determined to be warranted, the Monitoring and Performance Evaluation Report will provide additional information related to their implementation in accordance with Attachment B, Section E.8.b, of the Consent Order.

  This section will include the following information in the event the SCMs do not achieve performance criteria:

  - Documentation of what contingency SCMs have been implemented [if any];
  - A preliminary design report for any remaining contingency SCMs required under the MPECP;
  - A contingency plan to include identification of potential response actions (additional contingency SCMs) and a description of the process for evaluating, designing, and implementing them after inadequate performance of the initial contingency SCMs;
  - Description of assessment criteria for modifications to the long-term stormwater monitoring program; and
  - Description of performance evaluations to be conducted for stormwater treatment systems, including performance criteria, methodology, schedule, and system termination criteria.

  Proposed trigger mechanisms and assessment criteria that would warrant implementation of contingency SCMs are described in Section 8.2.3.
- **Section 6 – Conclusions and Recommendations.** This section will describe any interim measures implemented after the exceedances and recommendations for next steps including, but not limited to, maintenance recommendations, SCM upgrades, and implementation of contingency SCMs.
- **Appendix A – Field Documentation.** This appendix will include field forms, field notes, and any other field-generated documentation (e.g., photographs).
- **Appendix B – Laboratory and QA/QC Documentation.** This appendix will include copies of the original laboratory reports and Chain-of-Custody Forms, as well data validation reports generated after the receipt of the data.

8.1.1 BMP Implementation Reporting

Documentation of BMP implementation is described in Vigor's O&M Plan, included as Appendix A of the Revised Final Design Report (Floyd|Snider 2018). As described in the O&M Plan, the operations and maintenance records will be compiled on a quarterly basis and submitted to ODEQ annually. The annual Operations and Maintenance Report will include monthly filter inspection documents, stormwater inspection documents, field observation logs about site features or conditions, sweeping records, and quarterly catch basin cleaning records. The Operations and Maintenance Report will also include documentation of weekly regenerative air sweeping and biannual crane rail cleaning.

8.2 DATA EVALUATION METHODS AND PROTOCOLS

Industrial stormwater discharge and storm solids commonly include contaminants at concentrations that exceed the screening criteria by an order of magnitude or more; however, these exceedances do not necessarily cause or contribute to unacceptable risk to human health, aquatic life, or the environment. The screening criteria for evaluating stormwater for source control include the CULs specified in the 2017 Portland Harbor ROD (USEPA 2017) and the JSCS Table 3-1 SLVs for contaminants without CULs (refer to Table 1.1). The objectives of this MPECP are to assess the nature and magnitude of variations in stormwater quality in order to determine typical contaminant concentrations at the facility; and to evaluate the effectiveness of the stormwater SCMs and operational treatment systems. The primary WOE evaluation will compare stormwater data collected during implementation of this MPECP. The evaluation can result in the following outcomes:

- If the data indicate that the stormwater SCMs are reducing COI concentrations in facility discharge to less than the screening criteria, additional evaluation or implementation of contingency SCMs is not required.
- If the data indicate that the stormwater SCMs are not reducing COI concentrations in facility discharge to less than the screening criteria, a WOE approach will be used to determine whether implementation of contingency SCMs is warranted.

Section 5 of ODEQ's 2010 Guidance provides reasons why additional evaluation may be required before contingency SCMs are implemented, including the intermittent and variable nature of stormwater discharge and the mixing of stormwater, surface water, and sediment in the receiving water body. Therefore, it is possible to achieve source control in spite of exceedances of the screening criteria. The WOE evaluation is described in more detail in Section 8.2.2.

8.2.1 Statistical Data Analysis Methods

Variations in COI concentrations in stormwater grab samples are expected and may be caused by natural variations in storm intensity, duration, antecedent rainfall, and other factors. Therefore, it is common for stormwater effluent concentrations to vary significantly even at the same sampling location.

For determining compliance with stormwater SCM objectives and screening criteria, stormwater data collected at each sampling location will be evaluated using individual sampling event results.

For evaluating changes and trends in stormwater quality, Vigor will compare the summary statistics for each contaminant (i.e., mean, median, and range) to the summary statistics for the baseline dataset for both the substantially similar basin group and for a basin group where there is no treatment. Baseline data was collected in the data gaps investigation (ERM 2014). This data will be used to assess the changes in concentrations since the implementation of stormwater SCMs.

8.2.2 Data Assessment Methods and Weight-of-Evidence Evaluation

Data assessment criteria are divided into two categories: criteria for parameters with results that are less than the screening criteria and criteria for parameters that exceed the screening criteria.

Stormwater COI concentrations that are less than the screening criteria after at least four sampling events will indicate that Vigor's stormwater SCMs are working as designed to minimize contaminants in discharge. Vigor will continue to implement BMPs, as specified in its *Storm Water Pollution Control Plan* (Vigor 2018), perform routine inspections, and monitor discharge as required by the 1200-Z Permit. Changes in site conditions or operations that may affect stormwater quality will be recorded and included in future DMR submittals. However, Vigor proposes to discontinue sampling for any non-NPDES parameters that are less than the screening criteria at a particular location.

Vigor will perform a WOE evaluation on all contaminants that exceed the screening criteria. The WOE evaluation, including components presented in the JSCS and ODEQ's 2010 Guidance, will include the following elements:

- **Data Relative to Other Industrial Facilities.** Compare data to "typical" contaminant concentrations (when available) using the charts in Appendix B, which were originally provided in Appendix E of ODEQ's 2010 Guidance.
- **Magnitude of Exceedance.** The magnitude of exceedances at each sampling point will be considered to evaluate whether contingency stormwater SCMs are needed.
- **Trends in Stormwater Data.** Data will be evaluated for apparent trends and reduction in concentrations. Trends will be evaluated to describe drivers behind the changes in trends and measures in place to ensure that the reductions or trends will not be reversed.
- **Storm Event Protocols and Characteristics.** Storm event protocols described in Section 4.1 will be reviewed to evaluate the representativeness of the samples. If the storm event was particularly intense or followed a particularly long antecedent dry period, the contaminants concentrations in the stormwater may be greater than typical concentrations. If the contaminant concentrations are lower than typical concentrations, rainfall records will be examined to evaluate whether heavy rains

could have swept the site clean of contaminants. SCM performance may vary across storms of varying intensity and frequency.

- **Comparison to 1200-Z Permit Benchmarks and Impairment Pollutants.** Data will be compared to 1200-Z Permit benchmarks and impairment pollutant reference concentrations to evaluate stormwater discharge from the facility relative to Vigor's 1200-Z Permit requirements and other industrial 1200-Z Permit holders along the Willamette River.
- **Occurrence of Stormwater SCM Overflow.** Exceedances of screening criteria will be evaluated with visual monitoring reports to determine whether overflow around the stormwater SCMs may have contributed to elevated levels of COI concentrations in stormwater.
- **Hydrodynamics and Runoff Volume.** Flow rates of the receiving waterbody may be a factor in determining the extent to which stormwater discharges will impact surface water and sediments. Stormwater discharges entering a quiescent waterbody, such as the Swan Island Lagoon, may have a greater impact than runoff entering a flowing system, such as the Willamette River at the southern portion of the facility. Additionally, consideration will be given to the volume of runoff generated during storm events to evaluate whether the contaminant load from the facility is likely to have an impact on the receiving body.
- **Presence of High TSS.** Presence of high TSS will be evaluated in samples that exceed screening criteria to evaluate whether the SCMs in place are functioning effectively.
- **Outfall Sediments.** Available outfall sediment data will be reviewed to assess whether exceedances are likely related to historical and/or ongoing stormwater discharges.
- **Discharges to 303(d)-Listed Waterbodies.** COIs that exceed 303(d) impairment pollutants in the Willamette River will be evaluated more conservatively to protect the beneficial use of the waterbody.
- **Presence of Bioaccumulative Chemicals.** Consideration will be given to whether a COI is a bioaccumulative chemical and a known risk driver.
- **Facility Conditions.** Useful for determining whether on-site activities may have resulted in short-term spikes in concentration for certain parameters. Atypical activities could include the following:
    - A recent leak or spill that was not adequately cleaned up
    - Improperly controlled construction, painting, sandblasting, or paving activities
    - Improper handling of raw materials or waste products
- **Performance of Stormwater SCMs.** Review the stormwater SCM performance and removal efficiency data to determine whether the SCMs are performing as designed and to verify that appropriate and reasonable SCMs and BMPs have been implemented to the extent feasible. Ensure that maintenance is being performed according to an appropriate schedule, treatment media does not need to be replaced,

and substantial stormwater flow is not overflowing or bypassing the media filtration systems or downspout treatment measures. This evaluation is described in further detail in Section 8.2.3.

Stormwater SCM sampling data will be evaluated to better understand media maintenance requirements, estimated time until media breakthrough, and development of media replacement schedules for media filtration systems and downspout treatment measures. Data collected to assess the media performance and maintenance schedule will be included in the Monitoring and Performance Evaluation Report. Performance monitoring data collected after the submittal of the Monitoring and Performance Evaluation Report will be included in the quarterly Operations and Maintenance Reports that will be submitted annually to ODEQ.

If the data at a particular location span a large concentration range (e.g., a range from one-half the permit limit to more than double the permit limit), multiple components of the WOE evaluation should be considered to support the conclusion that the implementation of contingency SCMs either is or is not warranted. Additional sampling to make the dataset more robust may be warranted if the WOE evaluation is inconclusive for a particular location.

In the WOE analysis for contaminants without 1200-Z Permit benchmarks, consideration will be given to whether elevated concentrations may be caused by inadequate housekeeping BMPs; spills or other uncontrolled releases; deviations from the sampling SOPs; or other factors that can be addressed without the implementation of contingency SCMs. Identified inadequacies and planned improvements in housekeeping BMPs arising from individual screening criteria exceedances will be noted in each Monitoring and Performance Evaluation Report. Appropriate action will be taken to address these conditions as soon as possible after their identification. Additional sampling may be performed if the dataset for a particular location includes data that are not representative of site conditions.

8.2.3 Contingency SCM Criteria

If typical concentrations leaving the facility exceed screening criteria, Vigor will evaluate the treatment system performance and implementation of BMPs and complete a WOE evaluation in order to support a contingency SCM decision. The primary factors in this WOE evaluation are the magnitude of the exceedance and comparison of Vigor stormwater data relative to data from other industrial facilities. Exceedances of the screening criteria will be managed in the following manner:

- If the screening criteria are exceeded for a given parameter, but the concentrations are still within the range of other typical industrial facilities, additional contingency SCMs will not be proposed. The concentrations at the facility may be influenced by nonpoint urban sources (e.g., road runoff or atmospheric deposition) or by routine, properly controlled activities at the facility (e.g., off-gassing of phthalates from paint or leaching from galvanized building materials [ODEQ 2009]).

- The magnitude and frequency of the screening criteria exceedance, along with the WOE evaluation, will be used to determine whether contingency SCMs are warranted.

Before considering the implementation of contingency SCMs, Vigor will determine whether modifications to the existing SCMs are appropriate, using the following performance evaluations for stormwater treatment systems:

- **Sufficiency of System Maintenance.** Vigor will verify that manufacturer-recommended maintenance has been recently performed and that there are no visible indications of system malfunction, which may require observations of the system during a storm. If a substantial quantity of stormwater is overflowing or bypassing the media filtration systems or downspout treatment measures, Vigor will investigate the cause and potential remedies. For example, the filtration media may be clogged and in need of maintenance.
- **Removal Efficiency.** Vigor will calculate the removal efficiency for each parameter that exceeds the screening criteria, using influent and effluent data for the stormwater SCMs. If the removal efficiency data indicate that performance is significantly less than the expected removal efficiencies based on past performance or manufacturer's literature (e.g., removal efficiencies less than 20 percent or increases in effluent concentration), Vigor will investigate the potential causes and remedies.

  If the removal efficiency data indicate that the system is performing as expected to reduce parameter concentrations in stormwater, Vigor may consider the implementation of contingency SCMs, additional source control efforts, or media replacement.

Vigor does not expect to propose the removal of existing stormwater treatment systems; however, removal of an existing treatment system may be proposed if it will be replaced with a contingency SCM that is expected to result in improved contaminant removal performance relative to the existing SCM.

8.3 IMPLEMENTATION OF CONTINGENCY SOURCE CONTROL MEASURES

After a determination that contingency SCMs are necessary, contingency SCMs will be evaluated and proposed in the Monitoring and Performance Evaluation Report for the drainage basins that do not meet the performance criteria identified in Section 8.2. The contingency SCMs will be assessed for their feasibility, expected effectiveness, and implementation schedule in accordance with Attachment B, Section E.8.b, of the Consent Order. The Monitoring and Performance Evaluation Report describing the contingency SCMs will be submitted to ODEQ within 2 months of receiving validated laboratory results from the fourth event at all sampling locations. If received in sufficient time, ODEQ comments on the Monitoring and Performance Evaluation Report will be incorporated into the Tier II Report, which is required by the 1200-Z Permit and is due on December 31, 2019.

Potential contingency stormwater SCMs were previously identified in Vigor's Stormwater SCM Work Plan Rev 1 (ERM 2017a) and Stormwater SCM Preliminary Design Report (ERM 2017b) and are included in Table 3.1. The contingency SCMs will be implemented on an iterative basis in each of the drainage basins represented by the substantially similar outfall with contaminant concentrations that exceed the screening criteria and are determined necessary by the WOE evaluation.

After discussion with ODEQ, it was determined that the contingency SCM for the Group N-Series basins, if necessary, would be determined after further design of the Swan Island Lagoon remedial actions identified in the Portland Harbor ROD (USEPA 2017). The riverbank and sediment adjacent to the Group N-Series basins are part of larger lagoon remedial actions identified in the Portland Harbor ROD (USEPA 2017), and the ROD identifies the riverbank in the vicinity of the Group N-Series as a property with known contaminated riverbanks. Dredging, dredging with cap, and capping are remedial technology assignments that have been identified for sediments in the vicinity of the Group N-Series basins. ODEQ has indicated that the riverbank adjacent to the area may have to be excavated and regraded via sloping onto the upland portion of the facility. Accordingly, any SCMs, such as grading and paving or active treatment, installed now will likely have to be removed for ROD remedy implementation in the lagoon. A stormwater SCM that is consistent with reconfiguration to the riverbank and upland area will be determined in cooperation with ODEQ upon selection of remedial actions in this area. Vigor fully expects to incorporate contingency stormwater SCMs, if necessary, into the long-term remedial actions planned for the Swan Island Lagoon.

For Group Pier D, media filtration systems will be installed in the catch basins as a contingency SCM, in addition to implementing current BMPs, to promote increased contaminant removal. For drainage basins with media filtration systems and downspout treatment measures, including Groups G, M1, M, R, and LD1-B, alternative media will be considered as an adaptive management strategy for full-scale replacement or amendment to promote increased contaminant removal efficiencies. For example, APTsorb media may be amended with biochar to increase pH to reduce the solubility of contaminants, such as metals, and to increase the adsorption of metals to the peat media. After completion of the performance monitoring, Vigor will determine whether media filters are effective or whether the basins will be routed to the EC system as a contingency source control measure. The existing 1,000,000-gallon storage tank and EC system have the capacity to receive stormwater from additional areas of the facility; however, due to the unknown acreage that may require a contingency SCM, and unknowns associated with the existing infrastructure, conveyance requirements, and power requirements, it is unreasonable to commit to conveying all basins to the EC system at this time.

To better understand these unknowns, Vigor is currently conducting an infrastructure evaluation of more than 30 acres of the facility, including Basins M, O, O1, LD-1A through LD-7B, and Pier D, for conveyance to the EC system or a similarly effective treatment system(s). After completion of infrastructure review for these basins, Vigor will continue to evaluate other basins that may require implementation of a contingency SCM as will be determined by the results from the sampling described in this MPECP. The site must be evaluated holistically based on which basins will require treatment. The sampling conducted during implementation of this MPECP along with the ongoing infrastructure evaluation will assist in determining whether it is practical and feasible to implement conveyance of stormwater to the EC system as a contingency SCM.

As described in Section 3.2.3, the basins that are currently being adaptively managed (roof barrels for Building 50 in the T Basin and Building 72 in the R Basin) will be evaluated during the first two storm events. If the media amendment with biochar demonstrates enhanced removal efficiencies, all other media filtration SCMs that have not met CULs/SLVs will be amended with biochar as a contingency measure for the remainder of the MPECP monitoring events.

If media filtration systems, downspout treatment measures, and BMPs are unable to reduce the contaminant concentrations to acceptable levels, design and implementation of conveyance to the EC system or other stormwater treatment system(s) located closer to the target area will be considered as a contingency SCM.

9.0 Conclusions and Schedule

This MPECP was developed as a means for determining whether or not the stormwater SCMs implemented at the facility are adequately controlling stormwater as a potential contaminant pathway to the Willamette River and Swan Island Lagoon. The monitoring required per this MPECP will provide data that will be used in the following ways: to perform an evaluation of the effectiveness of the stormwater SCMs; for adaptive management of the SCMs and BMPs; and to implement contingency SCMs, as required.

In order to accomplish the efforts described in this MPECP, the schedule in the table below will be followed.

Action	Approximate Date
Monitoring and Evaluation Key Dates	
Revise and Submit Final MPECP	August 2018
Receive ODEQ Approval on Final MPECP	September 2018
Implement MPECP	September 2018
Adaptive Management of SCMs	Ongoing
Submit Monitoring and Performance Evaluation Report	2 months after receipt of validated data for fourth sampling event (estimated spring or summer 2019)
1200-Z Permit Key Dates	
Implement Monitoring per 1200-Z Permit	Ongoing
Tier II Evaluation Year	July 1, 2018, to June 30, 2019
Submit Tier II Report, if necessary	December 31, 2019
Implement Tier II Corrective Actions	No later than June 30, 2021

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Final Monitoring, Performance Evaluation, and Contingency Plan

Tables

Table 1.1
Stormwater Screening Criteria

Parameters[1]	Units	Screening Criteria[2]	CULs from Table 17 of Portland Harbor ROD[3]	SLVs from Table 3-1 of JSCS[4]	1200-Z Permit Benchmarks[5]	1200-Z Impairment Reference Concentration[5]	Reporting Limit[6]	Method
Metals								
Arsenic	µg/L	**0.1**	0.018	0.045	--	--	0.1	USEPA 200.8
Cadmium	µg/L	**0.1**	--	0.094	--	--	0.1	
Copper	µg/L	2.7	2.74	2.70	20	--	0.5	
Lead	µg/L	0.54	--	0.54	40	--	0.1	
Mercury	µg/L	0.77	--	0.77	--	2.4	0.1	USEPA 245.2
Zinc	µg/L	36	36.5	36	120	--	2	USEPA 200.8
Butyltins								
Tributyltin[7]	µg/L	0.063	0.063	0.072	--	--	0.0052	Krone et al. 1989
Polychlorinated Biphenyl (PCB) Aroclors								
Aroclor 1016	µg/L	0.96	--	0.96	--	--	0.02	USEPA 608
Aroclor 1221	µg/L	0.034	--	0.034	--	--	0.02	
Aroclor 1232	µg/L	0.034	--	0.034	--	--	0.02	
Aroclor 1242	µg/L	0.034	--	0.034	--	--	0.02	
Aroclor 1248	µg/L	0.034	--	0.034	--	--	0.02	
Aroclor 1254	µg/L	0.033	--	0.033	--	--	0.02	
Aroclor 1260	µg/L	0.034	--	0.034	--	--	0.02	
Aroclor 1262	µg/L	--	--	--	--	--	0.02	
Aroclor 1268	µg/L	--	--	--	--	--	0.02	
Total PCBs	µg/L	**0.02**	0.0000064	0.000064	--	0.5	0.02	
Phthalate Esters								
Dimethyl phthalate	µg/L	3	--	3	--	--	0.5	USEPA 625
Diethyl phthalate	µg/L	3	--	3	--	--	0.5	
Di-n-butyl phthalate	µg/L	3	--	3	--	--	0.5	
Butyl benzyl phthalate	µg/L	3	--	3	--	--	0.5	
Di-n-octylphthalate	µg/L	3	--	3	--	--	0.5	
bis(2-Ethylhexyl)phthalate	µg/L	**0.5**	0.20	2.2	--	--	0.5	
Polycyclic Aromatic Hydrocarbons (PAHs)								
2-Methylnaphthalene	µg/L	0.2	--	0.2	--	--	0.05	USEPA 8270-SIM
Acenaphthene	µg/L	0.2	--	0.2	--	95	0.05	
Acenaphthylene	µg/L	0.2	--	0.2	--	--	0.05	
Anthracene	µg/L	0.2	--	0.2	--	2,900	0.05	
Benzo(a)anthracene	µg/L	**0.05**	0.0012	0.018	--	1	0.05	
Benzo(a)pyrene	µg/L	**0.05**	0.00012	0.018	--	1	0.05	
Benzo(b)fluoranthene	µg/L	**0.05**	0.0012	0.018	--	1	0.05	
Benzo(g,h,i)perylene	µg/L	0.2	--	0.2	--	--	0.05	
Benzo(k)fluoranthene	µg/L	**0.05**	0.0013	0.018	--	1	0.05	
Chrysene	µg/L	**0.05**	0.0013	0.018	--	1	0.05	
Dibenz(a,h)anthracene	µg/L	**0.05**	0.00012	0.018	--	1	0.05	
Fluoranthene	µg/L	0.2	--	0.2	--	14	0.05	
Fluorene	µg/L	0.2	--	0.2	--	390	0.05	
Indeno(1,2,3-c,d)pyrene	µg/L	**0.05**	0.0012	0.018	--	1	0.05	
Naphthalene	µg/L	0.2	12	0.2	--	--	0.05	
Phenanthrene	µg/L	0.2	--	0.2	--	--	0.05	
Pyrene	µg/L	0.2	--	0.2	--	290	0.05	
Total PAHs[8]	µg/L	--	--	--	--	--	0.05	
Total cPAHs[8,9]	µg/L	**0.05**	0.00012	--	--	--	0.05	

Notes:

-- No standard.

BOLD Indicates screening criterion is set to the analytical reporting limit, when the CUL/SLV is less than the analytical reporting limit.

1 Parameters listed are those specified in the consent order for requiring source control.

2 Screening criteria consist of CULs presented in Table 17 of the USEPA Portland Harbor ROD (USEPA 2017) or SLVs from Table 3-1 of the JSCS (ODEQ 2005) where an SLV does not exist.

3 CULs as presented for surface water in Table 17 of the USEPA Portland Harbor ROD (USEPA 2017).

4 SLVs as presented in Table 3-1 of the JSCS (ODEQ and USEPA 2005) and Appendix D: Stormwater Data Reporting and Screening Table for Portland Harbor Sites (ODEQ 2009).

5 Benchmarks and Impairment Pollutant Reference Concentrations as presented in Vigor's 2017-2022 NPDES 1200-Z General Industrial Stormwater Permit (ODEQ2017).

6 Reporting limits were provided by the laboratory contracted to perform the analysis and are typical of the method in the medium indicated but may be elevated in some samples due to matrix interferences or insufficient sample volume. Additionally, reporting limits may be elevated for some compounds as a result of spectral or other interferences associated with the analysis. The laboratory will make every effort to obtain reporting limits that are less than the applicable target effluent

7 Reporting limits for tributyltin are for low-level tributyltin analysis by USEPA 8270D-SIM.

8 Laboratory did not provide reporting limits for cPAHs or PAHs; benzo(a)pyrene is used as surrogate. Actual reporting limits will vary based on reporting limits specific to sample.

9 Calculation of cPAHs assumes half of the detection limit for non-detects. Toxicity equivalency factors are applied to benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene in accordance with Provisional Guidance for Quantitative Risk Assessment of PAHs (USEPA 1993).

Abbreviations:

CUL Cleanup level
cPAH Carcinogenic polycyclic aromatic hydrocarbon
JSCS Joint Source Control Strategy
µg/L Micrograms per liter
NPDES National Pollutant Discharge Elimination System
ROD Record of Decision
SLV Screening level value
USEPA U.S. Environmental Protection Agency

Table 3.1
Drainage Areas and Stormwater Source Control Measures

Outfall ID	Drainage Area Representative Sampling Location[1]	Drainage Area (acres)	Total Roof Area (acres)	No. of Catch Basins	Current Stormwater Source Control Measures	Contingency Source Control Measure
A	G	0.14	0	3	Catch basin retrofit; increase housekeeping and sweeping frequency.	Enhance catch basin media filtration system (e.g., biochar amendment).
B		0.19	0	4		
C		0.07	0	1		
D	L	1.40	0.03	9	Catch basin retrofit; increase housekeeping and sweeping frequency.	Enhance catch basin media filtration system (e.g., biochar amendment).
E	Q	3.08	0.38	29	Convey to EC system at BWTP; increase housekeeping and sweeping frequency.	Modify EC system/add polishing media.
F		0.23	0	1	Convey to EC System at BWTP; catch basin retrofit; increase housekeeping and sweeping frequency.	
G	G	0.37	0.08	1	Catch basin retrofit; increase housekeeping and sweeping frequency.	Enhance catch basin media filtration system (e.g., biochar amendment).
H		0.34	0	1		
I	L	0.81	0.03	4	Catch basin retrofit; increase housekeeping and sweeping frequency.	Enhance catch basin media filtration system (e.g., biochar amendment).
J	G	0.36	0.02	1	Catch basin retrofit; increase housekeeping and sweeping frequency.	Enhance catch basin media filtration system (e.g., biochar amendment).
J1A	R	0.80	0	0	Catch basin retrofit and Grattix box; increase housekeeping and sweeping frequency.	Enhance catch basin and Grattix box media filtration system (e.g. biochar amendment).
J1B	G	0.27	0	1	Catch basin retrofit; increase housekeeping and sweeping frequency.	Enhance catch basin media filtration system (e.g., biochar amendment).
J2		0.47	0	1		
J3		0.30	0	1		
K	R	0.32	0.32	1	Grattix boxes on roof drains; increase housekeeping and sweeping frequency.	Enhance Grattix box media filtration system (e.g., biochar amendment).
L	L	2.19	0.08	4	Catch basin retrofit and catch basin fabric filters with media; increase housekeeping and sweeping frequency.	Enhance catch basin media filtration system (e.g., biochar amendment).
L1	G	0.42	0.00	4	Catch basin retrofit and catch basin fabric filters with media; increase housekeeping and sweeping frequency.	
M	M	10.18	4.60	33	Catch basin fabric filters with media and Grattix boxes on roof drains; increase housekeeping and sweeping frequency.	Enhance catch basin media filtration system (e.g., biochar amendment).
M1	L	1.65	0.05	3	Catch basin fabric filters with media; increase housekeeping and sweeping frequency.	
N	G	0.80	0.08	2	Catch basin fabric filters with media; increase housekeeping and sweeping frequency.	
N1		1.32	0	1	Silt fence, catch basin fabric filters with media, and BMPs.	Incorporate contingency SCM to Swan Island Lagoon USEPA ROD Remedial Action.
N2		0.21	0	1	Catch basin fabric filters with media and BMPs.	Incorporate contingency SCM to Swan Island Lagoon USEPA ROD Remedial Action.
N3		0.33	0	1		
N4		0.38	0	1		
N5		0.27	0	1		
N6		0.16	0	1		
O	M	7.21	3.22	21	Catch basin fabric filters with media; increase housekeeping and sweeping frequency.	Enhance catch basin media filtration system (e.g., biochar amendment).
P	P	8.46	0.19	3	Catch basin fabric filters with media.	Enhance catch basin media filtration system (e.g., biochar amendment).
Q	Q	8.22	1.70	32	Convey to EC system at BWTP; Grattix box and 55-gallon drum retrofit at building 73; increase housekeeping and sweeping frequency.	Modify EC system/add polishing media.
R	R	1.89	1.10	5	55-gallon drum retrofit and Grattix box; increase housekeeping and sweeping frequency.	Enhance downspout media filtration systems (e.g., biochar amendment).
R1		0.05	0.04	1	55-gallon drum retrofit on roof drain.	
S	Q	0.77	0.37	7	Convey to EC system at BWTP; increase housekeeping and sweeping frequency.	Modify EC system/add polishing media.
S1		0.14	0	2		
T	R	0.74	0.45	2	55-gallon drum retrofit and Grattix box; increase housekeeping and sweeping frequency.	Enhance downspout media filtration systems (e.g., biochar amendment).
LD-1A	LD-1B	0.41	0	1	Catch basin retrofit; increase housekeeping and sweeping frequency.	Enhance catch basin media filtration system (e.g., biochar amendment).
LD-1B		0.64	0	1		
LD-2A		0.52	0.06	1		
LD-2B		0.37	0	1		
LD-2C		0.42	0	1		
LD-3A		0.52	0.04	1		
LD-3B		0.51	0	1		
LD-3C		0.52	0	1		

Table 3.1
Drainage Areas and Stormwater Source Control Measures

Outfall ID	Drainage Area Representative Sampling Location[1]	Drainage Area (acres)	Total Roof Area (acres)	No. of Catch Basins	Current Stormwater Source Control Measures	Contingency Source Control Measure
LD-4A	LD-1B (cont.)	0.52	0.03	1	Catch basin retrofit; increase housekeeping and sweeping frequency.	Enhance catch basin media filtration system (e.g., biochar amendment).
LD-4B		0.48	0	1		
LD-4C		0.52	0	1		
LD-5A		0.46	0	1		
LD-5B		0.49	0	1		
LD-5C		0.44	0.01	1		
LD-6A		0.48	0.40	1		
LD-6B		0.42	0	1		
LD-7A		0.46	0.01	1		
LD-7B		0.27	0	1		
Pier C	Direct Discharge	1.31	0	NA	Operational BMPs.	Increase sweeping frequency.
Pier D	Direct Discharge after sump	4.59	0	105	Operational BMPs.	Install media filtration systems
	Total	*68.89*	*13.29*	*306*		

Note:

1 Representative outfalls and activity descriptions are based on Appendix A: Evaluation of Substantially Similar Effluents – Representative Discharge Points in Vigor's *Storm Water Pollution Control Plan* (Vigor 2018).

Abbreviations:

BMP Best management practice
BWTP Ballast Water Treatment Plant
EC Electrocoagulation
NPDES National Pollutant Discharge Elimination System
ROD Record of Decision
SCM Source control measure
USEPA U.S. Environmental Protection Agency

Table 4.1
Stormwater Sampling Containers and Requirements

Parameter	Method	Bottle Type/ Minimum Volume	Holding Time	Preservation
pH	USEPA 150.1	500-mL glass or plastic	15 minutes (Field Measurement)	None
Total Metals: Arsenic, Cadmium, Copper, Lead, and Zinc	USEPA 200.8	250-mL plastic	6 months	Cool to 4˚C, HNO_3 to pH<2
Total Mercury	USEPA 245.2	250-mL plastic	28 days	Cool to 4˚C, HNO_3 to pH<2
Polycyclic Aromatic Hydrocarbons	USEPA 8270D SIM	1-L amber glass	7 days preextraction; 40 days	Cool to 4˚C
Phthalate Esters	USEPA 625	1-L amber glass	7 days preextraction; 40 days	Cool to 4˚C
Tributyltin	Krone et al. 1989	1-L amber glass	7 days preextraction; 40 days	Cool to 4˚C
Polychlorinated Biphenyls	USEPA 608	1-L amber glass	7 days preextraction; 40 days	Cool to 4˚C
Total Suspended Solids	SM 2540 D	250-mL glass or plastic	7 days	None

Abbreviations:
˚C Degrees Celsius
HNO_3 Nitric acid
L Liters
mL Milliliters

Table 5.1
Data Quality Assurance Criteria

Parameter	Precision	Accuracy	Completeness	Method
pH	±20%	±30%	±95%	USEPA 150.1
Total Metals: Arsenic, Cadmium, Copper, Lead, and Zinc	±20%	±30%	±95%	USEPA 200.8
Total Mercury	±20%	±30%	±95%	USEPA 245.2
Polycyclic Aromatic Hydrocarbons	±20%	±30%	±95%	USEPA 8270D SIM
Phthalate Esters	±20%	±30%	±95%	USEPA 625
Tributyltin	±20%	±30%	±95%	Krone et al. 1989
Polychlorinated Biphenyls as Aroclors	±20%	±30%	±95%	USEPA 608
Total Suspended Solids	±20%	±30%	±95%	SM 2540 D

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Figures

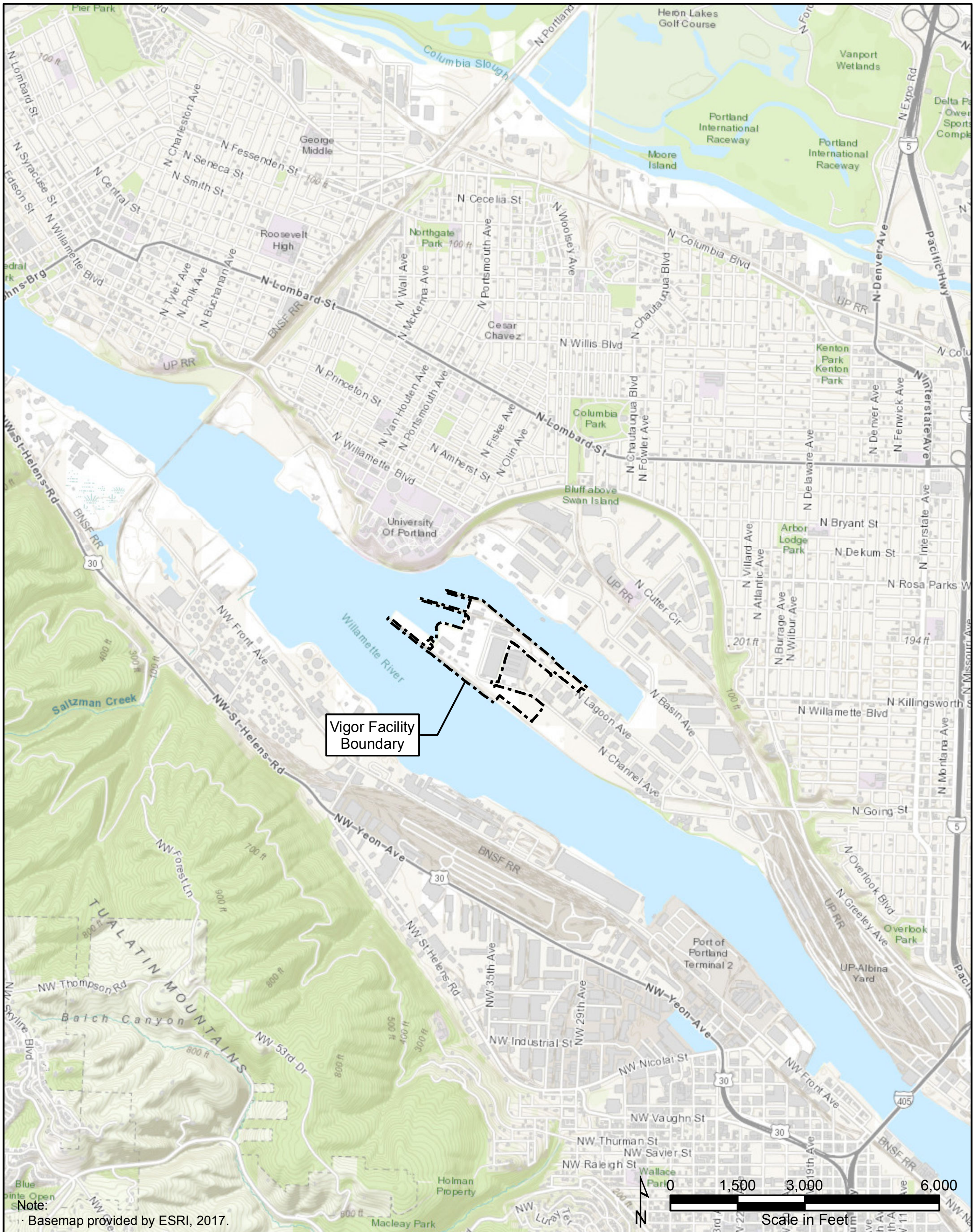

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Figure 1.1
Site Vicinity

I:\GIS\Projects\Vigor-Portland\MXD\MPECP\Figure 1.1 Site Vicinity.mxd
8/1/2018

Notes:
- Catch Basins in Lay Down Areas LD1 through LD7 are also outfalls.
- Orthoimagery obtained from NearMap, 2017.

Abbreviations:
EC = Electrocoagulation
SCM = Source control measure

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Figure 1.2
Stormwater SCMs and Monitoring and Performance Evaluation Sampling Points

I:\GIS\Projects\Vigor-Portland\MXD\MPECP\Figure 1.2 Stormwater SCMs and Monitoring and Performance Evaluation Sampling Points.mxd
8/16/2018

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Figure 3.1
Drainage Map with Substantially Similar Outfalls

I:\GIS\Projects\Vigor-Portland\MXD\MPECP\Figure 3.1 Drainage Map with Substantially Similar Outfalls.mxd
8/16/2018

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Appendix A
Standard Operating Procedures for Sample Collection

Appendix A
Standard Operating Procedures for Sample Collection

Standard Operating Procedure 1
Grab Sample Collection from a Discharging Outfall or Sampling Port

Grab samples are collected from discharging outfalls or sampling ports according to the following procedure:

1. Put on a clean pair of nitrile gloves.
2. Carefully remove the lid of the sample container and hold it or place it in a clean location so that it will not become contaminated. Make sure the inside edges of the lid do not come in contact with the ground surface or any other potential source of contamination. Do not touch the mouth of the container with your hands.
3. Collect a sample by placing the opening of the sample container facing the flow and filling the jar from the falling stream. Ensure that the sample container does not contact the lip or mouth of the outfall or sampling port. Fill the container to about ½ inch from the top.

   Note: If accessing the stormwater flow is difficult, the individual sample container may be taped to a pole to extend the reach of the sampler.
4. **Do not overfill the sample container**. An overfilled contained may bias the results (e.g., loss of preservative can result in artificially low concentrations of total metals). If a sample container with preservative overfills, note it on the field form or (if possible) collect a new sample.
5. Remove the sample container from the discharge stream and cap it securely.
6. Ensure that the label includes the date, time, sampler, sampling location, sample ID, and analysis to be performed.
7. Fill out the laboratory's Chain-of-Custody Form.
8. Place the sample in a zip-lock plastic bag, protect it with bubble wrap if appropriate, place it inside a cooler filled with ice.

Standard Operating Procedure 2
Safety Precautions Applicable to Grab Sample Collection from Location LD1-B

Sample collection at location LD1-B is performed by qualified West Coast Marine (WCM) employees, who collect the samples from a boat. Sampling must be arranged with WCM at least 2 hours before the sampling; when possible, 24 hours advance notice of possible sampling events is preferred. WCM staff, if available, will determine whether conditions are safe for sampling.

During the sample collection, personal flotation devices are worn by both the boat operator and the sampler. The sampler also wears waterproof clothing. The sampling procedure for location LD1-B is the following:

1. The Vigor sampling team will prepare the sample containers for WCM:
    a. Pre-label the sample containers with as much information as possible, including collection date, sampling location, sample ID, and analysis to be performed.
    b. Place the sample containers in zip-lock plastic bags and deliver them to WCM.
2. WCM will place the bagged sample containers and multiple pairs of clean nitrile gloves (in a sealed zip-lock plastic bag) in a larger bag or container that can be safely worn or carried into the boat by the sampler.
3. The WCM boat operator will move the boat into a position that locks it in against a pile pole or a rope will be placed around a pile pole to keep the boat from moving. The operator's goal is to position the boat within 5 feet of the sampling point.

    Once the boat is in position and properly secured, the sampler will proceed with sampling in accordance with instructions 4 through 13:
4. Put on a clean pair of nitrile gloves.
5. Carefully remove the lid of the sample container and place it in a clean location so that it will not become contaminated. Make sure the inside edges of the lid do not come in contact with the ground surface or any other potential source of contamination. Do not touch the mouth of the container with your hands.
6. Place the sample container in the bottle holder on a pole used for sample collection. Duct tape may be used to secure each sample container to the pole. Duct tape should not be placed on the top of the container, and care should be taken to protect the container label from the tape.
7. Collect a sample by placing the opening of the sample container facing the downstream flow and allow the water to flow into the container. Ensure that the sample container does not contact the lip or mouth of the outfall. Fill the container to about ½ inch from the top.

8. **<u>Do not overfill the sample container</u>**. An overfilled container may bias the results (e.g., loss of preservative can result in artificially low concentrations of total metals). If a sample container with preservative overfills, relay this information to the Vigor sampling team or (if possible) collect a new sample.
9. Remove the sample container from the discharge stream and cap it securely.
10. Label the sample container with the time of sample collection and the name of the sampler.
11. Place the sample in a zip-lock plastic bag and protect it with bubble wrap if appropriate.
12. Contact the Vigor sampling team when ready to collect the last sample, which will be collected for a field test of pH.
13. Collect the last sample by filling a clean container with a small volume of stormwater discharge. Note the exact time of sample collection so that conformance with the hold times can be determined by the Vigor sampling team. The Vigor sampling team will field test the sample for pH according to Standard Operating Procedure (SOP) 5.
14. Return the samples to the Vigor sampling team, a member of which will complete the laboratory's Chain-of-Custody Form and then place the samples inside a cooler filled with ice.

Standard Operating Procedure 3
Grab Sample Collection from Location M, Manhole 7

Collection of samples from location M, which is a manhole, involves a confined space entry. Only samplers that have completed the appropriate training for confined space entry may enter the manhole. Samples may be collected only under the following conditions:

- A second person who has received training in confined space entry is available to assist the sampler. This person will direct traffic away from the manhole and otherwise assist the sampler in collecting the samples.
- Air quality within the manhole has been deemed safe by Vigor's safety personnel.
- The sampler who will enter the manhole is wearing Level D personal protective equipment, a headlamp, and a harness that clips in to the rungs of the ladder in the manhole to prevent a fall or injury.
- Sampling personnel deems flow conditions within the manhole safe for sample collection. If the sampler cannot stand in the manhole without stepping in water, conditions are considered unsafe for sample collection.

Grab samples are collected from location M according to the following procedure:

1. Prepare the sampling gear and equipment before entering the manhole:
   a. Pre-label the sample containers with as much information as possible before entering the manhole, including collection date, sampler, sampling location, sample ID, and analysis to be performed. Field observations should be documented once back on the ground surface.
   b. Place sample containers and multiple pairs of clean nitrile gloves in re-sealable plastic bags and put these bags in a larger bag that can be safely worn or carried by into the manhole.
   c. If multiple samples will be collected, take only a few sample containers at a time to both reduce weight and allow sufficient room at the bottom of the manhole for sample collection.
2. Put on a harness, a headlamp, and a pair of rubber-grip gloves or leather gloves (work gloves) before descending the ladder into the manhole.
3. Once it is confirmed safe to enter the manhole by Vigor's safety personnel and the field sampler, clip the harness to the ladder and climb down into the manhole.
4. Make sure the footing is secure before collecting the samples: place your right foot on surface below the ladder and your left foot on the other side of the main pipe behind the lowest inlet.

5. Remove the work gloves and put on clean nitrile gloves.

   Note: If you touch a contaminated surface at any time during the sample collection, replace the gloves with a new, clean pair.

6. Carefully remove the lid of the sample bottle and hold it or place it in a clean location (e.g., within a zip-lock plastic bag placed in a bag you are wearing or holding) so that it will not become contaminated. Make sure the inside edges of the lid do not come in contact with the ground surface or any other potential source of contamination. Do not touch the mouth of the container with your hands.

7. Collect a sample by placing the opening of the sample container facing the flow and allowing the container to fill from the top of the water surface. Ensure that the sample container does not contact the bottom or sides of the manhole. Fill the bottle to about ½ inch from the top.

8. **<u>Do not overfill the sample container</u>**. An overfilled container may bias the results (e.g., loss of preservative can result in artificially low concentrations of total metals). If a sample container with preservative overfills, note it on the field form or (if possible) collect a new sample.

9. Remove the sample container from the discharge flow and cap it securely. Relay the sample collection time to the sampling assistant at the ground surface.

10. Place the sample in a zip-lock plastic bag and protect it with bubble wrap if appropriate.

11. For the last sample, collect a small volume of stormwater discharge in a clean open-mouth container. Note the time of sample collection. This sample will be field tested for pH at the ground surface according to SOP 5.

12. After sealing the sample containers in a zip-lock plastic bag, remove the nitrile gloves and put the work gloves back on to climb back up the ladder.

13. After exiting the manhole, remove the work gloves and put on clean nitrile gloves. Label the samples with the collection time.

14. Fill out the laboratory's Chain-of-Custody Form and record any other relevant notes in field logbook.

15. Place the samples inside a cooler filled with ice.

Standard Operating Procedure 4
Catch Basin Retrofit Sampling

Grab samples are collected from catch basin retrofits according to the following procedure:

1. Put on a clean pair of nitrile gloves.
2. Carefully remove the lid of the sample container and hold it or place it in a clean location so that it will not become contaminated. Make sure the inside edges of the lid do not come in contact with the ground surface or any other potential source of contamination. Do not touch the mouth of the container with your hands.
3. For influent samples, place the triangular stainless steel sampling apparatus at the corner of the catch basin to concentrate flow to a sampling port for bottle filling. Allow several sample bottle volumes of water to flow through the sampling apparatus.
4. Ensure that the sample container does not contact the lip or mouth of the catch basin sampling apparatus. Fill the container to about ½ inch from the top.

   Note: If accessing the stormwater flow is difficult, the individual sample container may be taped to a pole to extend the reach of the sampler.
5. **<u>Do not overfill the sample container</u>**. An overfilled contained may bias the results (e.g., loss of preservative can result in artificially low concentrations of total metals). If a sample container with preservative overfills, note it on the field form or (if possible) collect a new sample.
6. Remove the sample container from the discharge stream and cap it securely.
7. Ensure that the label includes the date, time, sampler, sampling location, sample ID, and analysis to be performed.
8. Fill out the laboratory's Chain-of-Custody Form.
9. Place the sample in a zip-lock plastic bag, protect it with bubble wrap if appropriate, place it inside a cooler filled with ice.
10. Following sample collection at a catch basin retrofit location, decontaminate the stainless steel sampling apparatus with a triple rinse of analyte free distilled water.

Standard Operating Procedure 5
Downspout Treatment Measures

Grab samples are collected from catch basin retrofits according to the following procedure:

1. Put on a clean pair of nitrile gloves.
2. Carefully remove the lid of the sample container and hold it or place it in a clean location so that it will not become contaminated. Make sure the inside edges of the lid do not come in contact with the ground surface or any other potential source of contamination. Do not touch the mouth of the container with your hands.
3. For influent samples, collect a sample by disconnecting the downspout line entering the Grattix box or 55-gallon drum retrofit and fill the sampling container from the falling stream.
4. For effluent samples, collect a sample by placing the opening of the sample container in the flow path of the effluent pipe from the Grattix box or 55-gallon drum retrofit before it discharges to the ground surface or drainage feature.
5. Ensure that the sample container does not contact the lip or mouth of the catch basin. Fill the container to about ½ inch from the top.

   Note: If accessing the stormwater flow is difficult, the individual sample container may be taped to a pole to extend the reach of the sampler.
6. **Do not overfill the sample container**. An overfilled contained may bias the results (e.g., loss of preservative can result in artificially low concentrations of total metals). If a sample container with preservative overfills, note it on the field form or (if possible) collect a new sample.
7. Remove the sample container from the discharge stream and cap it securely.
8. Ensure that the label includes the date, time, sampler, sampling location, sample ID, and analysis to be performed.
9. Fill out the laboratory's Chain-of-Custody Form.
10. Place the sample in a zip-lock plastic bag, protect it with bubble wrap if appropriate, place it inside a cooler filled with ice.

Standard Operating Procedure 6
Calibration of pH Meter

An OakTon pHTestr 30 pH meter is used to measure pH the field. A three-point calibration is performed with National Institute of Standards and Technology (NIST) buffer set standards (or an alternative set of standards approved by the manufacturer of the pH meter) and the following procedure:

1. Press the ON/OFF button to turn the unit on.
2. Dip the electrode about 2 to 3 centimeters into the pH standard buffer solution.
3. Press the CAL button to enter calibration mode. The CAL indicator will be shown. The upper display will show the measured reading based on the last calibration, and the lower display will indicate the pH standard buffer solution.

   Note: All Testrs have a dual display in calibration mode.

   Note: To abort the calibration, press the CAL button.
4. Allow about 2 minutes for the Testr reading to stabilize before pressing the HOLD/ENT button to confirm the first calibration point. The upper display will be calibrated to the pH standard buffer solution, and the lower display will then be toggling between readings of the next pH standard buffer solution.
5. Repeat with the other buffers, rinsing the electrode in deionized water before dipping into next buffer.

Standard Operating Procedure 7
Field Parameter Testing for pH

An OakTon pHTestr 30 pH meter is used to measure pH in the field. Calibration procedures for the pH meter are performed before the field testing for pH (refer to SOP 4). Field tests for pH are performed according to the following procedure:

1. Collect a stormwater grab sample in a clean open-mouth plastic jar following the SOP appropriate for the sampling location (refer to SOPs 1–3).
2. Press the ON/OFF button to turn the Testr on.
3. Dip the electrode about 2 to 3 centimeters into the sample. Stir and let the reading stabilize.
4. Note the pH reading or press the HOLD/ENT button to freeze the reading. Record the pH reading in the field logbook or on the field form. To release the reading, press the HOLD/ENT button again.
5. Press the ON/OFF button to turn the Testr off. If you have not pressed a button for 8.5 minutes, the Testr will automatically turn off to conserve the batteries.
6. After testing each sample, rinse the probe with deionized water.

Standard Operating Procedure 8
Composite Sampler Setup

To prepare the autosamplers for the collection of composite samples of stormwater in the selected locations, follow the procedures below:

1. To protect the sampler from accidental damage, set it in an upright position and secure it near the feature (outfall, manhole, or catch basin) where the sample will be collected.
2. Remove the battery charger from the unit and store it for later use.
3. Secure the sample bottle:
   a. Screw the bottle cap/float switch onto the sample bottle.
   b. Place the bottle in the autosampler enclosure and insert the hose of the peristaltic pump into the hole at the top of the bottle cap.
   c. Plugging the float switch lead into the jack on the front of the control panel.
4. Place a new sampling tube in the manhole/catch basin with the intake screen submerged near, but not touching, the bottom of the junction.
5. Program the autosampler for composite sampling:
   a. Select number of bottles to 1.
   b. Set carboy volume to 18 liters.
   c. Set suction line length.
   d. Select time-paced sampling.
   e. Set time between aliquot collections according to expected duration and desired aliquot volume.
   f. Select sequential sampling.
   g. Calculate aliquot size according to the expected storm duration (check weather references in work plan).
   h. Set sample volume. Sample volume should allow for same-volume sampling at regular intervals throughout the entire expected storm duration to fill the carboy.
   i. Set delay to start sampling at projected start of storm.
   j. Select run program.
6. Periodically check the sampler throughout the storm to ensure that stormwater is being collected.
7. At completion of the storm, transfer the water from the carboy to sample containers and deliver them to the laboratory.
8. Return the carboy to the laboratory for decontamination.

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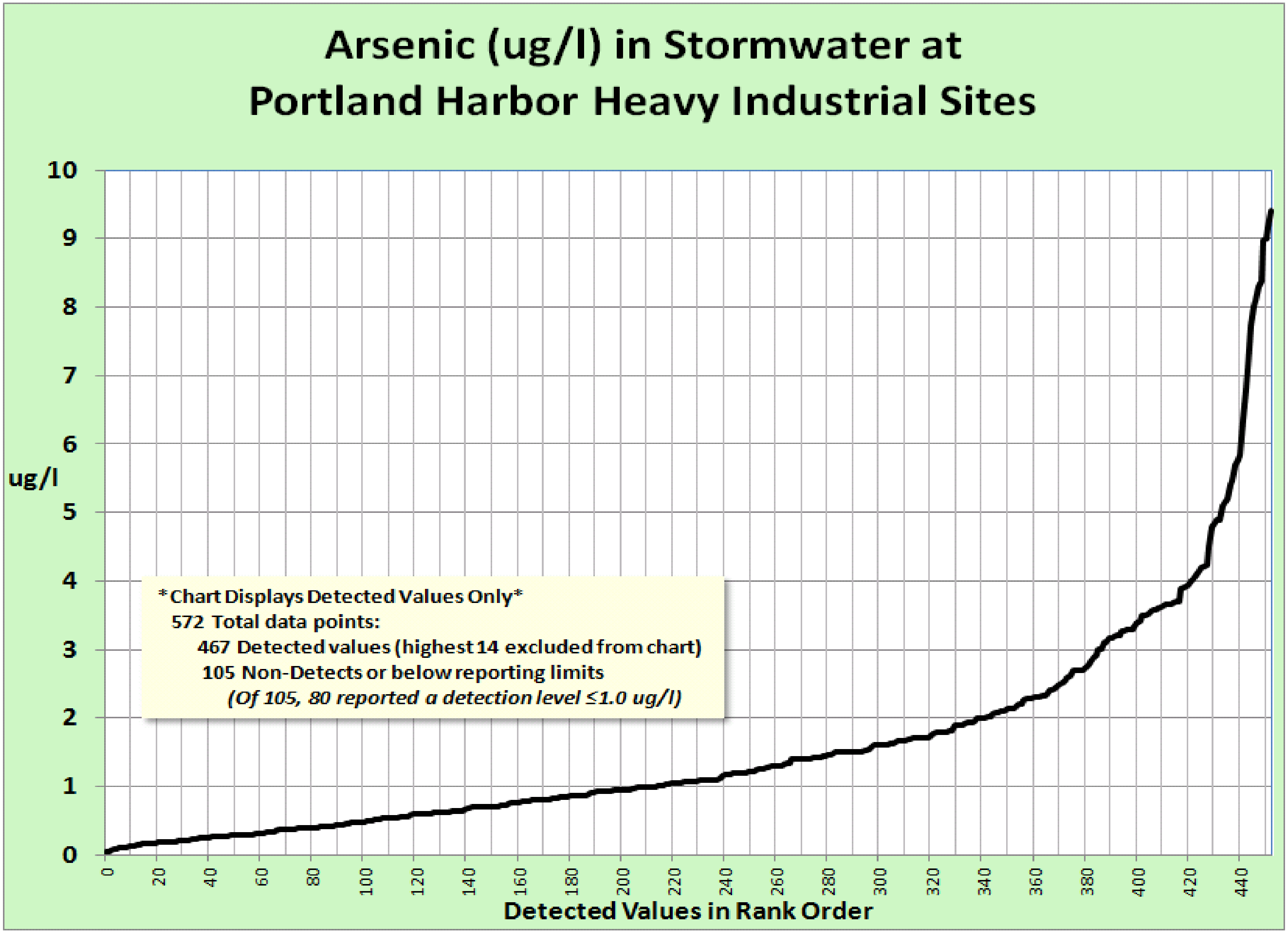
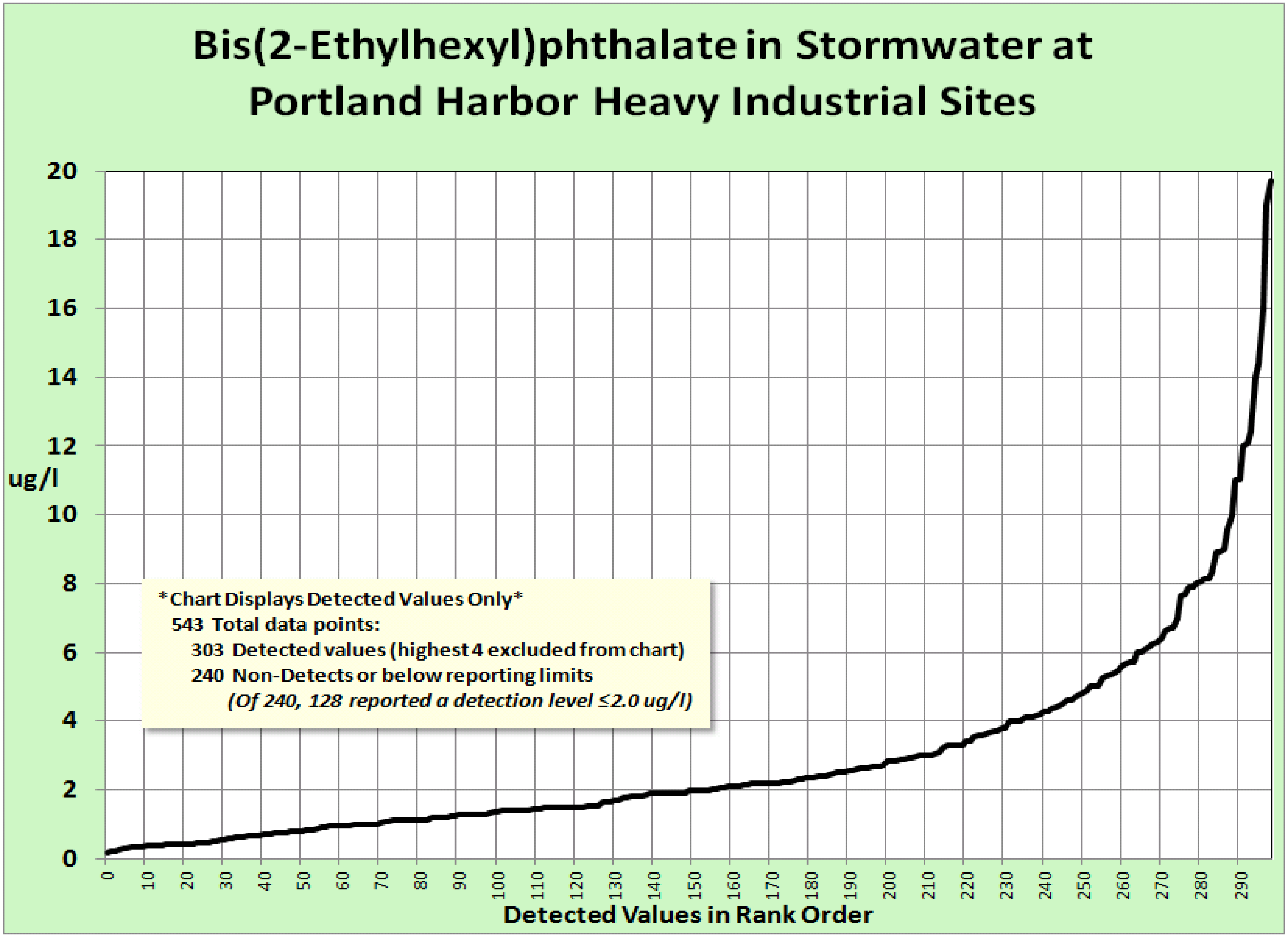
Appendix B
Rank Order Curves for Stormwater Contaminants at Portland Harbor Heavy Industrial Sites

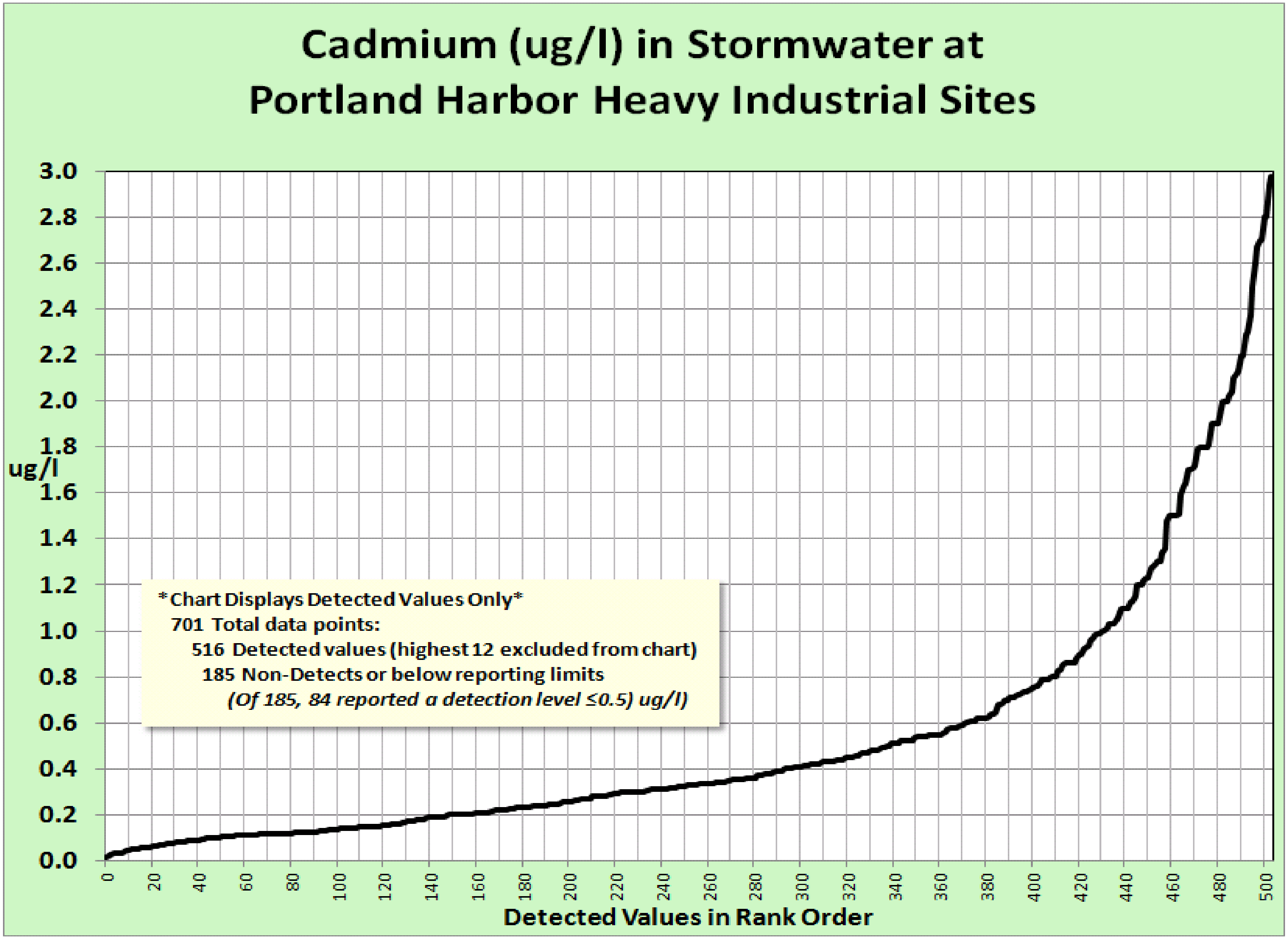
STORMWATER CHARTS

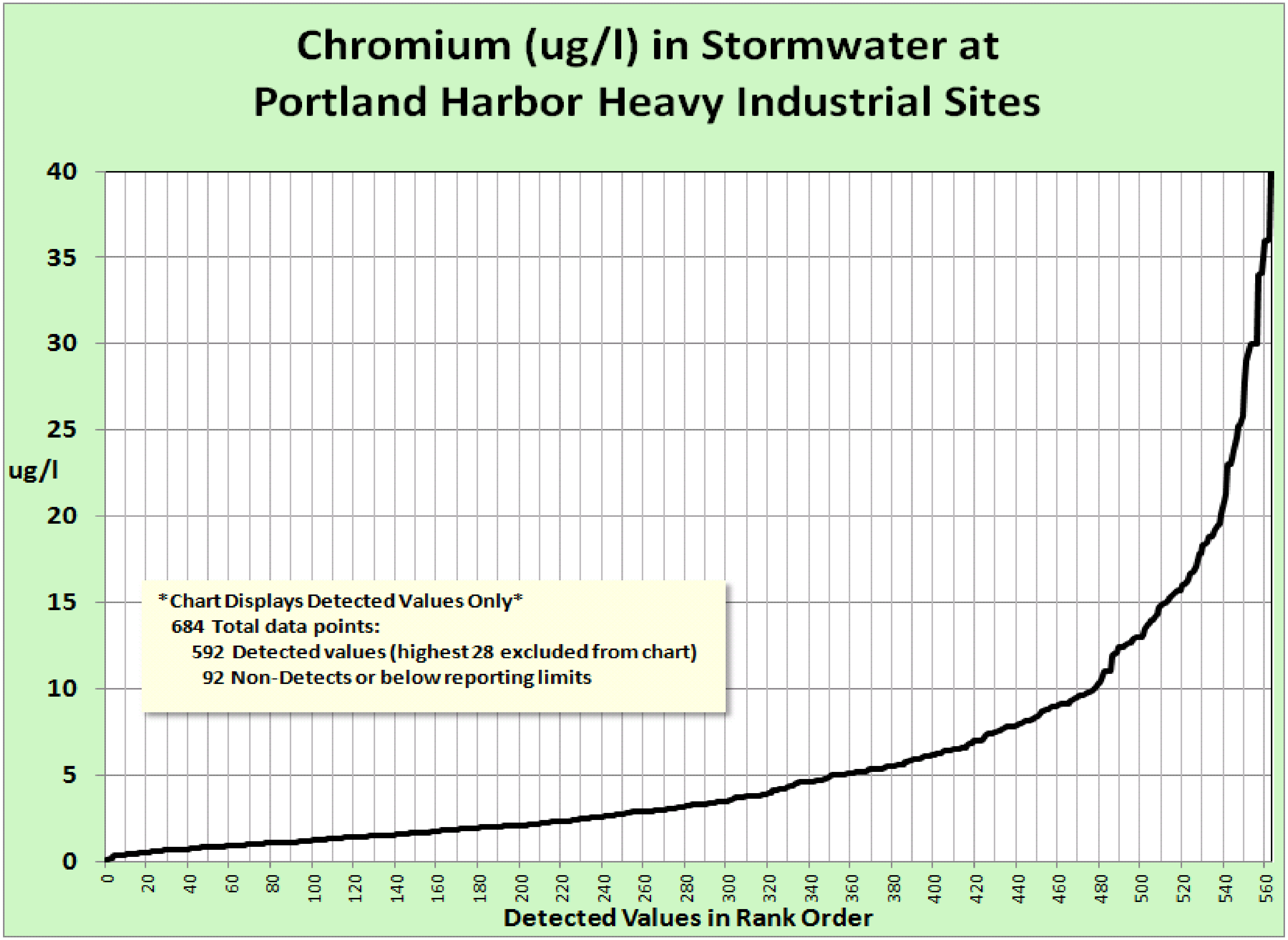
All stormwater data represents whole water/unfiltered samples.

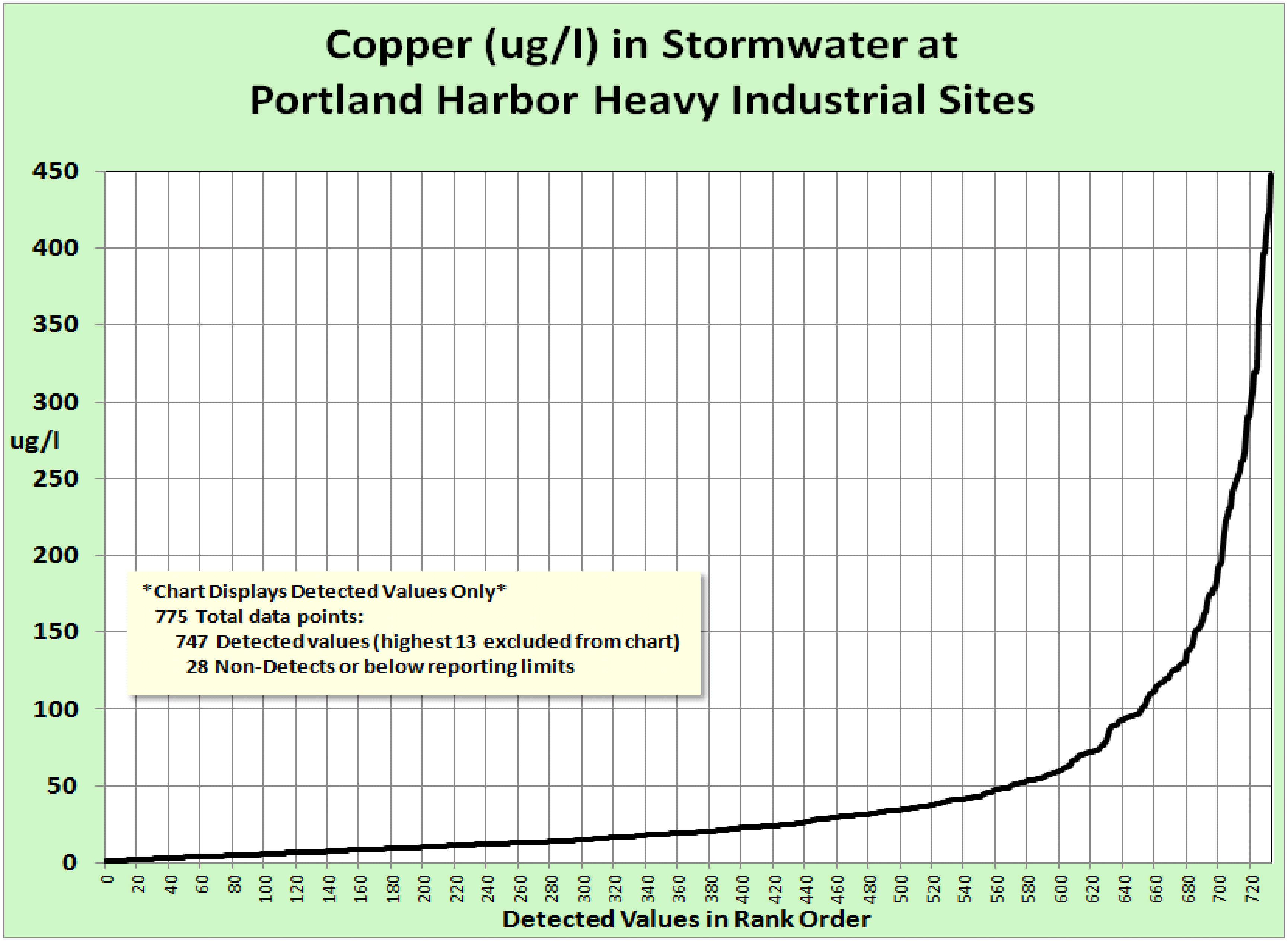

Arsenic (ug/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
ug/l
0
1
2
3
4
5
6
7
8
9
10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
Detected Values in Rank Order
Chart Displays Detected Values Only
572 Total data points:
467 Detected values (highest 14 excluded from chart)
105 Non-Detects or below reporting limits
(Of 105, 80 reported a detection level ≤1.0 ug/l)


Bis(2-Ethylhexyl)phthalate in Stormwater at
Portland Harbor Heavy Industrial Sites
ug/l
20
18
16
14
12
10
8
6
4
2
0
Chart Displays Detected Values Only
543 Total data points:
303 Detected values (highest 4 excluded from chart)
240 Non-Detects or below reporting limits
(Of 240, 128 reported a detection level ≤2.0 ug/l)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
Detected Values in Rank Order

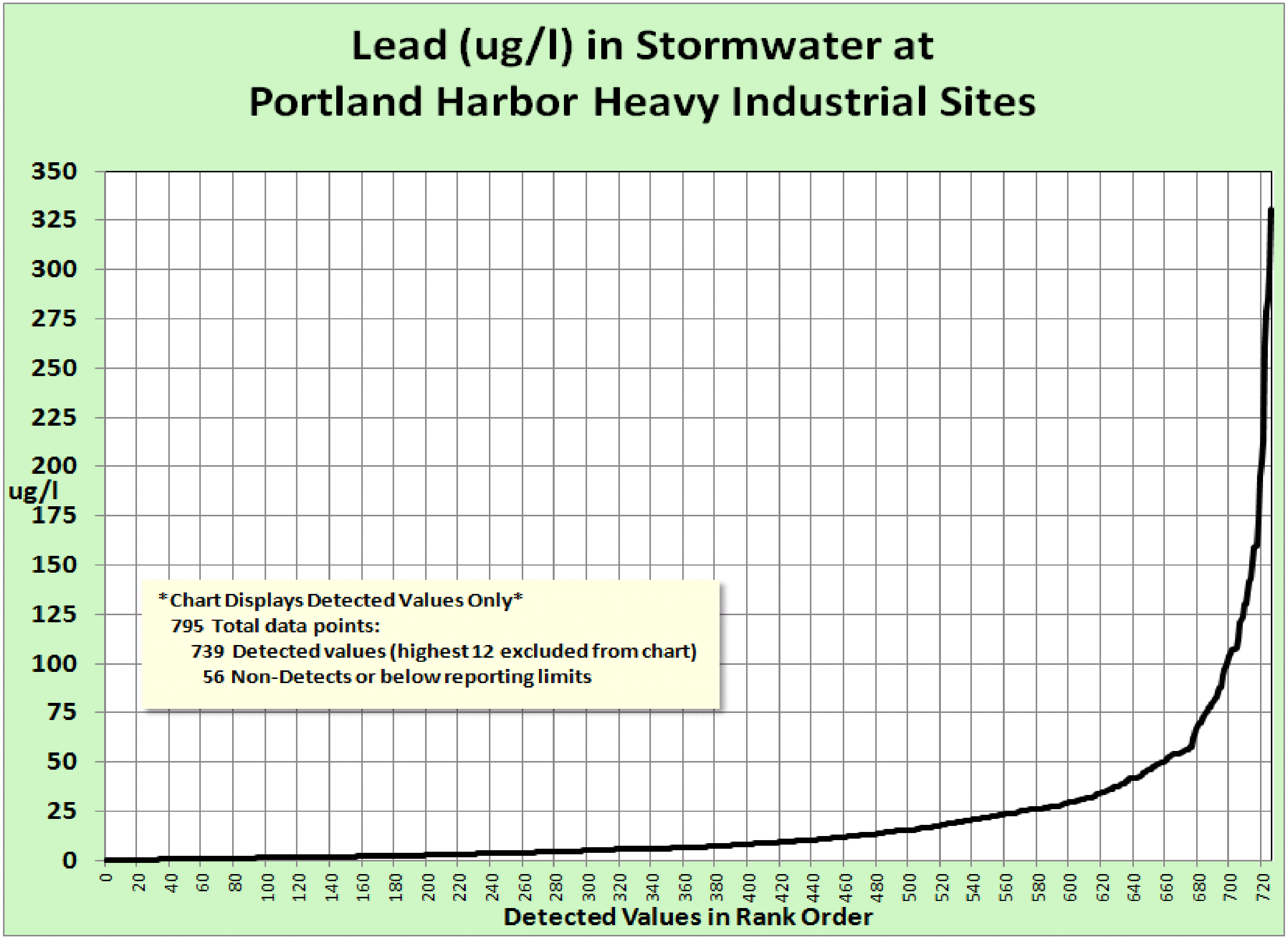
CADMIUM


Cadmium (ug/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
ug/l
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Chart Displays Detected Values Only
701 Total data points:
516 Detected values (highest 12 excluded from chart)
185 Non-Detects or below reporting limits
(Of 185, 84 reported a detection level ≤0.5) ug/l)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
Detected Values in Rank Order

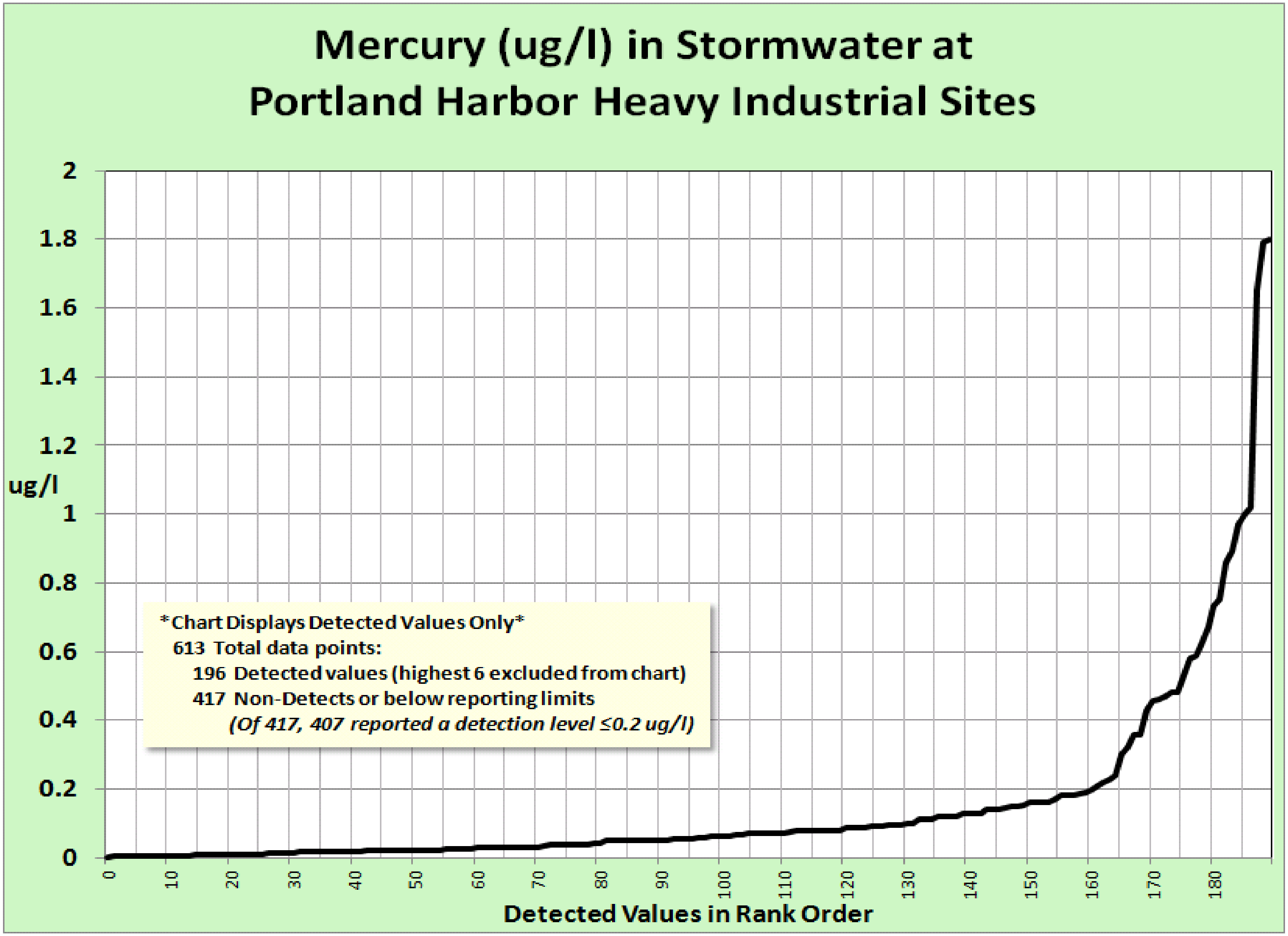

Chromium (ug/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
ug/l
40
35
30
25
20
15
10
5
0
Chart Displays Detected Values Only
684 Total data points:
592 Detected values (highest 28 excluded from chart)
92 Non-Detects or below reporting limits
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
520
540
560
Detected Values in Rank Order


Copper (ug/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
ug/l
0
50
100
150
200
250
300
350
400
450
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
520
540
560
580
600
620
640
660
680
700
720
Detected Values in Rank Order
Chart Displays Detected Values Only
775 Total data points:
747 Detected values (highest 13 excluded from chart)
28 Non-Detects or below reporting limits

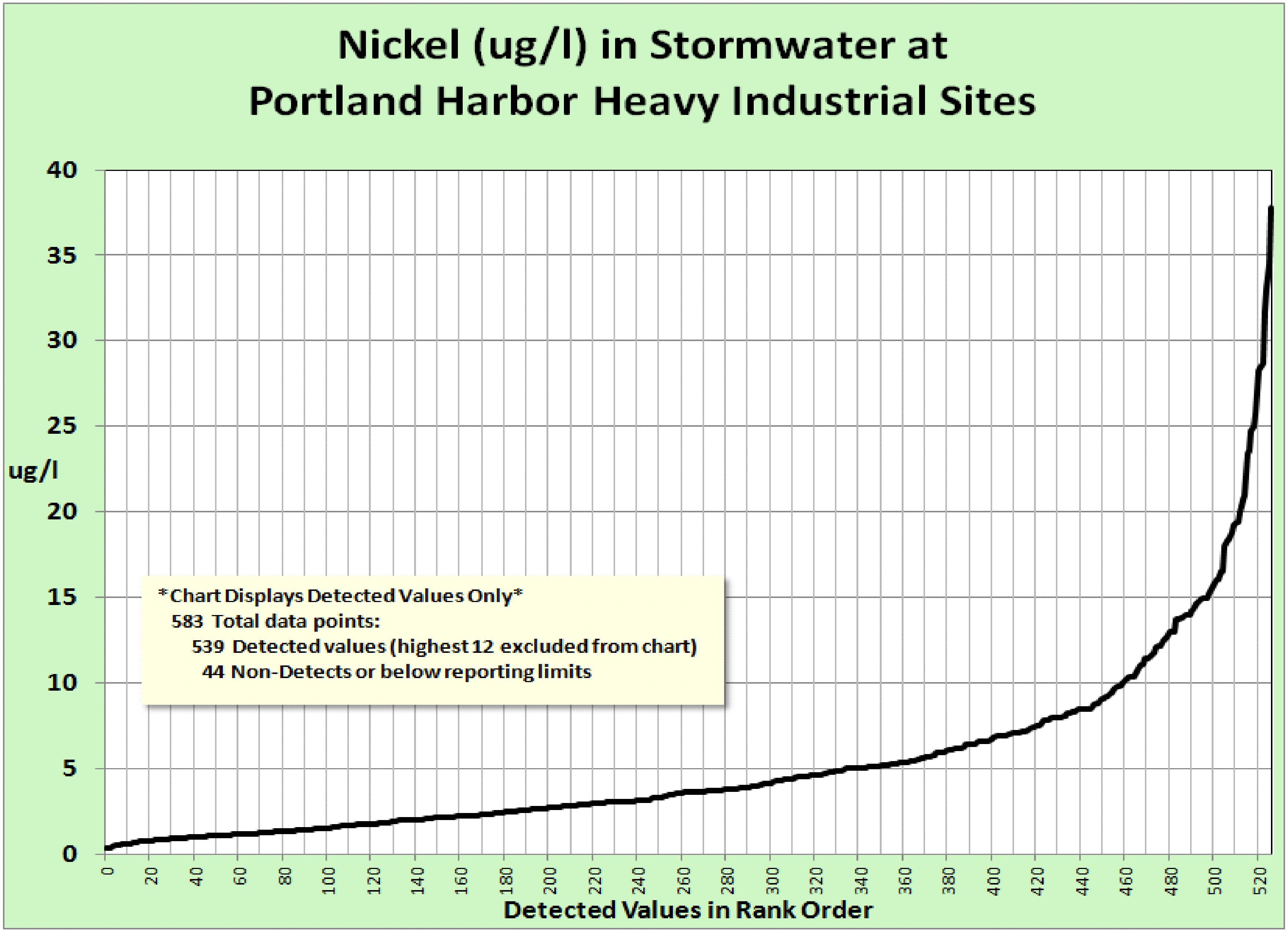
COPPER

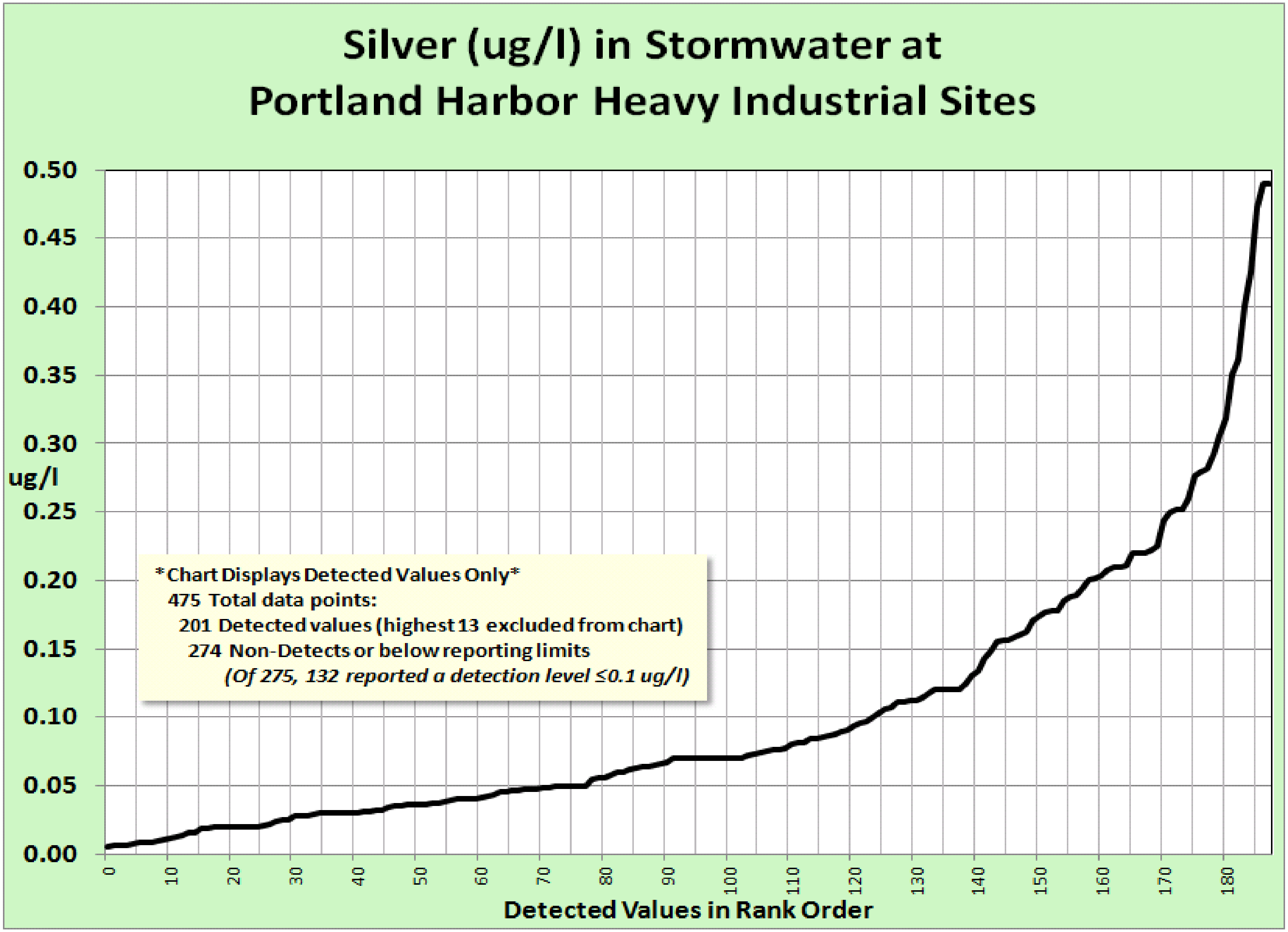

Lead (ug/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
ug/l
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
Chart Displays Detected Values Only
795 Total data points:
739 Detected values (highest 12 excluded from chart)
56 Non-Detects or below reporting limits
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700 720
Detected Values in Rank Order

LEAD


Mercury (ug/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
ug/l
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
Detected Values in Rank Order
Chart Displays Detected Values Only
613 Total data points:
196 Detected values (highest 6 excluded from chart)
417 Non-Detects or below reporting limits
(Of 417, 407 reported a detection level ≤0.2 ug/l)

NICKEL

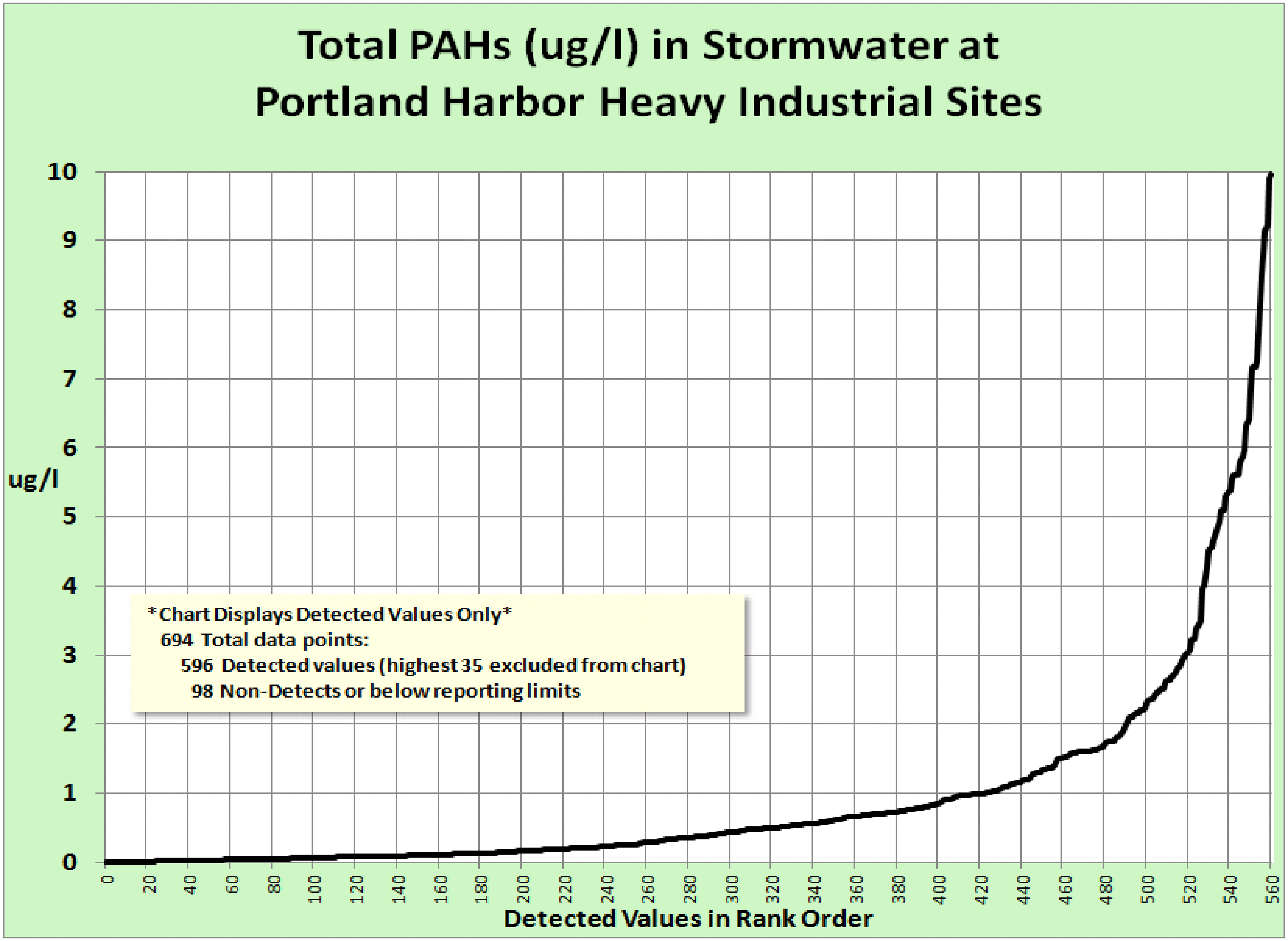

Nickel (ug/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
ug/l
0
5
10
15
20
25
30
35
40
Chart Displays Detected Values Only
583 Total data points:
539 Detected values (highest 12 excluded from chart)
44 Non-Detects or below reporting limits
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520
Detected Values in Rank Order

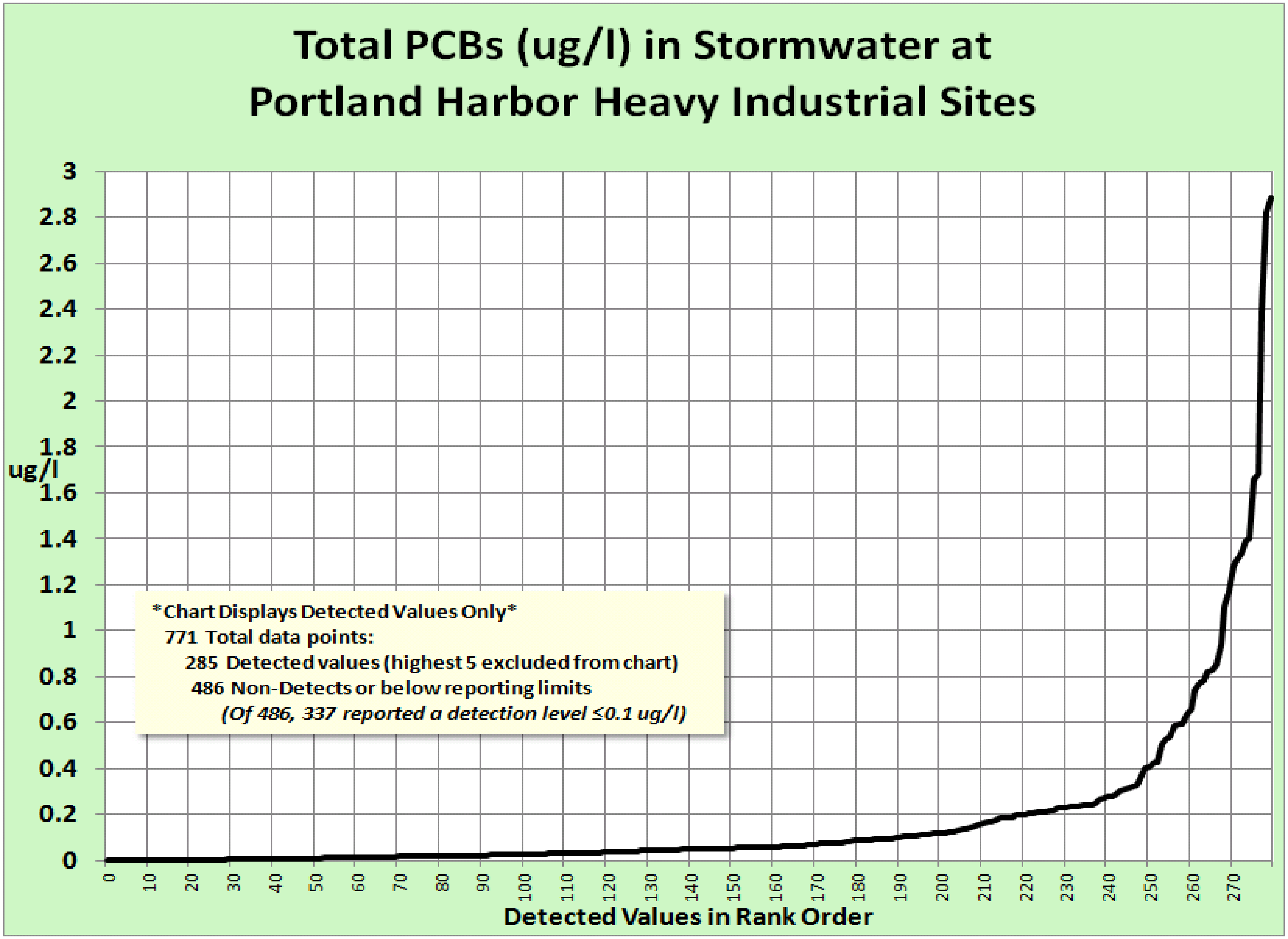


Silver (ug/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
0.50
0.45
0.40
0.35
0.30
ug/l
0.25
0.20
0.15
0.10
0.05
0.00
Chart Displays Detected Values Only
475 Total data points:
201 Detected values (highest 13 excluded from chart)
274 Non-Detects or below reporting limits
(Of 275, 132 reported a detection level ≤0.1 ug/l)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
Detected Values in Rank Order

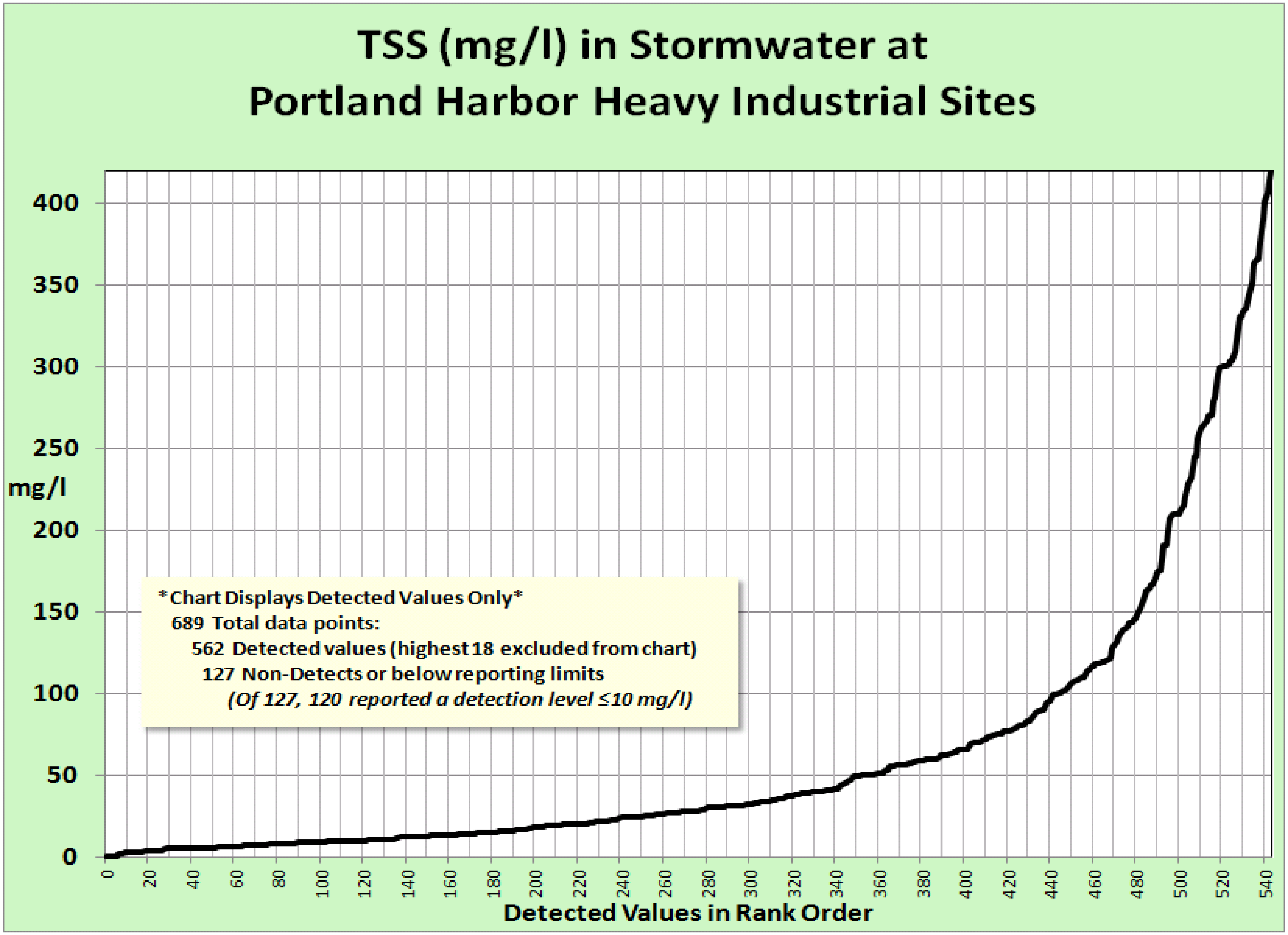
SILVER

TOTAL PAHs

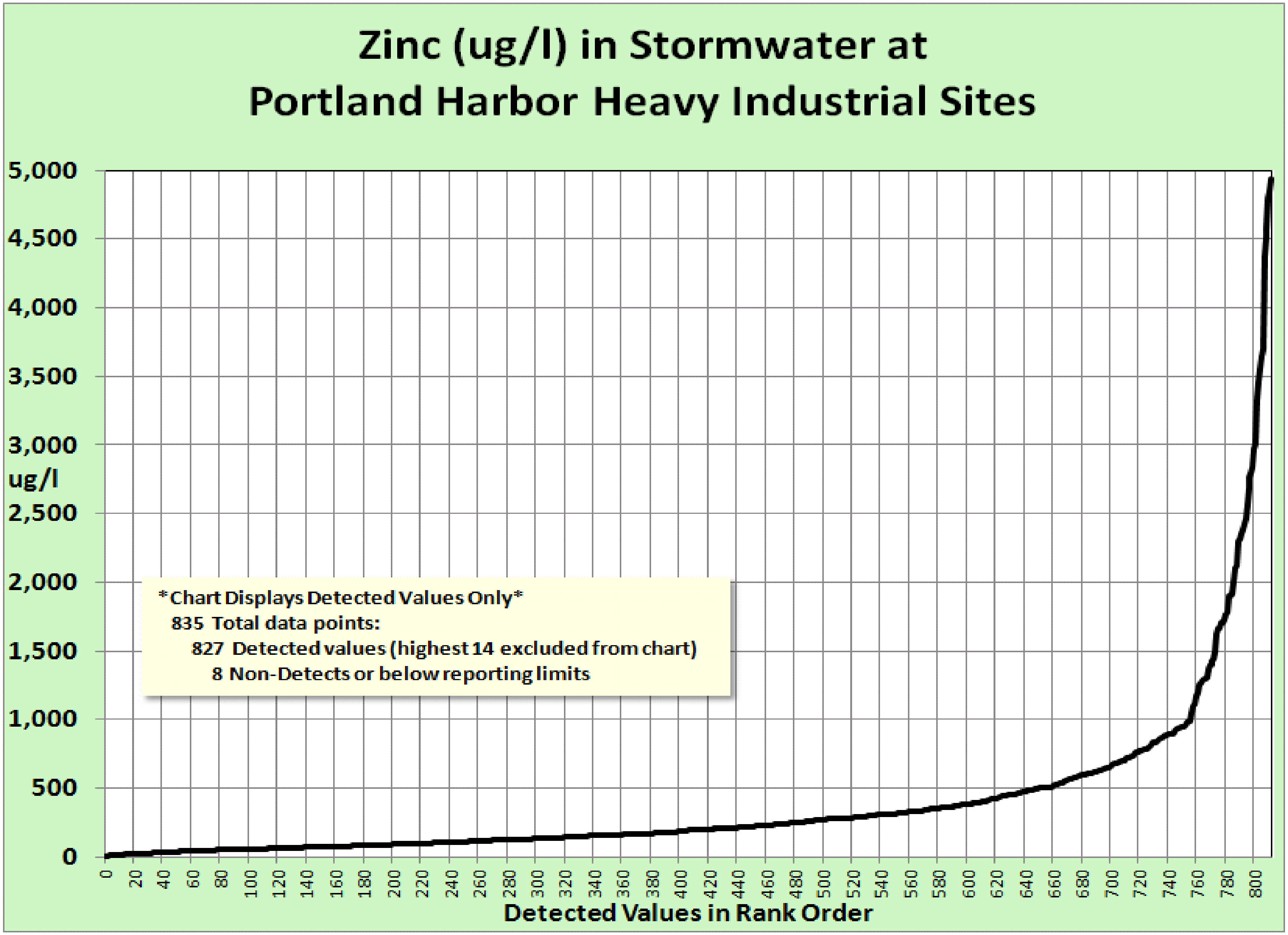

Total PAHs (ug/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
ug/l
10
9
8
7
6
5
4
3
2
1
0
Chart Displays Detected Values Only
694 Total data points:
596 Detected values (highest 35 excluded from chart)
98 Non-Detects or below reporting limits
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
520
540
560
Detected Values in Rank Order


Total PCBs (ug/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
ug/l
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270
Detected Values in Rank Order
Chart Displays Detected Values Only
771 Total data points:
285 Detected values (highest 5 excluded from chart)
486 Non-Detects or below reporting limits
(Of 486, 337 reported a detection level ≤0.1 ug/l)

TSS


TSS (mg/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
mg/l
0
50
100
150
200
250
300
350
400
Chart Displays Detected Values Only
689 Total data points:
562 Detected values (highest 18 excluded from chart)
127 Non-Detects or below reporting limits
(Of 127, 120 reported a detection level ≤10 mg/l)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
520
540
Detected Values in Rank Order

ZINC


Zinc (ug/l) in Stormwater at
Portland Harbor Heavy Industrial Sites
5,000
4,500
4,000
3,500
3,000
ug/l
2,500
2,000
1,500
1,000
500
0
Chart Displays Detected Values Only
835 Total data points:
827 Detected values (highest 14 excluded from chart)
8 Non-Detects or below reporting limits
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700 720 740 760 780 800
Detected Values in Rank Order