SAMPLING PLAN:

FIELD COLLECTION OF SEDIMENTS FOR PACIFIC LAMPREY TOXICITY STUDY

PREPARED BY STRATUS CONSULTING

FOR THE

PORTLAND HARBOR

NATURAL RESOURCE TRUSTEE COUNCIL

January 28, 2011

Sampling Plan:
Field Collection of Sediments for
Pacific Lamprey Toxicity Study

Prepared for:

Portland Harbor Natural Resource Trustee Council

Confederated Tribes of the Warm Springs Reservation of Oregon
Nez Perce Tribe
Confederated Tribes of Siletz Indians
Confederated Tribes of the Umatilla Indian Reservation
Confederated Tribes of the Grand Ronde Community of Oregon
National Oceanic and Atmospheric Administration
Oregon Department of Fish and Wildlife
U.S. Department of the Interior

Prepared by:

Stratus Consulting Inc.
PO Box 4059
Boulder, CO 80306-4059
303-381-8000

Contacts:

Jeff Morris
Jennifer Peers
Joshua Lipton

January 28, 2011
SC12120

Contents

1. Introduction

This Sampling Plan[1] describes objectives and procedures for the collection of sediments from the Willamette River, near Portland, Oregon. This collection is being conducted by the Portland Harbor Natural Resource Trustee Council (the Trustee Council) as part of a study of the potential toxicity of sediments in the Portland Harbor Study Area (PHSA) to Pacific lamprey ammocoetes (*Lampetra tridentata*; hereafter designated as PLA). This plan only addresses the collection of sediments. The collection of PLAs is addressed in the *Sampling Plan: Field Collection of Ammocoetes for Pacific Lamprey Toxicity Study* (Stratus Consulting, 2011b) and the analytical methods for toxicity testing are addressed in the *Portland Harbor Pacific Lamprey Ammocoete Study: Laboratory Testing Plan* (Stratus Consulting, 2011a).

1.1 Background

Contaminants such as chlorinated hydrocarbons, petroleum-related compounds, metals, and other hazardous substances have been released from various sources and have come to be located in Portland Harbor (the Harbor) sediments. Many of these compounds are elevated in the Harbor compared to upstream locations. Sediments from specific areas in the Harbor have demonstrated toxicity to benthic invertebrates, and sediment-associated biota and fish collected from the area have accumulated contaminants (Windward Environmental, 2009). Habitat in the Harbor may be an important resting and foraging area for PLAs as they transition to the lower Columbia River and prepare for their marine life stage. PLAs collected from the Harbor have been found to contain higher concentrations of some organochlorine compounds than PLAs collected upstream (Integral Consulting and Windward Environmental, 2007).

The Trustee Council is evaluating potential natural resource injuries to PLAs. Insufficient information is available to determine if contaminant exposures to PLAs exceed concentrations which could cause injuries to or prevent colonization of the Harbor by PLAs. In addition, restoration efforts for PLAs could be more successful if sediment toxicity to the species were better understood.

The toxicity of contaminated sediments collected from within the PHSA to PLAs will be evaluated through multiple laboratory experiments. PLAs collected from the Siletz River will be used to test PLA sensitivity to contaminated PHSA sediments by exposing PLAs to sediment collected from PHSA and to reference and (or) control sediments.

1. A previous version of this plan, dated July 22, 2010, was used in the field. This revised version has been edited to clarify references to other project documents.

The testing facility for this study will be the Fish Performance and Genetics Laboratory (FPGL), 34349 Electric Road North, Corvallis, OR 97331. FPGL is operated by the Oregon State University (OSU) Department of Fisheries and Wildlife – U.S. Geological Survey Cooperative Fish and Wildlife Research Unit.

1.2 Objective

The purpose of the activity described in this sampling plan is to collect surface sediments (defined as the upper 10 centimeters) for use in PLA toxicity evaluations to be conducted in the summer of 2010.

1.3 Document Organization

The approach to sampling is presented in Section 2 of this plan. Section 3 of this plan addresses project organization. Sample collection methods and quality assurance procedures are provided in Section 4. A Health and Safety Plan (HSP) covering sediment collection is provided in Appendix A. An equipment and supply list is provided in Appendix B. Detailed maps and coordinates for sampling locations are presented in Appendix C.

2. Sampling Approach

This section describes the sediment sampling design and sampling locations. To meet the objective described in Section 1.2, we used a combination of judgmental and probability-based sampling designs. Judgmental sampling involves the selection of sampling units on the basis of expert knowledge or professional judgment. Probability-based sampling designs apply sampling theory and random selection of sampling units to increase the representativeness of subsampling (U.S. EPA, 2002). First, we selected sample sites within Portland Harbor where multiple samples have been found to contain elevated concentrations of contaminants (see Section 2.1). Second, we identified randomized locations within each sample site from which to collect a representative composite sample (see Section 2.2).

2.1 Proposed Sample Site Selection

Contaminated sediments will be collected from up to 10 Portland Harbor locations (Figure 1; Table 1). These locations were selected by reviewing maps of contaminant concentrations (NOAA, 2010) in surface sediments and selecting locations where multiple samples have been

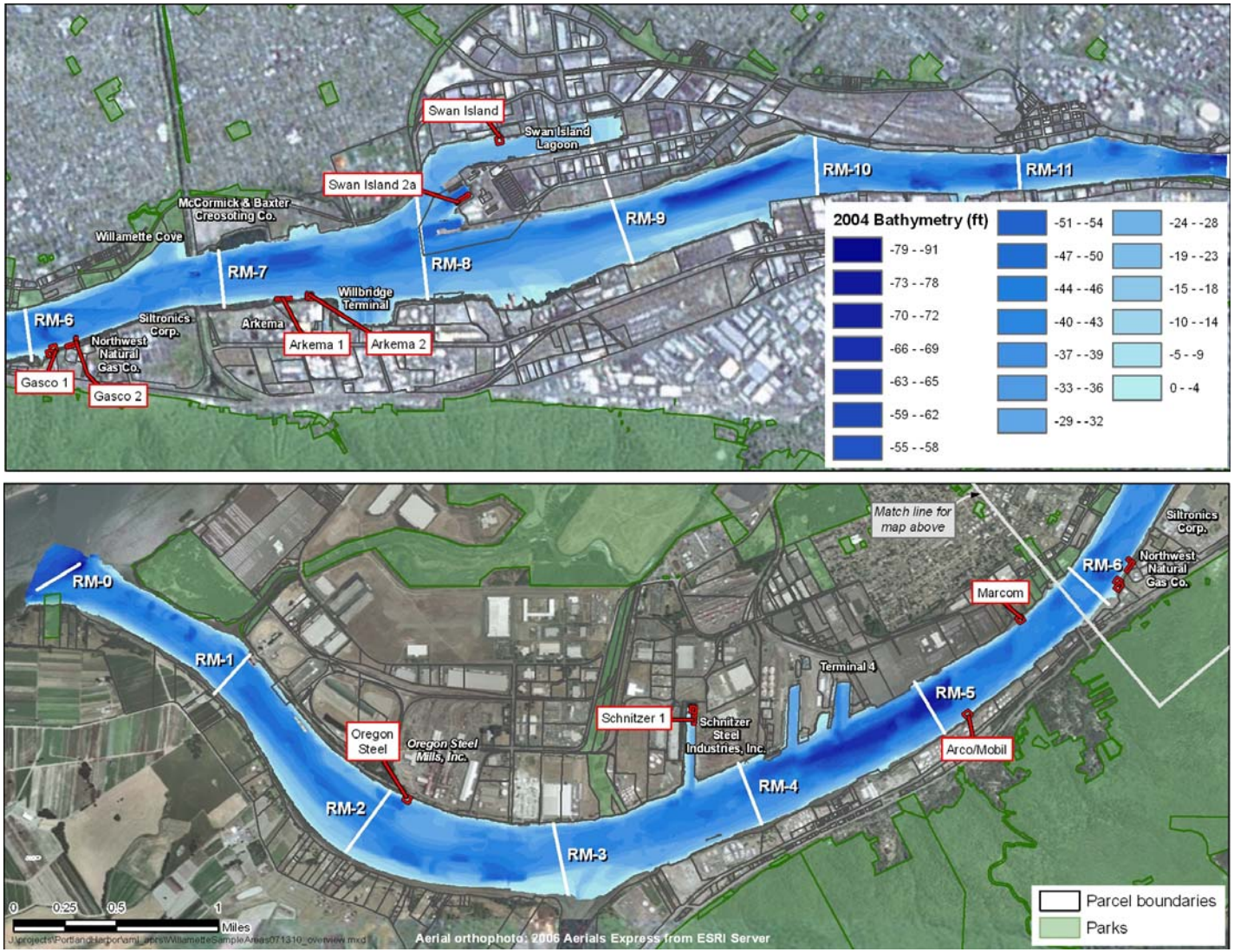


Figure 1. Proposed sediment sampling locations (boxes outlined in red) in Portland Harbor.

Table 1. Proposed sediment sampling locations

Sampling Site ID	Name	Approximate river mile	Primary contaminants of interest
OST	Oregon Steel	2.1	PCBs, zinc, copper
SC1/SCA	Schnitzer 1/Schnitzer 1 (alternate)	3.7	PCBs, phthalates, PAHs, zinc, copper
ARM	Arco/Mobil	5.1	PAHs, TPH (diesel)
MAR	Marcom	5.6	Tributyl tin, zinc, copper, PAHs
GA1/GAA	Gasco 1/Gasco 1 (alternate)	6.1	Cyanide, PAHs, DDx
GA2	Gasco 2	6.2	PAHs, DDx
AR1	Arkema 1	7.3	DDx, dioxins/furans, chlordane
AR2	Arkema 2	7.4	Perchlorate, DDx
S2A	Swan Island 2a	8.2	Tributyl tin, zinc
SWI	Swan Island	8.5	Copper, zinc, PAHs
RE1	Reference Site 1	19.1	None
RE2	Reference Site 2	23.2	None

found to contain elevated concentrations of one or more of the following contaminants: polychlorinated biphenyls (PCBs); dichlorodiphenyltrichloroethane (DDT) and its metabolites dichlorodiphenyldichloroethylene (DDE) and dichlorodiphenyldichloroethane (DDD; collectively referred to as DDx); polychlorinated furans (specifically, 2,3,4,7,8-pentachlorodibenzofuran); polycyclic aromatic hydrocarbons (PAHs); total petroleum hydrocarbons (TPH); tributyl-tin (TBT); perchlorate; zinc; copper; and cyanide.

Reference sediments will be collected from two locations in the Willamette River upstream of Portland Harbor (Figure 2). These locations were selected from preferred reference locations determined during Phase II of the Lower Willamette River Reference Area Study, conducted for the U.S. Army Corps of Engineers (USACE; Fuji and Clough, 2002). Reference Site 1 is located approximately at site HC-8 identified by Fuji and Clough (2002) and was characterized as having fine-grained sediments. Reference Site 2 is located approximately at site CD-3 identified by Fuji and Clough (2002) and was also characterized as having fine-grained sediments. Both locations were determined to be suitable reference areas for Tier III biological testing under USACE's Regional Dredged Material Evaluation Framework (USACE et al., 1998), based on bioassay results and chemical and physical analyses.

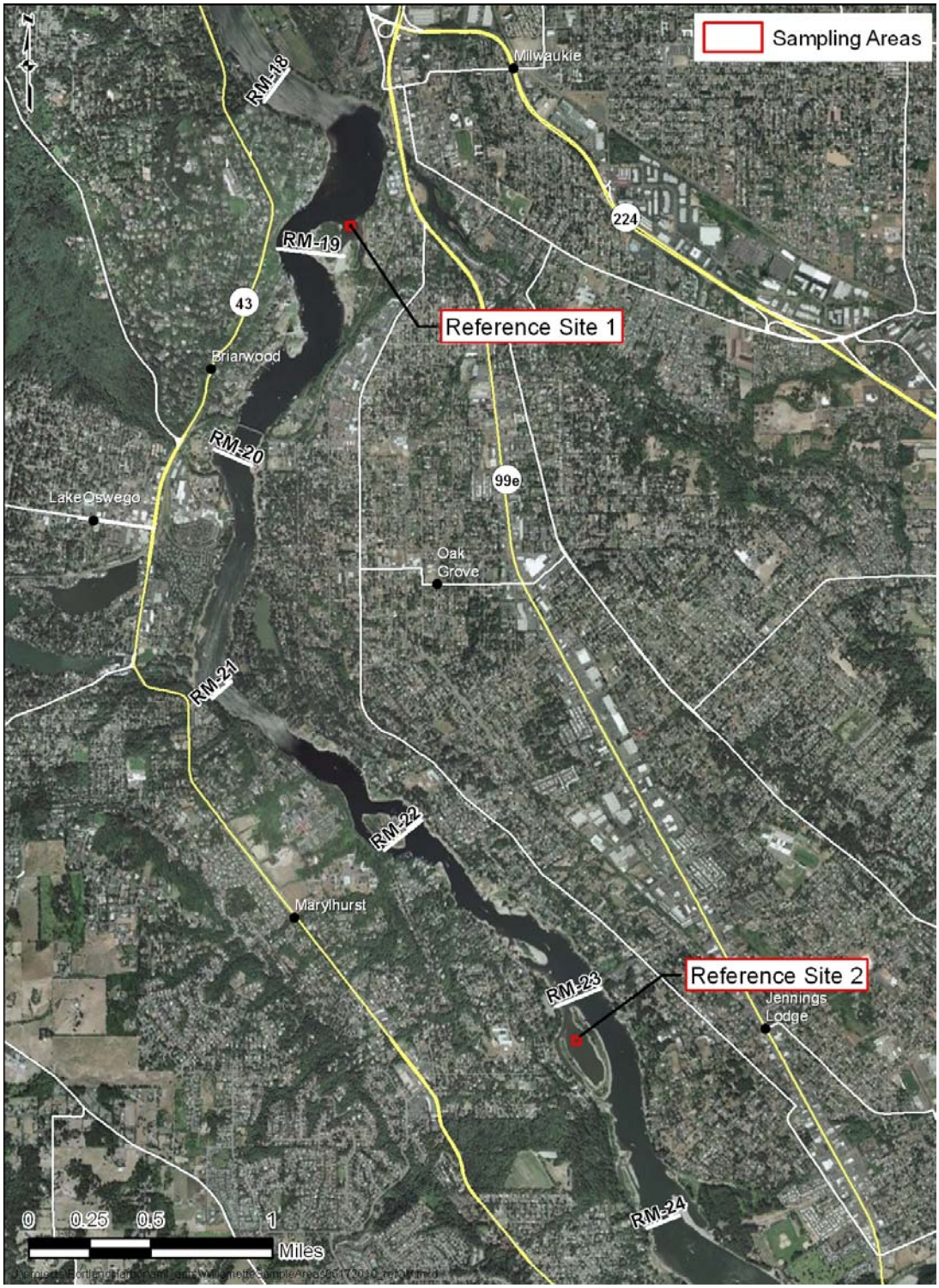


Figure 2. Proposed reference sediment sampling locations in the Willamette River upstream of Portland Harbor.

Each designated sampling site for the collection described in this plan comprises a 2,500 square meter area. Where possible, a 50 meter by 50 meter square was used to define the site. If the location of docks or other obstructions precluded the use of a square area, a rectangular area with the same area was selected. For two sampling areas (Gasco 1 and Schnitzer 1), a primary sampling site and an alternate sampling site were delineated, because of the possible presence of obstructions that could limit the site's accessibility. The alternate sampling site will only be used if the primary sampling site is inaccessible.

2.2 Sample Collection

Sediment will be subsampled from five individual sample dredging locations within each 2,500 square meter sampling site. Ten dredge locations within each sample site were randomly selected from a 2-meter grid overlaid on each sample site area. The first five dredge locations are the primary sample collection areas for the sampling site. The additional five dredge locations were preselected as alternate locations to be used if the primary dredge locations are inaccessible or sediment cannot be obtained. Appendix C contains detailed maps of these sampling sites with dredge locations identified. Tables of the dredge location coordinates are also presented in Appendix C.

3. Project Organization

This section presents the organizational structure for the collection of sediments.

3.1 Team Organization and Responsibilities

Stratus Consulting will coordinate the overall field effort, provide on-water navigation support, and be responsible for handling of sediment in the field as well as transport to the laboratory (FPGL). Jeff Morris will serve as the Field Study Coordinator.

Marine Sampling Services (MSS) will provide and operate the sample collection boat and power grab sampler. The U.S. Fish and Wildlife Service (USFWS) will provide and operate a second boat to assist in transport of personnel and samples as needed.

Additional personnel for this sampling effort will be provided by the National Oceanic and Atmospheric Administration, USFWS, and the Oregon Department of Environmental Quality.

3.2 Project Schedule

The anticipated dates for this sample collection are from Monday, July 26 to Friday, July 30. However, the sampling may extend into the weekend of July 31/August 1, if necessary, to collect all samples. Other factors that may affect the sampling schedule are weather, river conditions, and availability of personnel and equipment.

4. Sample Collection Procedures

This section describes the methods that will be used in the collection of sediment.

4.1 Sampling Vessels

MSS will provide the sampling vessel for the sediment collection effort. The Research Vessel (R/V) *Peter R* is a flat-deck, 26-foot catamaran, equipped with a hydraulically operated winch and a power grab sampler. The *Peter R* has a maximum draft of approximately 18 inches.

A smaller USFWS boat will be used during the sampling effort to transport supplies, samples, and personnel to and from the sampling vessel.

4.2 Sediment Collection

Composite sediment samples from five dredge locations within each sampling site will be collected using a power grab sampler. Samples will be collected from the pre-randomized locations within each sampling site (see Appendix C for maps and coordinates). Coordinates of the dredge locations will be entered into the global positioning system (GPS) device before sampling begins. The boat will proceed to the first dredge location and will drop the dredge in the vicinity of this location (within a radius of 5 meters, if possible). The actual coordinates of the dredge drop location will be recorded in the logbook. If the boat is unable to access this location, or an intact sample cannot be collected at the location after two attempts, the boat will proceed to the next dredge location in the list and collect a sample there. An intact sample is one that (1) contains sediment, (2) is not dominated by gravel or rock, and (3) meets the minimum depth requirement of 15 centimeters throughout the power grab dredge. This procedure will be followed until five dredges are successfully recovered.

The power grab sampler will be attached to a hydraulic winch. The sampler will be raised and lowered at a rate of 20 meters per minute or less to ensure that the sampler does not flip over during descent and that the sediment is not disturbed when being retrieved. After the sampler is

out of the water, it will be brought on board and placed on a stand or on the boat's surface. Access doors on the top of the sampler will be opened and the sample will be inspected for acceptability. An acceptable sample is one that appears intact visually, and has a minimum penetration of 15 centimeters.

Approximately 2 gallons of sediment will be collected from each of five dredge locations for a total of 10 gallons of sediment from each sampling site. Sediment from the top 15 centimeters of the dredge sample will be collected using a stainless steel scoop using the following procedure:

1. Visually divide the surface of the power dredge into four quadrants (see Figure 3)
2. Collect one scoop from the top 10 centimeters of sediment from each quadrant
3. Place scoop in 5-gallon bucket labeled according to the procedures in Section 4.7
4. Repeat steps two and three from undisturbed locations in each quadrant until the total amount of sediment is collected.

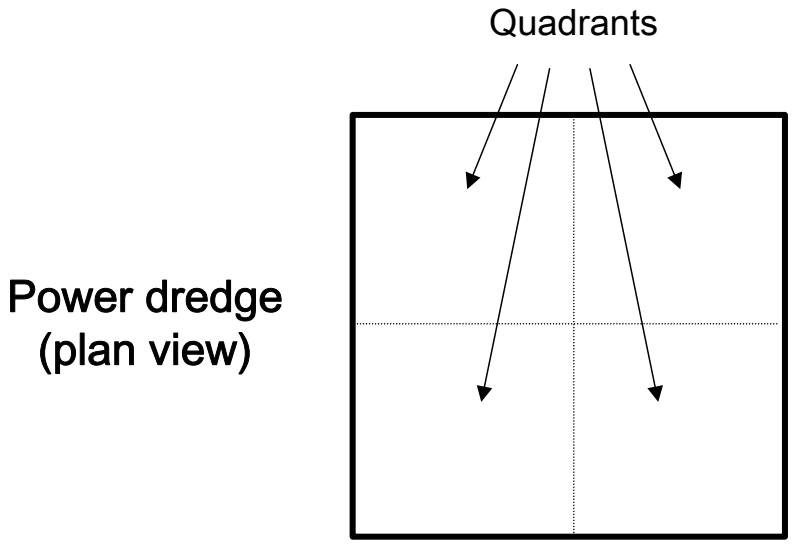


Figure 3. Schematic of power dredge quadrants.

Sediments remaining in the power dredge after 2 gallons have been removed will be returned to the sampling location by lowering the dredge back into the water until it rests on the surface sediment. At this time, the dredge will be opened and raised, so that the remaining sediment is deposited back onto the bottom of the river. This procedure will minimize resuspension of potentially contaminated sediments.

When a total of two 5-gallon buckets (10 gallons) are filled with sediment from the sampling site, they will be sealed with lids. At this time, the power dredge will be decontaminated (see Section 4.6) and the boat will move to the next sampling site.

4.3 Geographic Positioning Systems

Latitude and longitude positions will be obtained using a handheld GPS. Positions will be recorded in the Universal Transverse Mercator (UTM) Zone 10 coordinate system, in the North American Datum of 1983 (NAD 83). Positions of dredge locations will be recorded when the dredge is successfully deployed and before it is raised. If a dredge sample is not intact (defined in Section 4.2) after it is brought up to the boat, this fact will be noted in the field logbook or form next to the coordinates, and the collectors will move to the next location following the procedures in Section 4.2.

4.4 Collection Documentation

The field sampling team will document its sampling activities in a bound, waterproof field notebook. Notebooks will be maintained as follows:

- Entries will be made in indelible, dark waterproof ink.
- Entries will be made while activities are in progress or as soon afterward as practical.
- Entries for each sampling site will be made on a new, blank page.
- The individual recording the information will initial and date each page of the notebook. If more than one individual makes entries, each must initial and date the page.
- Corrections will be made with a single line through the correction, so that the original text is legible, with the corrector's initials.
- This notebook will remain in the possession of the Field Study Coordinator (or other responsible individual if the Field Study Coordinator is not onsite), or in a secure location at all times.
- At the conclusion of field work, original files and documents will be stored at Stratus Consulting Inc., 1881 9th Street, Suite 201, Boulder, CO 80302.

The following types of information are anticipated to be included in the field notebook:

- Daily:
  - Names of all field personnel
  - Record of health and safety meetings and updates
  - Record of photographs taken, including photograph number, date, time, orientation, and a description of the subject (on a separate page)
- At each sampling site:
  - Sampling site name
  - The date and time (based on a 24-hour clock) of the initiation of sampling
  - Weather conditions and other observations (if relevant)
  - The coordinates and time of each dredge drop
  - Any deviations from this sampling plan.

4.5 Equipment and Supplies

Equipment and supplies will include all equipment necessary for collection and transport of sediment, decontamination, logbooks and forms, safety equipment, and personal gear. A list of equipment and supplies is provided in Appendix B.

4.6 Decontamination Procedures

Sediment handling equipment that comes into direct contact with sediment samples, such as scoops and buckets, will be decontaminated prior to use at each sampling site. As sediment will be composited from the individual dredge locations within a sampling site, equipment does not need to be decontaminated between dredge drops at the same sampling site. Before being used to decontaminate equipment, brushes and wash containers will be rinsed with distilled water. Clean nitrile gloves will be worn to decontaminate equipment and will be discarded before samples are collected from the next sampling site.

The following procedure will be used to decontaminate buckets and sampling equipment prior to use:

1. Wash with Alconox™ or other phosphate-free detergent and a brush
2. Rinse with distilled water.

The following procedure will be used to decontaminate sampling equipment (e.g., scoops) after each site has been sampled:

1. Rinse with site water
2. Wash with Alconox™ or other phosphate-free detergent and a brush
3. Rinse with site water
4. Rinse with distilled water.

The following procedure will be used to decontaminate the power dredge after each site has been sampled:

1. Rinse with site water
2. Wash with Alconox™ or other phosphate-free detergent and a brush
3. Rinse with site water.

Rinse waters will be diluted with site water and discarded into the river.

4.7 Labeling

Buckets containing sediment will be labeled with the following information: date, time, three-digit sampling site ID, collector name, bucket number, and total number of buckets collected from this sampling site (e.g., bucket 1 of 2).

4.8 Holding and Transportation

4.8.1 Storage

Collected sediments will be stored and transported in covered 5-gallon plastic buckets. These buckets will be kept in a cool location out of direct sunlight during storage prior to and after transportation to FPGL.

4.8.2 Chain of custody

Samples are to remain in the custody of the Field Study Coordinator, or a representative of the USFWS, until they are delivered to FPGL. Samples will be stored each night in a secure area at the USFWS – Oregon Office in Portland (2600 SE 98th Avenue). Custody means that they are in the custodian's view, stored in a secure place, or placed in a container with custody seals. A chain of custody form will be completed and signed by each person who has custody of the samples.

References

Fuji, T. and H.F. Clough. 2002. Lower Willamette River Reference Area Study. U.S. Army Corps of Engineers, Portland, Oregon. Volume I. Report # 7402-01. Prepared by Hart Crowser Inc. for U.S. Army Corps of Engineers. April 9.

Integral Consulting and Windward Environmental. 2007. Portland Harbor RI/FS Round 3 Sampling for Lamprey (*Lampetra* sp.) Tissue Data Report. Draft. Prepared for the Lower Willamette Group by Integral Consulting Inc. and Windward Environmental LLC. August 24.

NOAA. 2010. Query Manager Database. Portland Harbor/Willamette River Oregon. Available: http://response.restoration.noaa.gov/topic_subtopic_entry.php?RECORD_KEY%28entry_subtopic_topic%29 = entry_id,subtopic_id,topic_id&entry_id(entry_subtopic_topic) = 376&subtopic_id(entry_subtopic_topic) = 5&topic_id(entry_subtopic_topic) = 2. Last updated 4/22/2010.

Stratus Consulting. 2011a. *Portland Harbor Pacific Lamprey Ammocoete Study: Laboratory Testing Plan*. Prepared for the Portland Harbor Natural Resource Trustee Council. Stratus Consulting Inc., Boulder, CO. January 28.

Stratus Consulting. 2011b. *Sampling Plan: Field Collection of Ammocoetes for Pacific Lamprey Toxicity Study.* Prepared for the Portland Harbor Natural Resource Trustee Council. Stratus Consulting Inc., Boulder, CO. January 28.

USACE, EPA, ODEQ, WA Department of Ecology, and WDNR. 1998. Dredged Material Evaluation Framework: Lower Columbia River Management Area. Prepared by U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Oregon Department of Environmental Quality, Washington Department of Ecology, and Washington Department of Natural Resources. November. As cited in Fuji and Clough, 2002.

U.S. EPA. 2002. *Guidance on Choosing a Sampling Design for Environmental Data Collection.* EPA QA/G-5S, Final. U.S. Environmental Protection Agency, Office of Environmental Information, Washington, DC. December.

Windward Environmental. 2009. Portland Harbor Remedial Investigation Appendix G. Baseline Ecological Risk Assessment. Draft under review by U.S. EPA. Prepared for the Lower Willamette Group by Windward Environmental LLC.

A. Health and Safety Plan

Project title: Pacific Lamprey Ammocoete Study, Sediment Collection

Site name: Willamette River

Dates of proposed activities: July/August 2010

Objectives

- Collect sediment for laboratory toxicity testing from up to 10 sites in Portland Harbor and two upstream Willamette River sediment collection sites.

Prime contractor: Stratus Consulting Inc.
Stratus Consulting Assessment Manager: David Allen (906-225-9102)
Stratus Consulting Project Manager: Jennifer Peers (303-381-8000)
Stratus Consulting Field Study Coordinator, Field Team Manager, and Site Safety Coordinator (SSC): Jeff Morris (303-381-8000; 303-910-2897 cell)

Client: Portland Harbor Natural Resource Trustee Council

Task description

- Collect 10 gallons of surface sediment from each sampling location using a power dredge deployed from a boat and a sub-sampling scoop.

Level of protection (personal protection equipment, PPE)

- Level D
    - Coveralls (as needed)
    - Rubber boots (as needed)
    - Rubber gloves (as needed)
    - Safety glasses or goggles

Hazards of concern and mitigating actions:

- Drowning
  - **Mitigating action**: Wear personal floatation device at all times when on the boat or near the water's edge. Maintain three points of contact while the boat is in motion.
  - The following requirements apply to personnel working on boats to collect river water and sediment samples:
    - Only experienced staff should operate the boat
    - U.S. Coast Guard boating safety guidelines or equivalent should be adhered to when operating a boat during sampling activities
    - All staff must wear personnel flotation devices when aboard the boat
    - The boat must be equipped with the required running lights for nighttime and poor visibility conditions
    - The boat must be equipped with a safety line and life preservers
    - The boat must be equipped with an anchor and alternative means of locomotion (e.g., extra motor, floatable oars)
    - The boat must be equipped with suitable signaling devices, such as an air horn and signal light
    - Weather and water conditions must be monitored (e.g., marine weather radio forecasts for storm, wave, current conditions, and watercraft warnings) to determine if it is safe to be out on a water body.
- Contact with contaminated water or sediments when collecting environmental samples
  - **Mitigating action**: Contaminants suspected or known to exist at the site include a wide suite of metals and organic constituents, including semi-volatile and volatile organic compounds, PCBs, pesticides, cyanide, and various metals. Protect yourself (skin, eyes) from exposure to contaminated water and sediment by wearing adequate protective clothing. Avoid unnecessary exposure by not eating, drinking, or smoking at a site or after leaving the site without taking proper sanitary precautions.
- Cold stress
  - **Mitigating action**: Protect exposed skin surfaces with appropriate clothing (such as face masks, gloves, and footwear) that insulates, stays dry, and blocks wind. Use adequate insulating clothing to maintain a body core temperature above

36°C. Have extra insulating clothing onsite. If wind is an issue, shield the work area with windbreaks to reduce the cooling effects of wind.

- Heat stress/sun exposure
  - **Mitigating action**: Have appropriate fluids readily available onsite and drink often. Wear a hat and clothing that breathe well and protect the head and body from sun exposure. Apply sunscreen with an appropriate protection factor early in the day before sun exposure occurs, and reapply as necessary.
- Automobile traffic in parking lots and near roadways
  - **Mitigating action**: Clearly delineate any sample locations that are located in traffic areas using appropriate items (e.g., barricades, traffic cones, delineators). Wear high visibility clothing such as safety vests when working near traffic.
- Chemical products stored and used onsite include, but may not be limited to Alconox™ detergent
  - **Mitigating action**: Refer to the material safety datasheet (MSDS) for each chemical product. Rubber gloves and safety glasses should be worn at all times when working with hazardous or unknown chemical products.
- Slip, trip, and fall hazards may be present in all areas of the site
  - **Mitigating action**: Keep all walkways clear of obstructions. Survey the area for any of these hazards upon entering an area. Clean up liquid spills immediately. Avoid clutter at sample locations and work areas.

Site personnel and responsibilities

All Stratus Consulting personnel will be responsible for familiarizing themselves with, and following, all procedures and guidelines described in this HSP.

Jeff Morris, the SSC, will be present as a member of the field sampling team. He will be responsible for ensuring that all field personnel adhere to the project HSP and that the appropriate PPE be utilized and available to all field personnel. The SSC will also conduct a health and safety meeting for all field personnel prior to initiation of field activities.

Medical emergency

Portland Harbor

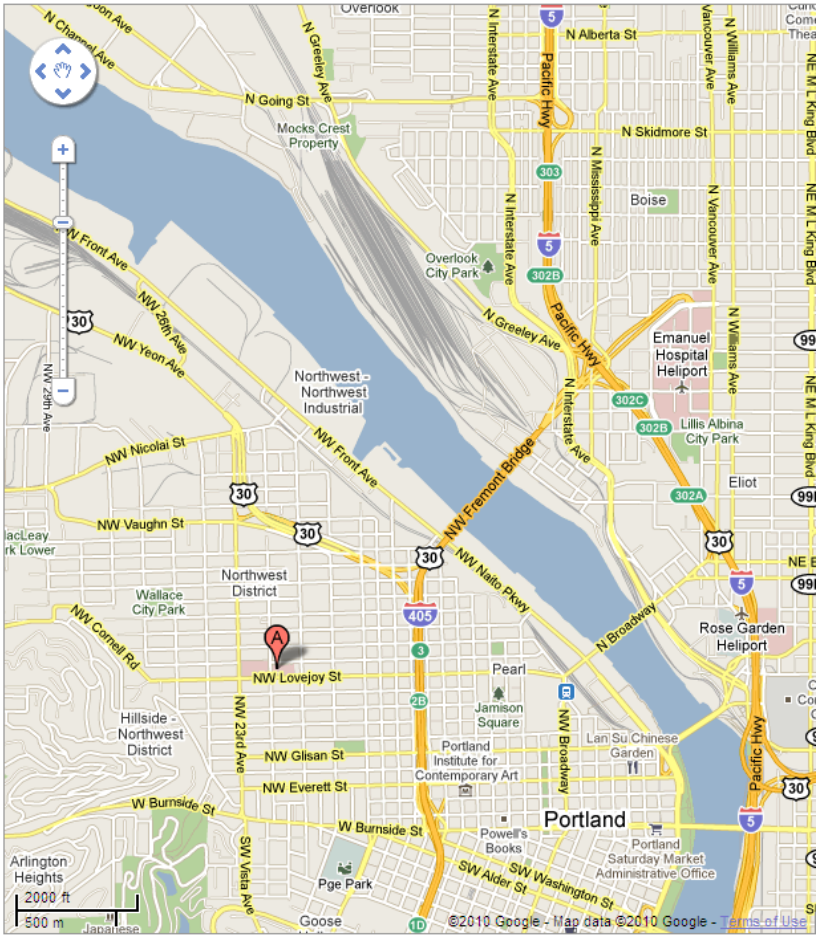
Alternative 1:

Hospital name/address: Legacy Good Samaritan Hospital & Medical Center
1015 NW 22nd Ave.
Portland, OR 97210

Hospital telephone number: 503-413-7711

Ambulance/police/fire emergency: 911

Map:



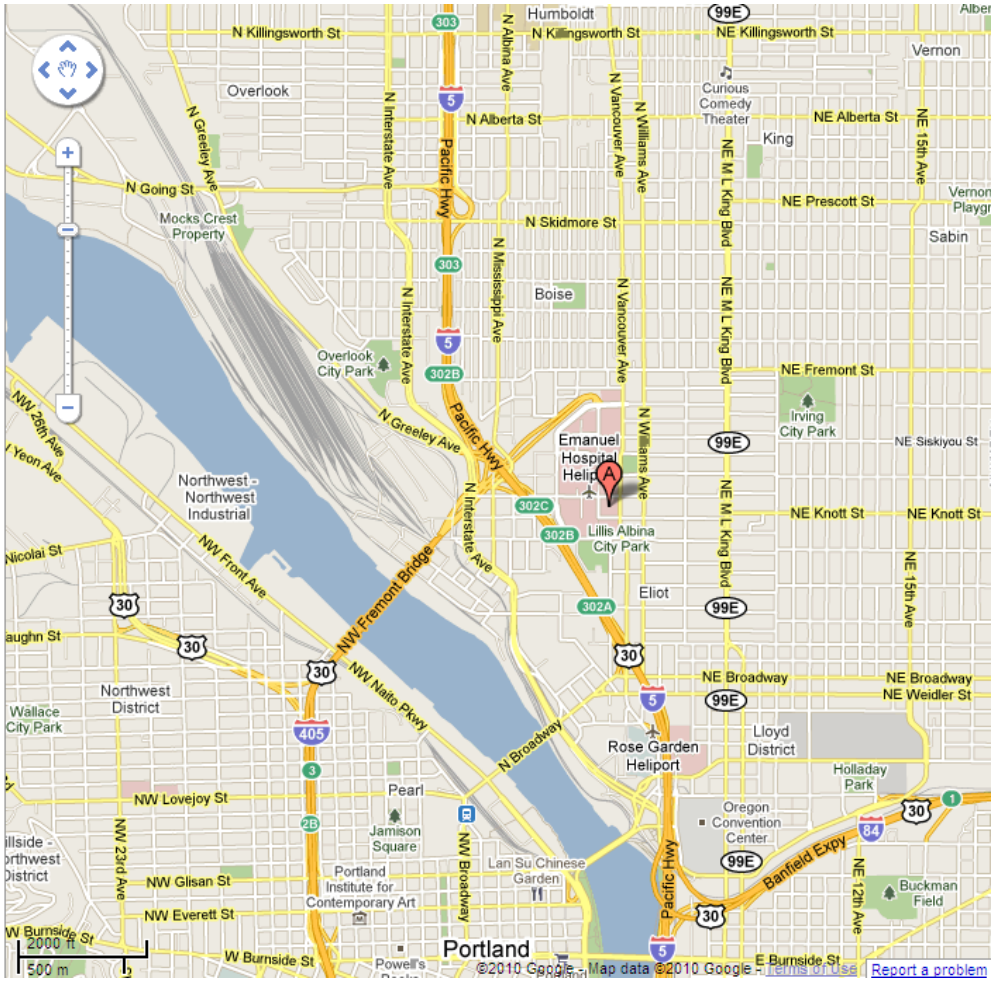
Alternative 2:

Hospital name/address: Emanuel Emergency Department
2801 North Gantenbein Ave.
Portland, OR 97227

Hospital telephone number: 503-413-4161

Ambulance/police/fire emergency: 911

Map:



B. Equipment and Supply List

- Sampling equipment
  - Power dredge
  - Scoops (stainless steel)
  - 5-gallon buckets with lids (2 per sampling site)
  - Permanent ink markers (black or dark ink)
  - Nitrile gloves
  - Heavy rubber gloves
  - Aluminum foil
- Decontamination
  - Brushes
  - Wash basin
  - Alconox™ or other phosphate-free detergent
  - Distilled water
  - Squirt/spray bottles (labeled with contents)
- Logbooks
  - Waterproof, bound log books
  - Permanent ink pens (black or dark ink)
- Safety equipment
  - Personal floatation device
  - Safety glasses
  - Protective clothing
  - Rubber or leather boots
- Personal gear
  - Hat
  - Sunblock
  - Water bottle
  - Food and snacks

C. Sampling Location Maps and Coordinates

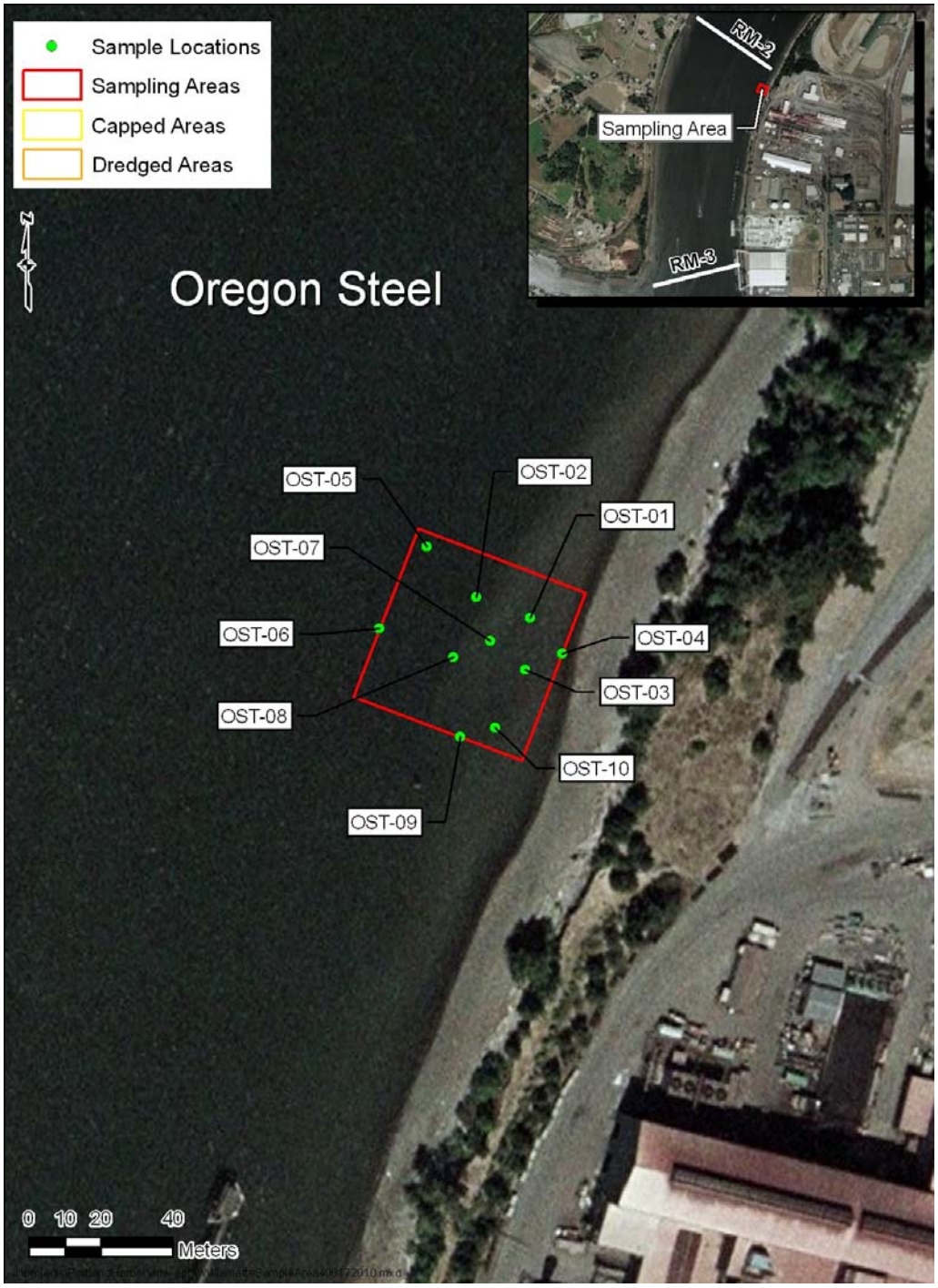


Figure C.1. Oregon Steel (OST).

Table C.1. Sampling site: Oregon Steel

Dredge location	Northing (UTM meters)	Easting (UTM meters)
OST-01	5053093	516729
OST-02	5053099	516715
OST-03	5053078	516728
OST-04	5053083	516738
OST-05	5053113	516701
OST-06	5053090	516688
OST-07	5053086	516718
OST-08	5053082	516708
OST-09	5053060	516710
OST-10	5053062	516720

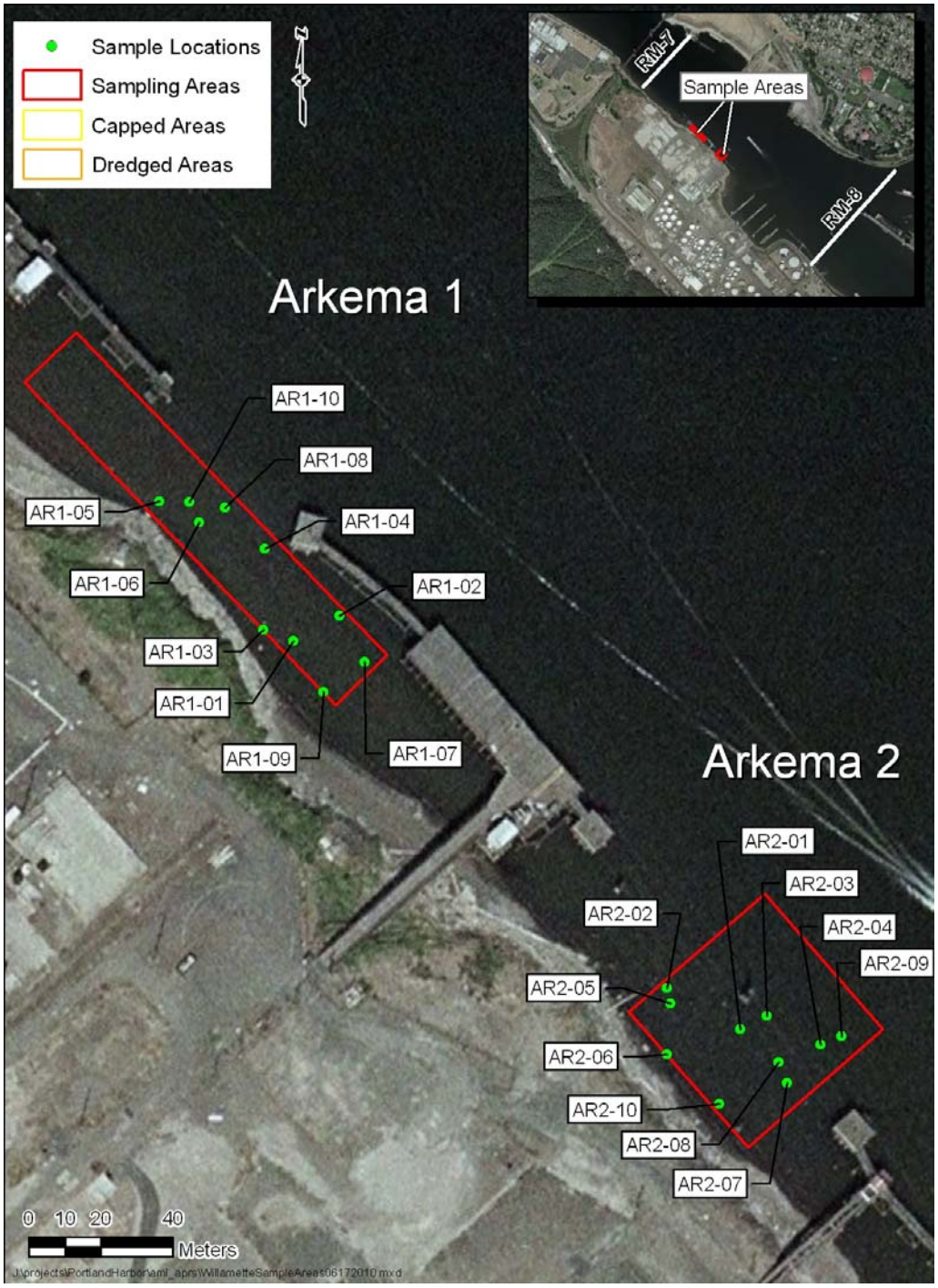


Figure C.2. Arkema 1 (AR1) and Arkema 2 (AR2).

Table C.2. Sampling site: Arkema 1

Dredge location	Northing (UTM meters)	Easting (UTM meters)
AR1-01	5046454	520103
AR1-02	5046461	520116
AR1-03	5046457	520095
AR1-04	5046479	520095
AR1-05	5046493	520066
AR1-06	5046487	520077
AR1-07	5046448	520123
AR1-08	5046491	520084
AR1-09	5046439	520112
AR1-10	5046492	520074

Table C.3. Sampling site: Arkema 2

Dredge location	Northing (UTM meters)	Easting (UTM meters)
AR2-01	5046345	520228
AR2-02	5046357	520207
AR2-03	5046349	520235
AR2-04	5046341	520250
AR2-05	5046353	520208
AR2-06	5046338	520207
AR2-07	5046330	520241
AR2-08	5046336	520239
AR2-09	5046343	520256
AR2-10	5046325	520222

Figure C.3. Swan Island 2a (S2A).

Table C.4. Sampling site: Swan Island 2a

Dredge location	Northing (UTM meters)	Easting (UTM meters)
S2A-01	5045951	521656
S2A-02	5045960	521596
S2A-03	5045961	521648
S2A-04	5045960	521588
S2A-05	5045961	521607
S2A-06	5045979	521539
S2A-07	5045959	521656
S2A-08	5045960	521631
S2A-09	5045970	521561
S2A-10	5045950	521637

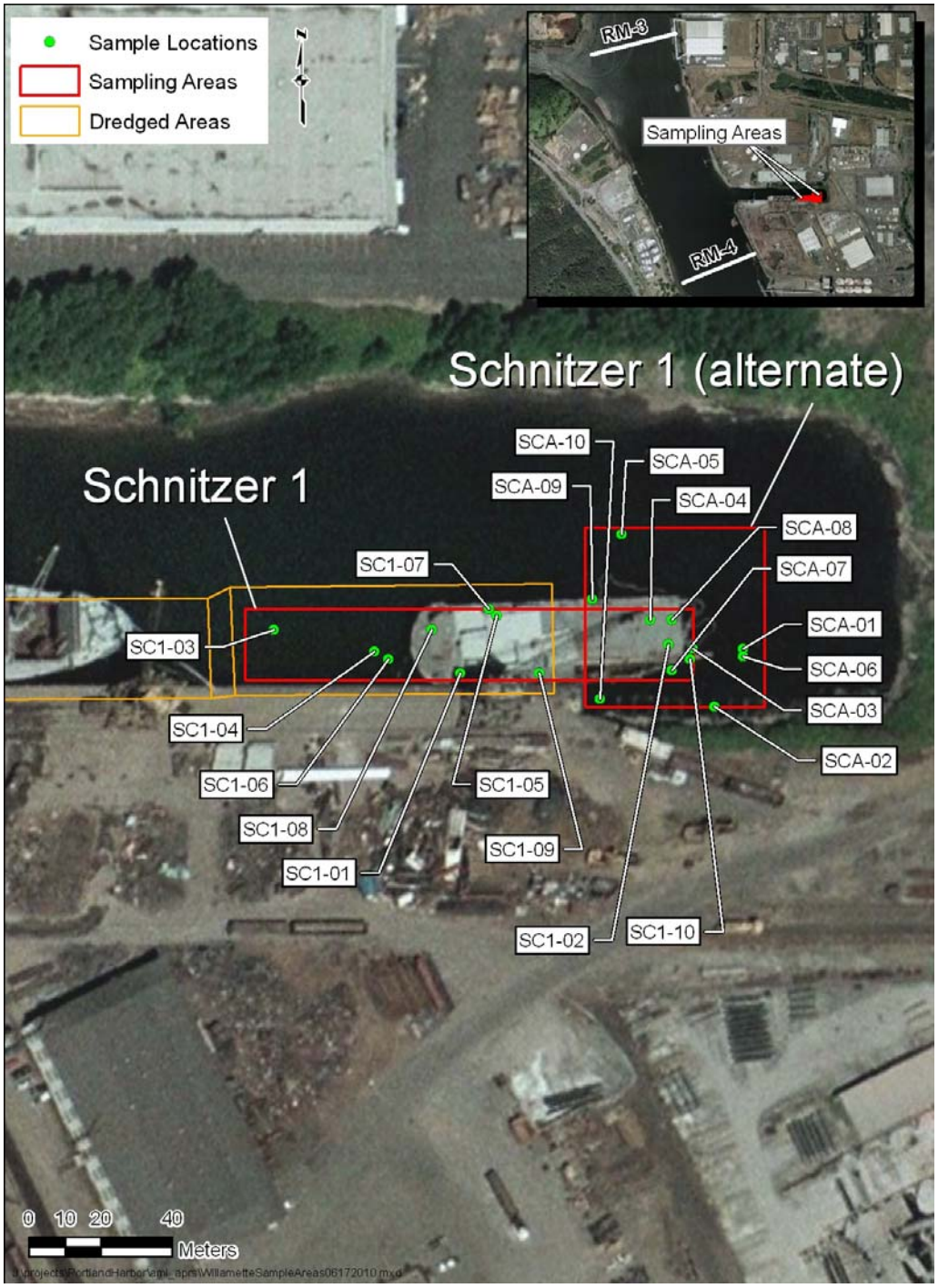


Figure C.4. Schnitzer 1 (SC1) and Schnitzer 1 (alternate) (SCA).

Table C.5. Sampling site: Schnitzer 1

Dredge location	Northing (UTM meters)	Easting (UTM meters)
SC1-01	5050851	517423
SC1-02	5050859	517481
SC1-03	5050863	517371
SC1-04	5050857	517399
SC1-05	5050867	517433
SC1-06	5050855	517403
SC1-07	5050869	517431
SC1-08	5050863	517415
SC1-09	5050851	517445
SC1-10	5050855	517487

Table C.6. Sampling site: Schnitzer 1 (alternate)

Dredge location	Northing (UTM meters)	Easting (UTM meters)
SCA-01	5050858	517502
SCA-02	5050842	517494
SCA-03	5050858	517488
SCA-04	5050866	517476
SCA-05	5050890	517468
SCA-06	5050856	517502
SCA-07	5050852	517482
SCA-08	5050866	517482
SCA-09	5050872	517460
SCA-10	5050844	517462

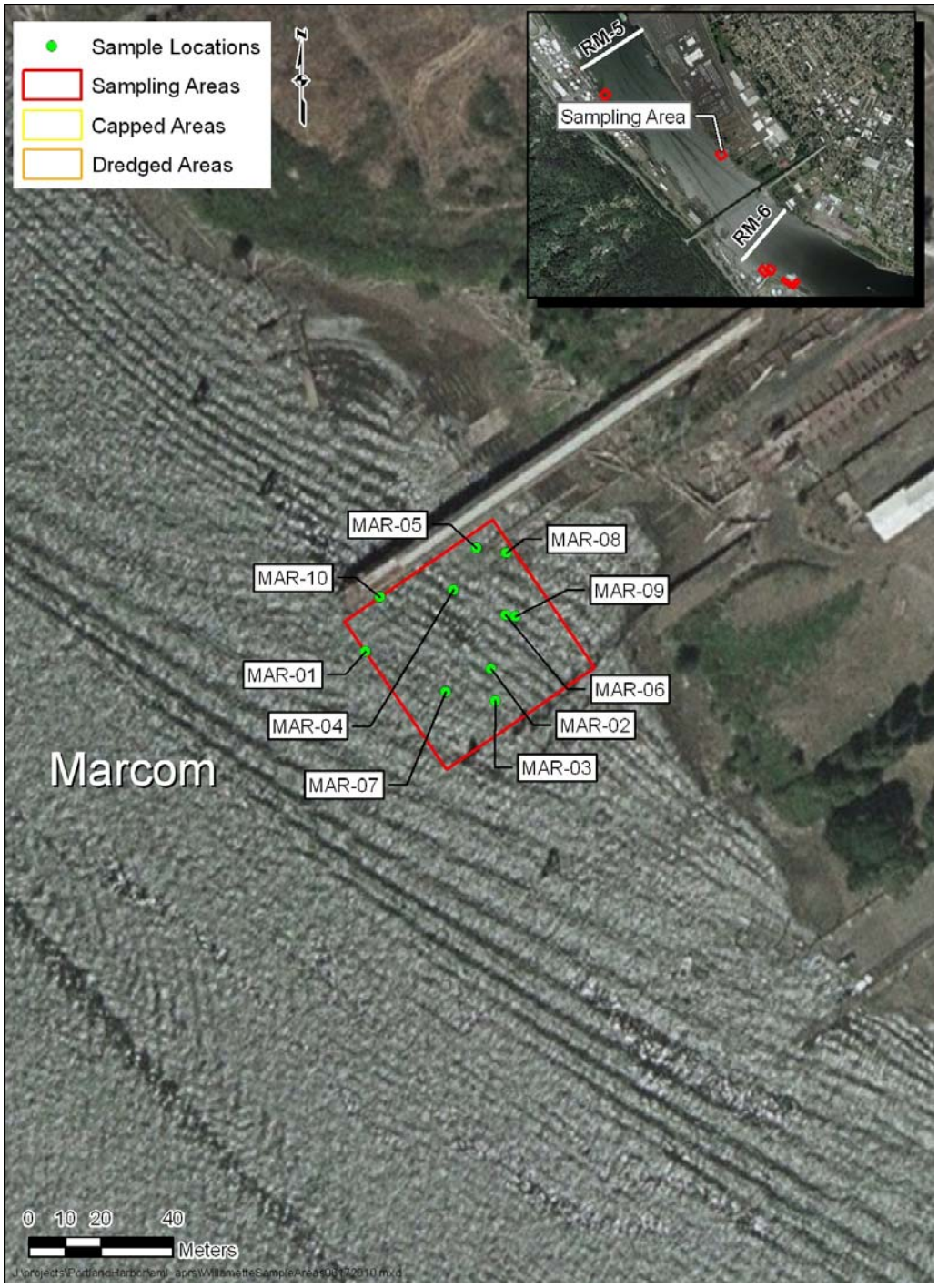


Figure C.5. Marcom (MAR).

Table C.7. Sampling site: Marcom

Dredge location	Northing (UTM meters)	Easting (UTM meters)
MAR-01	5048324	518239
MAR-02	5048319	518274
MAR-03	5048310	518276
MAR-04	5048341	518264
MAR-05	5048353	518271
MAR-06	5048334	518279
MAR-07	5048313	518262
MAR-08	5048351	518279
MAR-09	5048334	518281
MAR-10	5048339	518244

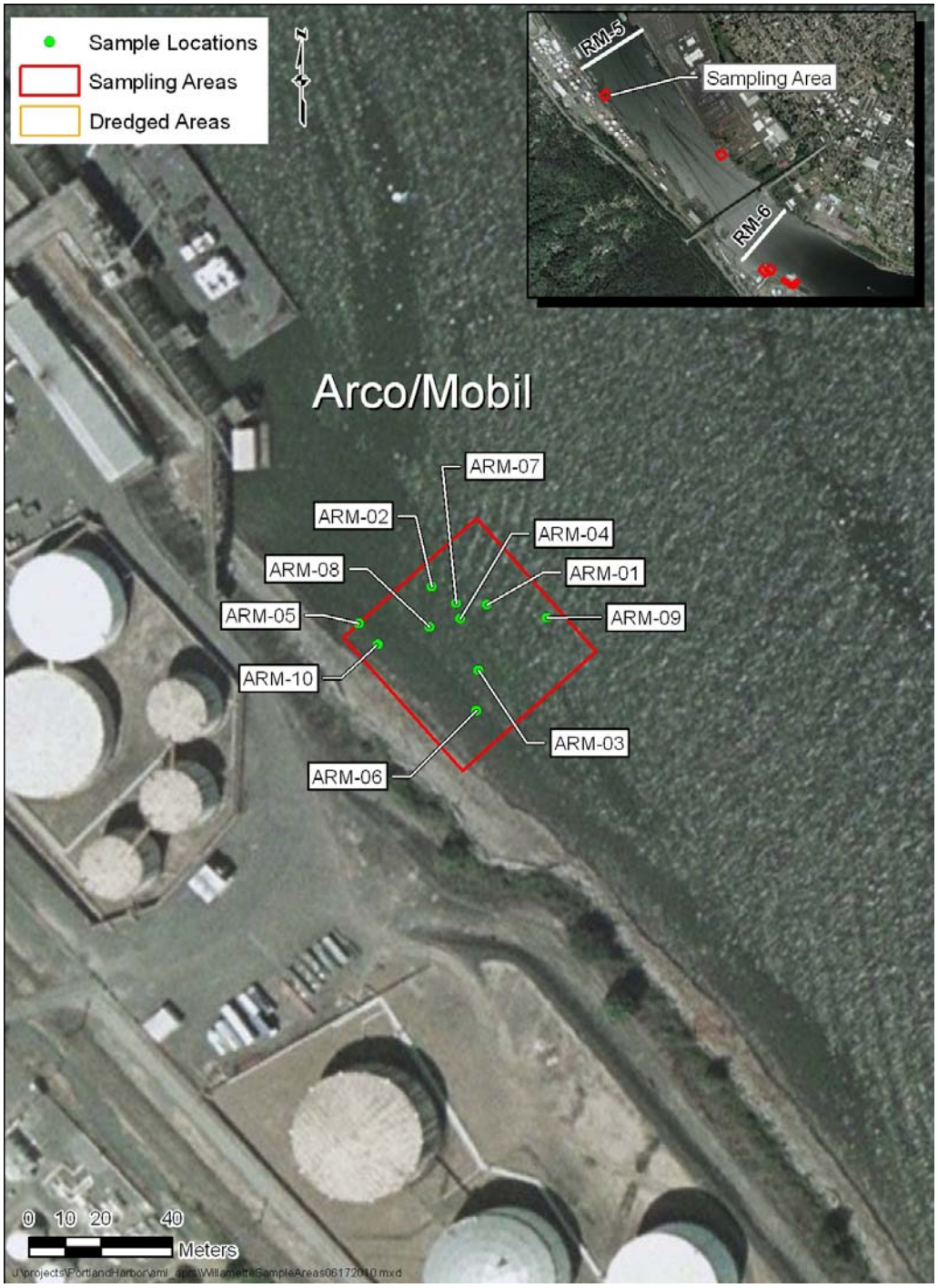


Figure C.6. Arco/Mobil (ARM).

Table C.8. Sampling site: Arco/Mobil

Dredge location	Northing (UTM meters)	Easting (UTM meters)
ARM-01	5048728	517515
ARM-02	5048733	517500
ARM-03	5048709	517513
ARM-04	5048724	517508
ARM-05	5048722	517480
ARM-06	5048698	517512
ARM-07	5048728	517507
ARM-08	5048721	517500
ARM-09	5048724	517532
ARM-10	5048716	517485

Figure C.7. Swan Island (SWI).

Table C.9. Sampling site: Swan Island

Dredge location	Northing (UTM meters)	Easting (UTM meters)
SWI-01	5046033	522125
SWI-02	5046031	522135
SWI-03	5046025	522136
SWI-04	5046041	522120
SWI-05	5046047	522100
SWI-06	5046029	522127
SWI-07	5046066	522154
SWI-08	5046033	522122
SWI-09	5046066	522152
SWI-10	5046054	522161

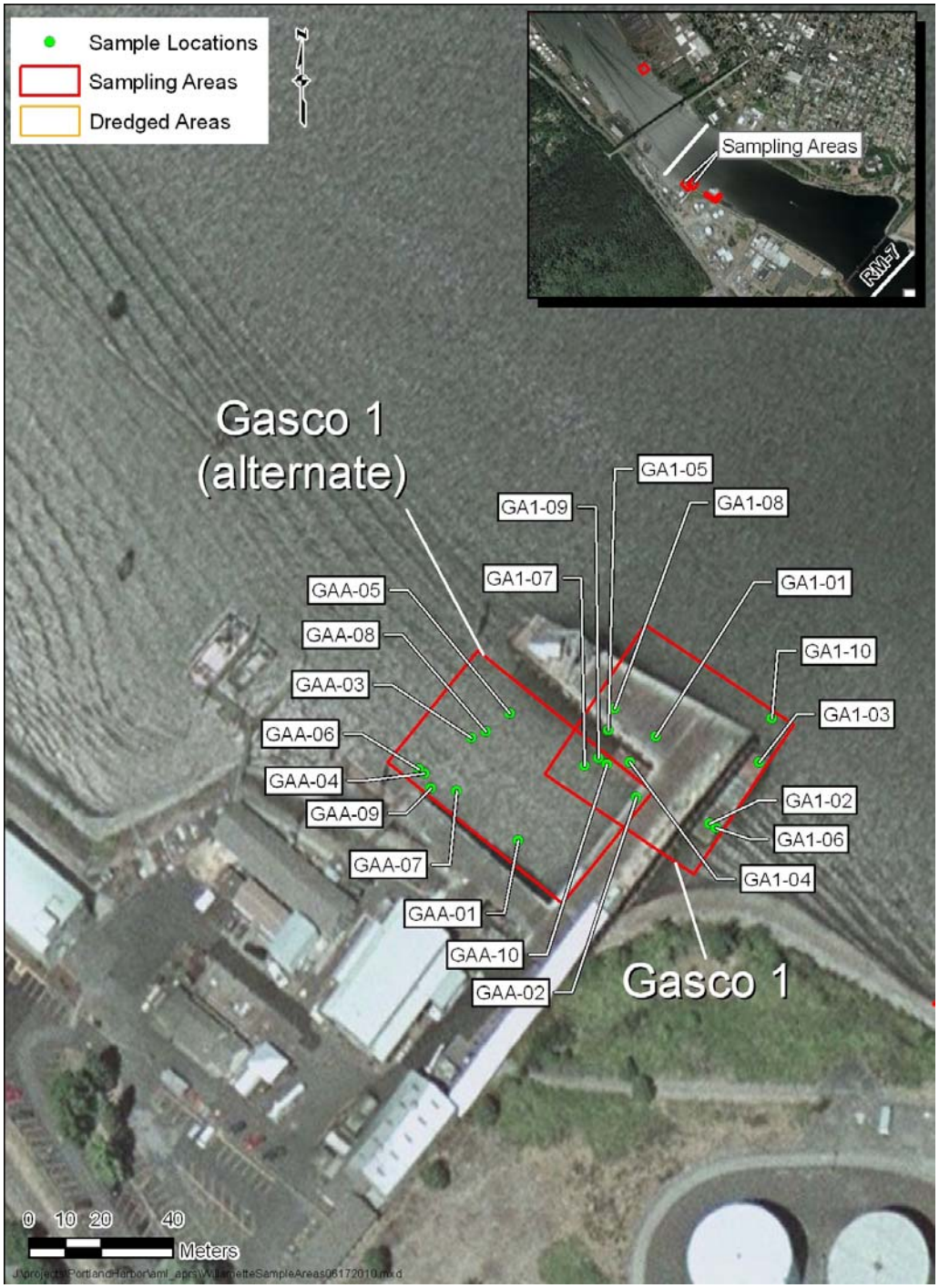


Figure C.8. Gasco 1 (GA1) and Gasco 1 (alternate) (GAA).

Table C.10. Sampling site: Gasco 1

Dredge location	Northing (UTM meters)	Easting (UTM meters)
GA1-01	5047577	518586
GA1-02	5047553	518601
GA1-03	5047570	518615
GA1-04	5047570	518579
GA1-05	5047579	518573
GA1-06	5047551	518602
GA1-07	5047569	518566
GA1-08	5047585	518574
GA1-09	5047571	518570
GA1-10	5047582	518618

Table C.11. Sampling site: Gasco 1 (alternate)

Dredge location	Northing (UTM meters)	Easting (UTM meters)
GAA-01	5047548	518547
GAA-02	5047560	518580
GAA-03	5047576	518534
GAA-04	5047567	518521
GAA-05	5047583	518545
GAA-06	5047568	518520
GAA-07	5047562	518530
GAA-08	5047578	518538
GAA-09	5047562	518523
GAA-10	5047569	518572

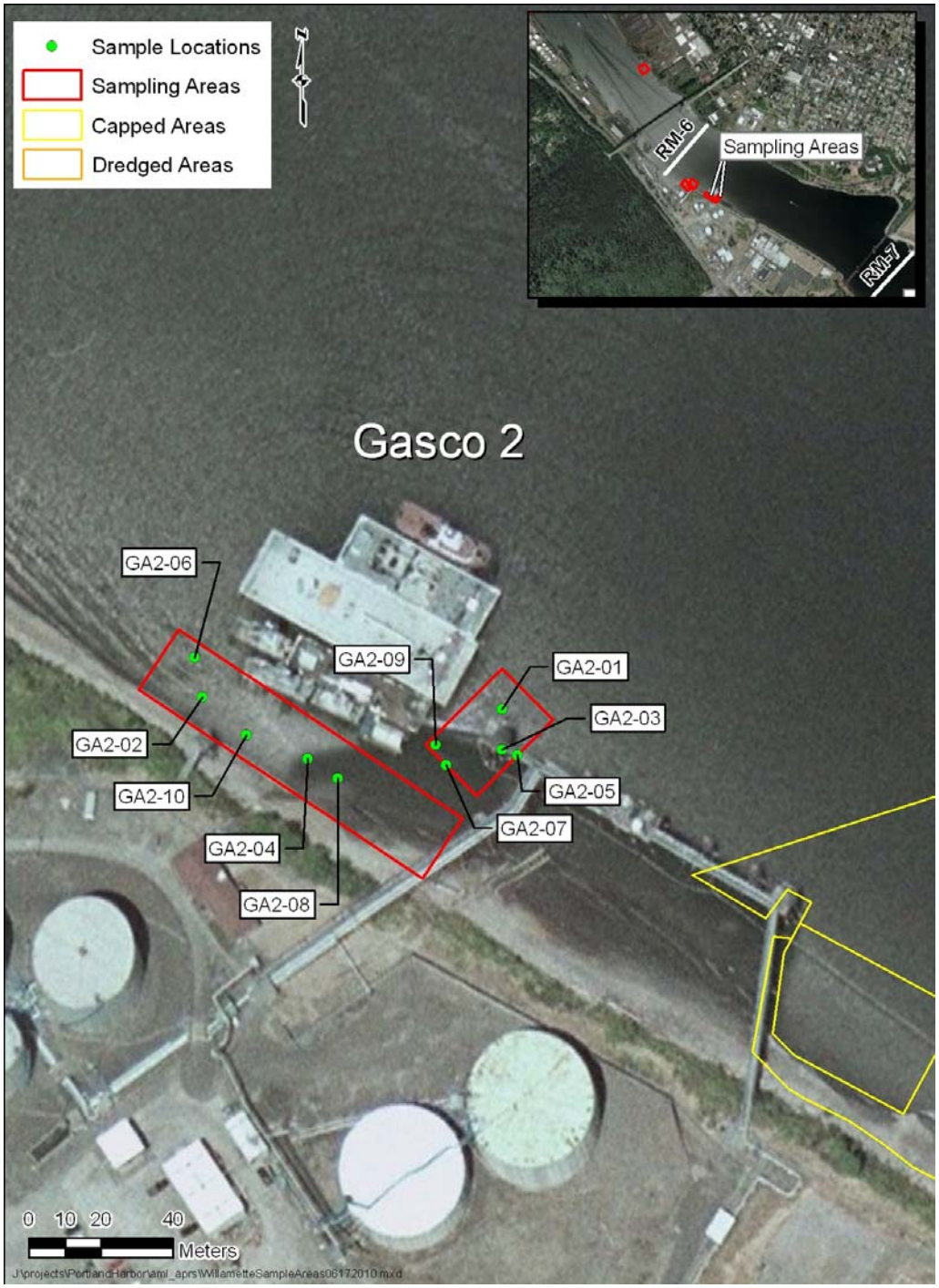


Figure C.9. Gasco 2 (GA2).

Table C.12. Sampling site: Gasco 2a

Dredge location	Northing (UTM meters)	Easting (UTM meters)
GA2-01	5047497	518764
GA2-02	5047500	518681
GA2-03	5047485	518764
GA2-04	5047483	518710
GA2-05	5047484	518769
GA2-06	5047511	518679
GA2-07	5047481	518749
GA2-08	5047478	518719
GA2-09	5047487	518746
GA2-10	5047490	518693

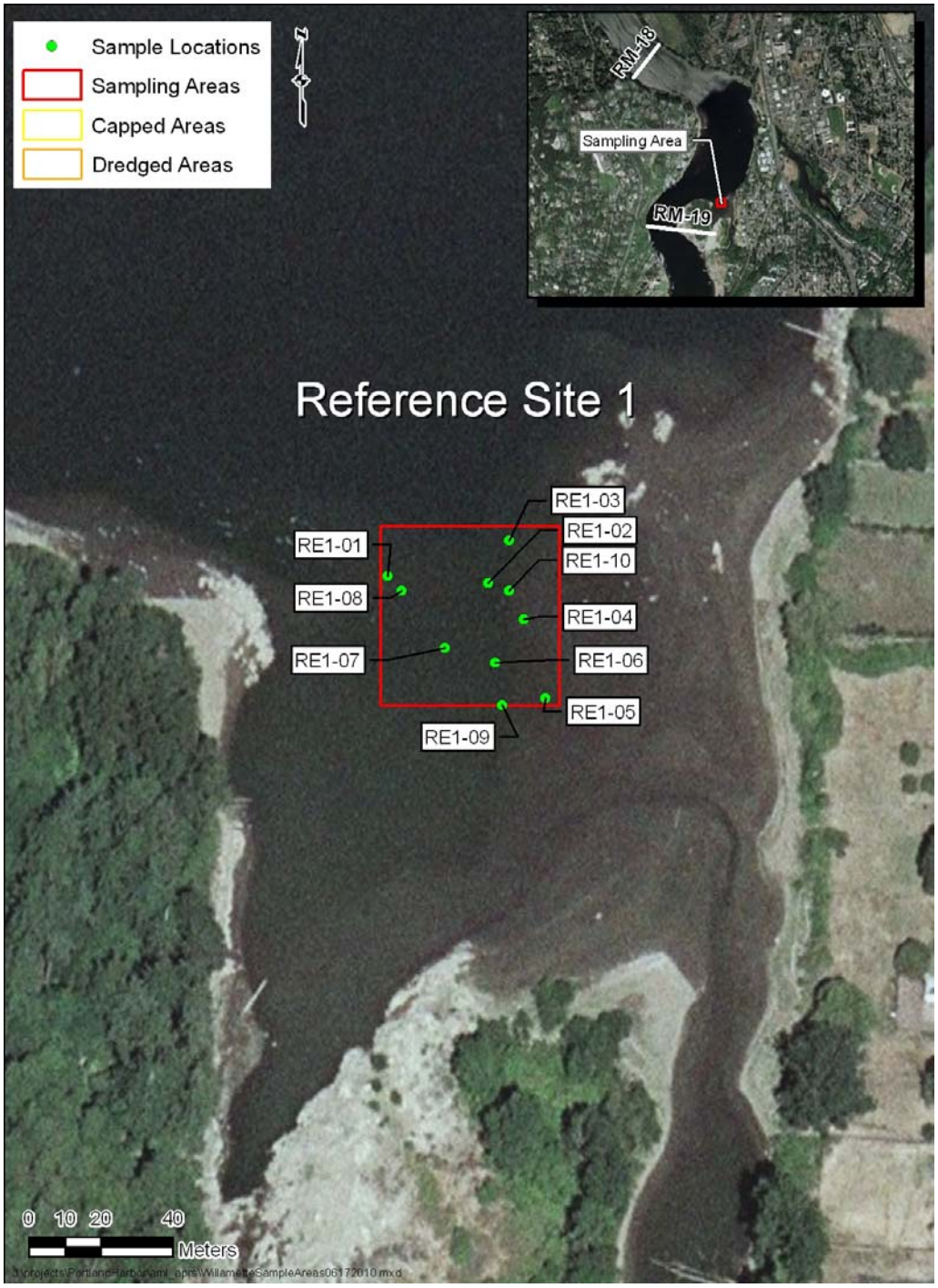


Figure C.10. Reference Site 1 (RE1).

Table C.13. Sampling site: Reference Site 1

Dredge location	Northing (UTM meters)	Easting (UTM meters)
RE1-01	5031593	527653
RE1-02	5031591	527681
RE1-03	5031603	527687
RE1-04	5031581	527691
RE1-05	5031559	527697
RE1-06	5031569	527683
RE1-07	5031573	527669
RE1-08	5031589	527657
RE1-09	5031557	527685
RE1-10	5031589	527687

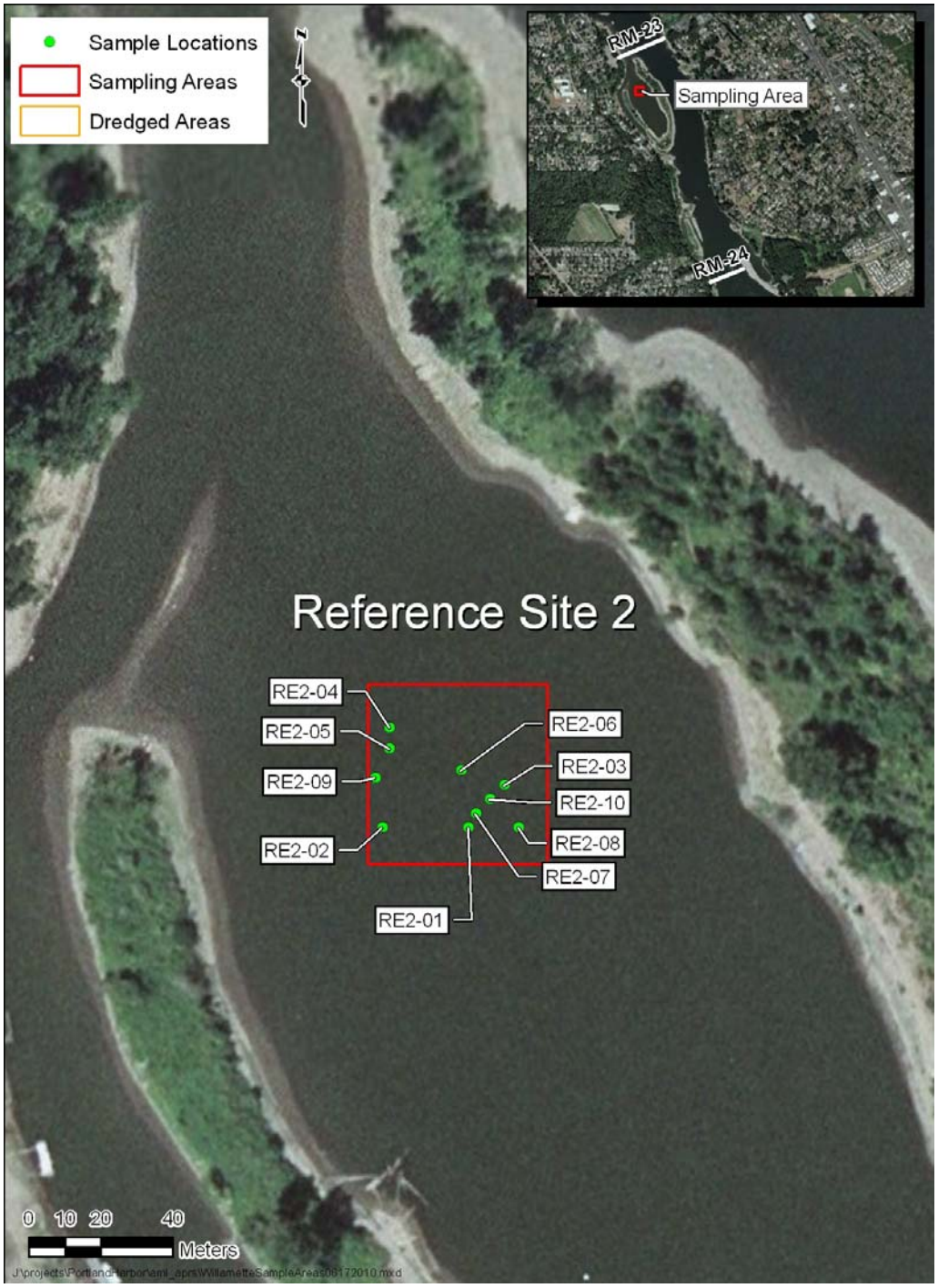


Figure C.11. Reference Site 2 (RE2).

Table C.14. Sampling site: Reference Site 2

Dredge location	Northing (UTM meters)	Easting (UTM meters)
RE2-01	5026170	529173
RE2-02	5026170	529143
RE2-03	5026182	529183
RE2-04	5026198	529151
RE2-05	5026192	529151
RE2-06	5026186	529171
RE2-07	5026174	529175
RE2-08	5026170	529187
RE2-09	5026184	529147
RE2-10	5026178	529179