March 18, 2022

Josie Clark
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
M/S DOC-01
Seattle, WA 98101
Josie.clark@epa.gov

Via e-mail

Re: Transmittal of Final Portland Harbor Superfund Site Information Management Plan

Dear Ms. Clark:

Enclosed for EPA approval is the Final Information Management Plan (IMP) for the Portland Harbor Superfund Site. The report was prepared in accordance with the Administrative Settlement Agreement and Order on Consent (ASAOC) between the City, State, and the U.S. EPA, CERCLA Docket No. 10-2019-0151 (effective November 5, 2019).

EPA provided comments on the IMP on December 2, 2021. We provided a revised draft IMP on January 31 to address these comments. EPA responded with additional comments on February 11, 2022. We addressed these comments as directed or consistent with email correspondence with you on March 03, 2022. The text has also been provided in a redline Word version showing changes made to the January 31 version of the IMP so you can more readily verify the revisions.

It is our understanding that EPA will circulate the Information Management Plan to ODEQ and the Technical Coordinating Team, which will meet the ASAOC Statement of Work Section 6.1 requirement to provide copies to EPA's partners.

Please feel free to contact me if you have questions.

Sincerely.

Dawn Sanders

Dawn Sanders
PICIAP/IMP Project Coordinator

Information Management Plan
Portland Harbor Superfund Site

Submitted by
City of Portland and State of Oregon
CERCLA Order on Consent No. 10-2019-0151

Prepared for
Environmental Protection Agency

March 18, 2022

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Contents

Tables

Figures

Appendix

Attachments

Abbreviations and Acronyms

ADU	advanced data user
API	application programming interface
ARAR	Applicable or Relevant and Appropriate Requirements
CAPTCHA	Completely Automated Public Turing Test
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDPHE	Colorado Department of Public Health and Environment
City	City of Portland
COTS	commercial off-the-shelf
CSDGM	Content Standard for Digital Geospatial Metadata
DBMS	database management system
DMP	Data Management Plan
DIVER	Data Integration Visualization Exploration and Reporting
EDD	electronic data delivery
EDMS	Environmental Data Management System
EIM	Washington State Department of Ecology Environmental Information Management System
EPA	U.S. Environmental Protection Agency
ERDAP	Environmental Research Division's Data Access Program (NOAA)
ERMA	Environmental Response Mapping Application
ESRI	Environmental Systems Research Institute
ETL	extract, transform, and load process
GIS	geographic information system
GUI	Graphical User interface
IC	institutional control
IMP	Portland Harbor Information Management Plan
IMS	Portland Harbor Information Management System
Intellus	Los Alamos National Laboratory Intellus
ISO	International Organization for Standardization
LiDAR	Light Detection and Ranging
MPCA	Minnesota Pollution Control Agency
NAVD 88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
ODEQ	Oregon Department of Environmental Quality
Order on Consent	Administrative Settlement Agreement and Order on Consent
PHIDB	Portland Harbor Interim Database

PHSS	Portland Harbor Superfund Site
Programmatic IC Plan	Programmatic Institutional Controls Implementation and Assurance Plan
QA/QC	quality assurance/quality control
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SOP	standard operating procedures
SQL	structured query language
State	State of Oregon
USACE	United States Army Corps of Engineers
WCMS	Web Content Management System
WGS 84	World Geodetic System 1984

Executive Summary

The Portland Harbor Superfund Site (PHSS) is one of the most complex Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sediment cleanup sites in the nation. It consists of a nearly 10-mile stretch of the Lower Willamette River in Portland, Oregon. In 2017, the U.S. Environmental Protection Agency (EPA) issued the Record of Decision (ROD) for the PHSS. The ROD describes the remedy to address contaminated river sediments, groundwater, surface water, and riverbank soils. The ROD directs performing parties[1] to actively remediate (i.e., through removal, capping, in-situ-treatment, and enhanced natural recovery) elevated contaminants of concern and use monitored natural recovery for the remaining areas.

In November 2019, the City of Portland (the City) and the State of Oregon (the State), through its Department of State Lands and Department of Transportation, entered an Administrative Settlement Agreement and Order on Consent[2] (Order on Consent) with EPA to develop this Information Management Plan (IMP) and the Portland Harbor Programmatic Institutional Controls Implementation and Assurance Plan (or Programmatic IC Plan) for the development of a Portland Harbor Information Management System (IMS). The IMS will include PHSS cleanup data, an Institutional Control (IC) Registry,[3] and other IC information, in an on-line format available to performing parties, agency personnel, and the public. IMS content and structure may be modified over time as needed.

IMP Objective

The Order on Consent identifies the primary objective of the IMP, which is to, "coordinate long-term maintenance of, and access to, site information, environmental data management and institutional controls in a centralized data management system" (i.e., the IMS [EPA, 2019]). Performing parties may collect cleanup data and implement area-specific ICs in more than a dozen separate areas; additionally, the ROD has mandated a fish advisory education and outreach program, referred to as a harbor-wide IC, and data will be collected associated with this harbor-wide IC. There is a need to compile these area-specific and harbor-wide data and related information in standardized formats to allow stakeholder access and facilitate long-term maintenance of the information. The final IMS content will prioritize data required by EPA under an order or agreement to support the interpretation of site conditions and remedy progress.

Programmatic IC Plan Coordination

Concurrently with this IMP, the City and State are preparing a Programmatic IC Plan. The Programmatic IC Plan includes the types of IC information performing parties will submit to an IC Registry within the IMS. The IC Registry will house an IC geographic database. Area-specific IC plans, IC Implementation Reports, IC Inspection Reports, and other relevant EPA approved IC documents and information will be housed on EPA's Superfund Enterprise Management System (SEMS). The IMS will provide organized hyperlinks to the documents housed on SEMS. The IC Registry is further described in the Programmatic IC Plan that is being issued alongside this IMP.

The Programmatic IC Plan also serves as a template for area-specific IC plans that will be prepared by performing parties. The Programmatic IC Plan identifies how harbor-wide and area-specific IC information will be documented and tracked during IC implementation, maintenance, and enforcement. Once the IMS and associated IC Registry are constructed, copies of the Programmatic IC Plan, area-specific IC plans, and

[1] Performing Parties are respondents to a Portland Harbor Administrative Settlement Agreement and Order on Consent or Unilateral Administrative Order for remedy design or implementation.
[2] Administrative Settlement Agreement and Order on Consent for Remedial Design or Site-wide Institutional Controls Implementation and Assurance Plan and Information Management Plan, CERCLA Docket No. 10-2019-0151.
[3] EPA considers an IC Registry as an informational device and states that "*registries can include database listings, web-based maps, document-based inventories, or all of these.*"

IC-related documentation from performing parties will be stored on the EPA SEMS and hyperlinks will be provided on the IMS. Together, the IMP and Programmatic IC Plan provide the basis for developing and populating the IMS.

Development of IMS Requirements and Beneficial Enhancements

The Order on Consent states that, "there is a broad range of possibilities for an information management system, and therefore, some requirements will be identified as necessary, and some will be identified as beneficial but not necessary" (EPA, 2019). Several methodologies were used to develop a list of required and beneficial enhancements. The City and the State conducted a Needs Assessment[4] to understand the needs of stakeholders regarding PHSS cleanup data and IC management. The Needs Assessment solicited input from community members, tribal governments, businesses, performing parties, and agency representatives. Additionally, an evaluation of options for the IMS was conducted by researching information and data management systems used in other parts of the country and at other regulatory agencies. This research identified additional IMS requirements. The results of this process are presented in IMP Table 1, IMS Requirements and Beneficial Enhancements, which provides various options for the development of the IMS categorized as required or beneficial.

Roles and Responsibilities

The IMP identifies the roles and responsibilities for the IMS. The following provides a brief summary.

- **IMS Developer** is responsible for developing (or retaining a Contractor to develop) the IMS consistent with this IMP's requirements.
- **IMS Operator** is responsible for operating and maintaining the IMS, consistent with this IMP's guidance.
- **EPA** has jurisdiction over the entire remedial action at the PHSS and provides administrative oversight of performing parties at the PHSS.
- **Performing Parties** are the primary contributors of laboratory data and IC information for the IMS.
- **Oregon Department of Environmental Quality (ODEQ)** provides administrative oversight of upland source control and upland ICs and provides technical support to EPA on the Portland Harbor cleanups. ODEQ may also undertake some remedial action for the PHSS riverbanks that are the subject of the ROD to expedite source control of contaminated upland areas as necessary.
- **IMS Users** are diverse groups with varying degrees of technical expertise. These users could include EPA, Performing Parties, government agencies, tribal governments, and the public.

Elements of the IMS

The IMS will consist of the following elements:

- An environmental data management system (EDMS);
- An IC Registry and IC Registry Resource Library; and
- A Portal for other PHSS information.

Figure 1, IMS Conceptual Framework, illustrates the conceptual framework for the IMS. Each of these elements is summarized below:

Environmental Data Management System (EDMS). Performing parties may collect laboratory data on samples from multiple types of media as a part of remedial design and remedial action performed at the PHSS. The performing parties will provide the validated results to the IMS at EPA's direction. The IMS EDMS

[4] The Final Needs Assessment Report was submitted on February 19, 2021 and approved by EPA on March 2, 2021.

will be designed to house the data in a consistent manner, and submitters will follow electronic data delivery specifications and valid values rules developed by the EPA to ensure data consistency. The EPA will mandate the adherence to these rules in their Orders on Consent for remedial design/remedial action and will provide continuing guidance for PHSS data management in the Portland Harbor Programmatic Data Management Plan (DMP)[5].

Pre-remedial design data is currently being housed in the Portland Harbor Interim Database (PHIDB) and the public can access the data via EPA's Scribe[6] system. Following development of the IMS, EPA will continue to use Scribe to store data, but the public will be directed to the IMS to obtain PHSS data. When the final IMS EDMS is built, PHIDB will be integrated into, or superseded by that system, and PHSS stakeholders will primarily access laboratory data using the IMS EDMS Interface and Data Visualization elements.

Figure 2, IMS Data Paths, presents the IMS data source, data submittal requirements, processing, and the portion of the IMS framework where the data are available for stakeholder access.

It will be beneficial for the IMS to contain contextual geospatial data in the form of a consistent set of geospatial base features familiar to stakeholders. The geographic information system (GIS) files for the PHSS include site area, site regions, sediment management area, docks and structures, contaminated riverbanks, river miles, navigation channel, and future maintenance dredge areas. It would also be beneficial for potential erosion areas, remedial technologies, and other contextual data to be available in the IMS.

In addition, the Programmatic IC Plan requires submittal of GIS data for the boundaries of easements or other proprietary authorizations to the IMS. It is required for the IMS to display this data in web map applications.

Institutional Controls Registry and Resource Library. EPA considers an IC Registry as an informational device and states that, "registries can include database listings, web-based maps, document-based inventories, or all of these" (EPA, 2012).

The IC Registry will house locations and information regarding ICs implemented and maintained in sediment management areas across PHSS to protect the remedy. The IC Registry will support the ability to:

- Find an IC via search form or map;
- View the IC registry in a tabular format with multiple attributes and hyperlinks;
- Display the geospatial extent of the IC in map view; and
- Display what type of restrictions are on a given property.

The IC Registry will provide hyperlinks to documents housed on the EPA SEMS records management system. The IC Registry EPA approved documents will be hyperlinked to the IMS as a document-based inventory referred to in the IMP as the IC Registry Resource Library. The IC Registry Resource Library may include any document or source of information associated with an IC either directly or indirectly.

Other PHSS Information. Other EPA approved PHSS documents that are not related to the IC Registry will also be available on EPA SEMS and hyperlinked to the IMS. These might include miscellaneous environmental investigation reports and related data that will not be in the IMS EDMS, IMS IC Registry, or as a part of the IC Registry Resource Library. PHSS documents that do not require EPA approval will be housed on the IMS.

[5] The current version of the DMP is dated December 2021; it is anticipated that EPA will periodically update and republish the DMP to adapt to changes in data management and/or the IMS.
[6] Scribe is a software tool developed by the EPA's Environmental Response Team (ERT) to assist in the process of managing environmental data. https://response.epa.gov/site/site_profile.aspx?site_id=ScribeGIS.

Minimum Requirements for the IMS Design

This IMP details the requirements for designing, developing, maintaining, and providing quality assurance/quality control (QA/QC) checks and the full document should be consulted to ascertain the details. Briefly, the IMP recommends that the IMS EDMS be maintained in an enterprise geospatially enabled database (e.g., Microsoft SQL-ArcSDE, Postgres-PostGIS) because of processing speed, security, access from multiple software clients, and structured query language (SQL) query support as stated in Section 5.4.2. The IMS Developer may demonstrate that another candidate system supports a design that accommodates all content and functional requirements.

A software system that is compatible with the current systems operated by the City and State will allow for more utilization of City and State map data services to display and query programs from other sources (e.g., ArcServer or similar system) is the recommended type of platform to manage the IC GIS database. However, other geospatial database platforms that achieve this functionality are acceptable.

The EPA's IC Vector Profile Technical Specification Std No.: EX000015.1 (EPA, 2006) provides the "relational tables" as a basis for the IMS IC Registry GIS data structure. The IMS Developer is required to design and implement the final IC Registry GIS data structure. It is possible there may be additional relationships between ICs not captured by EPA's IC Vector Profile Technical Specification, such as restrictions that are only applicable until, or only applicable after, certain remedial activities have been concluded or until site closure has been achieved. The IMS Developer will work with EPA to ensure the IC Data structure contains an adequate structure for long-term IC Registry GIS data management.

The IC Registry GIS data structure, submittal GIS database template, valid values, and data dictionary are to be finalized by the IMS Developer. A data submittal template will be provided as a geodatabase feature dataset and shapefile. In addition, the IMS Operator will draft a document outlining IC Registry GIS data submittal procedures requirements similar to Attachment A of EPA's Data Management Plan, which is the Electronic Data Delivery Specifications for the PHIDB.

IMS Maintenance

IMS web content and application maintenance involves continuous updating, analyzing, modifying, and re-evaluating existing software applications to ensure optimized applications. Therefore, the IMS Operator needs to change and implement maintenance strategies on an ongoing basis.

The IMS needs detailed standard operating procedures documentation to memorialize the methods and techniques for maintaining applications and content. The standard operating procedures will be a living document that will need to be updated as required when systems change (e.g., software upgrade). The IMS Operator needs to conduct monthly IMS specific maintenance that includes but is not limited to the activities described below.

- **Check IMS Links**. The IMS is to contain numerous external links to EPA and other regulatory websites. Therefore, it is required that the IMS Operator perform routine audits of all IMS hyperlinks to ensure they are valid and link to the correct document. (Table 1, Row 66).
- **Analyze IMS Performance**. Regular analysis of website reporting using Google Analytics or similar tools allows the IMS Operator to monitor website traffic, bounce rates[7], track form submissions, and other items.

[7] Represents the percentage of visitors who enter the site and then leave rather than continuing to view other pages within the same site.

- **Test IMS Forms and Graphical User interfaces (GUIs)**. The contact forms, email subscription forms, and GUIs must be tested to ensure they are working as expected. This includes a test for the internal process for responding promptly to any stakeholder inquiries.
- **Test Website Speed**. Running a page speed test using Google PageSpeed Insights or similar tools can help identify problematic pages.
- **Tuning IMS Data Services for Performance**. The IMS operator must review server logs for excessive draw times for data visualization applications.
- **Software**. The IMS developer will prepare an annual schedule to identify software upgrades. The updated software will be tested in a staging version of the IMS prior to public rollout.

Maintenance of the IMS EDMS and IC Registry requires close consultation with EPA. It is recommended that a reoccurring meeting schedule be arranged where updates to the databases are discussed. This includes updates to valid values, data dictionaries and documentation.

IMS Quality Assurance/Quality Control

Quality assurance (QA) focuses on preventing errors, and quality control (QC) focuses on identifying unexpected errors. Both the IMS applications and data content need to undergo routine procedures that prevent and identify unexpected errors in data quality and completeness. The IMS QA/QC requirements help to ensure a stable platform with accurate and defensible content.

The IMS Developer will prepare comprehensive standard operating procedures that include QA/QC documentation for internal operational use. The documentation describes an initial set of QA/QC checks for technical compliance with data submission or acquisition requirements, followed by a data quality assessment and signoff. The documentation will also include tests of implemented features against requirements. This approach applies to both structured and unstructured data. The IMS EDMS and IC data also require detailed metadata that involves data entry. A confirmation procedure needs to be in place to ensure the metadata are correct.

Defining and enforcing data standards are proactive strategies to prevent errors. The IMS EDMS and IC GIS data will have standards for the structure, units, and codes as outlined in Sections 6 and 7. Standards for PHIDB and related performing party data submittals currently exist and can be adopted and/or modified for the IMS. The IMS Operator's role is to maintain the data standards when processing the data for IMS applications. This can be accomplished by conducting an initial set of QA/QC checks for technical compliance with data submission or acquisition requirements, followed by a data quality assessment and signoff. This approach applies to all types of structured and unstructured data.

Outreach and Communication Strategy

Effective outreach and communication with the PHSS’s diverse stakeholders are essential to successful IMS development and implementation.

To ensure IMS functions and content meet users’ need, the IMP recommends that the IMS Developer will:

- Engage representatives of each stakeholder group early and often throughout development and implementation of the IMS to collect feedback regarding user-identified concept, design, and usability issues.
- Follow-up with these same users to convey how their feedback was addressed to ensure design and usability meet diverse needs of the various users, including the performing parties, agencies, tribal governments, and the public.
- Conduct usability testing to specifically evaluate the support documentation.

The IMS Developer will use a variety of methods, which may include holding audience-specific focus groups; seeking input at existing meetings; ongoing collaboration with stakeholder group representatives; and/or contracting with community groups, agencies, and business groups to develop stakeholder specific training and support materials. EPA will need to determine the level and scope of involvement for this engagement and usability testing.

SECTION 1: Introduction

The Portland Harbor Superfund Site (PHSS) consists of an approximately 10-mile stretch of the Lower Willamette River in Portland, Oregon. Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; informally called Superfund), the 2017 PHSS Record of Decision (ROD) issued by the U.S. Environmental Protection Agency (EPA) outlines active remediation of contaminants of concern at concentrations above Remedial Action Levels and/or Principal Threat Waste thresholds; use of monitored natural recovery for areas above cleanup levels; and implementation of institutional controls[8] (ICs) to protect human health and prevent damage to the remedies (EPA, 2012; EPA, 2017). PHSS remediation may be in more than a dozen separate areas, each generating cleanup data and IC information. Implementation of a user-friendly information management system (IMS) to house this information will serve to address the diverse needs of the communities affected by the cleanup, businesses, performing parties[9], government agencies, and tribal governments.

In September 2019, the State of Oregon and City of Portland entered into an Administrative Settlement Agreement and Order on Consent[10] ("Order on Consent") with the EPA for the development of a Portland Harbor Information Management Plan (IMP) and Programmatic Institutional Controls Implementation and Assurance Plan (Programmatic IC Plan) to provide plans for an IMS and to support ROD implementation. This IMP provides specifications and recommendations for the foundations of a Portland Harbor IMS. The Programmatic IC Plan is a separate document being developed concurrent with this IMP.

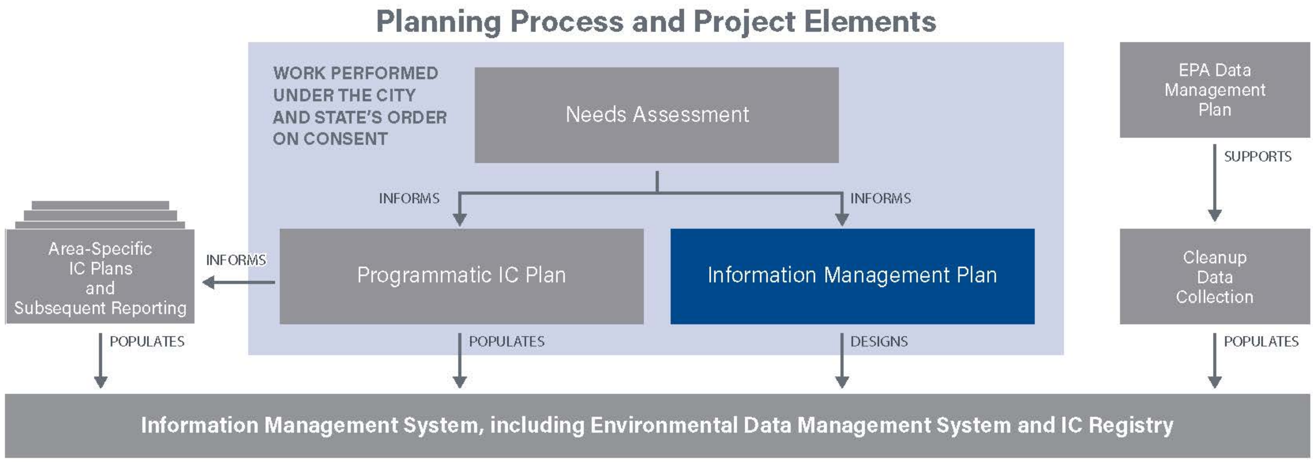
The City and the State performed a Needs Assessment to increase understanding of data and IC management needs of multiple stakeholders. The Needs Assessment was completed in November 2020, and EPA approved the *Final Needs Assessment Report* on March 2, 2021. Feedback obtained during the Needs Assessment process was used in part to develop this IMP. The approach and results of the Needs Assessment relevant to this IMP are summarized in Section 3.

As part of the remedial design phase for the PHSS, performing parties will be collecting information at the PHSS. The EPA has prepared a Data Management Plan (DMP) (EPA, 2021) to support the management of the cleanup data. Currently, cleanup data are in an interim database (described further in Section 2) but eventually will be stored and managed in the IMS. The IMS will include an Environmental Data Management System (EDMS) for performing parties to upload environmental data; recommendations for the foundations of this data management system are outlined in this IMP.

The diagram below illustrates the elements of the IMS; how the Needs Assessment informs the IMP and Programmatic IC Plan; and how the IMP and Programmatic IC Plan frame the IMS.

[8] EPA defines institutional controls as nonengineered instruments, such as legal and administrative controls, that help to minimize the potential for exposure to contamination and/or protect the integrity of a response action (i.e., remedy). EPA OSWER 9355.0-89.
[9] Performing Parties are respondents to a Portland Harbor Administrative Settlement Agreement and Order on Consent or Unilateral Administrative Order for remedy design or implementation.
[10] EPA, 2019. *Administrative Settlement Agreement and Order on Consent for Remedial Design of Site-Wide Institutional Controls Implementation and Assurance Plan and Information Management Plan*. U.S. Environmental Protection Agency, Region 10. CERCLA Docket No. 10-2019-0151.

Elements of the IMS Diagram



1.1 IMS and IMP Objectives

The Order on Consent identifies the primary objective of the IMP is to, "…coordinate long-term maintenance of, and access to, site information, environmental data management and institutional controls in a centralized data management system" (i.e., the IMS) (EPA, 2019). The final IMS content will prioritize data required by EPA under an order or agreement to support the interpretation of site conditions and remedy progress. Performing parties will collect cleanup data and implement area-specific ICs in more than a dozen separate areas and data associated with harbor-wide ICs. There is a need to compile these data and related information in standardized formats to allow access and facilitate long-term maintenance. The IMS content and structure may be modified over time as needed.

The following subsections detail the objectives for the IMS and IMP that need to be met to achieve the primary objective identified in the Order on Consent.

1.1.1 IMS Objectives

Key IMS Objectives:

- Provide transparent harbor-wide information for public agencies, tribes, performing parties, and the public.
- Maintain information to facilitate long-term comparability and effectiveness in evaluating progress on the cleanup and consistent public information during the cleanup.
- Serve as a centralized access point for area-specific IC information for all types of ICs, including:
  - Proprietary Controls;
  - Government Controls;
  - Enforcement Tools; and
  - Informational Devices.

The IMS provides benefits in several ways:

- Provides a tool to educate and inform the public.
- Streamlines decision making among multiple jurisdictions.
- Provides a platform for respective agencies to coordinate permit reviews of in-water work (e.g., maintenance dredging, pile removal) and helps reduce the risk of recontamination.
- Data consistency and comparability for future evaluations of remedy effectiveness increases the transparency of the cleanup process and progress through increasing public access to cleanup data and information.
- Enhancement of information transfer within and between stakeholder groups.

1.1.2 IMP Objectives

The IMP[11] will provide a generalized structure to develop an IMS that meets the needs of PHSS stakeholders and achieves the following objectives:

- Evaluates systems that may already exist that could be adapted to suit the long-term data management needs of the PHSS;
- Identifies the desired attributes for effective access to PHSS information;
- Identifies IMS requirements;
- Develops the requirements and specifications for an environmental data management system to be used by performing parties to document and upload environmental data to the IMS;
- Incorporates recommendations from the needs assessment to meet IMS users' needs; and
- Provides a platform for respective agencies to review site data, remedial measures, and underlying waste that remains in place geographically during coordination of permit reviews of in-water work (e.g., maintenance dredging, pile removal) to help reduce the risk of recontamination and for other uses such as EPA Five-Year Reviews.

1.1.3 IMP Coordination with the Programmatic IC Plan

Concurrently with this IMP, the City and State are preparing a Programmatic IC Plan. The Programmatic IC Plan includes the types of IC information performing parties will submit to EPA. The EPA approved documents and database will be available within the IMS as the IC Registry[12]. The Programmatic IC Plan also serves as a template for area-specific IC plans that will be prepared by performing parties. The Programmatic IC Plan identifies the methods to document and track IC implementation, monitoring, and enforcement for the entire PHSS and specific areas. Once the IMS and associated IC Registry are complete, they will hold a copy of the Programmatic IC Plan, area-specific IC plans, and IC-related documentation from performing parties. Together, the IMP and Programmatic IC Plan provide the basis for developing and populating the IMS.

1.2 IMP Scope and Organization

Section 2.2 of the Order on Consent requires the scope of the IMP to include:

- Description of roles and responsibilities;

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[11] The IMP is suitable to guide development and implementation of the IMS, but the IMP is a planning-level document that is not binding on EPA or performing parties.
[12] EPA considers an IC Registry as an informational device and states that, "*registries can include database listings, web-based maps, document-based inventories, or all of these.*"

- Description of the scope and content of the hardware and software architecture, including minimum requirements and beneficial requirements;
- Process for collecting and disseminating information on area-specific and Harbor-wide ICs;
- Process for providing sediment data and IC information for permitting agencies following remedy construction[13];
- Identification of environmental data that will be uploaded to the IMS;
- Geospatial data and accuracy and precisions requirements;
- An outreach strategy that describes where and how environmental data and IC information will be provided to stakeholder groups, a schedule for releasing information, and a communication strategy when releasing information; and
- Overall schedule for implementing the IMP.

An IMP outline was developed that organized these scope elements and was included in the Needs Assessment Report, Appendix K (Cascadia and GSI, 2021) for EPA review and approval prior to the preparation of the IMP. This IMP is organized in general accordance with the IMP outline contained in the Needs Assessment Report, as follows:

- **Section 2: Environmental Data Portal, EPA Data Management Plan (DMP) and Portland Harbor Interim Database (PHIDB)** describes the existing, interim system for managing PHSS data. EPA contemplated that the development and implementation of the IMS could take several years to complete and requested the State develop a Portland Harbor Environmental Data Portal that could house documents and structured datasets, and an interim database that could maintain Site analytical data (structured data) collected during pre-remedial design investigations and remedial design in a consistent manner while the IMS was being developed and constructed. This section discusses an ongoing effort by the State working with the EPA to implement a Portland Harbor Environmental Data Portal and PHIDB and how that relates to the EPA DMP (EPA, 2021).
- **Section 3: Needs Assessment** provides a summary of the methods and results of the Needs Assessment performed to solicit input from the potential users of the IMS to assist in framing this IMP and identifying the requirements of the IMS.
- **Section 4: Roles and Responsibilities** describes the roles and responsibilities of participating parties, including government agencies, performing parties, and other key stakeholders.
- **Section 5: Evaluation of Options for the IMS** presents the results of research performed to identify examples of other IMS's utilized across the country and the hardware and software that are available as options for the PHSS IMS.
- **Section 6: Environmental Data Management System and Contextual Geospatial Data** identifies the types of environmental data that will be uploaded to the IMS.
- **Section 7: IC Registry and Resource Library** describes the type of IC data that will be uploaded to the IC Registry database. Section 7 also describes the IC Registry Resource Library document-based inventories which will be housed in EPA's Superfund Enterprise Management System (SEMS). The IMS will provide intuitive access to the SEMS documents as organized hyperlinks.
- **Section 8: Other PHSS Information** is related to the PHSS that is neither environmental data nor related to ICs that will be generated during the life of the remedial action. Section 8 describes the types of information that are anticipated to be accessible on the IMS.

[13] This interpretation is consistent with guidance from EPA. See email from Hunter Young, EPA (Mar 10, 2020).

- **Section 9: Recommended Minimum IMS Requirements and Beneficial Enhancement** describes the scope and content of the hardware and software requirements for the IMS and identifies additional beneficial enhancements for consideration.
- **Section 10: IMS Maintenance** identifies the maintenance requirements for the IMS and includes a discussion of the necessary IMS security and backups. IMS web content and application maintenance involve continuous updating, analyzing, modifying, and reevaluating existing software applications to ensure optimized applications.
- **Section 11: Quality Assurance/Quality Control (QA/QC)** lists the QA/QC requirements to ensure accurate and defensible content as mandated by EPA. This may include, but is not limited to, standardized formats for documenting ICs, environmental database structure specifications, electronic data deliverable requirements, and data identification conventions.
- **Section 12: Geospatial Data Requirements** presents geospatial data requirement standards, including geodetic standards (datums and coordinate systems), and precision and accuracy requirements.
- **Section 13: Outreach and Communication Strategy** describes where and how environmental data and IC information will be provided to stakeholder groups, a schedule for releasing information, and a communication strategy when releasing information.
- **Section 14: Project Implementation Schedule Framework** provides an anticipated schedule for completing the development of the PHSS IMS.
- **Section 15: References**. References cited in the IMP are included in Section 15.

1.3 Overview of General Data Types and Conceptual IMS Framework

Data for the IMS will be generated or submitted in many different formats. This section describes and classifies these data types to assist data discussions in this document and provides the conceptual framework for the IMS to illustrate the anticipated content of the data management system.

1.3.1 General Data Types

The PHSS cleanup will generate data and information that stakeholders are interested in accessing on the IMS. The data and information will be prepared or available in different formats. The cleanup data are predominantly in the form of structured data such as laboratory, geospatial, and bathymetric data. However, the cleanup data also consist of data in unstructured formats, such as reports and guidance. Similarly, the IC data will have information that will include geospatial data, including areas that have use restrictions, and non-geospatial information contained in reports and other documents.

Based on this overview, the types of data on the IMS can be classified as structured and unstructured data, as follows.

Structured Data. Structured data are highly organized and are typically in letters and numbers that fit into the rows and columns of tables. Structured data commonly exist in spreadsheets and database tables. The IMS will contain structured data in the form of a database and various geographic information systems (GIS) data (e.g., geodatabases, shapefiles, and raster grids). The types of structured data on the IMS include laboratory data as a CSV file; IC GIS data as a geodatabase; and bathymetry data as a raster grid format.

Unstructured Data. Unstructured data does not have any predefined structure like a database and is typically in various formats. Examples of IMS unstructured data include IC documentation, photographs, field notes, inspection forms, and PDF documents (e.g., reports and work plans).

Discussion of structured and unstructured data occurs throughout this IMP.

1.3.2 Conceptual IMS Framework

Figure 1, IMS Conceptual Framework, illustrates the conceptual framework for the IMS. This framework is based on the objectives of the IMP and the results of the Needs Assessment, including information gained from stakeholders and a review of existing applications. Figure 1 presents the minimum required functions of the IMS.

Table 2, IMS Framework Matrix, presents a matrix of the types of data content and functionality related to the specific elements of the IMS Framework. The elements of the framework are discussed below.

EDMS: This portion of the IMS will house the structured EPA-approved cleanup data collected in the PHSS and materials related to the management of this data, including data dictionaries, and valid values. Metadata support materials will be maintained as unstructured information on the IMS. The types of laboratory data the EDMS will contain are described in Section 6.1, and EDMS requirements are presented in Section 9.1.

> **EDMS Data Download Access**: Users will access the EDMS via the EDMS Interface, which will allow users to access, search and download all or subsets of the laboratory data in standardized formats based on filters. Additionally, an application programming interface (API) or similar data service for accessing information will also be available. The requirements for download access for the EDMS are presented in Section 9.5.2.

IC Information: This section of the IMS will contain materials specific to storing and managing IC information including unstructured data such as fish advisory reports and updates; area-specific ICs Implementation and Assurance Plans (area-specific IC plans); IC Inspection reports; a non-compliant IC reporting tool; and the structured data maintained in the IC Registry. The IC Registry is discussed further in Section 7, and the requirements for IC Registry are presented in Section 9.2.

> **IC Registry Resource Library**: IC Registry documents will be housed on EPA SEMS. The IMS will provide access to the SEMS housed IC Registry documents using hyperlinks maintained on the IMS. Access to the unstructured IC Registry information will be available on the IMS as a document-based inventory referred to in the IMP as the IC Registry Resource Library.

> **IC Registry Database**: Stakeholders will access the IC Registry structured database via the IC Interface, as a GIS web map service, and in the data visualization interactive maps on the IMS.

> **IC Registry Download Access**: Stakeholders will access the IC Registry structured data via the IC Interface to search and download data in standardized formats. Additionally, an API or similar data service for accessing information will also be available. The requirements for download access for the IC Registry are presented in Section 9.5.2.

General Content: This will be the conventional content associated with a website. The home page welcomes stakeholders to the site where there are links to news, help center, IMS overview, email subscriptions, site map, and contact. This IMS element is discussed in Section 9.5.1.

Other PHSS Information: This is a data portal where stakeholders will access links to other data and reports related to PHSS that are not provided by the EDMS, IC Registry Database and IC Registry Resource Library. This IMS element is discussed in Section 8.

Data Visualization Applications: This will contain an interactive map application that displays a subset of the EDMS and IC Registry GIS data. Dashboards presenting long-term cleanup trends will also be available. The requirements for the data visualization applications are presented in Section 9.5.4.

SECTION 2: Environmental Data Portal, EPA DMP and PHIDB

The Order on Consent states that an interim system for sharing PHSS information and storing data, as well as clear requirements to ensure consistent electronic data reporting by performing parties, are needed while the IMP and Programmatic IC Plan are being prepared. To that end, the State entered into a separate Administrative Settlement Agreement and Order on Consent (EPA, 2020a) with the EPA to develop a Portland Harbor Environmental Data Portal to ensure that relevant documents and data prepared during remedial design are available to the public and an interim database to ensure that data consistency and quality requirements are met during remedial design.

To meet this requirement, the State developed the Portland Harbor Environmental Data Portal[14] (Environmental Data Portal) and the PHIDB. The Environmental Data Portal provides web-based access to a variety of EPA-approved analytical laboratory datasets, reports that document investigations or other actions at the PHSS. The State designed and rolled out the Environmental Data Portal in 2018. The PHIDB[15] houses analytical laboratory data collected during remedial design or during other activities relevant to the cleanup of the PHSS. The State built and implemented the PHIDB in 2020. The PHIDB is described in the PHIDB Design Document (Cascadia and Integral, 2021) including descriptions of the database tables, an entity relationship diagram, and data dictionary.

In addition, the EPA has prepared a Portland Harbor DMP (EPA, 2021) to ensure that environmental data collected at the PHSS during remedial design adhere to certain standards and practices. The DMP provides overall guidance and data requirements for the various performing parties that conduct sampling. EPA's DMP utilizes the PHIDB to house the data collected during these remedial design activities.

The Portland Harbor Environmental Data Portal, PHIDB, and DMP are described further below.

2.1 Portland Harbor Environmental Data Portal

Currently, the Environmental Data Portal[16] contains Portland Harbor data collected prior to implementation of the baseline pre-remedial design study conducted in 2018 (AECOM and GeoSyntec, 2019) and EPA-approved reports related to these studies. The Environmental Data Portal is structured as a table of downloadable data links with sortable column headers for year, study, author, sample types, measurements, geospatial extent, and date range. Content in the table is keyword searchable. The EPA-approved reports are from different authors, and in a variety of file formats. Most of the datasets associated with the reports are presented as Excel or Access data tables.

2.2 EPA DMP

The EPA DMP provides overall guidance for environmental data collection to performing parties conducting remedy-design investigations so that the data adhere to certain standards and practices. The objective of the DMP is to, "ensure that environmental data and supportive information are collected and documented consistently and managed in a manner that preserves, protects, and makes the information available to all stakeholders, performing parties, and other affected groups" (EPA, 2021). Implementation of the EPA DMP allows the PHSS pre-remedial design investigation and remedial design data to be housed in a single database in a consistent format. PHIDB is the current database storing this data. When this IMP is approved and implemented, the IMS EDMS will house the data.

[14] A data portal is a web application, website, or page of a website that holds data from different sources, organized under subsets or categories to make it simple for the users of the site to search.
[15] A database is an organized collection of structured information, or data, stored electronically in a computer system.
[16] http://ph-public-data.com/.

EPA has entered into a number of orders on consent with performing parties to conduct remedial design for cleanup in sediment management areas within PHSS. These EPA orders on consent include a requirement that data collected by performing parties under that order be submitted to PHIDB per guidance provided in the DMP. Compilation of data from multiple studies into a single system establishes consistency in data structure and encoding and facilitates data interpretation and presentation consistency.

The DMP includes data exchange guidance regarding electronic data delivery (EDD) format required to facilitate uploading data to the PHIDB. Because numerous parties will collect data, all of whom may manage data in different systems and structures, parties will be required to submit their data in a standard digital format or EDD. Attachment A of the DMP outlines data exchange procedures and includes the EDD specifications and valid values tables currently required (EPA, 2021). The DMP, EDD specifications, and valid values may need to be revised during the development of the IMS to be consistent with requirements adopted by the IMS.

2.3 PHIDB

The State developed the PHIDB to support the DMP and provide a centralized and standardized repository for environmental characterization and related administrative data for an interim period until the IMS system is built. The PHIDB contains only data collected after the Record of Decision (EPA, 2017). Data collected during pre-remedial design investigations and remedial design assessments are being housed in the PHIDB, which is designed for structured query language (SQL) data retrieval functions and is not accessible to all stakeholders. Unstructured data, including reports and other relevant documents or data tables, are currently housed in the Environmental Data Portal.

The PHIDB data management application is a relational database implemented using PostgresSQL (a free, open-source[17] relational database platform) and PostGIS (a PostgreSQL extension to manage geospatial data). The database stores environmental characterization data in tables that describe locations, samples, analytical chemistry data, toxicity test data, and species abundance data. This information can be linked to EPA orders, administrative actions, and performing parties. Decision data uploaded to the PHIDB is exported to the EPA Scribe database[18] format and represents the "data of record" (EPA, 2021). Stakeholder groups can access the data of record through the EPA Scribe database before the IMS completion. When the final IMS EDMS is built, PHIDB will be integrated into or superseded by that system.

[17] An open-source application means that the programming code is freely available for possible modification and redistribution and not part of a commercial package.
[18] Scribe is a software tool developed by the EPA's Environmental Response Team (ERT) to assist in the process of managing environmental data. https://response.epa.gov/site/site_profile.aspx?site_id=ScribeGIS.

SECTION 3: Needs Assessment

The Needs Assessment informed the development of the IMP. In the Needs Assessment, the City and State invited the stakeholder groups to provide input regarding PHSS cleanup data and IC management. Stakeholder groups identified for the Needs Assessment included:

- Community Group;
- Government Group (including Tribal Governments)[19];
- Business and Performing Party Group; and
- Advanced Data Users (ADU) (of whom participants could also be part of one of the above groups).

The Final Needs Assessment Report[20] (Cascadia and GSI, 2021) details the methods, scope, and results of the Needs Assessment; the following subsections provide a summary of the methods and results. These results informed the framing of this IMP and developing the requirements of an IMS.

3.1 Needs Assessment Input

Stakeholder input on the needs for an IMS focused on two primary elements: the EDMS and how to best access PHSS information related to cleanup of the harbor.

The type of input solicited and the methods for obtaining the input for the IMP and IMS are summarized below.

Type of Input Solicited for the IMP

Stakeholders were asked for input on an EDMS that would meet stakeholder needs. Specifically, this Needs Assessment sought input regarding the following:

- Stakeholder use of existing data management systems;
- Additional technical information or tools that stakeholders need; and
- Examples of other data management systems that stakeholders think could be modified to improve data sharing in Portland Harbor.

Input was requested from stakeholders regarding content and accessibility. Stakeholders were asked about:

- Use of the Interim Data Portal;
- Additional information or tools needed to obtain and visualize data;
- Access to IC information;
- Examples of data management systems used at other sites or by agencies to provide ideas and/or lessons learned; and
- Needs and preferences for accessing data in the future EDMS.

[19] Government agencies which participated in the Needs Assessment included: City of Portland; FEMA; Metro; Multnomah County; National Oceanic and Atmospheric Administration (NOAA), ODEQ, Oregon Department of Fish and Wildlife; Oregon Department of State Lands; Oregon Health Authority; Oregon Parks and Recreation Department; Oregon State Marine Board; Oregon Utility Notification Center; Port of Portland; Portland Sediment Evaluation Team; U.S. Army Corps of Engineers; U.S. Coast Guard; EPA; U.S. Fish and Wildlife; Washington Department of Ecology.
Tribal governments which participated in the Needs Assessment included: The technical consultant for the Confederated Tribes and Bands of the Yakama Nation and the technical consultant for five tribes (Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians of Oregon, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation of Oregon, and Nez Perce Tribe).

[20] **Placeholder for EPA to provide weblink for published final Needs Assessment Report**

More detail about the process can be found in Section 2 of the Final Needs Assessment Report (Cascadia and GSI, 2021).

3.2 Needs Assessment Findings

The stakeholder input and findings are summarized in the context of the following categories:

- Institutional controls;
- Post-Remedy Permit coordination and Review;
- Access to PHSS information;
- EDMS; and
- Information dissemination (a category specific to Community Group stakeholders).

3.2.1 Institutional Controls

Each stakeholder group expressed the need for IC information via maps. Other themes expressed often within the stakeholder groups include the following:

- Access to IC locations and types of restrictions in each location;
- Tools to develop area-specific IC plans, such as checklists and information on the government agencies and tribal governments involved in ICs;
- Digital tool to facilitate community reporting of IC deficiencies;
- Access to centralized IC data; and
- IC data formatted as GIS polygons available for download and in an online IMS.

3.2.2 Post-Remedy Permit Coordination and Review

As part of the Needs Assessment, participants in the Government Group indicated that a centralized location to obtain and view applicable ICs, analytical data, and monitoring/management information associated with the PHSS would help with processing permits and authorizations. The IMS and IC Registry (described in Section 7) will serve as a centralized source of IC information for permitting agencies authorizing in-water work (e.g., maintenance dredging, pile removal) and shoreline work (e.g., riverbank redevelopment).

Government Group participants indicated that they are currently coordinating with one another, and they frequently share data with EPA, the City of Portland, Oregon Department of State Lands, the United States Army Corps of Engineers (USACE), Oregon Department of Environmental Quality (ODEQ), Oregon Department of Fish and Wildlife, and the Oregon State Marine Board.

3.2.3 Access to PHSS Information

Across all four stakeholder groups, participants who have tried accessing IC information and cleanup data have found the process difficult and agree that a centralized IMS would be useful. All stakeholder groups preferred that the IMS include interactive maps that could also allow users to query and obtain usable data files and GIS layers.

Government Group and ADU Group members recommended query tools that have more options for advanced data analysis that may not be easily used by industry nonprofessionals. Government Group, Community Group, and ADU Group participants suggested that an IMS with two different applications—one that supports ADU analysis and another application for the casual or lay user—need to be considered. Community Group members also articulated the importance of continuing to include them during the development of the IMS to ensure a user-friendly interface.

3.2.4 Environmental Data Management System

Participants from all four stakeholder groups expressed a consistent need for laboratory, geospatial, and bathymetric data. Stakeholders provided input to help determine the desired attributes for the EDMS and the IMS using examples from existing regulatory agency systems.

Both Community Group and Government Group participants expressed needs to visualize: (1) contaminant concentration trends; and (2) the relative difference of concentration results by remedial action level and similar criteria. ADU Group participants identified the most important data attributes and/or structures that would make the IMS their preferred method of obtaining data.

3.2.5 Information Dissemination

Community Group members emphasized the need to use multiple engagement and communication channels to support equitable information access, project transparency, public awareness, and trust. They recommend, for example, making information accessible through a mobile app, a mobile-friendly website, and social media.

SECTION 4: Roles and Responsibilities

This section describes the roles and responsibilities of the administration, management and users of the IMS, including government agencies and tribal governments, performing parties, and other key stakeholders.

4.1 IMS Developer

The IMS Developer is one or more parties (e.g., project team) that will utilize this IMP to build the IMS. It is anticipated that the IMS Developer will enter into an order on consent with the EPA for the development of the IMS. The IMS Developer may choose to retain consultant(s) with specific expertise in the development of database systems to assist or complete the development of the IMS. The title, "IMS Developer," as used herein applies to both the project team that enters into the order on consent with the EPA and to the consultant(s) who are retained by the project team to develop the IMS. Development of the IMS will consider but is not limited to structured and unstructured data management, application development, web content authoring, QA/QC, and authoring metadata.

4.2 IMS Operator

The IMS Operator is one or more parties (e.g., project team) that will maintain the IMS. The IMS Developer and the IMS Operator may or may not be the same entity. It is anticipated that the IMS Operator will enter into an agreement with the EPA for operating and maintaining the IMS. The IMS Operator may choose to retain consultant(s) with specific expertise in database systems to assist or conduct the operation and maintenance activities of the IMS. The title, "IMS Operator," as used herein applies to both the project team that enters into the order on consent with the EPA and to the consultant(s) who are retained by the project team to develop the IMS. The IMS Operator will be tasked with ensuring structured and non-structured data submittals comply with technical requirements. The IMS Operator team will include an IMS Data Administrator who is the point of contact for questions, support, training, and data coordination and sharing.

4.3 EPA

EPA has several roles applicable to the IMS:

- EPA oversees the remedial action at the PHSS and will approve the engineering controls that are part of the remedy (e.g., caps) and the ICs needed to protect the remedy, the environment, and the public. ICs are an important part of the remedy for each sediment management area and ICs will initially be proposed as part of the 30 percent remedial design document prepared by performing parties (EPA, 2021) and finalized as part of the final design. Data and information related to the ICs will need to be submitted to the IMS, and EPA will be responsible for publishing the IC data submittal requirements. It is anticipated that the EPA will coordinate with the IMS Developer and/or the IMS Data Administrator in the development of these requirements. EPA is responsible for overseeing the ICs. EPA is also responsible for approving IC registry submittals developed by performing parties.
- EPA provides administrative oversight of performing parties at the PHSS. The agency works directly with performing parties on the type of sampling activities conducted. Central to this role is the identification of critical data needs on approved sampling activities. Currently the EPA maintains a DMP that identifies the data formatting requirements and submittal process for laboratory data being collected at the PHSS. It is anticipated that the EPA will continue to update the DMP (or similar document) to allow for changes in submittal contents, formats, and/or data assessment approaches (e.g., data summation rules). The designated Portland Harbor Remedial Project Manager for the EPA team will coordinate with the IMS Data Administrator to ensure that updates to the EPA DMP are coordinated with IMS updates. EPA currently approves laboratory data submittals to the PHIDB and will approve performing party laboratory data submittals to the IMS.

- EPA may also be laboratory data and/or IC information contributors for unassigned sediment management areas.
- EPA has a role in coordinating with the Technical Coordinating Team on the implementation activities of the IMS. The Technical Coordinating Team is the principal means of coordination and communication of data and information concerning PHSS by the EPA, ODEQ, Tribal Governments, and Natural Resource Trustees.[21]

4.4 Performing Parties

Performing parties are the primary laboratory and IC data contributors for the IMS. Performing parties will be under order by the EPA to implement cleanup activities. Their obligations for submitting data to the IMS will be described in the order by EPA. EPA provides oversight for the data elements and requirements that facilitate data collection and exchange. Performing parties are responsible for collecting the necessary data elements, pursuant to quality assurance plans approved by the EPA, and submitting this data to the IMS. The performing parties' data manager and/or project coordinator prepares the EDD data submittal and serves as the point of contact for all data matters.

Performing parties are responsible for the planning, implementation, and maintenance of ICs in perpetuity for engineered remedies. The performing parties will develop area-specific IC plans as part of the remedy design and submit to the IC information to the IC registry.

4.5 Oregon Department of Environmental Quality (ODEQ)

ODEQ provides administrative and technical oversight as the lead agency for upland and upriver source control, oversees cleanups upriver of PHSS, and provides technical support to EPA on PHSS in-water cleanups. ODEQ may also be IMS laboratory data contributors, such as data collected in upstream areas.

4.6 IMS Users

Users of the IMS are diverse groups with varying degrees of technical expertise. The anticipated use of the IMS by user group is summarized below.

EPA

EPA will utilize data and IC information during administration of the PHSS, including 5-year reviews to evaluate the protectiveness of the remedy. EPA will engage in public education and outreach using the IMS. For example, IMS graphics and data are useful communication tools for the Community Advisory Group and similar meetings.

Performing Parties

In addition to laboratory and IC data contributors, performing parties will also use the IMS to analyze harbor-wide cleanup data and ICs.

Government Agencies and Tribal Governments

These stakeholders may be responsible for the implementation, maintenance, enforcement, and modification/termination of some ICs. However, this is generally not their role and EPA maintains the ultimate authority for remedial actions at the PHSS.

[21] 2001 Memorandum of Understanding for Portland Harbor between the Technical Coordinating Team.

Government Agencies share cleanup data with other agencies as well as with performing parties, and the public. This group needs access to the locations of ICs and associated use restrictions to help with processing permits and authorizations. The IMS will assist this group with inter-agency and public data sharing. Tribal governments will use the IMS to analyze harbor-wide cleanup and IC data.

The United State Army Corps of Engineers (USACE) involvement in the PHSS is multifaceted as stated in the letter of agreement that describes EPA, ODEQ and USACE PHSS agency coordination. Pursuant to Section 404 of the Clean Water Act, the USACE issues permits for dredging and filling. The environmental dredging authority described in Section 312 of the Water Resource Development Act of 1990 may be used to plan and design any USACE environmental projects within the PHSS. The agency also monitors and maintains the Lower Willamette Federal Navigation Channel as authorized by United States Congress[22].

Portland Sediment Evaluation Team (PSET) and nationwide permit reviewers might use the IMS to both expedite their permit reviews and ensure the remedy is protected[23].

Public

Public interest in using the IMS is diverse and includes groups who want to access IC and data for various purposes. For examples, community members will use the IMS to monitor cleanup progress as well as report observed IC issues, such as damaged signage. Developers will access property-specific use restrictions. Academic institutions will use the IMS as a teaching tool and for research purposes. Permit applicants can access sediment and IC information to support application preparation.

Advanced Data Users

This group includes representatives from the above user groups with extensive data management experience and needs access to the IMS to download, use, and perform advanced data analyses. This group will want to access EDMS data, and materials related to the management of the EDMS, including data dictionaries, and valid values.

[22] EPA, ODEQ, and USACE 2002. Letter of Agreement Between the US EPA Region 10, the ODEQ and USACE Portland District Concerning the Lower Willamette River.
[23] PSET's role in permitting is discussed in the Programmatic IC Plan.

SECTION 5: Evaluation of Options for the IMS

This section discusses options for the IMS structure based on a review of existing similar data management systems, software, interface design, and hardware. The City and State performed an evaluation of the strengths and weaknesses of existing systems to determine attributes recommended for the IMS.

Many applications, databases, and information systems store, present, and distribute cleanup data and information. As a part of the Needs Assessment, the City and State identified and evaluated existing systems and researched resources to find information on the following:

- Systems currently used to store, present, and distribute cleanup information via database and mapping applications;
- IC applications and tracking systems used by state governments and at other Superfund sites.

This section summarizes the results of this research. The findings from the Needs Assessment and the evaluation presented in this section were used to develop the IMS requirements and beneficial enhancements presented in Section 5.7.

5.1 IMS Data Visualization Options

The following applications were identified and are described below:

- National Oceanic and Atmospheric Administration (NOAA) Data Integration, Visualization, Exploration, and Reporting tool (DIVER);
- NOAA Environmental Response Mapping Application (ERMA);
- Washington State Department of Ecology Environmental Information Management System (EIM);
- Minnesota Pollution Control Agency Tableau Dashboards;
- Los Alamos National Laboratory Intellus (Intellus);
- Multiple IC Specific Applications and Data; and
- Lincoln Park Technical Training Example.

5.1.1 NOAA Data Integration, Visualization, Exploration, and Reporting (DIVER)

DIVER is a NOAA custom-built open-source online data warehouse and query application containing natural resource damage assessment-related response, assessment, and restoration data, as well as historical cleanup data for sites across the United States. DIVER is frequently used for access to Superfund site data. DIVER is designed to support NOAA operations and is best suited for moderate to advanced data users. DIVER is not designed for laypersons.[24]

The DIVER data model structure supports various environmental data types: sample (e.g., sediment, tissue, and water), bioassay, instrument, field observation, shoreline assessment, telemetry, and photographic. Each data type contains dataset-specific detail fields in addition to the core fields. Core fields provide high-level descriptions of key information and are consistent across different types of data. Both core fields and detail fields are grouped into sets to support data access and querying.

To integrate data into the DIVER data warehouse, NOAA runs a process that ingests structured (e.g., analytical results of samples) and unstructured data (e.g., photographs of sediment cores) from various sources using templates to support the data exchange. DIVER integrates the disparate datasets using an

[24] DIVER is available online https://www.diver.orr.noaa.gov/.

extract, transform and load (ETL) process into the DIVER data model. NOAA recommends that data submitted to DIVER be compliant with the International Organization for Standardization (ISO) 19915-2 or Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata (CSDGM) metadata standards.

The DIVER website provides access to data via the DIVER Explorer query tool that allows users to access, query, visualize, and download data. The user may query DIVER Explorer three different ways, using either guided, keyword, or saved query options. The guided query tab contains pre-selected filters that limit the data to specific media, parameters, and analyses. The user may apply a custom filter by date, geospatial extent, and depth. The Keyword Search tab allows users to enter a search term and obtain a list of DIVER data displays matching categories and fields. Users can select detection limit treatments and obtain analyte summations (e.g., total polycyclic aromatic hydrocarbons). DIVER provides detailed data specifications online, including valid values and chemical codes. After the query execution, the Graphical User interface[25] (GUI) displays results on a map with five different data output tabs. The user can click on each tab to find more information on the following:

- **Summary tab**: Provides an overview of the DIVER Explorer query results. Information in the Summary tab provides the results.
- **Data and Export tab**: Displays results in a table format and supports downloading.
- **Charts tab**: Pie or bar charts are displayed for result visualization by several attributes. Clicking on a chart creates a new table specific to that portion of the graph.
- **Metadata tab**: Contains query details, data details, data caveats, and field definitions.
- **Study Notes tab**: Includes detailed information on the data source, data types, stations, sample replicates, calculated chemistry, and qualifiers.

DIVER also provides open-source data services, the Environmental Research Division's Data Access Program.[26]. The data server is a simple and consistent way to download subsets of data in machine-readable common file formats. High-volume data users can directly access the data stored in the DIVER warehouse and query tool.

NOAA DIVER data warehouse workflows and query explorer tool contain several attributes applicable for the IMS. The data warehouse ETL process workflow is a helpful example for the IMS of managing and relating data. The DIVER Explorer Query tool data output tabs present critical information about the data and metadata, which is an aspect worth emulating for the IMS. The visualization capabilities are limited in DIVER because it is primarily a data warehouse tool. NOAA developed a separate application for the visualization of data obtained in DIVER that is discussed in the following section.

NOAA will be importing much of the data collected throughout cleanup activities, including but not limited to remedial design data, into the DIVER database through the duration of the Natural Resources Damage Assessment (NRDA) process. If DIVER was integrated with the IMS it could improve efficiency, including cost efficiency, related to data entry.

A summary of the benefits and limitations of the DIVER is described in the table below.

[25] GUI is a system of interactive visual components for computer software. A GUI displays objects that convey information and represent actions that can be taken by the user. The objects may change color, size, or visibility when the user interacts with them.

[26] ERDDAP is a data server that provides a simple, consistent way to download subsets of gridded and tabular scientific datasets in common file formats and make graphs and maps.

DIVER Tool. Benefits and Limitations of DIVER as related to the PHSS IMS

Applicability to IMS	Attributes
Benefits	Authoritative Data Warehouse application utilized nationwide. DIVER will contain much of the PHSS data collected throughout cleanup activities. Use of Core and Detailed data field that relates structured and unstructured data. Efficient and vetted ETL methodology applied to data from other Superfund sites. Information-rich query results are displayed on separate tabs. Downloads contain comprehensive metadata provided in the ISO 19115 standard.
Limitations	Querying comprehensive data for an area of interest is only available in an abbreviated "overview" format. Different media require multiple queries and data output Requires importing data to a separate application (ERMA; see below) for enhanced visualization capabilities. IC data are not supported. Not designed for laypersons.

5.1.2 NOAA Environmental Response Mapping Application (ERMA)

NOAA developed the map application ERMA[27], an open-source online GIS mapping tool capable of displaying both static and near real-time data. In contrast to DIVER, ERMA is a robust map application that supports overlays and geospatial analysis but does not provide a mechanism to query cleanup data, which is the core function of DIVER. In ERMA, users can import exported data queries from DIVER. ERMA allows users to add geospatial data as a vector file, API, and web map service. There is no ability to retain ERMA data added to the map after users close their active session.

ERMA is intended for environmental responders and decision makers to support environmental planning, response, assessment, restoration, and incidents and natural disasters. It is ideal for technical users with basic GIS experience, and not easy to use for laypeople.

ERMA Tool. Benefits and Limitations of ERMA as related to the PHSS IMS

Applicability to IMS	Attributes
Benefits	Large amount of environmental publicly accessible data (bathymetry, fish consumption advisory). Users may add their own geospatial data (including IC data). Supports data layer overlays and geospatial analysis.
Limitations	No mechanism to query cleanup data. Not designed for laypersons. Requires importing data from DIVER.

[27] ERMA is available online https://response.restoration.noaa.gov/resources/maps-and-spatial-data/environmental-response-management-application-erma.

5.1.3 Washington State Department of Ecology Environmental Information Management (EIM) System

EIM is the Washington State Department of Ecology's custom-built open-source data warehouse and query application for regional cleanup data. EIM contains records on physical, chemical, and biological analyses and measurements. The application also includes supplementary information about the data (i.e., metadata), including information about environmental studies, monitoring locations, and data quality. EIM is a mature open-source system, originally launched in 1997. The City and State evaluated the EIM application to identify the desired attributes for user-defined data queries, accessibility, and submittal. The ADU stakeholder questionnaire included several questions related to EIM. The majority of ADU respondents cited EIM as an application they have used and that they particularly liked.[28]

EIM allows the users to: (1) search using a query form or in a map interface; (2) create a custom location, parameter, and study search; and (3) compare data with cleanup standards for environmental media. The application also provides detailed data specifications online, including data exchange templates, valid values, and a data dictionary—all relevant examples for a centralized IMS.

EIM does not support the visualization of data after the query is executed. Instead, it is designed to find studies or areas of interest and to extract all available data. Once a subset of data is queried using the map or the query tool, the user can view a table of the locations and download the data. The downloaded data contains all the analytical results for the selected locations. An EIM disclaimer is included with a data reliability statement. EIM includes substantial support materials written in a manner that is accessible to a broad range of users.

EIM. Benefits and Limitations of EIM as related to the PHSS IMS

Applicability to IMS	Attributes
Beneficial	Search via query form by Study, Location, Field Collection, and Result groups. Ability to create a comprehensive query for a custom area of interest. Large map interface displaying all sample locations. Substantial support materials accessible to a broad range of users.
Limitations	No visualization of queried results. IC data are not supported. Minimal metadata (data quality categories).

5.1.4 Minnesota Pollution Control Agency Tableau Dashboards

The Minnesota Pollution Control Agency (MPCA) application provides interactive access to the Watershed Pollutant Load Monitoring Network via commercial data visualization software, Tableau. Digital or analytical dashboards[29] are available "off the shelf" from a variety of software providers. The IMS could contain

[28] EIM is available online https://ecology.wa.gov/Research-Data/Data-resources/Environmental-Information-Management-database.

[29] A dashboard is a collection of several views, letting you compare a variety of data simultaneously.

dashboards from other commercial and open-source software applications (e.g., ArcGIS, R shiny). Dashboards support simultaneous comparisons of a variety of data to visualize trends.[30]

The Needs Assessment contained an MPCA dashboard example in the questionnaire. The majority of ADU Group respondents found the MPCA dashboard extremely useful to interact with the dashboard interface containing data summaries by area of interest. The MPCA dashboard combines several views of data in the form of an interactive map and graphs. Users can hover over watersheds and toggle the display of average and annual loads for different parameters. Average, annual, and daily data are also available for download. The clean dashboard design is useful for lay users without having them wade through documentation. The dashboard is an example of an easy-to-use interface that supports public access to digestible data and information. The dashboard links the display of charts with geospatial data that increase the amount of information conveyed to the user. Tableau does not store data, but it is able to connect to a variety of database systems (e.g., SQL Server, Postgres, Oracle). If Tableau is directly connected to the IMS EDMS, a secondary database is not necessary for data storage.

MPCA. Benefits and Limitations of MPCA Dashboard as related to the PHSS IMS

Applicability to IMS	Attributes
Beneficial	Approachable and easy to use for lay audiences. Does not require technical expertise for optimal use. Highly interactive dashboard design and easy to visualize trends.
Limitations	Predefined design; no pan and zoom on maps. Limited amount of content. IC data are not supported.

5.1.5 Los Alamos National Laboratory Intellus

Intellus is a public database containing environmental monitoring data provided by the Los Alamos National Laboratory, the New Mexico Environment Department, Department of Energy Oversight Bureau, and other third-party providers (including local and tribal government entities). The Intellus application was cited in the Needs Assessment when users were asked, "what is the name and/or web address of the data visualization tool(s) that you use?" For this reason, it is evaluated in the IMP. [31] The Intellus database contains more than 16 million records and 28 thousand documents and reports. The Intellus application allows users to search, map, export, and chart data and access documents. The Intellus application provides a "quick search" option for the casual data user that streamlines data retrievals after the user answers a few simple questions to obtain complex analytical results, field measurements, groundwater levels, and precipitation measurements. The quick search guides the user in filtering selections for data sources, locations, dates, and parameters with context to select the desired data. Once users obtain query results, they may download the data, save the query, or visualize the data on a web map. The web map offers the option to view the results as graduated circles (bubble plots) and includes a time slider that animates the data display for a user-specified period.

[30] The Watershed Pollutant Load Monitoring Network Data Viewer is available online https://public.tableau.com/app/profile/mpca.data.services/viz/WatershedPollutantLoadMonitoringNetworkWPLMNDataViewer/WPLMNBrowser.

[31] Intellus is available online https://www.intellusnm.com/.

Intellus provides an applicable and relevant example for the PHSS IMS on how to provide access to large databases and visualization tools to a broad group of users with varying technical skills.

Intellus. Benefits and Limitations of Intellus as related to the PHSS IMS

Applicability to IMS	Attributes
Beneficial	Query tool simplifies searching large complex database. Pictures and graphics make complex information easier to understand by a casual user. Quick search option for the layperson. Search for data by address.
Limitations	Visualizing queries may be slow or unresponsive in the map interface. Download contains no metadata. IC data are not supported.

5.1.6 Summary of Desired Data Visualization Attributes

The bullets below summarize desired attributes from the above examples for effective data visualization in a public IMS.

- Information-rich query results are displayed on separate tabs;
- Downloads contain comprehensive metadata provided in the ISO 19115 standard;
- Ability to create a comprehensive query for a custom area of interest;
- Interactive dashboard and visualizes trends;
- Includes features that do not require specialized technical skills to use and can be used by laypeople;
- Search for data by address; and
- Query tool to search database.

5.2 Institutional Control Applications and Data Options

To identify the desired attributes for IC elements of the IMS, the City and State evaluated IC applications and IC GIS databases maintained by ten environmental regulatory agencies. Of these, seven agencies offer either IC GIS data downloads or GIS-based applications, as shown in Appendix A, Table 1, Summary of IC Applications. To enhance access to the data, a subset of these agencies offers an API[32] service and/or an interactive web map application of the IC data. Links to the IC applications are provided in Appendix A, Table 1. The notes column in the table summarizes the contents of the IC applications.

Two of the states utilized GIS for their IC registries, a function that will be needed in the IMS. One is operated by the Florida Department of Environmental Protection, and the other is operated by the Indiana Department of Environmental Protection, and further descriptions of these GIS IC registries are provided in the subsections below.

[32] An API is a set of programming code that enables data transmission between one software product and the terms of the data exchange so that different software products can use the data.

5.2.1 Florida Department of Environmental Protection

The Florida Department of Environmental Protection provides a map layer that depicts sites included in their IC registry as a polygon GIS layer (available for download, as an API service, and an interactive map application called Map Direct). The application offers a large map window that is conducive to data visualization. Chevron-shaped icons allow the user to expand or minimize the legend, a tabular view of data, base maps, and miscellaneous tools that support data interaction. When the user selects an IC polygon, a tabular pop-up window displays detailed IC information for that polygon. Hyperlinks lead the user to additional IC documents. The Florida Department of Environmental Protection application, interface design, and hyperlink documents are beneficial examples of access to IC data for the PHSS IMS.

5.2.2 Indiana Department of Environmental Management

The Indiana Department of Environmental Management maintains a GIS IC Registry that is available as an interactive web map application and an API service of the IC data. The Indiana Department of Environmental Management map symbology differentiates between "approved" and "unverified" boundaries in the application display. Approved features are based on an IC legal description recorded on the property deed for which the GIS accuracy is verified. Unverified IC features indicate the legal description is unconfirmed, and the accuracy of the boundary is uncertain. This IC boundary verification process is a useful example for the PHSS, where the development of IC features may require a formal verification process and/or a need to differentiate the IC accuracy level.

5.2.3 Summary of Desired IC Registry Attributes

IC features are represented in GIS data as points, lines, or polygons. Some IC features, such as a fish advisory sign or a warning buoy, are spatially accurate when represented as a point (e.g., one XY coordinate). Additionally, a warning buoy may include not only X and Y coordinates, but also an elevation to identify the depth at which it is anchored (e.g., Z coordinate) to benefit ongoing maintenance.

However, other IC features that relate to an area—such as easement area, regulated navigation area, or zoning overlays—require detailed representation as a polygon (e.g., multiple XY coordinates). As indicated in Appendix A, Table 1, several of the map applications reviewed use point features to describe ICs that characterize an area based on a legal description or as promulgated. This type of geospatial generalization is inadequate for the accuracy requirements needed for the PHSS IMS.

The bullets below summarize desired attributes from the above examples for effective access to information on restrictions and ICs in a public IMS:

- Polygons to represent IC areas;
- Includes interactive web map applications that can be used by laypeople;
- Accuracy verification process and/or differentiation of the accuracy level of boundaries represented;
- Consistent interface and tools for the map application;
- Pop-up window displays detailed IC information for selected polygon; and
- IC data available in a geolocation-enabled mobile application.

5.3 Lincoln Park Superfund Site Technical Training Example

The Lincoln Park Superfund site, originally listed by EPA in 1984 as a cleanup candidate, received renewed community interest in the early 2000s when a former site operator applied for a license to renew operations. The site lies 2 miles south of Cañon City, near the community of Lincoln Park in Fremont County, Colorado. EPA and the Colorado Department of Public Health and Environment (CDPHE) collaborated to ensure open communication and appropriate opportunities for the community to learn about the project; to encourage community involvement through engagement; and provide, "accurate, timely information about cleanup activities and other important technical and administrative matters" (CDPHE and EPA, 2007).

The training included:

- Providing access to and training on the Scribe database. In 2016 and 2018, community members attended a training workshop on the EPA Scribe database, which stores data on the locations and amounts of contaminants at the site and includes more than 5 decades of data. After the training, community members were able to map project data in Google Earth, review and graph trends for contaminants, and understand which contaminants are tracked and measured.
- Developing a Scribe User Guide. The training included a community user guide with key background information that provided step-by-step instructions to aid community members in installing the Scribe application, accessing the data, and exporting the data to tables or maps for further review and visualization.

The Lincoln Park Site examples applicable for the IMS training outreach include:

- Use of plain language;
- Graphics and diagrams showing structures and processes at the site and the Superfund process;
- Links to specific web pages with more information; and
- Similar training would be useful to other stakeholders such as EPA and USACE.

5.4 IMS Software Options

A variety of software is capable and available for use in the building and maintaining of the IMS. The software selection needs to consider short-term and long-term costs for both the software and maintenance as well as the time required for the IMS Developer to develop custom applications and maintain the software.

5.4.1 Commercial and Open-Source Software Options

Both open-source and commercial off-the-shelf (COTS) software are widely utilized in the private and public sectors. Gartner, a leading software research and advisory company, reported in the publication, "State of the Open-Source Database Management System (DBMS) Market, 2019" that a third of survey respondents use free or open-source software in 50 percent of their organizations (Gartner, 2019). This metric indicates that commercial and government markets predominantly use COTS software. The following are generalities related to COTS and open-source software.

The initial price tag is high for the COTS software. However, the users are paying for products and support from a trusted commercial brand. The short- and long-term development costs must be considered when selecting software, not just the upfront software costs. In the selection of the IMS software, the IMS Developer must demonstrate how the selected software (i.e., either COTS or open-source software) meets the IMS requirements, is efficient, and provides a foundation for long-term stability. Highly customized applications using either open-source or COTS software could be time-intensive for long-term maintenance of the IMS.

Feedback from experienced operators also supports the use of COTS. In the Needs Assessment an experienced Operator of a Statewide Regulatory IMS stated, “If we were to do a system today, we would most likely go COTS.” The Operator of a National IMS stated, “An evaluation of the merits and drawbacks of using a commercial off-the-shelf package or open-source software is a major consideration.”

Based on the feedback obtained in the Needs Assessment, it is recommended that selection of software for the IMS be based on the capabilities of the software, and those be evaluated in conjunction with the design and costs.

5.4.2 Database Management System Software Options

A variety of COTS and open-source relational database systems are suitable for managing the PHSS analytical data for the IMS. COTS relational database systems such as Microsoft SQL and Oracle are time-tested options. However, Gartner states that, the "adoption of open-source relational database systems is a growing and increasingly significant component of the DBMS (database management system) market" (Gartner, 2019). Open-source database software most frequently used in cloud platforms is, "led by MySQL and Postgres databases" (Gartner, 2019).

As previously discussed, the data management application selected for the PHIDB is PostgresSQL, an open-source relational database platform. As described in Section 2.3, the EPA Scribe database currently represents the "data of record" that most Stakeholder groups will access before the IMS is completed. The "data of record" is the data displayed on the IMS and made available for download regardless of the relational database selected for the IMS.

An enterprise DBMS allows editing access to multiple users simultaneously that dramatically increases efficiency. Enterprise DBMS also supports storing geospatial geometry as a column in the same structure with other attributes. Enterprise geospatial databases is the preferred IMS solution because it offers the benefits of processing speed, security, access from multiple software clients, and SQL query support.

COTS databases such as Oracle, IBM DB2, and SQLServer have geospatial extensions that support geospatial data support. Open-source databases such as PostgreSQL and SQLite have geospatial extensions as additional open-source projects (PostGIS and SpatiaLite). In addition, Environmental Systems Research Institute (ESRI) has a geospatial extension called ArcServer that can work on top of the mentioned databases. COTS or open-source enterprise database may be acceptable for the IMS and benefits may be proposed by the Developer.

5.4.3 GIS and Web Map Software Options

The global leader in GIS software is the COTS vendor ESRI who produces what is commonly known as the "ArcGIS software suite," which contains the ArcGIS platform (ArcGIS Desktop, ArcGIS Pro, ArcGIS Server, ArcGIS Online). ESRI's ArcGIS online offers numerous resources for online web mapping with ready-to-use applications, dashboards, and prebuilt widgets that directly integrate with ArcGIS Desktop, ArcGIS Pro, and ArcGIS Server. In addition, ArcGIS Online's Web AppBuilder supports developing web map applications, and ESRI's JavaScript API supports various possibilities for customization. The ArcGIS Suite is the dominant GIS platform for government agencies and large organizations.

The open-source software QGIS, SAGA, GRASS GIS offer comparable alternatives to ArcGIS Desktop and ArcGIS Pro but do not constitute an integrated suite like the ArcGIS platform. Other open-source web map software Leaflet, Mapserver, and Mapbox support web map applications, can serve geospatial data in various formats, and offer a host of visualization options. However, the open-source GIS software offers less out-of-the-box integration and typically requires more programming than COTS.

Departments within the City and the State utilize GIS, web GIS, and GIS-centric data management applications produced by the ArcGIS software suite. The City and State offer extensive ArcGIS Server map and image services, some of which must be included in the IMS as discussed in Section 6. The ArcGIS suite is the preferred platform for the IMS because of its integration within the software suite and integration with the City and State ArcGIS resources and potentially other agencies. A combination of COTS GIS software and open-source GIS software is also a functional alternative software for the IMS if it can be demonstrated that this alternative provides a measurable benefit over the ArcGIS suite. Depending on IMS content and interactive functionality, the COTS web application Geocortex must also be considered for integration with the ArcGIS platform and supporting complex web mapping capabilities configurable using prebuilt tools.

5.4.4 Web Content Management System (WCMS) Software

A Web Content Management System (WCMS) (e.g., WordPress or Drupal) is one possible approach for the IMS to develop and maintain the IMS webpages and content. A WCMS is a program that helps maintain, control, change, and reassemble the content on a web page. A WCMS-specific database is also needed to store IMS page content, manage documents and metadata. In addition, certain WCMS programs like WordPress provide plugins to facilitate compliance with Section 508 Web Accessibility Standards and publish in multiple languages.

5.5 IMS Design Options

The objective of the IMS design and interface is intuitive navigation for all stakeholders. Portions of the IMS website text are required to be user-friendly and intuitive to all stakeholders. In addition, it is beneficial if the IMS will be compatible for display on mobile and desktop technology to support access via multiple devices.

5.5.1 Design

The IMS needs a clean and appealing design that is easy to read with intuitive navigation. The IMS color scheme and branding must follow design requirements of EPA websites and reports. The IMS Developer is to identify and finalize the system design requirements.

5.5.2 Functionality

Functionality is critical for a desirable experience. There are multiple requirements for the IMS function and interfaces that require code customization. The Operator of the IMS must balance the need for customization with consideration of long-term maintenance. Customization may lead to extensive long-term care that is best avoided depending on the software and selected approach.

For example, developing custom data visualization applications using software developer kits and APIs is ideal for delivering highly customized applications to meet the IMS requirements. However, the software developer kits, or APIs, might be revised and require recoding. APIs can be depreciated and take dozens of hours of coding to bring up to date. The IMS Operator must remain informed on current technology and forecast plans for software depreciation.

If a highly customized (either COTS or open-source) solution occurs for the IMS, the Operator may be only one of a few entities functionally capable of supporting the system. If less customization occurs, another contractor can transition to assume the IMS operations if needed. Regardless, custom application development is necessary to meet the requirements for the IMS presented in Section 9. The IMS Developer needs to balance functionality with customization that uses mainstream software that numerous contractors can support.

5.5.3 Graphical User Interface (GUI) Options

A GUI serves as a tool that allows users to access, query, and download data. The IMS will include a GUI EDMS and IC Registry data, which is referred to as the EDMS and IC Registry “Download Access” in Figure 1. The previously discussed DIVER, EIM, and Intellus applications provide design and functionality examples to emulate for the IMS. In addition, the GUI needs to have functions that are understandable to all stakeholders. For example, EDMS and IC Registry interfaces need menus that allow stakeholders to query by study, parameter, river mile, etc. The requirements for the EDMS interface and IC Registry interfaces are discussed in Section 9.5.2.

The IMS web map and dashboard GUIs link to interactive data displays. The GUI design must follow established best practices for graphical design principles and standards. The website Map IU Patterns[33] provides best practices and design principles for web map application design.

5.6 IMS Server Options

The IMS can be hosted by "on-premises" servers or remotely in the "cloud." The IMS Developer must install the selected software on servers. The servers could be physically accessible by the IMS Operator as "on-premises" or available in the cloud.

5.6.1 On-Premises Server

On-premises (on-site) is where the administrator has physical access to the hardware and retains more control over a local server configuration. An on-premises server can avoid downtime and internet connectivity issues but also requires reoccurring maintenance to ensure reliability. On-premises servers also benefit the IMS Operator by increased speed; storing data on local hard drives is faster than uploading data to the cloud. Additionally, the IMS operator retains complete control of backups and data access which may not be possible with some cloud servers.

One of the significant advantages of local storage is capacity. While 20 gigabytes are reasonable for cloud storage, a hard drive can easily provide two terabytes. In addition, there is complete control over how the data are stored and accessed over information security protocols. For local users (e.g., the IMS Operator), data access occurs via a local network and does not depend on the internet.

5.6.2 Cloud-Based Server

Cloud computing is a widely adopted solution for hosting internet applications that offers considerable benefits. Cloud computing eliminates the need to purchase hardware and much of the IT expertise required to operate the hardware. The cloud provider is a significant consideration for the IMS, and the services are not all the same. The specific agreement for cloud services is an important consideration, and some arrangements related to backups, privacy policies, and intellectual property are often non-negotiable. The IMS Developer and/or Operator must scrutinize the cloud provider's contract. If the IMS is not hosted on a dedicated cloud server, it could reduce performance. Cloud GIS servers can be based anywhere in the world. Distance from the Pacific Northwest is another consideration. Switching between system operators is likely to be more accessible when the system is in the cloud.

Either on-premises or cloud-based servers can support the IMS. The cost and capacity of the cloud versus on-premises option must be a consideration for request for proposals.

5.7 IMS Requirements based on Needs Assessment and Design Options

To prepare the IMP, the City and State summarized stakeholder feedback from the Needs Assessment into a list of “action points.” These action points are categorized by IMP sections. The City and State team reviewed the action points to determine whether they could be addressed as part of the IMP and/or Programmatic IC Plan and fit within the Order on Consent Statement of Work. Additional requirements identified outside the Needs Assessment based on the options discussed in this IMP are combined with the action points. Each

[33] https://www.mapuipatterns.com/.

action point is classified as content or a function. Content is data or information that will be included in the IMS, and a function is the IMS application or interface supporting specific access to the data. For example, a requirement to “include contextual GIS data” is classified as content, and the requirement to “support the ability to download data in a custom area” is classified as a function.

The Order on Consent states that, “there is a broad range of possibilities for an information management system, and therefore, some requirements will be identified as necessary, and some will be identified as beneficial but not necessary” (EPA, 2019). Table 1, IMS Requirements and Beneficial Enhancements, contains the action points related to the development of the IMS categorized as required or beneficial. Beneficial items may not be completed in the IMS rollout. Budget and schedule prioritize completing the scope of the required items. Table 1 includes the IMP section where a requirement is cited, and each row is listed when referenced in the following sections. The schedule presented in Section 14 outlines the development and review process to rollout the IMS.

Prior to implementation of this IMP and development of the IMS, it is required for the IMS Developer to prepare the following:

- Final IMS requirements;
- Final IMS and EDMS system design documentation;
- Final data path specific submittal procedures, processing procedures, and QA/QC procedures;
- Web content and interfaces design plan;
- IMS standard operating procedures (SOP) documentation;
- Final storage and system integration plan; and
- Internal beta testing and QA/QC plan.

SECTION 6: EDMS and Contextual Geospatial Data

This section describes the types of data the IMS EDMS must contain and associated data rules. Additionally, it is beneficial for the IMS to include supplemental geospatial data for download and data visualization applications as described in Section 5.7. Figure 2, IMS Data Paths, presents the IMS data source, data submittal requirements, processing, and the portion of the IMS framework where the data are available for stakeholder access. Data Paths 1, 2, and 3 are discussed in this section, while Data Path 4 is discussed in Section 7, and Data Path 5 is discussed in Sections 8.

6.1 Laboratory Data

Performing parties may collect samples from the following types of environmental media based on EPA oversight. An analytical laboratory analyzes the environmental media, and performing parties provide the validated results to the IMS at EPA's direction. It is required for the design of the IMS EDMS to support access to laboratory results for EPA-approved data[34] including upland source control data collected under EPA oversight/agreement for the following environmental media and sample collection methods:

- Sediment (Table 1, Row 1)
  - Surface Sediment
  - Sediment Cores
  - Sediment Traps
  - Composite Samples
  - Incremental Sampling Methodology samples
- Riverbank Soil (Table 1, Row 1)
  - Discrete Surface and Subsurface
  - Composite Samples
  - Incremental Sampling Methodology samples
- Fish Tissue Data (Table 1, Row 2)
  - Species Sampled
  - Individual Samples
  - Composite Samples
  - Whole Body Samples
  - Filet Samples
- Surface Water (Table 1, Row 3)
  - Vertical Transects, Horizontal Transects
  - Flow Weighted Average Samples
  - Shallow, Deep, Seasonal Differentiations
- Groundwater (Table 1, Row 3)
  - Discrete sample

[34] EPA-approved data is geographically collected in or near the Willamette River, upriver from PHSS to Oregon City (including Downtown Reach and Upriver Reach).

    - Passive sampling device sample
    - Seepage
- Porewater (Table 1, Row 3)
    - Discrete sample
    - Passive sampling device sample
- Bioassays (Table 1, Row 3)
- Stormwater (Table 1 Row 3) collected under agreements for PHSS (e.g., sufficiency assessment) not including historic data or municipal separate storm sewer system data.
    - Discrete stormwater grab
    - Discrete manual solids grab
    - Discrete catch basin grab
    - Composite samples
    - In-line sediment trap
    - Flow-weighted average samples
    - Time-weighted average samples

When the sampling data collected by various performing parties are loaded in the IMS EDMS, stakeholders will primarily access laboratory data using the IMS EDMS Interface and Data Visualization elements. This is "Path 1," as displayed in Figure 2. As previously stated in Section 2.3, when the final IMS EDMS is built, PHIDB will be integrated into or superseded by that system. Currently, public access to data in the PHIDB is via Scribe. Following implementation of the IMS, EPA will continue to use Scribe to store data, but the IMS will be where the public is directed to obtain site data. After the IMS EDMS is completed such that data are available for the public, it can serve as the data of record.

The EPA DMP (EPA, 2021) and PHIDB Design Document (GeoEngineers and Integral, 2021) provide valid values, summation rules for calculated chemistry, and a data dictionary for the PHIDB. The EPA DMP provides the data rules that will be adopted in the IMS EDMS. The IMS is to adopt any further EPA guidance related to the DMP and must incorporate the data currently housed in the PHIDB in a manner consistent with the DMP and the data rules prescribed by the EPA.

6.1.1 EDMS Data Submittal Procedure

Performing parties will be the primary laboratory and IC data contributors for the IMS. Performing parties will execute an order with the EPA to implement cleanup activities and the obligations for submitting data to the IMS will be described in that order.

Performing parties will be required by EPA to submit their data in a standard digital format or EDD per the DMP, as described in Section 2. Attachment A (EDD Specifications for PHIDB) of the DMP outlines data exchange procedures and includes the EDD specifications and valid values tables (EPA, 2021). The IMS Developer will determine if the process needs to be updated to align with the IMS. The IMS may have submittal requirements that differ from the current requirements for the PHIDB. Therefore, it is required that the IMS Developer prepare a list of recommended changes to the data submittal process to realign it with the proposed IMS within 60 days of contractor selection (Table 1, Row 4). This will allow the EPA to update the DMP with the new requirements expeditiously during the IMS development process.

6.2 Contextual Geospatial Data

It is beneficial for the IMS to contain contextual geospatial data in the form of a consistent set of geospatial base features familiar to stakeholders (Table 1, Row 5). This is "Path 2," as displayed in Figure 2 and the types of geospatial data are described below.

EPA's Portland Harbor Environmental Data Portal for PHSS contains a collection of cleanup-related GIS layers to fulfill most of this need. The GIS files for the PHSS include site areas, site regions, sediment management areas, docks and structures, potentially contaminated riverbanks, river miles, navigation channel, and future maintenance dredge areas. It would also be beneficial if potential erosion areas, remedial technologies, and other contextual data are available in the IMS. As the cleanup progresses, portions of the cleanup-related GIS layers will require updates from performing parties' GIS data submittals to reflect current conditions. EPA will coordinate with USACE to ensure the current navigation channel boundary geospatial layer is provided to the IMS Operator. The data source and procedures to update the PHSS GIS files are discussed in Section 9.3.

The Portland Harbor RI (Remediation Investigation) Report (EPA, 2016) contains historical contextual GIS data needed to assess remedial action objective achievement, which includes but is not limited to Ecological and Habitat data (e.g., water related features [Map 3.1-15]), shallow-water areas (Map 3.1-16), vegetative features (Map 3.1-18), wildlife habitat (Map 3.1-19). The RI Report also contains figures displaying other spatial data related to Endangered Species Act (ESA) listed species, tribally important species, and other critical habitats. EPA will determine which historical RI GIS data are required to be included in the IMS so that remedial action objective achievement can be assessed (Table 1, Row 6).

Performing parties will be required to submit GIS geospatial data for the boundaries of easements or other proprietary authorizations to the IMS. The IMS will display this data in web map applications (Table 1, Row 7).

Inflows of additional EPA approved contextual geospatial data will become available as the cleanup progresses. IMS content is to prioritize data required by EPA under an order or agreement to support the interpretation of site conditions and remedy progress. The following types of contextual GIS data are beneficial for consideration to include in the IMS, and further consideration is required during IMS implementation (Table 1, Row 8). The Operator of the IMS needs to perform QA/QC in coordination with the EPA before data are available on the IMS.

Other Beneficial Contextual GIS Data for Consideration to Include in the IMS

Data Type	Potential Data Source
Archeological	Oregon State Parks Historic Sites Database
Cultural and Historical Resources	City of Portland Willamette River Greenway Inventory, Oregon State Parks Historic Sites Database
Environmental	Metro, Oregon Geospatial Data Clearinghouse, Portland Maps
Federal Compensatory Mitigation information	NOAA/USFWS, Multnomah County, City of Portland, State of Oregon
Natural resources	City of Portland Willamette River Greenway Inventory

Data Type	Potential Data Source
Property Data	Metro, Multnomah County
Public Safety	Portland Police Bureau, City of Portland
Recreational Use and Open Space Plans	City of Portland, Multnomah County, State of Oregon
Restoration Sites	Portland Harbor Trustee Council, Natural Resource Damage Assessment
Transportation	Metro, Oregon Geospatial Data Clearinghouse, Portland Maps

6.2.1 Contextual Map Services

The IMS will include a variety of aerial imagery in the IMS web map applications (Table 1, Row 9). Existing contextual map services can be incorporated into the IMS to the extent practicable to meet IMS requirements and streamline implementation. ArcGIS Server image services authored by the City[35] and State[36] contain various spatially referenced recent and historical imagery. The imagery varies in geospatial and temporal resolution. The City offers imagery services for 1948, 1960, 1975, 1990 and from 1996 to 2020. The State offers imagery from 1995 to 2018. The imagery varies in geospatial resolution. The IMS Developer may determine the imagery most suitable for inclusion in the IMS data visualization applications. Other imagery services may be appropriate.

The IMS's web map applications will contain map services for reference maps (e.g., United States Geological Survey topographic, Open Streetmap, etc.) produced using ArcGIS online[37] and similar web map applications (Table 1, Row 10). It is beneficial for the IMS web map applications to include a variety of ArcGIS Web Map Services[38] offered by the City (Table 1, Row 11). Multnomah County maintains a tax lot GIS layer that the City provides as a map service containing property boundaries and ownership information. The City's Bureau of Environmental Services maintains a Water Utilities (Distribution System) and Sewer and Stormwater Utilities GIS layers available in the City's data services layer. The City maintains a Zoning layer that delineates industrial, residential, and commercial classifications. The IMS Developer will determine the appropriate map services to include in the IMS.

6.3 Bathymetry/Topography

There is a requirement for area-specific bathymetry to be available for download on the IMS. The IMS is required to provide access to bathymetric survey data (Table 1, Row 12). This is "Path 3," as displayed in Figure 2. Visualization of bathymetric data on the IMS is beneficial but not required.

Bathymetric and topographic datasets available for download are required to characterize the river nearshore area adequately (Table 1, Row 13). Several mapping efforts to integrate Light Detection and Ranging (LiDAR) and bathymetric data are underway, including by the USACE to support flood rise analysis,

[35] https://www.portlandmaps.com/advanced/?action=aerial.
[36] https://www.oregon.gov/geo/Pages/imagery.aspx
[37] https://www.esri.com/en-us/arcgis/products/arcgis-online/overview.
[38] https://www.portlandmaps.com/arcgis/rest/services/Public

and may be suitable for the IMS. EPA will assist in identifying the most appropriate available map or provide guidance on additional changes needed to an available map.

6.4 Community Impacts Mitigation Measures

During PHSS remedial action, there will be ongoing monitoring of water, air, and noise quality, which involves real-time data collection. EPA will work with performing parties on promptly reporting compliance with the site standards to EPA's Portland Harbor StoryMap or the IMS. It is not required, but will be beneficial if EPA-approved water, air and noise monitoring data collected during remedial action are linked to EPA's Portland Harbor StoryMaps[39] or available on the IMS (Table 1, Row 14).

[39] https://storymaps.arcgis.com/stories/ab89faf239624854a5b9c7723f1c43da

SECTION 7: Institutional Controls Registry and Resource Library

EPA considers an IC Registry an informational device and states that, “registries can include database listings, web-based maps, document-based inventories, or all of these” (EPA, 2012).

The IC Registry will house locations and information regarding ICs implemented and being maintained across PHSS to protect the remedy. The IC Registry supports the ability to:

- Find an IC via search form or map;
- View the IC registry in a tabular format with multiple attributes and hyperlinks;
- Display the geospatial extent of the IC in map view; and
- Display what type of restrictions are on a given property.

7.1 IC Registry Structured Data

This section describes the IMS’s IC Registry structured database that will be available for download via the IC Interface, as a GIS web map service, and displayed in the data visualization interactive maps on the IMS. This is "Path 4," as displayed in Figure 2 showing the data paths.

7.1.1 EPA IC GIS Data Standard

The EPA’s IC Vector Profile Technical Specification Std No.: EX000015.1 (EPA, 2006) establishes the standards for documenting IC geographic data and related method, accuracy, inspection, and description data. The EPA technical specifications provide the “relational tables,” which are a basis for the IMS Developer to prepare the IMS IC Registry database structure (see Attachment C, Institutional Control Data Structure Diagram). The IMS Developer is required to design and implement the final IC Registry database structure. The IMS Developer will work with the EPA to ensure the IC data structure contains an adequate level of detail and relationships to support the long-term IMS IC Registry GIS database management. Area-specific IC restrictions may be varied and complex from the standpoint of the data structures needed to store all the necessary attributes. Some of the relational data tables may be excluded; for example, it may be appropriate to exclude Table 3.6 of the EPA’s Vector Profile Technical Specification (i.e., “Contaminant Remaining”) or other tables, which may be determined unnecessary to track in the IC Registry database. In addition, there may be other relationships between ICs not captured by EPA’s IC Vector Profile Technical Specification. It is required for the IMS Developer to prepare a comprehensive list of possible ICs and determine what details are needed to implement the final IC Registry database structure and submittal procedure (Table 1, Row 15).

The main tables that identify the characteristics of and/or catalog IC information relevant to the IMS IC Registry are described below.

The following descriptions are the key relational tables shown in dark grey on Attachment C.

- **IC Instrument**: An administrative measure and/or legal mechanism establishes land or resource use restrictions, such as a proprietary control or restricted navigation area.
- **IC Objective**: The intended goal of protecting the integrity of an engineering control by limiting land or resource use in a particular media.
- **Location**: Point, line, or polygon that spatially characterizes the IC feature.
- **Engineering Control**: If the IC is protecting an engineered control (e.g., a sediment cap) the details on that associated engineering control are included in the IC Registry. The horizontal accuracy and

position are also required to be specified, which is consistent with the PHIDB data submittal requirements.

- **IC Affiliation**: Any individual or organization associated with an IC either directly or indirectly. An example of an affiliation with a direct IC relation is the performing parties responsible for maintaining the IC. An example of an affiliation with an indirect IC relation is a property owner of a site at which ICs are implemented.
- **IC Registry Resource Library**: Any document or source of information associated with an IC either directly or indirectly (e.g., area-specific remedy operation and maintenance plans). This is a linkage to the unstructured IC Registry data. Another example is digging into a riverbank cap to replace or place an outfall pipe or implementation of a Clean Water Act 404 piling removal permit.
- **IC Event**: Any occurrence or action taking place on a specific date for which data may be collected, processed, distributed, or used for purposes related to ICs. Inspections and terminations are examples of IC events.

7.1.2 IC Registry Structured GIS Data Submittal Procedure

Performing parties are required to submit a complete GIS representation of their area-specific ICs based on their IC implementation Report. The EPA approved IC Registry GIS data submittals will be combined into a larger dataset with a shared structure that will be the comprehensive IMS IC Registry database. The process for performing parties to submit GIS data to the IC Registry is displayed in Figure 3, IC Registry Submittals.

The IMS developer will coordinate with EPA to finalize the IC Registry database structure, valid values, and data dictionary. In addition, the IMS Developer and/or Operator is to work in concert with EPA to draft a document outlining IC Registry data requirements and GIS submittal process specifications. The IMS Operator will provide an IC Registry GIS data submittal template in geodatabase and shapefile formats. The World Geodetic System 1984 (WGS 84) is the required horizontal datum and projection for performing party's IC Registry data submittals, which is consistent with current PHIDB submittals. The horizontal accuracy of the IC feature (e.g., plus or minus in feet), and the method to derive horizontal geospatial positioning (e.g., Professional Land Survey[40] or differential global positioning system[41]) are also required. It is anticipated that the EPA will develop an IC Data Management Plan or revise the current DMP to incorporate the IMS Developer/Operator IC Registry specifications and be incorporated into performing party cleanup orders to provide the requirements for IC data submittal.

After receiving the submitted IC GIS data, the IMS Operator is required to verify the submitted IC features to validate the data structure and geometry integrity. The verification process needs to include a check to identify topology[42] errors. Elimination of topological errors ensures accurate area measurements and relationships between points, lines, and polygons. Examples of topological rules include no overlapping polygons or no sliver polygons smaller than a geospatial threshold. The verification process will confirm geospatial extent and population of required fields with valid values.

When the IMS Operator verification is complete, the IC Registry GIS data will be loaded to a staging database for EPA review for completeness and accuracy. If the IMS Operator or EPA finds the submittal does not meet the specifications, the issues are outlined in a report provided to the submitter. The corrected data are then resubmitted, and the process is repeated until the submittal passes review. After the submittal passes EPA

[40] PLS
[41] GPS
[42] Topology is a key GIS requirement for data management and integrity. In general, a topological data model manages geospatial relationships by representing geospatial objects (point, line, and area features).

review, the IC Registry GIS data are loaded to the operational IC Registry database, where they are available for stakeholder access on the IMS.

When EPA approves a modification of an IC, it will require resubmission to the IMS. For example, an inspection monitoring report amending an area-specific Institutional Controls Implementation and Assurance Plan, could trigger a revised IC data submittal. The previously described verification procedure needs to be performed again on the revised data submission as stated on Figure 3.

7.1.3 Oregon 811 One-Call System

The Oregon Utility Notification Center (Notification Center) Oregon 811 One-Call System (also known as "Call Before You Dig" or Oregon 811) is an information gathering service that homeowners and professional excavators are required by Oregon law to call prior to starting an excavation. The 811 One-Call System is an IC in which geospatial data and contact information are uploaded and maintained in the 811 system.

7.2 IC Registry Unstructured Data

The IC Registry also contains documents classified as unstructured data. This is "Path 5" in Figure 2 showing data paths. The unstructured IC Registry data will be available on the IMS as a document-based inventory referred to in the IMP as the IC Registry Resource Library. The IMS will provide access to the IC Registry Resource Library documents as hyperlinks to the SEMS records management system. The process for linking to EPA approved IC Registry documents is displayed in Figure 3. The IMS Developer is required to coordinate with EPA on the linking of relevant and related IC documents hosted on the EPA's website.

As discussed in Section 7.1.1., EPA's IC Vector Profile Technical Specification contains an "IC Resource" table to associate the unstructured IC Registry documents to specific records in the structured IC Registry database. The "IC Resource" table may include hyperlinks to any document or source of information associated with an IC either directly or indirectly.

The process to submit documents to the IC Registry is displayed in Figure 3. EPA-approved IC Registry documents will be housed on EPA SEMS and hyperlinks will be provided in the IMS as a part of the IC Registry Resource Library and available for public access and review.

The IMS will also provide external links to relevant reports that are not included in the IC Registry Resource Library such as the area-specific Administrative Settlement Agreement and Order on Consent, Operation and Maintenance Plan, and the Construction Completion Reports.

The subsections below list the area-specific and harbor-wide documents that the IC Registry Resource Library will house.

7.2.1 Area-Specific Documents

EPA will approve the following area-specific IC documents containing IC information and the IMS will provide SEMS hyperlinks as a part of the IC Registry Resource Library.

- **Programmatic IC Plan**: Support materials provided in the Programmatic IC Plan.
- **Area-Specific IC Plans**: For each area-specific IC Plan the performing party will select the ICs to be implemented, monitored and maintained in each area to protect human health and the remedy as outlined in EPA guidance (EPA, 2012). An example outline for the area-specific IC Plan is provided in Appendix F of the Programmatic IC Plan, being prepared concurrently with this IMP.

- **IC Implementation Report**: The performing party will prepare an IC Implementation Report that includes the IC locations; locations of contaminated media; current owner/occupant information; and contact information for the performing party.
- **IC Inspection Report**: The performing party will prepare IC Inspection Reports detailing the IC maintenance, and enforcement information for each IC outlined in the area-specific IC plans.
- **Five-Year Review**: EPA will conduct the Five-Year Review and summarize its findings in a report, which includes an evaluation of the effectiveness of the cleanup remedy for each sediment management area, including an evaluation of the effectiveness of any ICs implemented to protect the remedy. In addition to evaluating the effectiveness, Five-Year Reviews may require follow-on actions that may involve updating or adjusting IMS information.

7.2.2 Harbor-Wide Specific Documents

The IC Registry and Resource Library will link to the below listed documents which contain harbor-wide IC information.

- **OHA Fish Advisory Update**: OHA updates the fish advisory as data warrants. OHA will submit fish advisory updates to the IMS in close coordination with EPA.
- **Annual Fish Advisory Outreach and Education Program**: Lead entity will prepare annual education and outreach activities report and will submit reports to the IMS in close coordination with EPA.

SECTION 8: Other PHSS Information

Other PHSS documents and links to other PHSS resources that are not related to the IC Registry will also be available on the IMS. The IMS will contain unstructured data including miscellaneous environmental investigation reports and related data that will not be in the IMS EDMS, IMS IC Registry GIS database, or as a part of the IC Registry Resource Library. This is Path 5, as shown in Figure 2.

8.1 PHSS Reports

The Portland Harbor Environmental Data Portal currently houses a variety of PHSS data and associated reports. The IMS will link to all EPA approved documents on the SEMS record management system and any documents not hosted on SEMS will be hosted by the IMS at the direction of EPA. There will be no redundant posting between EPA SEMS and the PHSS IMS.

The current Portland Harbor Environmental Data Portal can either link with the IMS or be replaced with a redesigned version. The same process as the current Portland Harbor Environmental Data Portal will occur for document or information upload, where EPA approves and provides reports to the Portland Harbor Environmental Data Portal Contractor for upload and stakeholder access. A WordPress (or similar) document management plugin is recommended to enhance file organization and searchability of the numerous documents.

It is anticipated that Clean Water Act 404-permitted activities such as maintenance dredging may generate reports. The IMS may provide links to such reports, but it is not required. As part of EPA's coordination with USACE on dredge permits, EPA will ensure any sediment characterization data are submitted to the IMS Operator (Table 1, Row 16). As part of EPA's coordination with USACE on dredge permits, EPA will ensure the unstructured data are submitted to the IMS Operator.

8.2 PHSS Reports Metadata

Path 5 unstructured data require metadata included with the download. Metadata creation may follow a similar process currently used for the Environmental Data Portal where EPA provides approved documents with the minimum metadata to the Environmental Data Portal Contractor.

The IMP recommended metadata table will have a minimum of two columns, titled "item" and "value." The table will contain the following items:

- **Title**: A name that uniquely identifies the unstructured dataset. This may correspond to the name of a document such as a work plan.
- **Abstract**: A brief description of the unstructured data.
- **Publication Date**: Date of final report.
- **Preparer**: The name of the organization that prepared the unstructured data.
- **Document ID**: A unique identifier for the unstructured dataset.
- **Comments/Keywords**: Any other description of the unstructured dataset that is pertinent and valuable.

SECTION 9: Recommended Minimum IMS Requirements and Beneficial Enhancements

The Order on Consent states that "there is a broad range of possibilities for an information management system, and therefore, some requirements will be identified as necessary, and some will be identified as beneficial but not necessary" (EPA, 2019). Table 1, IMS Requirements and Beneficial Enhancements, contains the action points related to the development of the IMS categorized as required or beneficial. Budget and schedule prioritize completing the scope of the required items. This section presents the IMS requirements and beneficial enhancements and identifies the row in Table 1 that lists the action item. The feasibility of including beneficial enhancements in the IMS should be evaluated during IMS development.

EPA's PHSS ROD emphasizes the need for using an environmental justice lens in the Portland Harbor cleanup (EPA, 2017). Application of an environmental justice lens requires meaningful involvement of impacted communities in decisions, efforts, and programs that affect them. Additionally, EPA's Community Involvement Plan underscores the need for communities disproportionately affected by the contamination and the cleanup to have access to up-to-date data and information via a user-friendly website.

The PHSS Community Involvement Plan (EPA, 2020c) and the Needs Assessment Report (Cascadia and GSI, 2021) include relevant EPA policies, guiding principles, resources, and recommended actions for advancing environmental justice regarding information sharing for the PHSS. The IMS Developer will need to develop a plan describing how they will integrate environmental justice principles into IMS development, implementation, and maintenance (Table 1, Row 17). The plan must consider the needs identified by community members in the Needs Assessment Report. The IMS development and implementation process offers a unique opportunity to advance job training, local hiring, and equitable contracting to benefit communities affected by the PHSS.

For example, the IMS Developer could:

- Commit to preparing, recruiting, and hiring individuals from PHSS-affected communities to contribute to this project;
- Offer a specialized internship program focused on building technical and design skills from individuals from Superfund-affected communities;
- Work with community stakeholders to ensure the IMS content and interface meets community information and access needs;
- Contract with community groups to co-develop and deliver community-focused IMS trainings.

9.1 EDMS Platform

This IMP recommends that the IMS EDMS be maintained in an enterprise spatially enabled database (e.g., Microsoft SQL-ArcSDE, Postgres-PostGIS) because of processing speed, security, access from multiple software clients, and SQL query support as stated in Section 5.4.2. The IMS Developer may demonstrate that another candidate system supports a design that accommodates all content and functional requirements.

9.1.1 EDMS Database Structure

As previously stated in Section 2.3, when the final IMS EDMS is built, PHIDB will be integrated or superseded by that system. After the IMS EDMS is completed, it can serve as the data of record by providing the same public access as Scribe.

The EPA DMP and PHIDB Design Summary[43] (GeoEngineers/Integral, 2021), (GeoEngineers and Integral, 2021) provides valid values, summation rules for calculated chemistry, and a data dictionary for the PHIDB The EPA DMP[44] should also provide the IMS EDMS data rules. Therefore, there is a requirement for the IMS to adopt any further EPA guidance related to the DMP, and the IMS will need to incorporate the data currently housed in the PHIDB in a manner consistent with the DMP and the data rules prescribed by the EPA. As stated in Section 6.1.1, the IMS Developer is required to determine if the EDD submittal process needs to be updated or if the current process is adequate.

As shown in Table 1, it is required for the EDMS structure to include:

- Clear chemical naming conventions based on understandable database valid values and clarification on chemistry summation rules; these are largely addressed by adopting guidance from the EPA DMP (Table 1, Row 18).
- Attribute data with river zones (nearshore—including the side of the river—and navigation channel) (Table 1, Row 19).
- Correlation of data to geospatial locations (horizontal, vertical) (Table 1, Row 20).
- Data to contain unique station IDs for querying co-contaminants (Table 1, Row 21).

It is required for the EDMS to include the criteria values for the corresponding analyte as attributes and data classification breaks (bins) in data visualization applications (Table 1, Row 22). The criteria values include:

- The Principal Threat Waste[45] thresholds and Remedial Action Level[46] values as presented in ROD Table 21 (EPA, 2017) and as amended by applicable explanation of significant differences, including the August 2021 explanation of significant differences contained in Attachment A.
- Cleanup level[47] values for surface water, groundwater, soil/sediment, and fish/shellfish target tissue levels as presented in Errata #2 for PHSS Record of Decision ROD Table 17 (EPA, 2020b); current cleanup levels (as of August 2021) are included in Attachment A.
- Applicable or Relevant and Appropriate Requirements (ARARs) presented in the PHSS Feasibility Study Report Tables 2.1-4 and 2.2-12, (EPA, 2016) and contained in Attachment B for reference. ARARs for the PHSS are memorialized in the ROD and are summarized in ROD Section 15.2 and Tables 25a, 25b, and 25c.

The following is required for the EDMS:

- Laboratory data identified as pre- or post-remedial action (Table 1, Row 23). Historical data will be flagged by performing parties at the end of remedial action to identify areas that have been remediated during RA (e.g., removed by dredging, capped, etc.).

9.1.2 Database Content

The IMS EDMS will contain historical chemistry data necessary to assess remedial action objective achievement, including but not limited to the PHSS Remedial Investigation/Feasibility Study (RI/FS) data (EPA, 2016) (Table 1, Row 24). Specifically, sediment chemistry data from the FS database and all non-sediment data from the RI database are required to load into PHIDB. To load the data, the RI/FS data

[43] GeoEngineers and Integral Consulting, 2021. Portland Harbor Interim Database Design Summary. Prepared for State of Oregon. Version 2.0, December 16, 2021, Available online: http://ph-public-data.com/.
[44] EPA. 2021. Program Data Management Plan, Portland Harbor Remedial Design Investigation, Portland Harbor Superfund Site. Prepared by the U.S. Environmental Protection Agency. December 2021. Available online: http://ph-public-data.com/.
[45] Often abbreviated as PTW
[46] Often abbreviated as RAL
[47] Often abbreviated as CUL

need to be transformed and valid values translated into the current PHIDB or future IMS structure. As part of the remedial action completion process, performing parties will be required to provide an electronic data deliverable (EDD) that flags any sediment chemistry samples that have been removed or covered due to capping or dredging. The RI/FS database is currently available via the Environmental Data Portal.[48]

The IMS EDMS contents cannot be specified at this time. However, there are currently pre-remedial design investigations in progress at 13 project areas at the PHSS, and data collected in these investigations will be maintained in the PHIDB until the IMS is complete. In addition, the data collected during the 2018 Pre-Remedial Design Investigation baseline sampling (AECOM and Geosyntec, 2019) have been transformed and added to the PHIDB. These data will need to be incorporated into the IMS EDMS.

9.2 IC Registry GIS Database Platform, Structure and Submittals

A software system compatible with the current systems operated by the City and State will allow for more utilization of City and State map data services to display and query programs from other sources (e.g., ArcServer or similar system) and is the recommended type of platform to manage the IC GIS database. However, other geospatial database platforms that achieve this functionality are acceptable.

As previously stated, the EPA's IC Vector Profile Technical Specification Std No.: EX000015.1 (EPA, 2006) provides the "relational tables" as a basis for the IMS IC Registry GIS data structure. The IMS Developer is required to design and implement the final IC Registry GIS data structure. It is possible there may be additional relationships between ICs not captured by EPA's IC Vector Profile Technical Specification, such as restrictions that are only applicable until, or only applicable after, certain remedial activities have been concluded or until site closure has been achieved. The IMS Developer is to work with EPA to ensure the IC Data structure contains an adequate structure for long-term IC Registry GIS data management.

The IC Registry GIS data structure, submittal GIS database template, valid values, and data dictionary are to be finalized by the IMS Developer. A data submittal template will be provided as a geodatabase feature dataset and shapefile. In addition, the IMS Operator is to draft a document outlining IC Registry GIS data submittal procedures requirements like Attachment A of EPA DMP EDD Specifications for the PHIDB.

It is required for the IC Interface to contain the following access and content related to IC Registry:

- PDF documents of IC information hosted on IMS (Table 1, Row 25);
- Status and details regarding fish advisory and outreach activities associated with the harbor-wide IC (Table 1, Row 26);
- IC information available in a central repository for stakeholder use from construction to implementation (Table 1, Row 27); and
- A current and comprehensive IC layer that includes IC features and a link to inspection and contact information (Table 1, Row 28).

9.3 Construction Completion Report GIS Data Submittals

It is required that the IMS Developer prepare a procedure for performing parties to submit GIS data from Construction Completion Reports (CCR) that are related to remedy implementation but are not a part of the IC Registry (Table 1, Row 29), as displayed on Figure 4. EPA will determine which CCR features are required for performing party GIS data submittals. The IMS Developer is required to prepare a procedure for performing parties to submit data for the following features (Table 1, Row 30):

[48] http://ph-public-data.com/document/CDMSmith2018/.

- Areas of erosion potential requiring long-term monitoring;
- Cap/Dredge/Enhanced Natural Recovery Areas;
- Data on compensatory mitigation projects and associated institutional controls (ICs) including compensatory mitigation areas . This may include data collected for Habitat Equivalency Analysis pre-, during, and post compensatory mitigation and restoration actions (e.g., DSAYs and mitigation acres);
- Docks and structures;
- Future maintenance dredge boundaries;
- Groundwater plumes;
- Groundwater well locations and characteristics for groundwater wells that are part of long-term; monitoring under EPA oversight/agreement; and
- Habitat types and delineation of shoreline and in-water habitat for mitigation areas. GIS data to be provided in CCRs of where in-water habitat exists post remedy containing attributes that aid in the evaluation of whether habitat is still functioning based on monitoring and inspections.
- Presence and location of non-aqueous phase liquid (NAPL);
- Remedial action/construction footprints and remedial technology applications;
- Riverbank stabilization areas; and
- Sediment Management Areas, with vertical and lateral delineation.

It is beneficial for performing parties to submit the following data (Table 1, Row 31):

- Riverbank slope areas greater than 3:1;
- Climate change resiliency monitoring results related to flood rise modeling/analysis conducted during remedial design; and
- Areas of monitoring and maintenance activities (other than dredging which is a required element).

9.4 Non-Remedy Mitigation and/or Enhancement Areas

The IMS Operator may coordinate with relevant agencies to make mitigation data available for the IMS. It is beneficial for the IMS to contain the following mitigation data:

- Information on other non-remedy mitigation (Table 1, Row 32); and
- Provide voluntary enhancement site areas (Table 1, Row 33).

9.5 Access to Information

It is required for the IMS to contain conventional website content (Table 1, 34). The previously discussed examples from DIVER, EIM and Intellus, provide examples for this type of content, including:

- The home page that welcomes users to the site with related links;
- IMS overview;
- Email subscriptions;
- Site map;
- Contact form—for example, stakeholders may report a damaged IC sign;
- News; and

- Help center.

The following are requirements for the IMS web content:

- Text available in multiple languages, where feasible as determined by the IMS Developer and EPA (Table 1. Row 35).
- Website and PDFs to be compliant where possible with the requirements of the Section 508 Web Accessibility Standards to support visual and audio impairments (Table 1, Row 36).
- The content to be written in easy-to-understand language (i.e., "8th-grade reading level") where feasible (Table 1, Row 37).

It would be beneficial but not required for IMS content and applications to be mobile compatible (Table 1, Row 38). It is beneficial if the IMS WCMS supports automated templates, automated web standards upgrade, ease of editing content, and content syndication (email users when there are updates) (Table 1, Row 39). The WCMS selected must support the functionality discussed herein and accessibility standards.

9.5.1 IMS Design

The following are requirements for the web and graphical user interface design:

- Simple display design (e.g., the Minnesota Pollution Control Agency's Tableau dashboard) (Table 1, Row 40);
- Pictures and graphics in the design as an aid for communication (Table 1, Row 41); graphics make complex information easier to understand. Use icons to help users navigate and understand the elements of the river (e.g., fish icons to mark the fish advisory, buoy icons to indicate a waterway restriction)—like the Intellus example; and
- Equitable access to data and information; address the needs expressed by the Community Group (Table 1, Row 42). The Needs Assessment report describes examples of how the PHSS public would like to access data and information.

9.5.2 EDMS and IC Interfaces

The EDMS Interface will meet all the accessibility requirements currently provided by Scribe.

The IMS provides stakeholder access to the EDMS via an EDMS Interface and to the IC Registry via the IC Interface. The interfaces may be separate or combined depending on the final IMS design. The Interfaces will be similar in functionality to applications like DIVER and EIM.

The following are requirements for the IMS EDMS Interface:

- Ability to search for data like the DIVER, EIM, and Intellus applications reviewed in Section 5.1 (Table 1, Row 43). Specific examples include:
  - NOAA DIVER: Search by preselected data filters;
  - WA Ecology EIM: Search by selecting sample locations on a map;
  - NL Intellus: Search for data by address;
- Quick access and download; ease of export (Table 1, Row 44);
- User-friendly interface (e.g., the ability to submit queries for data, locate data using maps) (Table 1, Row 45);
- Ability to build queries by matrix (e.g., for soil, sediments, or tissue) (Table 1, Row 46);
- Export across different media types (Table 1, Row 47); and

- Ability to query all IMS database fields (Table 1, Row 48).

It would be beneficial for the interface to include the following features:

- Savable user queries on IMS (Table 1, Row 49); and
- Quick access to help and background (both database/application functionality and background/reports associated with the data) (Table 1, Row 50).

It is required for the IMS IC Interface to contain the following functionality related to IC Registry:

- Link IC and remediation areas to a unique identifier (Table 1, Row 51).

9.5.3 Data Services

There is a requirement for stakeholders to access the IMS EDMS in an open API or equivalent software interface to connect to database and analysis software (e.g., R, EQuIS) to support the ability to query all data fields (Table 1, Row 52). Representational State Transfer [49], JavaScript Object Notation[50], or service providing another machine-readable format can fulfill this requirement via a web service.

There is also a requirement to provide ArcServer connection for GIS web services for geospatial data (Table 1, Row 53).

9.5.4 Data Visualization Applications

The following are requirements for the web map applications and dashboards that display the cleanup and IC data:

- Easy to understand graphical representation of the data in the IMS (Table 1, Row 54);
- Data visualized as "bubble plots" or graduated circles of sample locations and chemistry concentration results to see relative differences by criteria (Table 1, Row 55);
- Interactive maps that allow users to click on an area to access more information on the IC or sediment contamination (Table 1, Row 56);
- Ability to download data in a custom area (e.g. drawing a polygon) like the functionality of NOAA DIVER and Ecology's EIM applications (Table 1, Row 57);
- Easily searchable area-specific ICs in a web map application (Table 1, Row 58);
- IC information and associated infrastructure (e.g., caps, signage) plotted on interactive maps that contain IC details (Table 1, Row 59);
- Surface sediment contaminant concentration trends over time displayed in visual formats to monitor cleanup progress (Table 1, Row 60); and
- Interactive map applications to display EPA criteria values (e.g., Remedial Action Level[51], Principal Threat Waste[52] thresholds and clean up level[53]) (Table 1, Row 61).

Beneficial but not required:

- Quick access to data summarizing concentrations in a custom area (Table 1, Row 62);

[49] Often abbreviated as REST
[50] Often abbreviated as JSON
[51] Often abbreviated as RAL
[52] Often abbreviated as PTW
[53] Often abbreviated as CUL

- Integration of map/tabular data features (zoom to), highly formatted, crosstab reports, clickable map objects linking to documents or data (Table 1, Row 63);
- Displaying data visually and right clicking to access a table with selected data (Table 1, Row 64);
- URL-based layer display (can share/email link); permissions-based layer display (Table 1, Row 65); and
- Documents linked to an interactive map where feasible (Table 1, Row 66).

9.5.5 IMS Support Materials

It is required for the IMS to contain support materials as self-guided help resources (Table 1, Row 67). The support materials need to be accessible to stakeholders. The technical nature of analytical laboratory data and IC geospatial data does require technical knowledge to analyze. It is required for the IMS to contain contact forms to obtain stakeholder feedback that may improve the IMS functionality (Table 1, Row 68).

SECTION 10: IMS Maintenance

IMS web content and application maintenance involves continuous updating, analyzing, modifying, and reevaluating existing software applications to ensure optimized applications. Therefore, the IMS Operator needs to change and implement maintenance strategies on an ongoing basis.

The IMS needs detailed SOP documentation to memorialize the methods and techniques for maintaining applications and content. The SOP will be a living document that will be updated as required when systems change (e.g., software upgrade). The IMS Operator needs to conduct monthly IMS-specific maintenance that includes but is not limited to the activities described below.

- **Check IMS Links**. The IMS is to contain numerous external links to EPA and other regulatory websites. Therefore, it is required that the IMS Operator perform routine audits of all IMS hyperlinks to ensure they are valid and link to the correct document. (Table 1, Row 69).
- **Analyze IMS Performance**. Regular analysis of website reporting using Google Analytics or similar tools allows the IMS Operator to monitor the traffic volume to the website, bounce rates[54], track form submissions, and other items. User privacy is protected by use of IP anonymization, which prevents the storage of the users full IP addresses.
- **Test IMS Forms and GUIs**. The contact forms, email subscription forms, and GUIs must be tested to ensure they are working as expected. This includes a test for the internal process for responding promptly to any stakeholder inquiries. For example, how long does it take for IMS Operator to respond to a regulatory input question?
- **Test Website Speed**. Running a page speed test using Google PageSpeed Insights or similar tools can help identify problematic pages.
- **Tuning IMS Data Services for Performance**. The IMS operator must review server logs for excessive draw times for data visualization applications.
- **Software**. The IMS developer will prepare an annual schedule to identify software upgrades. The updated software will be tested in a staging version of the IMS prior to public rollout.

10.1 EDMS and IC Registry Maintenance

Maintenance of the IMS EDMS and IC Registry requires close consultation with EPA. It is recommended that a reoccurring meeting schedule be arranged where updates to the databases are discussed. This includes updates to valid values, data dictionaries, and documentation. It is anticipated that the IMS Operator will schedule the meetings and prepare the agenda. The participants will include EPA, the IMS Operator, and other entities as needed. The frequency of the meetings and needed updates for the IMS EDMS and IC Registry Databases is unknown at this time and will need to be reevaluated when an IMS Operator is selected.

10.2 Security

The IMS EDMS will be required to contain robust permissions and database security. This IMP recommends that the IMS security include CAPTCHA[55] tests to ensure IMS functions are not compromised by "bots" or malicious software. The IMS Operator must conduct regular security checks or work with a provider who offers this service.

[54] Represents the percentage of visitors who enter the site and then leave rather than continuing to view other pages within the same site.
[55] Completely Automated Public Turing Test.

10.3 Backups

The IMS Operator must back up all the operational and staging content. The Operator will maintain rolling backups, where the generation of a complete copy of each server (data and operating systems) occurs each day or week. IMS backup must occur during off-schedule hours (Pacific time zone) to reduce performance issues. There is value in redundant backups that occur on-premises and in the cloud regardless of the selected hosting option. In addition, immutable[56] backups of the data, code, and applications can protect the IMS assets in the event of a sophisticated ransomware attack. Finally, cloud-based backups outside the Pacific Northwest can protect the IMS in case of a regional natural disaster. Atlassian Bitbucket or a similar source code repository is needed to backup code, test, and deploy IMS web and application content.

[56] An immutable backup secures data by making it fixed and unchangeable which protects data from accidental or intentional deletion or ransomware attacks.

SECTION 11: Quality Assurance/Quality Control (QA/QC)

Quality assurance (QA) focuses on preventing errors, and quality control (QC) focuses on identifying unexpected errors. Both the IMS applications and data content need to undergo routine procedures that prevent and identify unexpected errors in data quality and completeness. The IMS QA/QC requirements help to ensure a stable platform with accurate and defensible content.

The IMS Developer will prepare comprehensive SOPs that include QA/QC documentation for internal operational use. The documentation describes an initial set of QA/QC checks for technical compliance with data submission or acquisition requirements, followed by a data quality assessment and signoff. The documentation will also include tests of implemented features against requirements. This approach applies to both structured and unstructured data. The IMS EDMS and IC data also require detailed metadata that involves data entry, and a confirmation procedure needs to be in place to ensure the metadata are correct.

Defining and enforcing data standards are proactive strategies to prevent errors. The IMS EDMS and IC GIS data will have standards for the structure, units, and codes as outlined in Sections 6 and 7. Standards for PHIDB and related performing party data submittals currently exist and can be adopted and/or modified for the IMS. The IMS Operator's role is to maintain the data standards when processing the data for IMS applications. This is accomplished by conducting an initial set of QA/QC checks for technical compliance with data submission or acquisition requirements, followed by a data quality assessment and signoff. This approach applies to all types of structured and unstructured data.

11.1 IMS Applications

All IMS applications and web-based content will undergo recommended comprehensive QA/QC beta testing by an experienced technical professional who is not involved in the application development. The tests will be of the implemented features to ensure the requirements are fulfilled. The testing will attempt to identify bugs and instability that impact the IMS accuracy or functionality. Programmatic scripts will identify data errors by performing automated checks on IMS data available in the EDMS and IC Interfaces and data visualization applications.

11.2 IMS EDMS

Performing party laboratory data submittals to the PHIDB are subjected to approximately 100 QA conformance checks for data integrity before being loaded to PHIDB. After the submittal is loaded, the data are subject to EPA review. It is recommended that this workflow be maintained for the IMS EDMS.

It is the responsibility of the IMS Operator to ensure the data maintain the specifications and structure for use in the IMS. A series of programmatic checks can be run on the IMS EDMS data to ensure integrity. The programmatic checks include but are not limited to summary statistics of concentrations, depths, and coordinates that are directly compared to the data received. Additionally, scripts can also identify nonsensical values for units, sample depths, and coordinates.

11.3 IC Registry GIS Data

Performing parties' IC GIS data submittals undergo a systematic QA/QC process to ensure completeness. The IMS Developer is to develop a standardized data structure and submittal process. The submittal process includes a comparison of submitted IC features and attributes to the Construction Completion Report and EPA review. EPA will be responsible for submitted data meeting a level of accuracy to display on IMS.

It is the responsibility of the IMS Operator to routinely run programmatic scripts to maintain the completeness of the IC GIS data.

11.4 Unstructured Data

As previously stated in Section 8.1, web content of the IMS and the various documents posted on the IMS require EPA approval. All IMS web content will undergo regulatory review and/or a designated IMS editor for accuracy and appropriate language.

SECTION 12: Geospatial Data Requirements

This section presents geospatial data requirement standards, including geodetic standards (datums and coordinate systems), and precision and accuracy requirements.

12.1 Geodetic Standards (Datums and Coordinate Systems) per EPA DMP

The specifications recommended in this section are chosen for consistency with EPA DMP and PHIDB. The EDD Specifications Attachment to the EPA DMP references WGS 84 as the geographic coordinate system and horizontal datum for PHIDB. WGS 84 is a spherical geographic coordinate system where the units are in degrees and is the native coordinate system for global positioning systems.[57] Web map applications often use WGS 84 projection to publish web map services. This IMP recommends WGS 84 as the IMS horizontal datum and coordinate system.

Regarding the vertical datum, this IMP recommends the IMS adopt the North American Vertical Datum of 1988 (NAVD 88), where the units are in feet, which is consistent with PHIDB. Multiple harbor-wide bathymetric surveys are in NAVD 88 datum, and units are in feet, and there is value in using this datum and unit for consistency.

12.2 Precision and Accuracy Requirements per EPA DMP

The IMS precision and accuracy requirements are consistent with the EPA Latitude/Longitude Data Standard. [58] This existing standard defines requirements for recording latitude/longitude information for point data.

12.3 Horizontal and Vertical Unit Standardization

Horizontal and vertical units are required to be in feet in the IMS EDMS. The vertical unit for all GIS data must be in feet in NAVD 88; the horizontal units may be in degrees if WGS 84 is the geographic coordinate system. All measurements (e.g., distance, length, and area) of data are required to be in feet.

12.4 Web Map Coordinate System Specifications and Guidance on Publishing Data Services

Many agencies publish their map systems in Web Mercator projection, where the datum is WGS 84. The IMS Developer will consider this specification of using WGS 84 as the projection and horizontal datum. The IMS Developer may determine a projected cartesian coordinate system is needed to support specific IMS requirements. In this case, the IMS recommended cartesian coordinate system is the Oregon Coordinate Reference System Standard; Oregon Statewide Lambert Conformal Conic, North American Datum of 1983 (NAD 1983), International Feet, Geodetic Reference System 1980 (GRS 1980) Spheroid.

12.5 Metadata

Most structured data are also geospatial data that contain coordinates or correspond to a geospatial location. This IMP recommends the IMS EDMS and IC Registry GIS structured data include metadata in the

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[57] GPS

[58] https://www.epa.gov/geospatial/latitudelongitude-data-standard

ISO 19115 standard[59] consistent with the format provided with NOAA DIVER data. Full instructions of the technical metadata specification are in the EPA Metadata Technical Specification Geospatial online[60]. Metadata compliant with this technical specification will also be compliant with minimum Project Open Data and ISO 19115 standards and EPA's central geospatial metadata catalog. The IMS Operator is required to prepare metadata for the EDMS and IC Registry in the ISO 19115 standard (Table 1, Row 70). Metadata will not be created for contextual GIS data from other providers. Unstructured meta data are discussed in Section 8.2. It is also beneficial for the IMS Metadata to contain links to data sources and information about data lineage/processing (Table 1, Row 71).

[59] ISO 19115-2 is a metadata standard developed and adopted by the ISO that defines how to document and describe information.
[60] https://www.epa.gov/geospatial/epa-metadata-technical-specification.

SECTION 13: Outreach and Communication Strategy

The IMS environmental and IC data and information will be publicly accessible via the internet for download and visualization via the IMS. The main components of the outreach strategy involve IMS stakeholder focus groups, usability testing, and training. The communication strategy is to provide email updates when new training is available. Effective outreach, communication, and training with the PHSS's diverse stakeholders are essential to successful IMS development and implementation.

To ensure IMS functions and content meet user needs, the IMP recommends that the IMS Operator and IMS Developer will:

- Engage representatives of each stakeholder group early and often throughout development and implementation of the IMS to collect feedback regarding user-identified concept, design, and usability issues;
- Follow-up with these same users to convey how their feedback was addressed to ensure design and usability meet diverse needs of the various users, including the performing parties, agencies, tribal governments, and the public; and
- Conduct usability testing (Table 1, Row 72) to specifically evaluate the support documentation discussed in Section 9.5.5 to ensure it is accessible to stakeholders.

The IMS Developer will use a variety of methods, which are outlined below, to conduct the above activities, but it is recommended that the IMS Developer also consult the Needs Assessment Report, EPA's Community Involvement Plan, and the Programmatic IC Plan for more detail. Methods include holding audience-specific focus groups; seeking input at existing meetings; ongoing collaboration with stakeholder group representatives; contracting with community groups, agencies, and business groups to develop stakeholder specific training and support materials. EPA will need to determine the level and scope of involvement for this engagement and usability testing. This is different from the QA/QC beta testing discussed in Section 11.1.

13.1 Outreach Strategy During Implementation

Outreach during the development and implementation of the IMS will be performed by developing users guides and training materials and conducting training sessions as identified in this section. Training materials will be tailored to meet the diverse user (e.g., regulatory agencies, performing parties, tribal governments, and the public) needs.

13.1.1 Agency Training

At the end of the IMS initial development rollout, all functions and content will be complete. IMS Developer will have drafted comprehensive tailored user support materials to meet the needs of diverse users, and data developmental documentation.

It is beneficial for the IMS Developer to conduct agency training per the Programmatic IC Plan (Table 1, Row 73). The IMS Developer and/or Operator will provide training materials on the IMS and IC Registry to federal, state, and City staff that review plans and issue permits for in-water and riverbank areas in Portland Harbor. The training will be available when the IMS is launched and as a recorded presentation and housed on the IMS for future viewing. The training would be updated as needed.

13.1.2 Performing Party Training

The IMS Developer will develop user guides describing how data will be uploaded to the IMS and how performing parties and/or their consultants can access and download environmental and IC data from the

IMS. It is recommended that at least one training session be scheduled that presents the information in the users guides and allows for questions and answers by the performing party attendees.

The IMS Operator is required to designate a Data Administrator as the communication point of contact for data submittals, coordination, and sharing (Table 1, Row 74).

13.1.3 Tribal Government Training

The IMS Developer and/or Operator will utilize the user guides and training materials developed for the agencies and performing parties to facilitate training for tribal governments needing to access the data and information in the IMS. It is recommended that at least one training session for tribal government representatives be scheduled that presents the information in the training materials and allows for questions and answers by the attendees.

13.1.4 Training for Public

Training on the implementation and use of the IMS would be beneficial for the public to enhance its usability and use. The IMS Developer could use the training and user guide developed for the Lincoln Park Superfund Site as an example (Table 1, Row 75). The Developer and Operator should:

- Invite users to inform the development of comprehensive audience-specific resources and trainings to meet the needs of diverse users, and data developmental documentation; and
- Invite representatives of each user group to review the draft support and training materials for clarity, accessibility, and usability before finalizing.

The Lincoln Park Site examples applicable for the IMS training include:

- Use of plain language;
- Graphics and diagrams showing structures and processes at the site and the Superfund process; and
- Links to specific web pages with more information.

The IMS Developer should coordinate with the EPA Portland Harbor Community Involvement Plan[61] (EPA, 2020d) to develop a similar training approach as Lincoln Park for the IMS. The training should explain IMS functionality and content. Recordings of the training will be made available online and updated when needed. As noted in Section 9, the development and delivery of trainings geared for community members offer the IMS Developer an opportunity to advance environmental justice for communities disproportionately affected by the PHSS. The IMS Developer could contract with community groups and members to:

- Co-develop training content and support materials;
- Lead necessary community engagement; and
- Co-facilitate community focused trainings.

13.2 Ongoing Outreach

Training materials and user guides, and video presentations of these materials, will be posted to the IMS website and links to the EPA's Portland Harbor StoryMap will be included to allow for ongoing outreach throughout the implementation and operation of the IMS. EPA will determine the need for and scope of additional training sessions during the operational phase of the IMS.

[61] https://semspub.epa.gov/work/10/100261772.pdf

13.3 Communications

The Needs Assessment Report notes that all stakeholder groups requested timely notifications when new information is published to the IMS. Examples of events that would require updates include availability of new data, changes to ICs, fish advisory updates, and cap repairs. The IMS Operator is required to provide updates using an email subscribers list, which will include updates on cleanup and IC data (Table 1, Row, 76). As stakeholders communicated a range of preferred frequencies for notifications, it would be beneficial if the IMS Operator provides users with email notification frequency preferences to meet varied needs. The IMS Developer will work with EPA to determine when and what other modes of information sharing should be used to communicate cleanup data, information, and progress updates.

The IMS Operator and Developer will leverage existing networks and communication channels to ensure diverse user groups are aware of and involved in the IMS development, implementation, and operation as discussed above. The IMS Operator and Developer will use a variety of methods and messages to engage and inform users about input opportunities, trainings, availability of new information, and mechanisms for ongoing user involvement to enable system and communication improvements. Examples of established communication channels include:

- Agency, business, and community email lists, social media, websites, and meetings;
- Portland Harbor Collaborative meetings and associated Working Group meetings Community-led person-to-person engagement;
- Portland Harbor Community Advisory Group (CAG); and
- EPA Portland Harbor StoryMap.

It is recommended that the IMS Developer review the Needs Assessment Report, Programmatic IC Plan, EPA's Community Involvement Plan, and the Multnomah County Health Department Recommendations for an Education and Outreach Program in support of the Portland Harbor Lower Willamette River Fish Advisory Institutional Control for detailed information about existing networks to leverage.

Stakeholders will have opportunities to provide feedback on functionality or content enhancement to the IMS via the IMS website. Feedback needs to be processed by EPA and the IMS Operator to determine whether the feedback warrants changes to the IMS and the implications of suggested changes. The primary focus is limited to IMS user support and error reporting.

SECTION 14: Project Implementation Schedule Framework

Included below is the overall schedule for implementing the IMP and completing development of the IMS. We anticipate that it will take a minimum of 16 to18 months to design, develop, and implement the IMS. The estimated schedule provided below includes stakeholder review and involvement throughout the IMS development and implementation. Opportunities for Tribal, State and Federal Trustee review will be provided in accordance with the existing Memorandum of Understanding for Portland Harbor Superfund Site (EPA, 2001) that specifies trustee reviews and reviewers. Community input and public involvement opportunities are recommended in Section 13.

Schedule changes may be needed to allow sufficient time for stakeholder engagement and review.

Ongoing stakeholder engagement is necessary for the design, development, and implementation of both the IMS and related trainings and support materials. Collaborating with stakeholders enables the Developer and Operator to leverage existing networks, access stakeholder-specific expertise and perspectives, and address emerging issues prior to IMS rollout. Consulting stakeholders throughout the development process allows the Developer and Operator to learn about user experiences and spotlight opportunities and challenges that may otherwise not be identified until after implementation, or not at all. Additionally, it lays the foundation for effective outreach and communications following IMS completion, which can result in greater awareness, use, and trust in the IMS.

Such engagement requires audience-specific approaches. The Needs Assessment report describes examples of how PHSS stakeholders would like to be engaged and how they could support the IMS design, development, implementation, and training.

Below lists the anticipated tasks to be completed to achieve implementation of the IMS. These tasks require a number of subtasks for completion. After the IMS Developer has selected an IMS contractor, the schedule can be refined to include a work breakdown structure for each subtask. EPA and stakeholder review occurs in two to three review cycles and the scope of the review will be specified by EPA. The IMS schedule involves implementing the following tasks:

- Task 1: Develop IMS requirements;
- Task 2: Develop IMS and EDMS system design documentation;
- Task 3: Develop data path specific submittal procedures, processing procedures, and QA/QC procedures;
- Task 4: Develop web content and interfaces;
- Task 5: Prepare IMS SOP documentation;
- Task 6: Prepare storage and system integration plan;
- Task 7: Conduct Internal beta testing and QA/QC;
- Task 8: Conduct recommended Stakeholder usability testing; and
- Task 9: Develop support and training materials.

The anticipated IMS schedule is detailed below to identify how each task will be implemented and the anticipated time frame for completion of each task. Note that the task numbers referenced below are consistent with the task numbers identified above.

0 - 90 Days (90-Day Period)

- Task 1: Develop IMS application function and data content requirements in addition to the content of IMS Requirements and Beneficial Enhancements.

- Task 2: Develop IMS System design document detailing how PHIDB, and/or other database management systems will meet the requirements listed in Table 1.
- Task 3: Develop submittal procedures, processing procedures, and QA/QC procedures for all data paths, which includes:
    - Task 3a: Laboratory data (Path 1). Adopt or revise existing submittal procedures, processing procedures, and QA/QC procedures;
    - Task 3b: Contextual GIS data (Path 2);
    - Task 3c: Bathymetry data (Path 3);
    - Task 3d: IC Registry data (Path 4) standards for the structure, units, and codes, and submittal procedures. In addition, the IMS Operator is to draft a document like Attachment A of the EPA DMP titled EDD Specifications for the PHIDB, which contains laboratory data (Path 1) structure and submittal procedures; and
    - Task 3e: Data and Reports (Path 5).

90 - 180 Days (90-Day Period)

- Task 1: EPA review of IMS application function and data content requirements.
- Task 2: EPA review of IMS and EDMS system design document.
- Task 3: EPA review of submittal procedures, processing procedures, and QA/QC procedures for all data paths.
- Task 4: Develop web content and interfaces for review.
- Task 5: Draft SOP documentation.
- Task 6: Draft storage and systems integration plan.

180 - 210 Days (30-Day Period)

- Task 1: Revise IMS application function and data content requirements.
- Task 2: Revise IMS and EDMS system design document.
- Task 3: Revise submittal procedures, processing procedures, and QA/QC procedures for all data paths.
- Task 4: EPA review of Web content and interfaces.
- Task 5: Revise SOP documentation as needed based on Tasks 1 and 2.
- Task 6: EPA review of storage and systems integration plan.

210 - 240 Days (30-Day Revisions)

- Task 1: Final EPA review of IMS application function and data content requirements.
- Task 2: Final EPA review of IMS and EDMS system design document.
- Task 3: Final EPA review of submittal procedures, processing procedures, and QA/QC procedures for all data paths.
- Task 4: Revise web content and interfaces.
- Task 5: Revise SOP documentation as needed based on input from Task 1 through 4.
- Task 6: Revise storage and systems integration plan.

240 - 330 Days (60-Day Revisions)

- Task 1: Incorporate final EPA comments; Stakeholder review of IMS application function and data content requirements.

- Task 2: Incorporate final EPA comments; Stakeholder review of IMS and EDMS system design document.
- Task 3: Stakeholder review of submittal procedures, processing procedures, and QA/QC procedures for all data paths.
- Task 4: Final EPA review of web content and interfaces.
- Task 5: Revise SOP documentation as needed based on input from Tasks 1 through 4.
- Task 6: Final review of storage and systems integration plan.
- Task 7: Conduct internal beta testing and QA/QC.
- Task 9: Develop support and training materials for accessing the IMS.

330 - 390 Days (60-Day Revisions)

- Task 1: Address Stakeholder comments and Finalize IMS application function and data content requirements. Task 1 is completed.
- Task 2: Address Stakeholder comments and Finalize IMS and EDMS system design document. Task 2 is completed.
- Task 3: Address Stakeholder comments and Finalize submittal procedures, processing procedures, and QA/QC procedures for all data paths. Task 3 is completed.
- Task 4: Stakeholder review of web content and interfaces.
- Task 5: Revise SOP documentation as needed based on input from Tasks 1 through 4.
- Task 6: Finalize storage and systems for integration.
- Task 7: Conduct internal beta testing and QA/QC. Task 7 is completed.
- Task 9: Stakeholder review of training materials.

390 - 450 Days (60 Days)

- Task 1: complete.
- Task 2: complete.
- Task 3: complete.
- Task 4: Address Stakeholder comments and Finalize web content and interfaces. Task 4 is completed.
- Task 5: Finalize SOP documentation. Task 5 is completed.
- Task 6: Implement storage and systems for integration. Task 6 is completed.
- Task 7: complete.
- Task 8: Conduct recommended usability testing. Task 8 is complete.
- Task 9: Revise IMS support and training materials based on usability and beta testing conducted for tasks 6 and 7.

450 - 485 Days (35 Days)

IMS switches from implementation to operational status

- Task 1: complete.
- Task 2: complete.
- Task 3: complete.
- Task 4: complete.

- Task 5: complete.
- Task 6: complete.
- Task 7: complete.
- Task 8: complete.
- Task 9: Revise IMS support materials per usability feedback. Task 9 is complete.

485 Day (1 Day)

Public rollout of the IMS

Post 485 Day

- Conduct Stakeholder Trainings (beneficial but not required).
- Conduct General Trainings (beneficial but not required).
- Conduct Agency Trainings (beneficial but not required).

SECTION 15: References

AECOM and Geosyntec. 2019. PDI Evaluation Report. Portland Harbor Superfund Site, Portland, Oregon. Prepared for the Pre-RD AOC Group.

Cascadia Associates and GSI. 2021. *Final Needs Assessment Report, Portland Harbor Information Management Project*. Prepared for the City of Portland and State of Oregon. Prepared by Cascadia Associates, LLC (Cascadia), and GSI Water Solutions, Inc. (GSI).

CDPHE and EPA. 2007. *Community Involvement Plan, Lincoln Park Superfund Site and Associated Activities at the Cotter Corporation Uranium Mill*. Prepared by the Colorado Department of Public Health & Environment and the U.S. Environmental Protection Agency, Region 8.

EPA, ODEQ, and USACE. 2002. Letter of Agreement Between the US EPA Region 10, the ODEQ and USACE Portland District Concerning the Lower Willamette River.

EPA. 2001. Memorandum of Understanding for Portland Harbor Superfund Site. Entered into by and between the following govenerment parties: the United States Environmental Protection Agency (EPA), the Oregon Department of Environmental Quality (DEQ), the Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of the Grand Ronde Community of Oregon, the confederated Tribes of Siletz Indians, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Nez Perce Tribe, the National Oceanic and Atmospheric Administration, the Oregon Department of Fish and Wildlife, the U.S. Department of the Interior.

EPA. 2006. *Institutional Control Data Standard*. Prepared by the U.S. Environmental Protection Agency.

EPA. 2012. Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites, OSWER 9355.0-89 and EPA/540/R-09/001.

EPA. 2016. Remedial Investigation/Feasibility Study, Portland Harbor Superfund Site, Portland, Oregon. Prepared by EPA Region 10.EPA. 2017. Record of Decision, Portland Harbor Superfund Site, Portland, Oregon. Prepared by EPA Region 10.

EPA. 2019. *Administrative Settlement Agreement and Order on Consent for Remedial Design of Site-Wide Institutional Controls Implementation and Assurance Plan and Information Management Plan*. CERCLA Docket No. 10-2019-0151.,U.S. Environmental Protection Agency, Region 10.

EPA. 2020a. *Administrative Settlement Agreement and Order on Consent for Remedial Design of an Interim Database, CERCLA Docket No. 10-2020-0103*, dated October 22, 2020. Gartner, Inc. 2019. State of the Open-Source DBMS Market, 2019.

EPA. 2020b. Errata #2 for Portland Harbor Superfund Site Record of Decision ROD Table 17.

EPA. 2020c. Portland Harbor Superfund Site Community Involvement Plan (CIP). Prepared by U.S. Environmental Protection Agency (EPA), August 12, 2020.

EPA. 2021. *Program Data Management Plan, Portland Harbor Remedial Design Investigation, Portland Harbor Superfund Site*. Prepared by the U.S. Environmental Protection Agency. August 2020.

Gartner. 2019. *State of the Open-Source DBMS Market, 2019*. Prepared by Gartner.

GeoEngineers, Inc. and Integral Consulting. 2021. *Portland Harbor Interim Database Design Summary*. Prepared for State of Oregon.

TABLES

Table 1. IMS Requirements and Beneficial Enhancements

ID	Category	IMS Need	Required[1]	Beneficial[1]	IMP Section	Function	Content
1	Laboratory Data	Sediment/riverbank soil sampling locations and results.	X		6.1		X
2	Laboratory Data	Fish tissue contaminant levels sampling locations and results.	X		6.1		X
3	Laboratory Data	Surface Water, groundwater, porewater, bioassay, and stormwater sampling locations and results.	X		6.1		X
4	EDMS Data Submittal Procedure	The IMS Developer prepares a list of recommended changes to the data submittal process to realign it with the proposed IMS within 60 days of contractor selection.	X		6.1.1		X
5	Contextual Spatial Data	Develop a standard set of cleanup-related GIS layers that include area boundaries (from the Order on Consent and defined sediment management areas), existing docks and structures, monitoring and maintenance activities, construction footprints, areas of erosion potential, and areas showing remedial technology applications.		X	6.2		X
6	Contextual Spatial Data	Historical RI GIS data required to assess remedial action objective achievement.	X		6.2		X
7	Contextual Spatial Data	There is a need for digital information of the boundaries on easements or other proprietary authorizations executed by the State.	X		6.2		X
8	Contextual Spatial Data	Inflows of additional EPA approved contextual geospatial data for consideration as displayed in the IMP Other Beneficial Contextual GIS Data table.		X	6.2		X
9	Contextual Spatial Data	Aerial imagery.	X		6.2.1		
10	Contextual Spatial Data	To view reference maps (e.g., USGS topo, streetmaps, etc.).	X		6.2.1		X
11	Contextual Spatial Data	Include variety of ArcGIS Map Services offered by the City.		X	6.2.1		X
12	Bathymetry/Topography	Access to bathymetric survey data.	X		6.3		X
13	Bathymetry/Topography	Bathymetric and topographic datasets available for download are required to characterize the river nearshore area adequately.	X		6.3		X
14	Community Impacts Mitigation Measures	EPA approved water, air, and noise monitoring data collected during remedial action be linked to the StoryMap or available on the IMS.		X	6.4		X
15	EPA IC GIS Data Standard	IMS Developer will determine what details are needed to implement the final IC Registry database structure and submittal procedure.	X		7.1.1		X

ID	Category	IMS Need	Required[1]	Beneficial[1]	IMP Section	Function	Content
16	PHSS Reports	EPA will ensure any maintenance dredging sediment characterization data are submitted to the IMS Operator.	✖		8.1		
17	Environmental Justice	Development of an environmental justice plan for implementation of the IMS.	✖		9		✖
18	EDMS	Clear chemical naming conventions based on understandable database valid values and clarification on chemistry summation rules.	✖		9.1.1		✖
19	EDMS	Attribute data with river zones (nearshore and midriver).	✖		9.1.1		✖
20	EDMS	Correlation of data to spatial locations (horizontal, vertical).	✖		9.1.1		✖
21	EDMS	Data to contain unique station IDs for querying co-contaminants.	✖		9.1.1		✖
22	EDMS	For the database to include EPA criteria values (e.g., RAL, PTW and CUL). Also FS ARAR values.	✖		9.1.1		✖
23	Institutional Controls	Identify the data as pre- or post-remedial action.	✖		9.1.1		✖
24	Database Content	The IMS EDMS will contain historical sediment chemistry data necessary to assess remedial action objective achievement, including but not limited to the PHSS Remedial Investigation/Feasibility Study (RI/FS) data.	✖		9.1.2		✖
25	Institutional Controls	PDF documents of IC information hyperlinked to EPA SEMS.	✖		9.2		✖
26	Institutional Controls	Status and details regarding fishing advisory IC.	✖		9.2		✖
27	Institutional Controls	IC information needs to be available in a central repository for stakeholder use from construction to implementation.	✖		9.2		✖
28	Institutional Controls	Provide a current and comprehensive IC layer that includes IC features and a link to inspection and contact information.	✖		9.2		✖
29	Construction Completion Report	EPA will determine the procedure and format for performing parties to submit features from Construction Completion Reports that are related to remedy implementation but are not a part of the IC Registry.	✖		9.3		✖
30	Construction Completion Report	Performing parties submit CCR required GIS layers as specified in IMP Section 9.3.	✖		9.3		✖
31	Construction Completion Report	Performing parties submit CCR beneficial GIS layers as specified in IMP Section 9.3.		✖	9.3		✖
32	Non-Remedy Mitigation and/or Enhancement Areas	Information on other non-remedy mitigation.		✖	9.4		✖

Table 1. IMS Requirements and Beneficial Enhancements

ID	Category	IMS Need	Required[1]	Beneficial[1]	IMP Section	Function	Content
33	Non-Remedy Mitigation and/or Enhancement Areas	Provide voluntary enhancement site areas.		X	9.4		X
34	Access to Information	IMS to contain conventional website content.	X		9.5		X
35	Access to Information	Text available in multiple languages in portions of the IMS.	X		9.5		X
36	Access to Information	Website and PDFs to be compliant where possible with the requirements of the Section 508 Web Accessibility Standards to support visual and audio impairments.	X		9.5		X
37	Access to Information	Text written at an "8th-grade level" in portions of the IMS.	X		9.5		X
38	Access to Information	The IMS needs to be mobile-device compatible where feasible.		X	9.5	X	
39	Access to Information	IMS WCMS supports automated templates, automated web standards upgrade, ease of editing content, and content syndication (email users when there are updates).		X	9.5	X	
40	IMS Design	Simple display design (e.g., the Minnesota Pollution Control Agency's Tableau dashboard).	X		9.5.1	X	
41	IMS Design	IMS must contain pictures and graphics in the design as an aid for communication (like the Intellus example).	X		9.5.1		X
42	IMS Design	Equitable access to data and information; a specific application and/or interface may best address the needs expressed by the Community Group.	X		9.5.1	X	
43	EDMS and IC Interfaces	Ability to navigate and search like the DIVER, EIM, and Intellus.	X		9.5.2	X	
44	EDMS and IC Interfaces	Quick access; download ease of export.	X		9.5.2		
45	EDMS and IC Interfaces	User-friendly interface (e.g., the ability to submit queries for data, locate data using maps).	X		9.5.2	X	
46	EDMS and IC Interfaces	Ability to build queries by matrix (e.g., for soil, sediments, or tissue).	X		9.5.2	X	
47	EDMS and IC Interfaces	Export across different media data types.	X		9.5.2	X	
48	EDMS and IC Interfaces	Ability to query all IMS database fields.	X		9.5.2	X	
49	EDMS and IC Interfaces	Savable user queries on IMS.		X	9.5.2	X	
50	EDMS and IC Interfaces	Quick access to help and background (both database/application performance and background/reports associated with the data).		X	9.5.2		X
51	EDMS and IC Interfaces	Link IC and remediation areas to a unique identifier.	X		9.5.2		X
52	Data Service	Portland Harbor laboratory data available via an API service.	X		9.5.3		X
53	Data Service	Access server connection for ArcGIS GIS web services for spatial data (ArcGIS online).	X		9.5.3		X

ID	Category	IMS Need	Required[1]	Beneficial[1]	IMP Section	Function	Content
54	Data Visualization Applications	Easy-to-understand graphical representation of data in the IMS.	X		9.5.4		X
55	Data Visualization Applications	Visualize data as "bubble plots" or graduated circles of sample locations and chemistry concentration results to see relative differences by screening criteria.	X		9.5.4	X	
56	Data Visualization Applications	Interactive maps that allow users to click on an area to access more information on the IC or sediment contamination.	X		9.5.4	X	
57	Data Visualization Applications	Ability to download data in a custom area (e.g. drawing a polygon) like the functionality of NOAA DIVER and Ecology's EIM applications.	X		9.5.4	X	
58	Data Visualization Applications	Area specific ICs need to be easily searchable in map application.	X		9.5.4	X	
59	Data Visualization Applications	Plot IC information and associated infrastructure (e.g., caps, signage) on interactive maps that contain IC details	X		9.5.4		X
60	Data Visualization Applications	Visualize surface sediment contaminant concentration trends over time to monitor cleanup progress.	X		9.5.4	X	
61	Data Visualization Applications	For interactive map applications to display EPA criteria values (e.g., RAL, PTW and CUL).	X		9.5.4		X
62	Data Visualization Applications	Quick access to data summarizing concentrations of contaminants of concern in underlying sediments.		X	9.5.4	X	
63	Data Visualization Applications	Integration of map/tabular data features (zoom to), highly formatted, cross-tab reports, clickable map objects linking to documents or data.		X	9.5.4	X	
64	Data Visualization Applications	Displaying data visually and right clicking to access a table with selected data.		X	9.5.4	X	
65	Data Visualization Applications	URL based layer display (can share/email link).		X	9.5.4		
66	Data Visualization Applications	Link documents to an interactive map where feasible.		X	9.5.4	X	
67	IMS Support Materials	IMS to contain support materials as self-guided help resources.	X		9.5.5		
68	IMS Support Materials	IMS to contain contact forms to obtain stakeholder feedback that may improve the IMS functionality.	X		9.5.5		
69	Maintenance	Stable file paths/links for users.	X		10	X	
70	Metadata	Prepare metadata for the EDMS and IC Registry in the ISO 19115 standard.	X		12.5		
71	Metadata	Metadata with links to data source and information about data lineage/processing.		X	12.5		
72	Outreach and Communication	For a subset of all stakeholder groups to perform usability testing of the IMS.		X	13	X	
73	Agency Trainings	Training on the IMS per Section 5 of the PICIAP.		X	13.1.1	X	
74	Performing Party Training	The IMS Operator is required to designate a data administrator as the communication point of contact for questions, support, and data coordination and sharing.	X		13.1.2		
75	General Public Training	Training on the IMS for general public.		X	13.1.4	X	

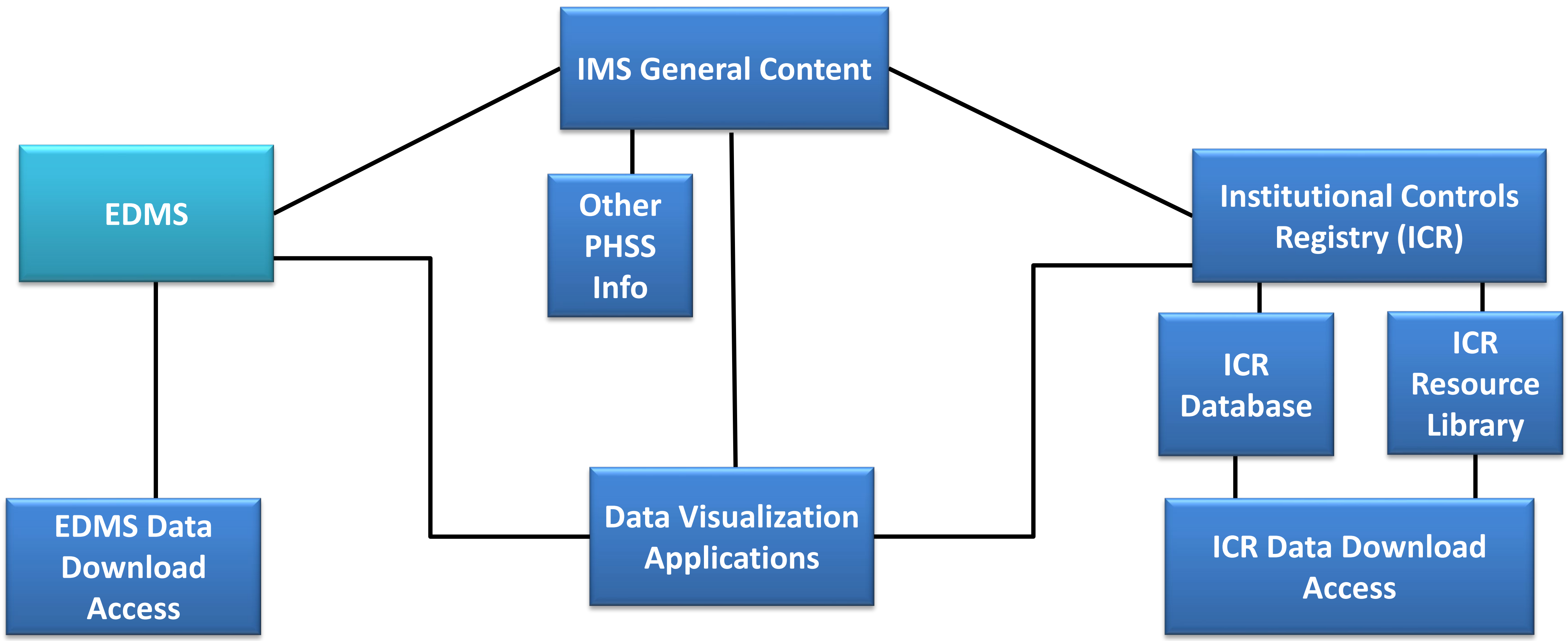
ID	Category	IMS Need	Required[1]	Beneficial[1]	IMP Section	Function	Content
76	Communication	Provide Portland Harbor Site cleanup and IC data status updates using an email subscribers list.	✖		13.3		✖

[1] "There is a broad range of possibilities for an IMS, and therefore, some requirements will be identified as necessary, and some will be identified as beneficial but not necessary." (EPA, 2019)

Table 2. IMS Framework Matrix

Function/Content	IMS Framework						
	IMS General Web Content	EDMS	EDMS Download Access	Data Visualization	IC Registry	IC Data Download Access	PHSS Data and Reports
Website Home	X						
Help Center	X						
FAQ	X						
Email Listserv	X						
Site Map	X						
Contact	X						
Download Lab Data			X				
Download IC Data						X	
Data Services			X			X	
EDMS Valid Values		X					
EDMS Data Dictionary		X					
Metadata		X					
Interactive Maps				X			
Long Term Trends Dashboard				X			
Laboratory Data				X			
IC Registry Data				X			
Bathymetry				X			X
Contextual GIS Data				X			X
Area Specific IC Plans					X		X
Fish Advisory Activity					X		X
Monitoring Reports					X		X
External Links					X		
Examples Area Specific IC Plans					X		
Example Monitoring Reports					X		
Data Submittal Templates					X		
Links					X		
Area Specific Information							X
EPA Website Links					X		
Report Damaged IC					X		

FIGURES



Primary Users

All Stakeholders

Advanced Data Users

EDMS: Environmental Data Management System
PHSS: Portland Harbor Superfund Site

FIGURE 1

IMS Conceptual Framework

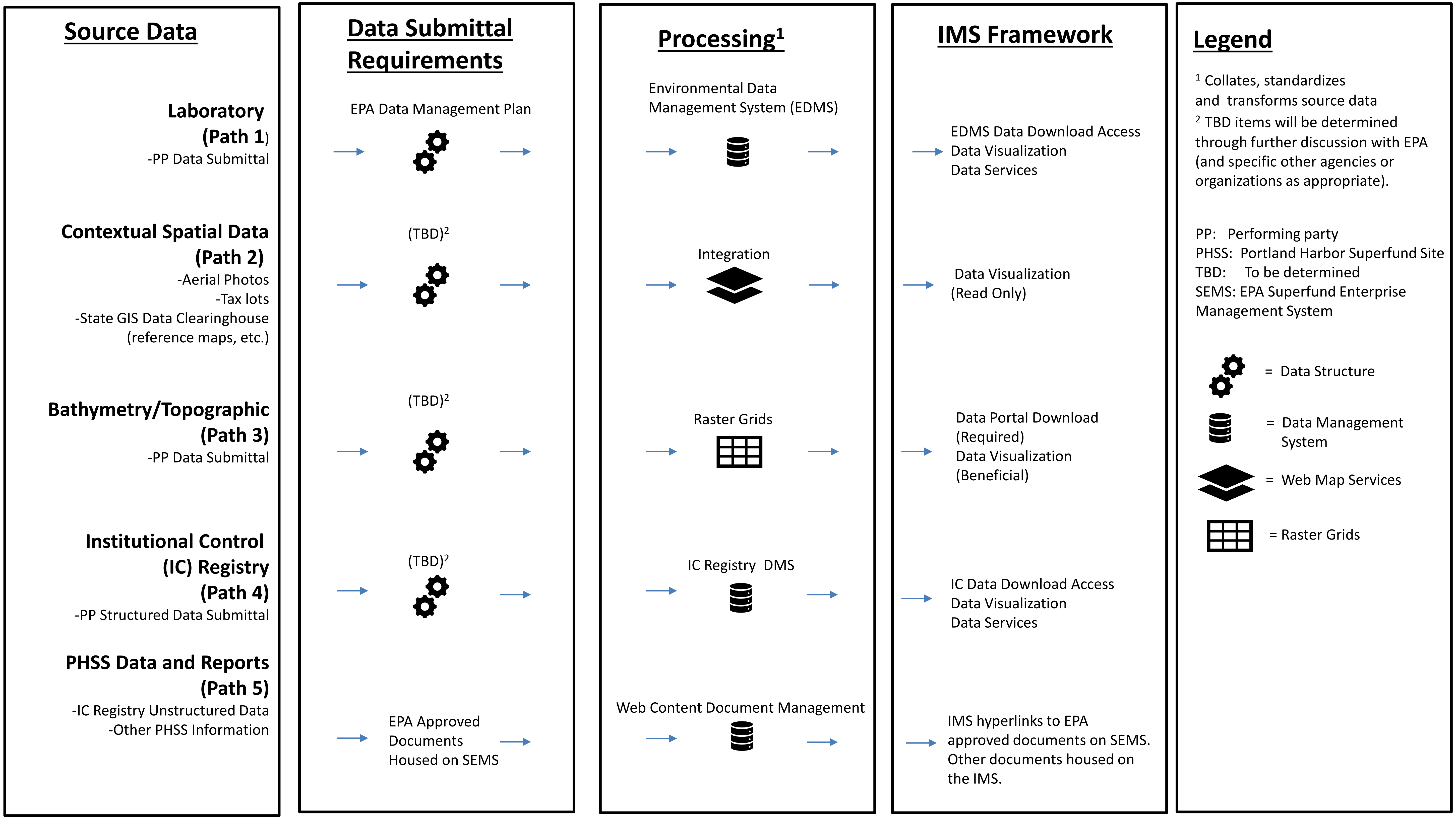
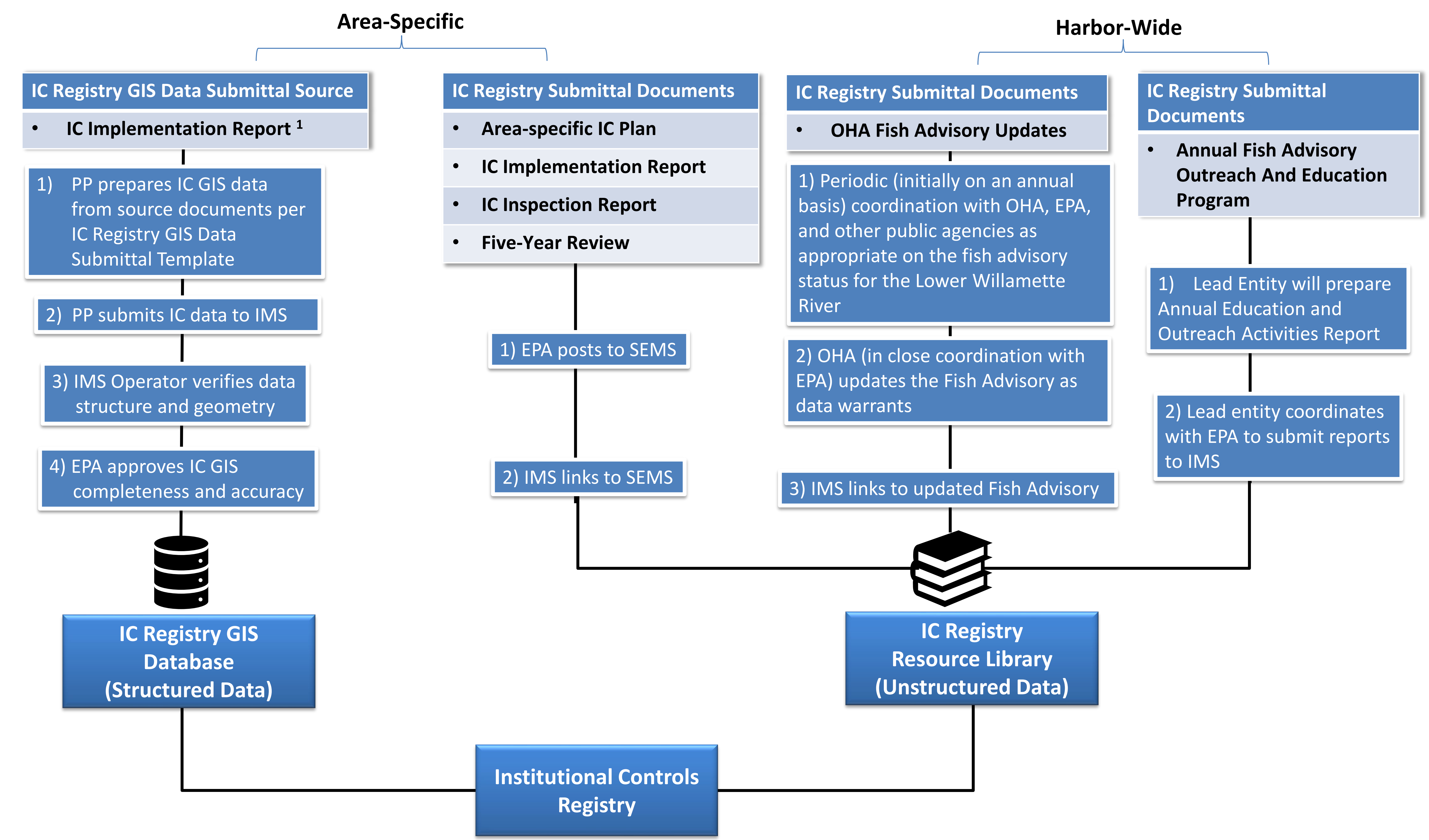


FIGURE 2

IMS Data Paths



[1] When EPA approves a modification of an IC, it will require PP resubmission to the IMS.

IC: Institutional Control
PP: Performing Party
OHA: Oregon Health Authority
SEMS: Superfund Enterprise Management System

Note: The IC registry submittal process is subject to change based on agreements drafted between EPA and performing parties

FIGURE 3

IC Registry Submittals

Required CCR GIS Data Submittal Source

- Areas of erosion potential requiring long term monitoring
- Cap /Dredge/Enhanced Natural Recovery Areas
- Data on compensatory mitigation projects and associated institutional controls (ICs), including compensatory mitigation areas
- Docks and structures
- Future maintenance dredge boundaries
- Groundwater plumes
- Groundwater well locations and characteristics for long term monitoring wells
- Habitat types and delineation of shoreline and in-water habitat for mitigation areas
- Navigational channel boundary
- Presence and location of non-aqueous phase liquid (NAPL) presence
- Remedial action/construction footprints and remedial technology applications
- Riverbank Stabilization Areas
- Sediment Management Areas, with vertical and lateral delineation

Beneficial CCR GIS Data Submittal Source

- Riverbank slopes > 3:1
- Climate change resiliency monitoring results
- Areas of monitoring and maintenance activities

1) PP prepares IC GIS data from source documents per IC Registry GIS Data Submittal Template

2) PP Submits IC Data to IMS

3) IMS Operator Verifies Data Structure and Geometry

4) EPA Approves IC GIS completeness and accuracy

IMS CCR GIS Database (Structured Data)

IC: Institutional Control
PP: Performing Party
CCR: Construction Completion Report

Note: Requirements are subject to change based on the final IMS requirements.

FIGURE 4

Construction Completion Report (CCR) GIS Data Submittal

APPENDIX A
Table 1—Summary of IC Applications

Table 1. Summary of IC Applications

Agency	Tool Name	Web Address	Online Web Map Application and/or Service (API)	Are IC GIS layers available for download?	IC Geographic Representation	Downloadable PDFs for IC information?	Links from the interactive map to the PDF?	Notes
EPA Region 8	Environmental Dataset Gateway	edg.epa.gov/data/Public/R8/	No	Yes	Polygon	No	No	▪ Data set consists of IC data from multiple Superfund sites in EPA Region 8. ▪ Provides the downloadable data only.
Indiana Department of Environmental Management	Environment / Remediation IC Site (Map Server)	www.arcgis.com/home/webmap/viewer.html?url=https%3A%2F%2Fgis.in.gov%2Farcgis%2Frest%2Fservices%2FDEM%2FRestrictedSites%2FFeatureServer&source=sd	Yes	Yes	Polygon	Yes	No	▪ Institutional Control Sites, (IDEM, 20200402) ▪ Shows 4,061 sites in Indiana on the IC registry
Florida Department of Environmental Protection	Institutional Control Registry Open Data Portal	ca.dep.state.fl.us/mapdirect/?webmap=cff8d21797184421ab4763d3e4a01e48	Yes	Yes	Polygon	Yes	Yes	▪ Selecting a polygon brings up a detail on the IC. ▪ Detailed information can be exported as a CSV file. ▪ Map application is mobile compatible ▪ Mobil application compatible but not geolocation enabled.
Colorado Department of Public Health & Environment	Colorado Institutional Controls map	arcgis.com/home/webmap/viewer.html?webmap=aedf83fab1ed4bca9b880a8c83b97b62&extent=-110.0728,35.8404,-100.8442,41.8085	Yes	Yes	Polygon	Yes	Yes	▪ Users can filter map layers. ▪ After selecting polygon, users can see a detail popup tabulated data viewer with options for area, length, ID, and links to PDF of IC. ▪ A summary PDF and a PDF of the IC document available for download for each IC.
Louisiana Department of Environmental Quality	Fish Consumption and Swimming Advisories (web and mobile app)	deq.louisiana.gov/page/fishing-consumption-and-swimming-advisories	Yes	No	Polygons and points	No	No	▪ Bodies of water with fish consumption and swimming advisories display as polygons ▪ Users need to select the icon/point on the body of water to see details view. ▪ Mobil application available in Apple App Store ▪ Geolocation enabled (displays the user's location on the application map).
Minnesota Pollution Control Agency	Minnesota Pollution Control Agency Institutional Controls	mpca.maps.arcgis.com/apps/webappviewer/index.html?id=483aabfa54d24b1b92945538ecafc95f	No	Yes	Point	No	No	▪ Provides location points, addresses, and property identification numbers (PINs) of existing ICs. ▪ Data download available gisdata.mn.gov/dataset/env-institutional-controls
New York State	Environmental Site Remediation Database Search	dec.ny.gov/cfmx/extapps/derexternal/index.cfm?pageid=3	No	No	None	No	No	▪ Database housing IC information that can be searched for by IC type, address, site name, etc. ▪ Tabulated data can be downloaded as a CSV or XLS file ▪ No GIS data or web map application
Oregon State Marine Board	Boat Oregon	www.boatoregon.com/map	Yes	No	Polygons	No	No	▪ Use restrictions/regulations (such as a no wake zone) shown as polygons ▪ Entry points and other features are shown as points ▪ Link to Oregon State Marine Board text
Oregon Department of Environmental Protection	Environmental Cleanup Site Information Database	www.deq.state.or.us/lq/ECSI/ecsiquery.asp?listtype=lis&listtitle=Environmental+Cleanup+Site%20Information+Database	No	No	None	Yes	No	▪ Information is search by location (not by IC) ▪ PDFs are long reports or other media ▪ Available information varies across locations
South Carolina Department of Health and Environmental Control	Fish Consumption Advisory	gis.dhec.sc.gov/gisportal/apps/webappviewer/index.html?id=c71943bc743b4ca196e0ef0406b1d7ab	Yes	No	Polygons and lines..	No	No	▪ Bodies of water with fish consumption and swimming advisories are displayed as polygons ▪ Features display pop-up windows when clicked ▪ Points display tissue sample location ▪ Tabulated details can be downloaded as a CSV file

Notes

CSV = comma separated values
EPA = U.S. Environmental Protection Agency
GIS = geographic information system
IC = institutional control
N/A= not applicable
PDF = portable document format
XLS = Microsoft Excel file format

ATTACHMENT A

Portland Harbor Record of Decision (Tables 17 and 21) (EPA, 2016)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 155
Seattle, WA 98101-3123

SUPERFUND &
EMERGENCY
MANAGEMENT DIVISION

January 14, 2020

MEMORANDUM

SUBJECT: Errata #2 for Portland Harbor Superfund Site Record of Decision ROD Table 17

FROM: Sean Sheldrake, Remedial Project Manager
Office of Environmental Cleanup

THRU: Lori Houck Cora, Assistant Regional Counsel
U.S. Environmental Protection Agency, Region 10

TO: Portland Harbor site file

This memorandum to the Site File documents errors identified in Table 17 of the Portland Harbor Superfund Site Record of Decision (ROD), dated January 2017 and updates the Table 17 presented in the Errata dated April 3, 2018. In implementing remedial designs at the Site, some errors and omissions to Table 17 were discovered. Several contaminants and their cleanup levels were left off the Table. Additionally, some cleanup levels were erroneously translated from the Portland Harbor Feasibility Study (FS), dated June 2016; the Portland Harbor Remedial Investigation Report (RI), dated February 8, 2016; and the Portland Harbor Baseline Ecological Risk Assessment (BERA), dated December 16, 2013. This Errata #2 is being issued to make those corrections and to be consistent with Section 9.1 of the ROD. Additionally, the revised carcinogenic polycyclic aromatic hydrocarbons (cPAH) sediment cleanup levels documented in the final Explanation of Significant Differences (ESD) are added to the corrected Appendix II, ROD Table 17. Additionally, to provide transparency regarding the basis of the cleanup levels, a new column has been added indicating the applicable RAO that was the basis of each cleanup level. An explanation of the corrections being made to Appendix II, ROD Table 17 follows:

1. The cleanup levels for aldrin, PCBs, and dioxin/furans in surface water should be revised to be shown in scientific notation for clarity.

2. The following groundwater contaminants of concern (COCs) and cleanup levels should be added to the groundwater column. These COCs and preliminary remediation goals (PRGs) were identified in FS Table 2.2-11 and were mistakenly left off the original ROD Table 17. These are ecological risk-based values so an “R_E” should be added to the basis column for these contaminants:

    a. Benzo(g,h,i)perylene cleanup level of 0.4 micrograms per liter (μg/L)

    b. Fluoranthene cleanup level of 6.2 μg/L

    c. Fluorene cleanup level of 3.9 μg/L

    d. 2-Methylnaphthalene cleanup level of 2.1 μg/L

e. Naphthalene cleanup level of 12 µg/L

f. Phenanthrene cleanup level of 6.3 µg/L

g. Pyrene cleanup level of 10 µg/L

3. The groundwater cleanup level for cadmium should be changed from 0.091 to 0.094 µg/L. This appears to be a transcription error from FS Table 2.1-4 referring to the Section 304(a) list of National Recommended Water Quality Criteria (NRWQC).Additionally, the Oregon Water Pollution Act (ORS 468B.048) Aquatic Life Chronic Criteria (OAR 340-41 8033, Table 30) reference on FS 2.1-4 should also be 0.094 µg/L. FS Table 2.2-11 lists the cadmium BERA toxicity reference value (TRV) and ARAR as 0.09 µg/L, which appears to be a rounded value. BERA Table 6-43 lists the source of the TRV as an ambient water quality criteria (AWQC).

4. The basis for the copper surface water cleanup level should be changed from "A" to "R_E" since it is an ecological risk-based value. The basis of the PRG is identified in FS Table 2.2-10.

5. The basis for the dichlorodiphenyltrichloroethane and its derivatives (DDx) groundwater cleanup level should be changed from "A" to "A_{EA}/R_E" since it is an ecological risk-based value and an ARAR. FS Table 2.2-11 identifies the ARAR to be 0.001 µg/L. In addition, FS Table 2.2-11 identifies the "TRV from BERA" to be 0.01 µg/L; however, BERA TRV Table 2 in Attachment 10 notes that the TRV value is 0.001 µg/L with the caveat, "An alternative TRV (0.011 µg/L; see Section 2) was derived because the selected AWQC- based TRV protects birds from dietary exposure (specifically egg-shell thinning) and is not appropriate for the evaluation of aquatic receptors."

6. The basis for the groundwater cleanup level for copper and should be changed from "A/R" to "R_E" since this is an ecological risk-based value. The basis for the groundwater cleanup levels for lead and zinc should be changed from "A/R" to "A_{EA}/R_E" since these are ecological risk-based values and AWQC values. The basis for the groundwater cleanup level for polychlorinated biphenyls (PCBs) should be changed from "A/R" to "A_{EN}/R_E" since this is an ecological risk-based value and an NRWQC value. The basis of the PRGs for these chemicals is identified in FS Table 2.2-11, with the exception of zinc. The "ARAR or TBC" for zinc is erroneously listed as "NA." Although FS Table 2.2-11 has values for lead and PCBs in the "ARAR or TBC" that match the values in the "TRV from BERA" column, these "ARAR or TBC" values correspond to surface water criteria.

7. The dichlorodiphenyldichloroethene (DDE) river bank soil/sediment cleanup level should be changed to 50 micrograms per kilogram (µg/kg). The 226 µg/kg value is from FS Tables 2.2-9 and B4-2. However, the logistic regression model (LRM) derived sediment quality value (SQV) for 4,4'-DDE in BERA Table 6-11 is 50 µg/kg when the SQV is converted to µg/kg dry weight using the equation in FS Appendix B Section B4.1. This LRM-derived SQV was mistakenly not translated into FS Table 2.2-8, where it should have been selected as the PRG. (The LRM-derived SQV for DDE in FS Table 2.2-8 was erroneously listed as 359 µg/kg.) This is an ecological risk-based value so an "R_E" should be added to the basis column for this contaminant.

8. The cPAH river bank soil/sediment cleanup level should be changed from 12(7) ug/kg to "774/85/1,076" µg/kg along with a reference to note (7). This is a human health risk-based value so the basis for the cPAH river bank soil/sediment cleanup level should be changed from "B" to "R_H". This PRG was revised by ESD Table 1.

9. The river bank soil/sediment cleanup level of 0.01 µg/kg for Dioxins/Furans (2,3,7,8-TCDD eq) should be added. This PRG was identified in FS Table 2.2-4 and was mistakenly left off the ROD Table 17. This is a human health risk-based value so an "R_H" should be added to the basis column for this contaminant along with a reference to note (8).

10. The heading for the fish/shellfish tissue target concentrations should be revised to read "Fish/Shellfish Tissue (4)". While shellfish have always been considered in the development of target values for this column, it was not previously explicitly stated in the title of this column.

11. The following fish/shellfish tissue target concentrations should be corrected:

    a. These targets were identified in FS Table 2.2-5 and appear to be transcription errors:

        i. 0.00008 µg/kg for 1,2,3,4,7,8-HxCDF should be 0.00006 µg/kg.

        ii. 0.000008 µg/kg for 1,2,3,7,8-PeCDD should be 0.000006 µg/kg.

        iii. 0.00003 µg/kg for 2,3,4,7,8-PeCDF should be 0.00002 µg/kg.

        iv. 0.00008 µg/kg for 2,3,7,8-TCDF should be 0.00006 µg/kg.

        v. 0.000008 µg/kg for 2,3,7,8-TCDD should be 0.000006 µg/kg.

    b. 7.1 µg/kg for cPAH (BaP eq) should be 51.6 µg/kg, based on ESD Table 1.

    c. The basis for the fish/shellfish tissue target level for mercury should be changed to "R_H" to indicate that it is a human health risk-based.

    d. The fish/shellfish tissue target level for polybrominated diphenyl ethers (PBDEs) should be changed to 1.28 µg/kg. Although a PRG for PBDEs was calculated in FS Table B3-5, it was mistakenly not translated into FS Table 2.2-4 and the original Table 17. Upon further review, the PRG calculation for PBDEs in FS Table B3-5 was determined to be incorrect because the calculation of noncancer hazard for PBDE through the infant breastmilk consumption pathway should have been calculated by applying an infant risk adjustment factor (IRAF) of 38 to the noncancer hazard estimates for the adult mother in accordance with the methodology described in Appendix F, Attachment F3 of the HHRA.

$$\mathrm{PRG_{tis}} = \left[\frac{\mathrm{THQ} \times \mathrm{BW_m} \times \mathrm{AT_{nc}}}{\mathrm{ED_a} \times \mathrm{EF} \times \frac{1}{\mathrm{RfD}} \times \mathrm{CR} \times 0.001\ \mathrm{kg/g}}\right] \times \left(\frac{1{,}000\ \mu\mathrm{g/mg}}{\mathrm{IRAF}}\right)$$

PRG_{tissue} = risk-based PRG in fish/shellfish (µg/kg – wet weight)
THQ = target hazard quotient = 1
BW_m = average body weight – maternal = 66 kg
AT_{nc} = averaging time, noncancer = 10,950 days
RfD = reference dose = 0.0001 mg/kg-day
ED_a = exposure duration – adult = 30 years
EF_a = exposure frequency – adult (maternal exposure) = 350 days/yr
CR = maternal consumption rate of fish = 142 g/day
IRAF = infant risk adjustment factor = 38

Using this methodology, the fish/shellfish tissue target level for PBDEs based on the infant breastmilk consumption pathway is 1.28 µg/kg.

12. The following changes are being made to the notes to provide transparency regarding the cleanup level selection process described in the FS and to facilitate remedial design analysis. Notes 7 and 8 clarify the applicable exposure pathways for the selected values.

    a. The following text should be added to Note (2): "Note: Groundwater cleanup levels are generally the ecological risk-based or human health risk-based concentration that protects the most sensitive receptor that are relevant and protective for receptor exposures to groundwater. An exception to this is if an ARAR (promulgated standard) for a contaminant is higher than a risk-based number, but the ARAR [such as maximum contaminant levels (MCLs)] is determined to be protective, then the less protective ARAR is selected as the cleanup level."

    b. The following text should be added to Note (3): "The lower of the PRG values for RAOs 1, 2 (sediment through Fish/Shellfish Consumption), 5, and 6 were selected as the cleanup level regardless of the exposure pathway."

    c. Note (4) should be revised to read: "Fish/Shellfish Tissue Targets - RAOs 2 and 6. The lower of the PRG values for RAOs 2 and 6 were selected as the target regardless of the exposure pathway."

    d. The following text should be added as Note (7): "The cleanup level for cPAHs of 774 µg/kg is based on direct contact with sediment and is applicable to nearshore sediment exclusive of recreational beaches and navigation channel sediments. The cleanup level applicable to recreational beach sediments is 85 µg/kg and the cleanup level applicable to the navigation channel sediment is 1,076 µg/kg and is based on human consumption of clams."

    e. The following text should be added as Note (8): "The 2,3,7,8-TCDD eq cleanup level for river bank soil/sediment is based on RAO 1, which includes a dietary component (incidental ingestion) in addition to direct exposure. The river bank soil/sediment cleanup levels for the individual dioxin/furan congeners are based on RAO 2, which accounts for bioaccumulation from sediment through the food chain."

f. The following text should be added as Note (9): "This Table 17 identifies fish/shellfish tissue target levels and site-specific cleanup levels for each of the following media: sediment (including beaches), river bank soil, surface water, and groundwater. However, these cleanup levels represent the lowest PRG value identified across all identified site receptors for the indicated RAOs. Since exposure area averaging may impact the concentrations to which a receptor is potentially exposed, Chapter 8 and Table 16 of the ROD should be consulted in the development of remedial actions."

13. In the abbreviations list, the following changes should be made:

   a. To provide transparency regarding the basis of the cleanup levels, a new column has been added indicating the applicable RAO that was the basis of each cleanup level. The RAO column is provided to identify the basis of the CUL value, it does not indicate a media application limitation or exposure pathway limitation of the CUL. Due to the numerous additions, these changes are only shown in the updated Table 17 and are not enumerated separately in this memorandum. The definition of the RAOs should be added to the abbreviation list as follows:

      i. "RAO1 – Reduce cancer and non-cancer risks to people from incidental ingestion of and dermal contact with COCs in sediment and beaches to exposure levels that are acceptable for fishing, occupational, recreational, and ceremonial uses."

      ii. "RAO2 – Reduce cancer and non-cancer risks to acceptable exposure levels (direct and indirect) for human consumption of COCs in fish and shellfish."

      iii. "RAO3 - Reduce cancer and noncancer risks to people from direct contact (ingestion, inhalation, and dermal contact) with COCs in surface water to exposure levels that are acceptable for fishing, occupational, recreational, and potential drinking water supply."

      iv. "RAO4 - Reduce migration of COCs in groundwater to sediment and surface water such that levels are acceptable in sediment and surface water for human exposure."

      v. "RAO5 – Reduce risk to benthic organisms from ingestion of and direct contact with COCs in sediment to acceptable exposure levels."

      vi. "RAO6 – Reduce risks to ecological receptors that consume COCs in prey to acceptable exposure levels."

      vii. "RAO7 - Reduce risks to ecological receptors from ingestion of and direct contact with COCs in surface water to acceptable exposure levels."

      viii. "RAO8 - Reduce migration of COCs in groundwater to sediment and surface water such that levels are acceptable in sediment and surface water for ecological exposure."

b. To provide additional transparency regarding the sources of the cleanup levels, the basis descriptions have been appended with subscripts indicating the sources of the selected cleanup levels. Due to the numerous additions, these changes are only shown in the updated Table 17 and are not enumerated separately in this memorandum. To explain the subscripts, the following abbreviations should be added:

   i. "A_{EA} - ARAR based value from ODEQ OAR 340-41-8033, Table 30: Aquatic Life Water Quality Criteria for Toxic Pollutants (effective August 4, 2015)"

   ii. "A_{EN} - ARAR based value from EPA National Recommended Water Quality Criteria – Aquatic Life Criteria Table (chronic)"

   iii. "A_{HA} - ARAR based value from ODEQ OAR 340-41-8033, Table 40: Human Health Water Quality Criteria for Toxic Pollutants (effective April 18, 2014). (chronic, organism+water)"

   iv. "A_{HN} - ARAR based value from EPA's National Recommended Water Quality Criteria (NRWQC) (organism+water)"

   v. "A_{HM} - ARAR based value from Maximum Contaminant Level (MCL) as listed in EPA Regional Screening Levels (RSLs)"

   vi. Abbreviation for "R" should be deleted and replaced by:

      1. "R_E - ecological risk-based number"

      2. "R_H – human health risk-based number"

c. Abbreviation for "MCL - maximum contaminant level" should be added.

d. Abbreviation for "RSL - regional screening level" should be added.

References for this memorandum are documented in the administrative record (i.e., Portland Harbor Feasibility Study, Portland Harbor Baseline Ecological Risk Assessment, and Portland Harbor Explanation of Significant Differences) and support the corrections for each of the items above.

Attachments

- ROD Table 17 with Redlined Revisions for Errata #2

References

- Portland Harbor Feasibility Study, dated June 2016 (related Tables)
  - Table 2.2-4 RAO 1 PRG Derivation
  - Table 2.2-5 RAO 2 PRG Derivation
  - Table 2.2-7 RAO 4 PRG Derivation
  - Table 2.2-10 RAO 7 PRG Derivation
  - Table 2.2-11 RAO 8 PRG Derivation

- Portland Harbor Explanation of Significant Differences Table 1. cPAH (BaPeq) CUL and Highly Toxic PTW Thresholds
- Portland Harbor Baseline Ecological Risk Assessment TRV Table 2 in Attachment 10

Table 17. Summary of Cleanup Levels or Targets by Media

	Surface Water (1)				Groundwater (2)				River Bank Soil/Sediment (3)				Fish/Shellfish Tissue (4)			
Contaminant	**Unit**	**Conc.**	**RAO**	**Basis**	**Unit**	**Conc.**	**RAO**	**Basis**	**Unit**	**Conc.**	**RAO**	**Basis**	**Unit**	**Conc.**	**RAO**	**Basis**
Aldrin	µg/L	~~0.00000077~~ 7.7E-07	RAO3	A_{HN}					µg/kg	2	RAO2	R_H	µg/kg	0.06	RAO2	R_H
Arsenic	µg/L	0.018	RAO3	A_{HN}	µg/L	0.018	RAO4	A_{HN}	mg/kg	3	RAO1	B	mg/kg	0.001	RAO2	R_H
Benzene					µg/L	0.44	RAO4	A_{HA}								
BEHP	µg/L	0.2	RAO3	A_{HA}					µg/kg	135	RAO6	R_E	µg/kg	72	RAO2	R_H
Cadmium					µg/L	~~0.091~~ 0.094	RAO8	A_{EA}/R_E(5)	mg/kg	0.51	RAO5	R_E				
Chlordanes	µg/L	0.000081	RAO3	A_{HA}					µg/kg	1.4	RAO5	R_E	µg/kg	3	RAO2	R_H
Chlorobenzene					µg/L	64	RAO8	R_E								
Chromium	µg/L	100	RAO3	A_{HM}	µg/L	11	RAO8	A_{EN}								
Copper	µg/L	2.74	RAO7	~~A~~ R_E	µg/L	2.74	RAO8	~~A/~~R_E	mg/kg	359	RAO5	R_E				
Cyanide					µg/L	4	RAO4	A_{HN}								
DDx	µg/L	0.01	RAO7	R_E	µg/L	0.001	RAO8	A_{EN}/R_E	µg/kg	6.1	RAO2	R_H	µg/kg	3	RAO2	R_H
DDD	µg/L	0.000031	RAO3	A_{HA}	µg/L	0.000031	RAO4	A_{HA}	µg/kg	114	RAO5	R_E				
DDE	µg/L	0.000018	RAO3	A_{HN}	µg/L	0.000018	RAO4	A_{HN}	µg/kg	~~226~~ 50	RAO5	R_E				
DDT	µg/L	0.000022	RAO3	A_{HA}	µg/L	0.000022	RAO4	A_{HA}	µg/kg	246	RAO5	R_E				
1,1-Dichloroethene					µg/L	7	RAO4	A_{HM}								
cis-1,2-Dichloroethene					µg/L	70	RAO4	A_{HM}								
Dieldrin									µg/kg	0.07	RAO2	R_H	µg/kg	0.06	RAO2	R_H
2,4-Dichlorophenoxyacetic acid					µg/L	70	RAO4	A_{HM}								
Ethylbenzene	µg/L	7.3	RAO7	R_E	µg/L	7.3	RAO8	R_E								
Hexachlorobenzene	µg/L	0.000029	RAO3	A_{HA}									µg/kg	0.6	RAO2	R_H
Lindane									µg/kg	5	RAO5	R_E				
Lead					µg/L	0.54	RAO8	A_{EA}/R_E	mg/kg	196	RAO5	R_E				
Manganese					µg/L	430	RAO4	R_H								
MCPP	µg/L	16	RAO3	R_H												
Mercury									mg/kg	0.085	RAO5	R_E	mg/kg	0.03	RAO2	~~A~~ R_H
Pentachlorophenol	µg/L	0.03	RAO3	A_{HN}	µg/L	0.03	RAO4	A_{HN}					µg/kg	2.5	RAO2	R_H
Perchlorate					µg/L	15	RAO4	A_{HM}								
PBDEs													µg/kg	1.28 ~~26~~	RAO2	R_H
PCBs	µg/L	~~0.0000064~~ 6.4E-6	RAO3	A_{HA}	µg/L	0.014	RAO8	A_{EN}/R_E	µg/kg	9	RAO2	B	µg/kg	0.25 (6)	RAO2	R_H
PAHs									µg/kg	23000	RAO5	R_E				
cPAHs (BaP eq)	µg/L	0.00012	RAO3	A_{HN}	µg/L	0.00012	RAO4	A_{HN}	µg/kg	774/85/1,076 (7)	RAO1	~~B~~ R_H	µg/kg	51.6 ~~7.1~~	RAO2	R_H
Acenaphthene					µg/L	23	RAO8	R_E								
Acenaphthylene																
Anthracene					µg/L	0.73	RAO8	R_E								
Benzo(a)anthracene	µg/L	0.0012	RAO3	A_{HN}	µg/L	0.0012	RAO4	A_{HN}								
Benzo(a)pyrene	µg/L	0.00012	RAO3	A_{HN}	µg/L	0.00012	RAO4	A_{HN}								
Benzo(b)fluoranthene	µg/L	0.0012	RAO3	A_{HN}	µg/L	0.0012	RAO4	A_{HN}								
Benzo(g,h,i)perylene					µg/L	0.4	RAO8	R_E								
Benzo(k)fluoranthene	µg/L	0.0013	RAO3	A_{HA}	µg/L	0.0013	RAO4	A_{HA}								
Chrysene	µg/L	0.0013	RAO3	A_{HA}	µg/L	0.0013	RAO4	A_{HA}								
Dibenz(a,h)anthracene	µg/L	0.00012	RAO3	A_{HN}	µg/L	0.00012	RAO4	A_{HN}								
Fluoranthene					µg/L	6.2	RAO8	R_E								
Fluorene					µg/L	3.9	RAO8	R_E								
Indeno(1,2,3-c,d)pyrene	µg/L	0.0012	RAO3	A_{HN}	µg/L	0.0012	RAO4	A_{HN}								
2-Methylnaphthalene					µg/L	2.1	RAO8	R_E								
Naphthalene	µg/L	12	RAO7	R_E	µg/L	12	RAO8	R_E								
Phenanthrene					µg/L	6.3	RAO8	R_E								
Pyrene					µg/L	10	RAO8	R_E								
Dioxins/Furans (2,3,7,8-TCDD eq)	µg/L	~~0.00000000051~~ 5.1E-10	RAO3	A_{HA}					µg/kg	0.01	RAO1	R_H (8)				
1,2,3,4,7,8-HxCDF									µg/kg	0.0004	RAO2	B	µg/kg	~~0.00008~~ 0.00006	RAO2	R_H
1,2,3,7,8-PeCDD									µg/kg	0.0002	RAO2	B	µg/kg	~~0.000008~~ 0.000006	RAO2	R_H
2,3,4,7,8-PeCDF									µg/kg	0.0003	RAO2	B	µg/kg	~~0.00003~~ 0.00002	RAO2	R_H
2,3,7,8-TCDF									µg/kg	0.00040658	RAO2	R_H	µg/kg	~~0.00008~~ 0.00006	RAO2	R_H
2,3,7,8-TCDD									µg/kg	0.0002	RAO2	B	µg/kg	~~0.000008~~ 0.000006	RAO2	R_H
Tetrachloroethene					µg/L	0.24	RAO4	A_{HA}								
Toluene					µg/L	9.8	RAO8	R_E								
TPH-Diesel									mg/kg	91	RAO5	R_E				
Aliphatic Hydrocarbons C10-C12					µg/L	2.6	RAO8	R_E								
Tributyltin	µg/L	0.063	RAO7	A_{EA}					µg/kg	3080	RAO5	R_E				
Trichloroethene					µg/L	0.6	RAO4	A_{HN}								
2,4,5-TP (Silvex)					µg/L	50	RAO4	A_{HM}								
Vanadium					µg/L	20	RAO8	R_E								
Vinyl Chloride					µg/L	0.022	RAO4	A_{HN}								
Xylenes					µg/L	13	RAO8	R_E								
Zinc	µg/L	36.5	RAO7	A_{EA}/R_E	µg/L	36.5	RAO8	A_{EA}/R_E	mg/kg	459	RAO5	R_E				

Notes:

(1) Surface Water Cleanup Levels - RAOs 3 and 7

(2) Groundwater Cleanup Levels - RAOs 4 and 8. Note: Groundwater cleanup levels are generally the ecological risk-based or human health risk-based concentration that protects the most sensitive receptor that are relevant and protective for receptor exposures to groundwater. An exception to this is if an ARAR (promulgated standard) for a contaminant is higher than a risk-based number, but the ARAR [such as maximum contaminant levels (MCLs)] is determined to be protective, then the less protective ARAR is selected as the cleanup level.

(3) Sediment Cleanup Levels - RAOs 1, 2, ~~and~~ 5, and 6. The lower of the PRG values for RAOs 1, 2 (sediment through Fish/Shellfish Consumption), 5, and 6 were selected as the cleanup level regardless of the exposure pathway.

(4) Fish/Shellfish Tissue Targets - RAOs 2 and 6. The lower of the PRG values for RAOs 2 and 6 were selected as the target regardless of the exposure pathway.

(5) A/R indicates that the ARARs-based number and the risk-based number are the same.

(6) The tissue target is a risk-based number and does not represent background levels. Additional data will be collected to determine background fish tissue concentrations for PCBs during design and construction of the Selected Remedy.

(7) The cleanup level for cPAHs of 774 µg/kg is based on direct contact with sediment and is applicable to nearshore sediment exclusive of recreational beaches and navigation channel sediments. The cleanup level applicable to recreational beach sediments is 85 µg/kg and the cleanup level applicable to the navigation channel sediment is 1,076 µg/kg and is based on human consumption of clams.

(8) The 2,3,7,8-TCDD eq cleanup level for river bank soil/sediment is based on RAO 1, which includes a dietary component (incidental ingestion) in addition to direct exposure. The river bank soil/sediment cleanup levels for the individual dioxin/furan congeners are based on RAO 2, which accounts for bioaccumulation from sediment through the food chain.

(9) This Table 17 identifies fish/shellfish tissue target levels and site-specific cleanup levels for each of the following media: sediment (including beaches), river bank soil, surface water, and groundwater. However, these cleanup levels represent the lowest PRG value identified across all identified site receptors for the indicated RAOs. Since exposure area averaging may impact the concentrations to which a receptor is potentially exposed, Chapter 8 and Table 16 of the ROD should be consulted in the development of remedial actions.

Table 17. Summary of Cleanup Levels or Targets by Media

Abbreviations:

2,4,5-TP (Silvex) - 2-(2,4,5-Trichlorophenoxy)propionic acid, also known as Silvex

A_{EA} - ARAR based value from ODEQ OAR 340-41-8033, Table 30: Aquatic Life Water Quality Criteria for Toxic Pollutants (effective August 4, 2015)

A_{EN} - ARAR based value from EPA National Recommended Water Quality Criteria (NRWQC) – Aquatic Life Criteria Table (chronic)

A_{HA} - ARAR based value from ODEQ OAR 340-41-8033, Table 40: Human Health Water Quality Criteria for Toxic Pollutants (effective April 18, 2014). (chronic, organism+water)

A_{HN} - ARAR based value from EPA's National Recommended Water Quality Criteria (NRWQC) (organism+water)

A_{HM} - ARAR based value from Maximum Contaminant Level (MCL) as listed in EPA Regional Screening Levels (RSLs)

ARAR - applicable or relevant and appropriate requirement

B - Background-based number

BEHP - bis(2-ethylhexyl)phthalate

BaP eq - benzo(a)pyrene equivalent

C - carbon

Conc - concentration

cPAH - carcinogenic polycyclic aromatic hydrocarbon

DDD - dichlorodiphenyldichloroethane

DDE - dichlorodiphenyldichloroethene

DDT - dichlorodiphenyltrichloroethane

DDx - DDD + DDE + DDT

HxCDF - hexachlorodibenzofuran

MCL - maximum contaminant level

MCPP - 2-(4-chloro-2-methylphenoxy)propanoic acid

mg/kg - milligram per kilogram

PAH - polycyclic aromatic hydrocarbon

PBDE - polybrominated diphenyl ether

PCB - polychlorinated biphenyl

PeCDD - pentachlorodibenzo-p-dioxin

PeCDF - pentachlorodibenzofuran

~~R - risk-based number~~

R_E - ecological risk-based number

R_H - human health risk-based number

RAO - remedial action objective

RAO1 - Reduce cancer and non-cancer risks to people from incidental ingestion of and dermal contact with COCs in sediment and beaches to exposure levels that are acceptable for fishing, occupational, recreational, and ceremonial uses.

RAO2 - Reduce cancer and non-cancer risks to acceptable exposure levels (direct and indirect) for human consumption of COCs in fish and shellfish.

RAO3 - Reduce cancer and noncancer risks to people from direct contact (ingestion, inhalation, and dermal contact) with COCs in surface water to exposure levels that are acceptable for fishing, occupational, recreational, and potential drinking water supply.

RAO4 - Reduce migration of COCs in groundwater to sediment and surface water such that levels are acceptable in sediment and surface water for human exposure.

RAO5 - Reduce risk to benthic organisms from ingestion of and direct contact with COCs in sediment to acceptable exposure levels.

RAO6 - Reduce risks to ecological receptors that consume COCs in prey to acceptable exposure levels.

RAO7 - Reduce risks to ecological receptors from ingestion of and direct contact with COCs in surface water to acceptable exposure levels.

RAO8 - Reduce migration of COCs in groundwater to sediment and surface water such that levels are acceptable in sediment and surface water for ecological exposure.

RSL - regional screening level

TCDD - tetrachlorodibenzo-p-dioxin

TCDF - tetrachlorodibenzofurans

TPH - total petroleum hydrocarbons

µg/kg - microgram per kilogram

µg/L - microgram per liter

ROD Table 21. Sediment RALs and PTW Thresholds for Selected Remedy - Updated for ESD

Contaminants	Site Wide RALs[1] (μg/kg)	PTW Thresholds [2] (μg/kg)	Navigation Channel RALs (μg/kg)
Focused COCs			
PCBs	75	200	1,000
Total PAHs	30,000	NA	170,000
2,3,7,8-TCDD	0.0006	0.01	0.002
1,2,3,7,8-PeCDD	0.0008	0.01	0.003
2,3,4,7,8-PeCDF	0.2	0.2	1
DDx	160	7,050	650
Additional Contaminants			
2,3,7,8-TCDF	NA	0.6	NA
1,2,3,4,7,8-HxCDF	NA	0.04	NA
cPAHs (BaP Eq)	NA	774,000	NA
Chlorobenzene	NA	>320	NA
Naphthalene	NA	>140,000	NA

Notes:
1 – Site wide includes all areas of the Site except the navigation channel. FMD areas are subject to these RALs.
2 – PTW thresholds are based on highly toxic PTW values (10^{-3} risk) except chlorobenzene and naphthalene, which are threshold values for not reliably contained PTW.

Abbreviations:
BaP Eq – benzo(a)pyrene equivalent
cPAH –carcinogenic polycyclic aromatic hydrocarbon
COC – Contaminant of concern
DDx – dichlorodiphenyldichloroethane + dichlorodiphenyldichloroethene + dichlorodiphenyltrichloroethane
FMD – future maintenance dredge
HxCDF - hexachlorodibenzofuran
NA – not applicable
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
PeCDD – pentachlorodibenzo-p-dioxin
PeCDF – pentachlorodibenzofuran
PTW – principal threat waste
RAL – remedial action level
TCDD – tetrachlorodibenzo-p-dioxin
TCDF – tetrachlorodibenzofuran
μg/kg – microgram per kilogram
> – greater than

ATTACHMENT B

Portland Harbor Feasibility Study Report (Tables 2.1-4 and 2.2-12) (EPA, 2016)

Table 2.1-4
Numeric Criteria Associated with Chemical-Specific ARARs
Portland Harbor Superfund Site
Portland, Oregon

		Surface Water								Surface Water and Groundwater
	Statute/Regulation:	**Clean Water Act, 33 U.S.C. 1313 and1314, Section 304(a) List**				**Oregon Water Pollution Control Act ORS 468B.048**				**Safe Drinking Water Act 42 U.S.C. 300f, 40 CFR Part 141, 143**
		Aquatic Life		**Human Health**		**Aquatic Life**		**Human Health**		**Human Health**
	Receptor:	**CMC (acute)**	**CCC (chronic)**	**Current (water + organism)**	**Current (organism only)**	**CMC (acute)**	**CCC (chronic)**	**Current (water + organism)**	**Current (organism only)**	**MCL**
	Consumption Rate:			**22 g/day**	**22 g/day**			**175 g/day**	**175 g/day**	
Contaminant	**CAS #**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Acenaphthene	83-32-9	NA	NA	70	90	NA	NA	95	99	NA
Acenaphthylene	208-96-8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	309-00-2	3.0[1]	NA	0.00000077[7]	0.00000077[7]	3[1]	NA	0.000005	0.000005	NA
Anthracene	120-12-7	NA	NA	300	400	NA	NA	NA	NA	NA
Arsenic	7440-38-2	340[2]	150[2]	0.018[7,8]	0.14[7,8]	340[7]	150[2]	2.1[8,12]	2.1[8,13]	10
Benzene	71-43-2	NA	NA	2.1[7]	58[7]	NA	NA	0.44	1.4	5
Benzo(a)anthracene	56-55-3	NA	NA	0.0012[7]	0.0013[7]	NA	NA	0.001	0.002	NA
Benzo(a)pyrene	50-32-8	NA	NA	0.00012[7]	0.00013[7]	NA	NA	0.001	0.002	0.2
Benzo(b)fluoranthene	205-99-2	NA	NA	0.0012[7]	0.0013[7]	NA	NA	0.001	0.002	NA
Benzo(g,h,i)perylene	191-24-2	NA	NA	NA	NA	NA	NA	0.001	0.002	NA
Benzo(k)fluoranthene	207-08-9	NA	NA	0.012[7]	0.013[7]	NA	NA	0.001	0.002	NA
Bis(2-ethylhexyl) phthalate (BEHP)	117-81-7	NA	NA	0.32[7]	0.37[7]	NA	NA	0.2	0.2	6
Cadmium	7440-43-9	0.52[2,3,14]	0.094[2,3,14]	2	NA	0.8[3,11]	0.9[2,3,11]	NA	NA	5
Chlordanes	57-74-9	2.4[1]	0.0043	0.00031[7]	0.00032[7]	2.4[1]	0.004	0.0001	0.0001	2
Chlorobenzene	108-90-7	NA	NA	100	800	NA	NA	74	160	100
Chromium	7440-47-3	NA	NA	100	NA	NA	NA	NA	NA	100
Chromium (III)	16065-83-1	183[2,3,14]	24[2,3,14]	NA	NA	183[2,3,11]	24[2,3,11]	NA	NA	NA
Chromium (VI)	18540-29-9	16[2]	11[2]	NA	NA	16[2]	11[2]	NA	NA	NA
Chrysene	218-01-9	NA	NA	0.12[7]	0.13[7]	NA	NA	0.001	0.002	NA
Copper	7440-50-8	5[2,3,14]	4[2,3,14]	1,300	NA	5[3,11]	4[3,11]	1,300	NA	1,300
Cyanide	57-12-5	22[4]	5.2[4]	4	400	22[4]	5.2[4]	130	130	200
DDx		1.1[1,6]	0.001[1,6]	NA	NA	1.1[1,6]	0.001[1,6]	NA	NA	NA
DDD (2,4´- and 4,4-DDD)	72-54-8	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4'-DDD	53-19-0	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDD	72-54-8	NA	NA	0.00012[7]	0.00012[7]	NA	NA	0.00003	0.00003	NA
DDE (2,4- and 4,4-DDE)	72-55-9	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	72-55-9	NA	NA	0.000018[7]	0.000018[7]	NA	NA	0.00002	0.00002	NA
DDT (2,4´- and 4,4´-DDT)	50-29-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	50-29-3	NA	NA	0.000030[7]	0.000030[7]	NA	NA	0.00002	0.00002	NA
Dibenz(a,h)anthracene	53-70-3	NA	NA	0.00012[7]	0.00013[7]	NA	NA	0.0013	0.0018	NA
1,1-Dichloroethene (1,1-DCE)	75-35-4	NA	NA	300	20,000	NA	NA	230	710	7

Table 2.1-4
Numeric Criteria Associated with Chemical-Specific ARARs
Portland Harbor Superfund Site
Portland, Oregon

		Surface Water								Surface Water and Groundwater
	Statute/Regulation:	Clean Water Act, 33 U.S.C. 1313 and1314, Section 304(a) List				Oregon Water Pollution Control Act ORS 468B.048				Safe Drinking Water Act 42 U.S.C. 300f, 40 CFR Part 141, 143
		Aquatic Life		Human Health		Aquatic Life		Human Health		Human Health
	Receptor:	CMC (acute)	CCC (chronic)	Current (water + organism)	Current (organism only)	CMC (acute)	CCC (chronic)	Current (water + organism)	Current (organism only)	MCL
	Consumption Rate:			22 g/day	22 g/day			175 g/day	175 g/day	
Contaminant	**CAS #**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
cis-1,2-Dichloroethene (cis-1,2-DCE)	107-06-2	NA	NA	9.9[7]	650[7]	NA	NA	NA	NA	70
Dieldrin	60-57-1	0.2	0.06	0.0000012[7]	0.0000012[7]	0.2	0.06	0.000005	0.000005	NA
2,4-Dichlorophenoxyacetic acid (2,4-D)	94-75-7	NA	NA	NA	NA	NA	NA	NA	NA	70
Ethylbenzene	100-41-4	NA	NA	68	130	NA	NA	160	210	700
Fluoranthene	206-44-0	NA	NA	20	20	NA	NA	14	14	NA
Fluorene	7782-41-4	NA	NA	50	70	NA	NA	390	530	NA
Hexachlorobenzene	118-74-1	NA	NA	0.000079[7]	0.000079[7]	NA	NA	0.00003	0.00003	1
gamma-Hexachlorocyclohexane (γ-BHC, or Lindane)	58-89-9	0.095	NA	4.2	4.4	1.0	0.08	0.17	0.18	0.2
1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-HxCDF)	70648-26-9	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-c,d)pyrene	193-39-5	NA	NA	0.0012[7]	0.0013[7]	NA	NA	0.001	0.002	NA
Lead	7439-92-1	14[2,3,14]	0.54[2,3,14]	NA	NA	14[2,3,11]	0.54[2,3,11]	NA	NA	15
Manganese	7439-96-5	NA	NA	NA[9]	100	NA	NA	NA	NA	NA
Methylchlorophenoxypropionic acid (MCPP)	7085-19-0	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	1.4[2]	0.77[2]	NA	NA	2.4	0.012	NA	NA	2
2-Methylnaphthalene	91-57-6	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	118-96-7	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-PeCDD)	40321-76-4	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,4,7,8-Pentachlorodibenzofuran (2,3,4,7,8-PeCDF)	57117-31-4	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	87-86-5	11[5]	8[5]	0.03[7]	0.04[7]	11[5]	8[5]	0.2	0.3	1.0
Perchlorate	14797-73-0	NA	NA	NA	NA	NA	NA	NA	NA	15
Phenanthrene	85-01-8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Polybrominated diphenyl ethers (PBDE)	67774-32-7	NA	NA	NA	NA	NA	NA	NA	NA	NA
Polychlorinated Biphenyls (PCBs)	1336-36-3	NA	0.014	0.000064[7]	0.000064[7]	2	0.014	0.000006	0.000006	0.5
Polycyclic Aromatic Hydrocarbons (PAHs)	130498-29-2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	129-00-0	NA	NA	20	30	NA	NA	290	400	NA
2,3,7,8-Tetrachlorodibenzofuran (2,3,7,8-TCDF)	51207-31-9	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	1746-01-6	NA	NA	0.000000005[7]	0.0000000051[7]	NA	NA	0.0000000005	0.0000000005	0.00003
Tetrachloroethene (PCE)	127-18-4	NA	NA	10[7]	29[7]	NA	NA	0.24	0.33	5
Toluene	108-88-3	NA	NA	57	520	NA	NA	720	1,500	1,000
Total Petroleum Hydrocarbons (TPH) C10-C12 Aliphatic		NA	NA	NA	NA	NA	NA	NA	NA	NA
Tributyltin (TBT)	688-73-3	0.5	0.07	NA	NA	0.46	0.063	NA	NA	NA
Trichloroethene (TCE)	79-01-6	NA	NA	0.6[7]	7[7]	NA	NA	1.4	3.0	5

Table 2.1-4
Numeric Criteria Associated with Chemical-Specific ARARs
Portland Harbor Superfund Site
Portland, Oregon

		Surface Water								Surface Water and Groundwater
	Statute/Regulation:	Clean Water Act, 33 U.S.C. 1313 and1314, Section 304(a) List				Oregon Water Pollution Control Act ORS 468B.048				Safe Drinking Water Act 42 U.S.C. 300f, 40 CFR Part 141, 143
		Aquatic Life		Human Health		Aquatic Life		Human Health		Human Health
	Receptor:	CMC (acute)	CCC (chronic)	Current (water + organism)	Current (organism only)	CMC (acute)	CCC (chronic)	Current (water + organism)	Current (organism only)	MCL
	Consumption Rate:			22 g/day	22 g/day			175 g/day	175 g/day	
Contaminant	**CAS #**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
2-(2,4,5-Trichlorophenoxy)propionic acid (2,4,5-TP)	93-72-1	NA	NA	100	400	NA	NA	NA	NA	50
Vanadium	7440-62-2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	75-01-04	NA	NA	0.022[7]	1.6[7]	NA	NA	0.02	0.2	2
Xylenes	1330-20-7	NA	NA	NA	NA	NA	NA	NA	NA	10,000
Zinc	7440-66-6	36[2,3,14]	36[2,3,14]	7,400	26,000	36[2,3,11]	35[2,3,11]	2,100	2,600	NA

Notes:
1 - If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.
2 - Expressed in terms of dissolved metal in the water column.
3 - Expressed as a function of hardness (mg/L) in the water column. The value given corresponds to a hardness of 25 mg/kg.
4 - Expressed as free cyanide.
5 - Expressed as a function of pH. Value corresponds to a pH of 7.2.
6 - This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).
7 - This criterion is based on carcinogenicity at a 10^{-6} risk.
8 - This criterion for arsenic refers to the inorganic form only.
9 - The National AWQC criterion for manganese is not based on toxic effects, but rather is intended to minimize objectionable qualities such as laundry stains and objectionable tastes in beverages. Thus, it is not an ARAR.
10 - EPA is not updating criteria for this chemical pollutant at this time; thus, the current criterion apply.
11 - Criteria are calculated using the following table:

Chemical	mA	bA	mC	bC
Cadmium	1.128	-3.828	0.7409	-4.719
Chromium (III)	0.819	3.7256	0.819	0.6848
Copper	0.9422	-1.464	0.8545	-1.465
Lead	1.273	-1.460	1.273	-4.705
Pentachlorophenol				
Zinc	0.8473	0.884	0.8473	0.884

12 - This criterion is based on carcinogenicity of 10^{-4} risk.
13 - This criterion is based on carcinogenicity of 10^{-5} risk.
14 - Criteria are calculated using the following table:

Chemical	mA	bA	mC	bC
Cadmium	1.0166	-3.924	0.7409	-4.719
Chromium (III)	0.819	3.7256	0.819	0.6848
Copper	0.9422	-1.700	0.8545	-1.702
Lead	1.273	-1.46	1.273	-4.705
Zinc	0.8473	0.884	0.8473	0.884

Table 2.2-12
RAO 9 PRG Derivation
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	RAO 9 Reduce migration of COCs in riverbanks to sediment and surface water such that levels are acceptable in sediment and surface water for human health and ecological exposures.							
	Sediment							
	Units	RAO 1 Beach PRG	RAO 1 Sediment PRG	RAO 2 Sediment PRG	RAO 5 Sediment PRG	RAO 6 Sediment PRG	Background	PRG
Aldrin	µg/kg			2				2
Arsenic	mg/kg	3	3				3	3
BEHP	µg/kg					135	62	135
Cadmium	mg/kg				0.5		0.1	0.5
Chlordanes	µg/kg			1.5	1.4		0.5	1.4
Copper	mg/kg				359		26	359
DDD	µg/kg				114		1.2	114
DDE	µg/kg				359	226	1.7	226
DDT	µg/kg				246			246
DDx	µg/kg			6.1	578	760	3.1	6.1
Dieldrin	µg/kg			0.07	22			0.07
Hexachlorobenzene	µg/kg						0.3	0.3
Lindane	µg/kg				5			5
Lead	mg/kg				196		7.7	196
Mercury	mg/kg				0.09		0.03	0.09
PCBs	µg/kg		370	9	500	36	9	9
PAHs	µg/kg				23,000		113	23,000
cPAHs (BaP Eq)	µg/kg	12	106	3,950			12	12
1,2,3,4,7,8-HxCDF	µg/kg			0.0004		0.03	0.0004	0.0004
1,2,3,7,8-PeCDD	µg/kg			0.0002		0.001	0.0002	0.0002
2,3,4,7,8-PeCDF	µg/kg			0.0003		0.004	0.0003	0.0003
2,3,7,8-TCDD	µg/kg		0.01	0.0002		0.0008	0.0002	0.0002
2,3,7,8-TCDF	µg/kg			0.0004		0.004	0.0003	0.0004
TBT	µg/kg				3080			3,080
Zinc	mg/kg				459		77	459

Notes:
NA - Not applicable

ATTACHMENT C

Institutional Control Data Structure Diagram
(Institutional Control Data Standard Appendix A)
(EPA, 2006)

Appendix A
Institutional Control Data Structure Diagram