Maryland Department of the Environment
Sparrows Point Steel Mill Site
Status of the Environmental Activities Under the 1997 Consent Decree
August 2011

Background Summary

The 2,300-acre Sparrows Point steelmaking plant has long been a significant part of Baltimore's history and it is perhaps the most complex environmental cleanup site in the Chesapeake Bay watershed. The 1997 Consent Decree required Bethlehem Steel Corporation to comprehensively address pollution from historic and ongoing operations at the site. The Consent Decree also included provisions for waste minimization/pollution prevention projects to reduce the amount of waste produced, and for recycling of specific waste streams in the ongoing operations of the plant.

Corrective Measures Status

The land portion of the site investigation was completed in 2006. Prior to completion of the entire onshore/offshore investigation, EPA required that then-owner Severstal implement interim measures to address the significant subsurface contamination -- consisting primarily of benzene and naphthalene -- in the former Coke Oven area. In response to EPA's directive, Severstal developed and has begun implementation of a free product recovery and groundwater treatment plan to capture and treat the subsurface plumes (described in more detail below). New owner RG Steel has continued to implement the interim plans begun by Severstal in the Coke Ovens area and has assumed responsibility to complete all remaining obligations under the Consent Decree, consisting primarily of an offshore investigation and a corrective measures study to identify and select final remedial measures to address contamination associated with the site.

The approved interim remedial system consists of 6 remediation cells designed to recover and treat the benzene and naphthalene identified in the sitewide investigation, and to prevent offsite migration of the contaminants.

- **Cell 1** has been operational since July 2010 and uses a combination of air sparge and soil vapor extraction to remove benzene from the shallow groundwater.
- **Cell 2** will utilize a combination of pumping from the deeper zone beneath the slag aquifer, air sparging, and soil venting in the shallow slag and deeper zone to address contaminated groundwater migrating off-site toward the shipyard Graving Dock. Permit applications were submitted to MDE's Air and Water administrations for operation of these systems, with the permitting process anticipated to be completed by year's end.
- **Cell 3** is comprised of an air sparge/SVE trench similar to Cell 1 that will be installed along Cove Point to treat shallow groundwater seeping into the Cove area in the southern portion of the Coke Point Peninsula. RG Steel reported to MDE that Cell 3 became operational in June 2011.
- **Cell 4** will use nutrient enhancement in recirculated shallow groundwater to encourage anaerobic biodegradation of the heavier semi-volatiles such as naphthalene near the former Coal Tar Storage Area. EPA and MDE approved the design plan on March 31, 2011. The cell construction was completed in June and initial nutrient injections took place in early July.

- **Cell 5** is designed as a pump-and-treat and reinjection cell to address elevated levels of naphthalene in the shallow groundwater near the former Coal Tar Storage Area. Like Cell 2, the system will become operational once all permitting requirements for water appropriation and discharge permits have been met, expected to be by year's end.
- **Cell 6** consists of the removal of benzene-contaminated carrier oil near the former Coke Oven Area from multiple recovery wells. To date, the system has recovered approximately 5,500 gallons of free product.

Landfill Compliance Status

Greys Landfill -- In 2008, the installation of the sediment and stormwater basins, slope stabilization, counter berm installation, and final seeding and slope stabilization measures were completed at Greys Landfill. Thirty-one groundwater monitoring wells have been sampled on a quarterly basis since July 2009. Sample results indicate that the highest levels of contaminants -- including naphthalene and volatile organic compounds -- were detected in four shallow monitoring wells adjacent to the northern portion of the landfill. Monitoring wells further from the landfill show either very low levels of contaminants, or are non-detect. The need for additional remediation will be determined through ongoing sampling.

Coke Point Landfill -- For the past decade, the Coke Point landfill area has been used primarily for stockpiling iron-bearing materials for reuse, with limited material disposal. RG Steel is continuing to implement measures such as re-grading, berming, and stormwater controls to restrict site access, improve stability, and control stormwater runoff.

New Landfill -- On June 17, 2010, Severstal submitted an application to MDE for a new industrial waste landfill to be located on approximately 60 acres in the vicinity of Greys Landfill. The proposed landfill will be designed and constructed in accordance with current State regulations. A public informational meeting was held on January 20, 2011. Phase I of the permitting process is now complete and the applicant is now preparing the required Phase II (geotechnical evaluation) and Phase III (engineering design report) portions of the application. If the landfill meets all requirements and is permitted and constructed, the closure plans for both Greys and Coke Point landfills will be initiated.

Offshore Investigation

Prior to evaluating and selecting remedies to address contamination related to the site, an offshore investigation must be completed. Severstal and prior owners ISG/Mittal refused to conduct a comprehensive offshore investigation as detailed in the Consent Decree, because they argued that the terms of the original bankruptcy purchase from Bethlehem Steel Corporation released them from liability for historic, offshore contamination. Since Severstal and EPA/MDE were unable to come to an agreement under the dispute resolution provision in the Consent Decree, a federal District Court judge heard arguments in March 2011 and issued a series of rulings on July 5, 2011 (see MDE's website for a copy of the judge's rulings). In a related ruling, the Chesapeake Bay Foundation (CBF) petitioned the court and was granted the motion to intervene in the off-site sampling dispute. The companies – with current owner RG Steel now primarily responsible -- along with EPA, CBF, and MDE are following the judge's directive to continue to negotiate an acceptable scope of work for an offshore investigation. If the parties cannot develop a mutually acceptable plan, the judge will then determine what constitutes compliance under applicable law.

Air Emissions – Kish

The Kish Reduction Requirements outlined in the 1997 Consent Decree were satisfied in 2004 with the implementation of the Kish Reduction Plan. While kish complaints have been greatly reduced, MDE continues to investigate reported kish emissions whenever complaints are received.

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Site-related documents and links to the EPA information relating to the site are available by visiting the MDE website at:

http://www.mde.state.md.us/Programs/LandPrograms/Hazardous_Waste/hazwastecleanupsites/sparrowspt.asp

Severstal Sparrows Point (Formerly: ISG Sparrows Point, Bethlehem Steel)

North Point Blvd
Sparrows Point, MD 21219
Congressional District 2
EPA ID #: MDD053945432
Site Property Area: 2300 acres
Last Updated: 08/11/2010

Status

Consent Decree
On October 8, 1997, EPA, MDE, and BSC entered into a 3008(h) Consent Decree to address the following issues:

1. Complete a site wide investigation to investigate releases of hazardous constituents from the facility to learn the need for potential corrective action,
2. Use interim measures to address releases that require immediate action,
3. Apply compliance standards for two solid waste landfills (Greys Landfill and Coke Point Landfill),
4. Apply a compliance standard for visible emissions from the roof monitor at the Basic Oxygen Furnace,
5. Implement projects to minimize kish emissions,
6. Inspect and perform associated repairs of (a) all active sumps and associated trenches that are located in the Cold Sheet Mill and the Tin Mill that contain significant amounts of acid, caustic, plating, and coating solutions, and (b) all above ground storage tanks with capacity greater than 500 gallons that store hazardous substances, and
7. Implement projects to minimize waste production.

Site Wide Investigation (EPA lead)
The Consent Decree requires BSC to complete a comprehensive evaluation of the potential for both current and future risk to human health and the environment from current and past releases of hazardous wastes and hazardous constituents at the Facility.

The Consent Decree requires that BSC begin the Site Wide Investigation with an evaluation of the onsite areas. BSC submitted a Description of Current Conditions report on the facility on January 20, 1998. The Description of Current Conditions report describes potential contaminant sources and proposes a detailed frame work for future investigations.

On March 8, 1999 BSC submitted Phase 1 Site Wide Investigation Work Plans to EPA which contain a site background summary, a plan for hydrogeologic investigation, a plan for ecological investigation, a community relations plan, a data management plan, and a data quality assurance plan. EPA provided comments to BSC on December 16, 1999. On February 11, 2000, BSC submitted partial response to EPA's comments deferring response to ecological comments. On March 15, 2000, at EPA's request, BSC submitted to EPA a proposal to refocus the side wide investigation on the Environmental Indicators--groundwater and human health exposure–as the priority, while deferring ecological characterization. EPA accepted the proposal. On December 12, 2000, BSC presented a schedule and the detail on how this refocus approach would be accomplished.

The Consent Decree has designated 5 special study areas that require assessment within 48 months of the effective date of the Consent Decree, excluding agency review time. The five areas are Tin Mill Canal/Finishing Mills, Greys Landfill, Coke Point Landfill, Coke Oven Areas, and Humphreys Impoundment. BSC submitted work plans of all 5 Special Study Areas to EPA in summer 2001. Initial investigation focuses on hydrogeology characterization. EPA approved all work plans and field work began shortly and was completed in fall 2001. Based on the field data collected, BSC submitted a "Site Wide Groundwater Study Report" to EPA in December 2001.

EPA received a work plan, "Site-Wide Investigation Work Plan to Evaluate the Nature and Extent of Releases to Groundwater from the Special Study Areas" in July 2002 which EPA approved in October 2002. This work plan focused on characterizing the nature and extent of contamination in the 5 special study areas. The field work has begun in December 2002 in accordance with the EPA approved work plan tasks and the well installation work was completed in 2003. Sampling from these newly installed wells was delayed in 2003 due to ownership change of the facility. International Steel Corporation (ISG) has become the new owner of the Sparrow Point facility in summer of 2003. On March 12, 2004, ISG submitted a revision to the 2002 EPA approved Work Plan "Site-Wide Investigation Work Plan to Evaluate the Nature and Extent of Releases to Groundwater from the Special Study Areas." EPA approved this revised work plan in April 13, 2004. The sampling required by the Work Plan was completed in 2004 and the Site Wide Investigation Report-Nature and Extent of Releases to Groundwater From Special Study Areas was submitted to EPA in January 2005. EPA has reviewed and determined that the report has met the investigation objectives and no additional field data is needed at this time; however, several clarification revisions are needed to finalize the report.

In accordance with the November 2004 work plan, IAG has completed data collection for the environmental Indicator (EI) Human Health evaluation. ISG submitted the EI-Human Health evaluation report to EPA in spring 2005 and EPA approved the report shortly concluding the EI-Human Health Control has met.

On June 29, 2006, ISG submitted an Ecological Risk Assessment Work Plan for On-Site habitats investigation. This Work Plan will defer investigation of off-shore habitats, surface water and sediment investigation, to the next phase. After a couple rounds of revision, EPA approved the on-site ecological assessment work plan around November 2006. All field work specified in the work plan was completed during 2007. The screening level ecological assessment for on-site habitats was submitted to EPA on April 2, 2008. After several rounds of revision, EPA approved the screening level assessment on July 9, 2009. Based on approval of the approach in the screening level assessment, EPA is awaiting final baseline ecological assessment for on-site habitats in summer 2010.

On August 13, 2009, MDE requested Severstal to expedite development of an offshore sampling plan. On February 3, 2010, EPA conditionally approved the offshore sampling plan submitted by Severstal, outlining the deficiencies that Severstal must address. On March 4, 2010, Severstal disputed its obligation to assess historical offshore sediment contamination before the bankruptcy sale along the entire shoreline of the steel mill. EPA and Severstal are currently engaged in the dispute resolution process to resolve this matter. Pending on the dispute resolution, Severstal is to complete the ecological and human health risk assessments to conclude the site-wide investigation by 2012

Interim Measures (EPA lead)

The Consent Decree requires BSC to continue operating the ongoing remediation system at the former Rod and Wire Mill, Sludge Bin Storage area, and to report on the remediation activities by January 31 of each year. The remediation addresses releases of cadmium and zinc to the soil and groundwater which resulted from former operations at the former Rod and Wire Mill. When the Consent Decree was entered, the remediation system included leaching of slightly acidic water through contaminated soil and pumping and treating groundwater to remove cadmium and zinc contamination. The system did not operate in low temperatures and had been in operation since 1986. BSC submitted a report on remediation activities in January 1998, continued remediation in 1998, and submitted a report on remediation activities in January, 1999. The January 1999 report included plans to reevaluate the remedy while the remediation components were temporarily dismantled. The remediation components were temporarily dismantled to assist dismantlement of the former mill. Throughout 1999, EPA and MDE reviewed and approved BSC's re-evaluation of the twelve-year-old remedy. The re-evaluation of the remedy is described in BSC's (Annual) Report on Remediation and Monitoring Activities, Sludge Bins Storage Area Closure, Former Rod and Wire Mill submitted to the Agencies on January 28, 2000.

On July 26, 2000, BSC submitted a work plan for reestablishment of the interim measures for the Former Rod & Wire Mill Sludge Bin Storage Area. The interim measures proposed include posting warning signs regarding the contaminated area as an institutional control, installing a pump-and-treat system to recover contaminated groundwater from two recovery wells, and upgrading a groundwater monitoring network to evaluate the effectiveness of the pump-and-treat system. EPA approved the Work Plan on November 3, 2000. Installation of the system was completed in 2001 and the system has been in continuous operation since summer 2001. In 2007, a total of 355 pounds of cadmium and 16,601 pounds of zinc were removed by the system, which is a slightly lower than in 2006 suggesting a continued trend of declining mass in the source area.

Based on the site-wide investigation, EPA has identified that the former Coke Oven area to be heavily contaminated with product phase hydrocarbons (predominantly benzene and naphthalene in groundwater. On February 19, 2009, EPA required Severstal to submit a work plan to implement interim measures to recover hydrocarbon product. In accordance with EPA approved work plan, Severstal conducted pilot testing in 2009 to collect design data for groundwater pumping and vapor extraction. In August 2010, after several interactions, EPA approved Severatal's plan to phase in installation of 6 remediation cells within 12 months, or until July 2011. The remediation cells employ a combination of groundwater pumping, vapor extraction, product skimming, air sparging, groundwater injection, and enhanced bioremediation technologies to eliminate the source and contain migration of the plume.

Coke Point and Greys Landfills Compliance (MDE lead)
The 1997 Consent Decree imposed more stringent compliance requirements for the operation of Greys and Coke Point Landfills to meet MDE's standards for solid waste landfill management. MDE has the sole jurisdiction to enforce the requirements.

Construction work for the Greys Landfill to stabilize slopes, control sediment release and surface runoff was initiated in 2005 and completed in 2008. Monitoring wells abandoned due to the slope stabilization process have been replaced and the monitoring well network has been sampled quarterly since July 2009. The landfill will operate until the final elevation of 141 feet is reached and will be capped in accordance with an approved closure plan.

Coke Point landfill has been utilized for mainly for recycling with minimal waste disposal. Since the Coke Point Landfill will not be used for waste disposal to the degree envisioned in grading and closure plans previously submitted by prior owners, Severstal is currently developing an alternate plan to address the slope stabilization issue and revise the operations manual for the landfill.

In June 2010, MDE received a permit application for a new lined landfill to replace both Greys and Coke Point Landfill.

Basic Oxygen Furnace (BOF) Visible Emissions Compliance (MDE lead)
The 1997 Consent Decree imposed more stringent compliance requirements of air emission from the BOF at the Roof Monitor. EPA and MDE jointly enforce the compliance.

Since October 22, 1997, BSC has been out of compliance with the BOF Roof Monitor visible emission standard on six instances: February 17, 19, and 23, 1999 and October 25, 28, and 29, 1999.BSC was assessed and has payed penalties of $9000 for the February, 1999 violations and $19,000for the October, 1999 violations.

Monitoring is currently conducted in accordance with the requirements outlined in the Maryland State Implementation Plan (SIP) that was promulgated by the State of Maryland on 10/2/2000 and approved by EPA on 11/6/2001. With approval of the SIP by EPA, compliance requirements of visible emissions from the BOF Shop roof monitor are now implemented by requirements of the SIP and not the Consent Decree.

Kish Reduction Compliance (MDE lead)
On January 6, 1998, BSC submitted a Kish Reduction Work Plan pursuant to the Consent Decree. MDE has the jurisdiction to enforce the compliance with EPA to provide technical support.

At the request of the community, EPA collected samples for kish analyses between 1997 and 1998.Bulk kish samples, or source samples, were collected from the BOF and Blast Furnace bag houses, and fallout and air filter samples were collected at the community receptor area. Samples were analyzed by EPA Laboratory by electronic microscopy and X-Ray diffraction for particle size and elemental composition, high temperature combustion for carbon content, and TCLP characteristic. Particulate matter size of 10 micrometers or less is respirable, and is regulated by EPA because of its potential adverse health risk by inhalation. The results were presented in a March 1, 2000 report which determines: (a) that the source kish samples do not exceed TCLP limits to be classified as hazardous waste, (b) that the Blast Furnace kish is finer and more respirable than the BOF, (c) that the BOF kish is alkaline (pH=12.4) and more diverse in elemental composition, (d) that the Blast Furnish kish is acidic (pH=3.4 to 3.8) and less diverse in elemental composition, (e) that respirable sized kish had reached the community, but (f) that receptor air filter sample volumes were too small to be usable in quantifying the elemental composition or potential health effect on the community.

In August of 2003, the Skimmer Slag Ladle Dumping Process was relocated to the No. 2 Soaking Pit Building located northeast of the Caster. This structure provides cover that controls and significantly reduces fugitive kish emissions from the dumping of slag ladles from the slag skimming operation. The project development included access to the structure by extension of slab hauler road. The south side of the building was altered to provide direct access to the facility. Additional wall sheeting, lighting, fire protection, internal grading and ramps for dumping were installed. Additional improvements to the No. 2 soaking Pit Building were completed in 2004 including installation of a fabricated wall sheet to close in the east side of the building further minimize fugitive emission form the building. Completion of this project satisfies the kish reduction requirements outlined in the Consent Decree.

Waste Minimization Plan (MDE lead)

1. *Sumps, Trenches and Above Ground Tanks*: On January 18, 1999, EPA and MDE approved a work plan from BSC to identify and inspect all active sumps and associated trenches located in the Cold Sheet Mill and the Tin Mill that contain significant amounts of acid, caustic, plating, and coating solutions as well as all above ground storage tanks with capacity greater than 500 gallons that store hazardous substances. The inspection has been completed and all repair work necessary to prevent leakage has been implemented.

2. *Tin Mill Canal Discharge Report:* A Tin Mill Canal Discharge Report to identify the contribution sources was submitted in July 1998 in accordance with the consent Decree requirements.

3. *Strong Caustic Solution Reuse Work plan:* On December 19, 1997, BSC submitted a work plan that describes a beneficially reuse of spent caustic solution from the Humphreys Creek Wastewater Treatment Plant and a controlled discharge of spent pickle liquor and pickling rinse water to the Tin Mill Canal. BSC has been implementing the Work plan tasks since 1998. Implementation of the approved work plan has been completed.

4. *Waste Minimization Activity Cost Projection*: On April 8, 1998, BSC submitted a waste minimization activity cost projection. This cost projection will be used to ascertain the potential economic infeasibility of any of the three following waste minimization activities (which are more fully described in the Consent Decree): recycling slurry from the treatment of gas from the blast furnace, recycling oxide fume sludge from the treatment of the exhaust gas from the Basic Oxygen Furnace, and recycling the sludge generated from the treatment of waste waters at Humphreys Creek Wastewater Treatment Plant.

5. *Blast Furnace Gas Cleaning Slurry Recycle Work Plan:* On October 8, 1998, BSC submitted a schedule for implementing plans to recycle slurry from the treatment of gas from the blast furnace by February 20, 2003. This recycling activity was expected to reduce the disposal of de-watered filter press cake from the slurry at Greys Landfill from 100 tons a day to less than 30 tons a day. Testing and evaluation of three recycling technologies (Hydrocycloning Scrubber Slurry, BOF Slag Conditioning, and Cement Blending) has been underway. A successful pilot test for the hydrocycloning technology was completed in 2002. Installation of the upgrades was initially anticipated to occur in 2011, but due to unanticipated shut down of the blast furnace in July 2010 due to market conditions, actual upgrade installation will be postponed indefinitely.

6. *Recycling of BOF Fume Sludge Work Plan:* On April 8, 1999, BSC submitted a plan to recycle up to 80% of the fume sludge from the basic oxygen furnace back into the steel making process. Testing and evaluation of two technologies (Cement Blending, and Substitute Coolant at BOF) were underway. Recycling of the fine grained material halted in 2008, due to air emission concerns. The 2009 yearly report details a proposal for incorporating the material into a blend suitable for use as a road base or structural fill at the property. The proposal is currently under consideration.

7. *Humphreys Creek Wastewater Treatment Plant Sludge Work Plan:* On October 8, 1999, BSC submitted a plan to recycle sludge from the wastewater treatment plant. Testing and evaluation of several technologies were underway: Injection in the Sinter Plant, Microbial De-Oiling, Use in Sub-Base for Roadway Construction, Recyling at the BOF, Cement Blending and Microwave De-Oiling. Evaluation of the various recycling options and efforts to lower the levels of oil and grease in the sludge were underway. A study would be conducted during 2010 to determine if the de-oiled sludge can be pelletized and used as feedstock for the sinter plant.

8. *Dredging of the Tin Mill Canal Work Plan:* On October 8, 1998, BSC submitted a work plan that describes the handling of the material generated during maintenance dredging of the Tin Mill Canal. The Work Plan provide for dredging of approximately 500 to 1000 cubic yards of material per event. Dredging is proposed only when wastewater flow from Sewers 34 and 36 becomes restricted into Tin Mill Canal, which occurs about every 18 to 24 months. In accordance with the work plan, a concrete pad has been constructed to contain and dewater the dredged material prior to disposal to landfills. The work plan also requires the facility to notify MDE before each dredging. This project has been

completed and the requirements have been met.

9. *Facility Wide Waste Minimization Plan:* The Plan submitted in 1999 and updated in 2002 have identified 16 voluntary waste minimization projects. As of 2006, 11 of the 16 projects have been completed and the remaining are in progress.

1. Blend kish with BOF sludges - in progress
2. Recycle Chromic Acid - on hold
3. Replace Caster Lubrication System - completed
4. Install Caustic Washer on No. 3 Coating Line - completed
5. Slag Splashing BOF Vessels - completed
6. Replace Dip Tank on Coating Lines - completed
7. MSA Change -Halogen Tin Plating Lines - No. 2 Line completed
8. Reduce process discharges - new Cold Mill - completed
9. Kish Exchange or Sale - no progress
10. Pickle Liquor Reuse - completed
11. Steelmaking Slag Commercial Use - in progress
12. Eliminate Sulphur dioxide in Treatment Process at Chrome Wastewater - completed
13. Hot Strip Mill Lubrication Conservation Program - ongoing
14. Recycle of Blast Furnace/Sinter Plant Wastewater Treatment Plant Discharges - completed
15. Reduction of Loop Seal Discharges - completed
16. Recycle of Humphreys Creek Wastewater Treatment Plant Discharges - completed

Civil Penalties and Pollution Prevention Credits (MDE lead)
In reaching the Consent Decree agreement, MDE sought a civil penalty from BSC for previous violations of the BOF visible emission standard. As required pursuant to the Consent Decree, BSC (a) paid a penalty of $350,000 to MDE within 30 days of the effective date of the Consent Decree, and (b) agreed to implement specified pollution prevention and waste minimization activities in lieu of additional penalties ("the pollution prevention credit"). BSC may be required to pay additional penalties if certain waste minimization activities are not completed.

1. EPA and MDE will continue to oversee the site-wide investigation with focus on the Environmental Index
2. EPA and MDE will oversee the implementation of an Interim Measures Work Plan to restart a pump-and-treat system at the Former Sludge Bin Storage Area to reduce cadmium and zinc contamination in groundwater from previous operation.
3. MDE and EPA will continue to oversee the progress of the waste minimization projects and to identify opportunities for further waste minimization.
4. MDE, with EPA's technical support, will continue to enforce compliance requirements for the Greys and Coke Point Landfills operation, the BOF emission compliance, and the kish reduction plan implementation.

Facility Description

The Bethlehem Steel - Sparrows Point facility is located on approximately 2300 acres of a peninsula on the north side of the Patapsco River approximately nine (9) miles southeast of downtown Baltimore.

Maryland Steel built the first furnace at Sparrows Point in 1887. The first iron was cast in 1889. Bethlehem Steel purchased the facility in 1916 and enlarged it by building finishing mills. During peak production in 1959, the facility operated 12 coke-oven batteries, 10 blast furnaces, and four open-hearth furnaces. The coke ovens ceased operations in December 1991 and the coke batteries have been or are being torn down. BSC currently operates a sintering plant, a blast furnace (for iron production), two basic oxygen furnaces (for steel production), a continuous strip castor (two lines), hot strip mills, cold reduction mills, and tin mills. Waste management at the property includes air pollution controls throughout the manufacturing processes, two solid waste landfills, and waste water treatment. A shipyard on contiguous property owned by BSC when the Consent Decree was entered, a former town on Bethlehem Steel's property, and management of waste iron, oil, and slag by other companies on Bethlehem Steel's property are included in the site wide investigation. Through a RCRA Facility Assessment and review of the Description of Current Conditions Report, EPA and the Maryland Department of the Environment have determined that further investigation and/or action is needed at 81 solid waste management units and 28 areas of concern.

RCRA Corrective Action activities at this facility are being conducted under a Consent Decree issued by EPA and MDE to BSC in 1997. Shortly after issuance of the Consent Decree, BSC sold the shipyard portion of the facility to an independent operator but BSC retained the environmental liability of the shipyard.

In 2001, BSC filed for Chapter 11 reorganization but informed EPA that BSC intends to comply with the Consent Decree requirements. In 2003, the court has approved BSC’s bankruptcy proceeding. Effective April 30, 2003, International Steel Group (ISG) has become the new owner of the Sparrow Point Facility and has informed EPA that it will comply with BSC’s Consent Decree. EPA subsequently modified the Consent Decree to substitute ISG for BSC for compliance with all Consent Decree requirements.

On July 15, 2006, at the request of the shipyard owner, EPA and MDE approved removal of the shipyard from the Consent Decree compliance so that the shipyard can apply for and pursue clean up under the MDE Voluntary Cleanup Program.

In 2007, the Department of Justice ordered ISG to sell the facility to settle antitrust concerns, suggesting that new ownership of the facility will soon take place. On May 7, 2009, Severstal has become the new owner of the facility and has informed EPA that it will assume the Consent Decree compliance responsibility.
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In 2007, the Maryland Port Administration (MPA) expressed interest in purchasing an inactive portion of the ISG property and turns it into a dredged spoil disposal area and ultimately reclaims the land for use as a port facility. The area the Maryland Port Administration interested in acquiring is the southwest peninsular portion of the property covering the Coke Point Landfill and former Coke Oven area. Based on the site-wide investigation, the former Coke Oven area is known to be the most contaminated land with product phase volatile and semi-volatile organic compounds present in groundwater. Any property transaction must address the environmental

liability in cleaning up this highly contaminated portion of the land. The MPA interest in purchasing the parcel is currently on hold awaiting new ownership of the facility.

A broad range of contaminants were detected at the site associated with steel making process: antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, tin, zinc, ammonia, benzene, cyanide, ethyl benzene, ethylene glycol, hydrogen cyanide, hydrogen sulfide, naphthalene, PAHs, PCBs, pentachlorophenol, phenols, pyrene, sodium phenolate, styrene, sulfuric acid, toluene, trichloroethylene, xylene, coal tar, oils, lime sludge, waste alkaline rinses, mill scale, and ship yard wastes.

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For more information about the site, visit EPA Corrective Action web page at www.epa.gov/reg3wcmd/correctiveaction.htm or MDE web page at http://www.mde.state.md.us/Programs/LandPrograms/Hazardous_Waste/hazwastecleanupsites/sparrowspt.asp

DRAFT

WORK PLAN

RISK ASSESSMENT OF OFFSHORE AREAS ADJACENT TO THE PROPOSED COKE POINT DREDGED MATERIAL CONTAINMENT FACILITY AT SPARROWS POINT

Prepared for
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PORT OF BALTIMORE 1706

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April 2010

EA Project No. 14534.17

DRAFT

WORK PLAN

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BALTIMORE, MARYLAND

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April 2010

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LIST OF ACRONYMS AND ABBREVIATIONS

ABS	Dermal Absorption Factor
AWQC	Federal Ambient Water Quality Criteria
COPC	Chemical of Potential Concern
CSM	Conceptual Site Model
DMCF	Dredged Material Containment Facility
EA	EA Engineering Science and Technology
EcoSSL	Ecological Soil Screening Level
EI	Environmental Indicator
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ER-L	Effects-Range Low
ET	Ecotoxicological Threshold
FERC	Federal Energy Regulatory Commission
ft	Feet
FS	Feasibility Study
GIABS	Gastrointestinal Dermal Absorption Factor
HHRA	Human Health Risk Assessment
HHRE	Human Health Risk Evaluation
IRIS	Integrated Risk Information System
ISG	International Steel Group
MAH	Mono aromatic hydrocarbon
MDE	Maryland Department of the Environment
MPA	Maryland Port Administration
NAPL	Non-aqueous phase liquid
OSWER	EPA Office of Solid Waste and Emergency Response
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RE&I	Rust Environmental & Infrastructure

RFI	RCRA Facility Investigation
RSL	Regional Screening Level
SAV	Submerged aquatic vegetation
SF	Slope Factor
SQB	Sediment Quality Benchmark
SQS	Sediment Quality Standards
SVOC	Semivolatile organic compound
SWI	Site Wide Investigation
TEL	Threshold Effects Level
TRV	Toxicity Reference Value
UCLM	Upper Confidence Level on the Mean
URS	URS Corporation
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
VOCs	Volatile organic compounds

1. INTRODUCTION

The Sparrows Point Facility is located on approximately 2,300 acres on the north side of the Patapsco River in Baltimore County, Maryland, approximately nine miles southeast of downtown Baltimore (**Figure 1**). The Maryland Port Administration (MPA) has expressed an interest in acquiring the Coke Point Peninsula (Coke Point) on the Sparrows Point property as a potential site for a Dredged Material Containment Facility (DMCF) for placement of dredged material from channels in Baltimore Harbor.

Sediment dredged from the Patapsco River west of the North Point-Rock Point line (**Figure 1**) is statutorily prohibited by the State of Maryland from being re-deposited in an unconfined manner into or onto any portion of the Chesapeake Bay waters or its tributaries. With only two existing placement sites currently available [the Cox Creek DMCF and the Masonville DMCF (currently under construction)], the impending dredged material placement capacity shortfall has resulted in an ongoing need to study, select, and implement new sites capable of accepting dredged material from within the Baltimore Harbor. A group of community members, citizens groups, and state and local government representatives, referred to as the Harbor Team, was tasked by MPA with identifying possible locations for placement of dredged material. After an extensive screening process by the Harbor Team, the Coke Point Peninsula was identified as one of the potential sites for construction of a DMCF.

The Coke Point Peninsula is part of a site regulated under the Resource Conservation and Recovery Act (RCRA). MPA conducted a Site Assessment of Coke Point to collect data to evaluate the nature and extent of onshore chemical sources, and to assess potential impacts to offshore sediment and surface water in concert with due diligence activities for the potential purchase of the site for use as a DMCF. This assessment included investigation of contaminants in surface water and sediment offshore from the Coke Point Peninsula (EA 2009b). The Site Assessment found that sediment quality was substantially adversely affected adjacent to most of the Peninsula shoreline, and concentrations of polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and metals were elevated above average background levels. In addition, groundwater fluxes from northwestern and eastern parts of the Peninsula to the adjacent Patapsco River and Turning Basin have negatively affected sediment and surface water quality.

MPA has requested that a risk assessment of the offshore environment be performed to assess whether the observed impacts to sediment and water present unacceptable risk, therefore warranting corrective action. A risk assessment of the area offshore of the Coke Point Peninsula will quantify the risks to both ecological systems and people who would have access to the offshore area under current conditions. This work plan describes the purpose, approach, and methods for conducting an ecological and human health risk assessment of the area offshore of Coke Point Peninsula. It also identifies data needed to support the risk assessment. If a property transfer occurs, the risk assessment will provide information for the planning and design of potential remedial measures that would accompany DMCF development. The results of the risk assessment will be integrated into the Corrective Measures Study and the Feasibility Study (FS) for the proposed DMCF construction at the Coke Point Peninsula.

1.1. PROJECT PURPOSE

The purpose of this project is to provide a preliminary assessment of human health and ecological risks for the offshore environments around the Coke Point Peninsula under current conditions. The risk assessment will quantify baseline risks at the site to support evaluation of potential risk reduction. This serves several essential purposes in support of the proposed DMCF.

First, Coke Point Peninsula is part of a site regulated under RCRA, and several chemical sources were identified at the site (EA 2009b). Results of the Site Assessment (EA 2009b) indicated that the elevated concentrations of PAHs, VOC, and metals observed in the offshore environments (specifically surface water and surface sediments) are most likely associated with sources related to Coke Point Peninsula. The construction of the proposed DMCF would provide additional dredged material capacity for sediments from the Baltimore Harbor navigation channels. This construction would require coordination with any future efforts associated with RCRA corrective measures should they be necessary. A risk assessment is necessary to identify any unacceptable site-related risks, liabilities, or remediation needs associated with the chemicals in the offshore environment to ensure a clear understanding of regulatory context and potential remediation requirements.

The results of the risk assessment will support evaluation of potential risk reduction that could be achieved through potential remedial measures. By documenting ecological and human health risks from Coke Point Peninsula-related chemicals in offshore environments under current conditions, the risk assessment provides a standard for comparison against conditions that would be expected if remedial measures were put in place and a DMCF were constructed. As discussed above, the proposed DMCF would be a component of corrective measures that are expected to result in a beneficial reduction of source-related risks. Quantifying risk reduction is an important aspect of the benefit of a DMCF at the site.

Another essential purpose of the risk assessment is to provide necessary information that could influence the design and footprint of potential alternative alignments for the DMCF, and results that will be used in the evaluation of remedial alternatives for the offshore areas in the Corrective Measures Study. Potential remedial alternatives include but are not necessarily limited to sediment capping, environmental dredging, and extending the DMCF offshore by in-water dike construction. An appropriately designed DMCF could cover sediments containing chemicals originating from the site. If the DMCF cannot be extended due to design, permitting, or other regulatory constraints, the risk assessment results will inform decisions regarding other offshore alternatives. Therefore, it is essential to conduct a risk assessment to quantify baseline risks as part of evaluating overall risk reduction.

The specific objectives of this work plan include:

1. Establish conceptual site models (CSMs) defining the potential exposure pathways linking human and ecological receptors to chemicals from Coke Point offshore environments;

2. Define the approach and methods that will be used to characterize risks;

3. Identify data gaps that should be addressed prior to initiation of the risk assessments.

1.2. SITE HISTORY

The Sparrows Point Facility has a long history of steelmaking activities. Pennsylvania Steel built the first furnace at Sparrows Point in 1887. Bethlehem Steel Corporation (BSC) purchased the facility in 1916 and enlarged it by building mills to produce hot rolled sheet, cold rolled sheet, galvanized sheet tin mill products, and steel plate. During peak steel production in 1959, the facility operated twelve coke-oven batteries, ten blast furnaces, and four open-hearth furnaces. Coke production facilities were first built on Coke Point in about 1903, expanded through the 1930s and 1950s, and operated until 1991 [Rust Environmental & Infrastructure (RE&I 1998)]. Coal tar, a primary byproduct of coking operations, was contained while awaiting sale in the Coal Tar Storage Area along the east coast of Coke Point (**Figure 2**). In addition to tar, the gas stream from the coking ovens also contained VOCs, including benzene, toluene, xylenes, and diphenyl, which were removed from the gas using absorbing oil. The VOCs were extracted from the oil and then distilled for sale in the Benzol Processing Area, to the west of the coking ovens (**Figure 2**). Organic compounds associated with these byproducts of the coking process, in particular benzene and naphthalene, have been identified in previous reports as the primary constituents of concern in groundwater on Coke Point [CH2MHill (CH2M) 2001]. Coking operations ceased in 1991, and the coke batteries have been torn down. The Sparrows Point Facility is still an active steelmaking operation, currently owned and operated by OAO Severstal.

A Consent Decree for the Sparrows Point Facility was issued by the U. S. Environmental Protection Agency (USEPA) and the Maryland Department of the Environment (MDE) in 1997. The Consent Decree provided a synopsis of activities and conditions of concern at Sparrows Point, outlined corrective measures, and included requirements for interim measures, a Site Wide Investigation (SWI), and a Corrective Measures Study. In addition, the Consent Decree mandated a comprehensive evaluation of the potential for both current and future risks to human health and the environment from current and past releases of hazardous waste and hazardous constituents at the facility. The USEPA is the lead regulatory agency for the active enforcement of RCRA requirements at the Sparrows Point Facility.

1.3. PREVIOUS SITE CHARACTERIZATION RESULTS

Previous studies at the Sparrows Point Facility focused on documenting current conditions and characterizing the subsurface hydrogeology and groundwater impacts within five special study areas. The Description of Current Conditions (RE&I 1998) reviewed the potential sources of impacts and proposed a detailed framework for future investigations. Follow-up SWI reports focused on characterizing the nature and extent of groundwater impacts within these study areas [CH2M 2001, 2002; URS Corporation (URS) 2005a, 2005b, 2006]. The Site Assessment prepared for MPA delineated the sources of chemicals and evaluated the lateral and vertical extent of the transport of chemicals to the offshore environments (EA 2009b).

Most of the Coke Point Peninsula consists of slag fill material approximately 30 feet (ft) thick. The underlying native geological formations include the Talbot Formation (primarily soft marine silt and sand with bivalve shells) that is underlain by the Patapsco Formation (generally sand and gravel with lenses of sandy clay). The Talbot Formation in the area ranges in thickness from 5 to 100 ft, and the Patapsco Formation ranges from 145 to 255 ft in thickness (RE&I 1998).

Unconfined groundwater exists within a shallow aquifer composed of the slag fill material, and intermediate and deep aquifers exist within the Talbot and Patapsco formations, respectively (URS 2005a, 2005b). The three aquifers are hydraulically interconnected, but are partially separated in areas by discontinuous lenses of silt and clay. Groundwater flow direction in the shallow aquifer is radially away from the north central portion of the Peninsula toward adjacent shoreline areas (**Figure 2**). More specifically, radial flow on the western side of the Peninsula, in the Benzol Processing Area, is toward the Patapsco River to the west. Flow on the south side of the Peninsula is south toward the southern shoreline. Flow on the east side of the Peninsula, in the Coal Tar Storage Area, is toward the Turning Basin to the east. Groundwater flow direction within the intermediate aquifer along the western portion of the Peninsula is northwestward, apparently influenced by historic pumping activities in the area of the Graving Dock (URS 2005a, 2006). Groundwater flow direction within the intermediate aquifer along the eastern portion of the Peninsula is south-southwest in the apparent direction of the natural gradient. Groundwater flow direction within the deep aquifer is unidirectional to the east-northeast.

Observed groundwater impacts resulting from historic releases on the Coke Point Peninsula are limited to the shallow and intermediate aquifers. Impacts to shallow groundwater include dissolved mono aromatic hydrocarbons (MAHs), in particular benzene and toluene, emanating from the Benzol Processing Area that have migrated in a westerly and northwesterly direction toward the Patapsco River and the Graving Dock Area (URS 2005a, 2006). Impacts to shallow groundwater also include dissolved PAHs, primarily naphthalene, emanating from the Coal Tar Storage Area that have migrated in an easterly direction toward the Turning Basin (URS 2005a, 2006). High concentrations of benzene (Suthersan 1997) occur within the intermediate aquifer of the site region referred to as the Graving Dock Area (**Figure 2**), presumably because historic pumping activities beneath the Graving Dock pulled the shallow groundwater benzene plume downward and northwestward (URS 2005a, 2006).

Recent field investigations (EA 2009a, 2009b) further delineated the sources [i.e., non-aqueous phase liquid (NAPL) and impacted slag fill material] of the previously observed subsurface impacts in the Benzol Processing, Graving Dock, and Coal Tar Storage Areas, and assessed the effects of the sources on surface water and sediment quality in the Patapsco River and the turning basin adjacent to the Peninsula. Results of the offshore investigation revealed dissolved MAHs and PAHs in surface water off the northwestern and eastern parts of the Peninsula (EA 2009a, 2009b). Based on modeling, the occurrence of these offshore dissolved constituents appeared to be related to impacted groundwater entering nearshore waters from the identified onshore source areas. Offshore sediment also had elevated PAHs and metals. PAH fingerprinting suggested that the sediment impacts are related to release(s) resulting from industrial practices at Coke Point (EA 2009b). As a result, surface water and sediment are potential media of concern for offshore receptors.

2. CONCEPTUAL SITE MODEL

A CSM has been developed for the Coke Point Peninsula. This CSM examines the potential chemical sources, chemical fate and transport mechanisms, exposure routes, and potential receptors for the site to identify complete exposure pathways that will require assessment. These exposure pathways link receptors (e.g., wildlife and humans) to the elevated chemical concentrations observed in the offshore environment.

For purposes of this risk assessment work plan, the area of interest is defined as the area within the potential outer edge of the impacted sediments that would require a corrective measure for remediation. This boundary defines the extent of chemical influence from the Coke Point Peninsula. Additional sampling planned for March 2010 may change the understanding of the boundary of the affected area.

This CSM for the Coke Point Peninsula offshore area identifies:

- the potential sources and release mechanisms for chemicals with elevated concentrations,
- the fate and transport of these chemicals,
- the media of concern at the site,
- potential pathways for ecological and human receptors, and
- potential wildlife receptors and human populations that could be exposed.

Exposure pathways that are complete and significant for the site will be included in the risk characterization. An exposure pathway describes the mechanism by which a potential receptor contacts chemicals present at a site. A complete exposure pathway requires the following four components:

- a source and mechanism of chemical release to the environment,
- an environmental transport medium for the released chemical,
- a point of potential contact with medium containing chemicals, and
- an exposure route (e.g., ingestion or dermal absorption) at the point of exposure.

All four components must exist for an exposure pathway to be complete and for exposure to occur. Incomplete exposure pathways do not result in actual exposure of receptors (wildlife or human) and will not be evaluated in the risk assessment. The exposure pathways for the ecological and human health components of the risk assessment are summarized in **Figure 3** and **Figure 4**, respectively.

2.1. CHEMICAL SOURCES AND RELEASE MECHANISMS

Potential sources of chemicals that have affected the offshore environments adjacent to the Coke Point Peninsula include the facilities, equipment, and waste associated with the steel making process. The different sources are:

- Groundwater plumes – Two groundwater plumes at the site containing substantially elevated concentrations of VOCs and PAHs were shown to be migrating into surface water (URS 2005a, 2006; EA 2009b). Generally, the plume on the west side of the site contributes benzene; the plume on the east side contributes naphthalene.

- Slag and coal tar – The Coke Point Peninsula consists of an approximately 30 foot layer of slag from steel making operations (EA 2009b). This slag acts as a potential source of metals, such as lead and zinc. The slag may also be associated with the products of combustion of hydrocarbons, which would include PAHs. Slag could also contain dioxins if PCBs or other chlorinated organic compounds were combusted.

- Graving Dock Area operations – Organotin compounds were used as anti-fouling compounds on ship hulls, and historical ship construction and repair operations may have contributed organotins to sediments in the graving dock area.

- Hydraulic equipment and transformers – The 1999 RCRA Environmental Indicators Determination for the site indicates that PCBs are a constituent of interest for the Sparrows Point Facility (USEPA 1999a). While this determination indicates that they are unlikely to have been released offshore, more recent sediment sampling indicated otherwise (EA 2009a). Because combustion of PCBs can produce dioxins, dioxins are also considered source-related compounds.

2.2. CHEMICAL TRANSPORT

Fate and transport pathways govern the transfer of elevated concentrations of chemicals between different environmental media and between different portions of the site (**Figure 3** and **Figure 4**).

Chemicals in groundwater may be transported to surface water at seeps. Elevated chemical concentrations in groundwater are currently migrating into surface water on the west and east sides of the Peninsula (EA 2009b). These chemicals may become bound in sediments or may remain dissolved and enter the water column. It is expected that concentrations in surface water contributed by seeps would be highest at ebb tide.

Chemicals in slag or soil may be transported by erosion, leaching, runoff, and adsorption/desorption. Slag onshore may be eroded and transported directly into the offshore environment. Similarly, erosion and deposition may carry sediment containing chemicals farther away from the site. Metals and other chemicals in slag may be dissolved in water during precipitation events. These may be leached downward into groundwater or may dissolve in surface runoff. Slag that is already submerged offshore forms part of the sediment. Depending on environmental conditions, chemicals in sediment may dissolve/desorb into the water column; alternatively, the sediment may adsorb chemicals from the water column.

Chemicals such as PCBs, dioxins, and organotins are hydrophobic and tend to bind to sediments; they do not tend to become dissolved in the water column. Chemicals such as VOCs and PAHs demonstrate variable dissolution, which depends on their overall concentration in the water column. Metals vary in their solubility based on pH, concentration, and the presence of oxygen. Reducing conditions in brackish, permanently submerged sediments tend to produce forms of most cationic metals (i.e. copper, lead, nickel, zinc) that remain bound in sediment, but these same reducing conditions may favor solubilization of anionic metals (i.e. arsenic).

Chemicals could become airborne in suspended dust from soil or by vaporization from surface water, but this is expected to be a relatively insignificant pathway. Another pathway is deposition of combustion product chemicals from the air.

Bioaccumulation is also a relevant transport pathway. Plants and animals that come in contact with elevated concentrations of chemicals in sediment or water may uptake chemicals, and, depending on the chemical and the organism, these chemicals may accumulate in tissue. Several metals (i.e., arsenic and lead), PCBs, and dioxins are known bioaccumulators. PAHs may bioaccumulate in crustaceans and other organisms.

2.3. MEDIA OF CONCERN

Media of concern for the risk assessment are surface sediments and surface water within the Patapsco River and the Turning Basin. For surface water, the full length of the water column is considered the exposure medium. As discussed above, chemicals in groundwater may be transported to surface sediment and surface water at seeps. Chemicals in soil may contribute to surface sediment and surface water through erosion and runoff. Surface media are the primary concern because these are the media to which, fish, wildlife, and receptors are most likely to be exposed. Subsurface sediments are unlikely to provide a significant route of exposure to ecological or human receptors.

Results of previous studies confirm that surface sediment and surface water have been affected by chemicals from the site (EA 2009b). Previous sampling has found dissolved VOCs and PAHs in surface water connected to onshore source areas. Offshore sediment also had elevated PAHs and metals. PAH fingerprinting suggested that the sediment impacts are related to release(s) resulting from industrial practices at Coke Point (EA 2009b). Groundwater connections to surface water still exist, and slag from past activities is still expected to be present in onshore and offshore environments. As a result, there is a continual mechanism for the release of chemicals to the offshore surface water and surface sediments.

2.4. ECOLOGICAL RISK - EXPOSURE PATHWAYS AND RECEPTORS

The conceptual site model for the ecological risk assessment (ERA) is based on an examination of site ecology. Based on the habitats and species expected at the site, complete pathways, assessment endpoints, and representative receptor species are selected for evaluation in the risk assessment.

2.4.1. Site Ecology

The Coke Point Peninsula is surrounded by the Patapsco River to the west and south, and the Turning Basin to the east. The water bodies around Coke Point are typically well mixed mesohaline aquatic environments in which chemical transport is greatly affected by tidal flow and surface water input from storm events (EA 2009b). Water depths adjacent to the Coke Point Peninsula are typically 2.5 to 6 ft near the shoreline, and drop off to deeper than 10 to 15 ft within 100 feet of the shoreline (GBA 2005). Sediments are predominantly silty clay (EA

2009a, 2009b, 2003), with a substantial occurrence of slag close to the shoreline. Water quality in the Patapsco River is often poor because of eutrophication, and anoxic bottom water conditions have been measured in the vicinity of the Coke Point Peninsula (EA 2003)

A Reconnaissance Study (EA 2003) characterized shoreline habitats along the Coke Point Peninsula. Most of the upland areas around the Coke Point Peninsula provide little or no habitat. Vegetation along the shoreline is sparse and comprised primarily of invasive and/or exotic species. Birds, including herons, cormorants, terns, gulls, and ospreys, utilize the site, and a cove on the western shoreline provides some deciduous cover near which ospreys have nested. No evidence of mammals or rare, threatened or endangered species was observed during the reconnaissance study. However, **Table 1** provides a list of threatened or endangered species that could potentially be present on site; no rare species were identified as potentially present (FERC 2008).

The offshore environment adjacent to the Coke Point Peninsula was also characterized in the Reconnaissance Study through fisheries studies, benthic community surveys, and review of submerged aquatic vegetation (SAV) maps (EA 2003). White perch and Atlantic silversides dominated fish surveys, although other fish species and blue crabs were collected. Benthic community survey results were evaluated using the Benthic Index of Biotic Integrity. The evaluation found that the survey locations south of the Peninsula were marginally degraded, while the survey locations west and east of the Peninsula met restoration goals. SAV maps of the area showed no stands of SAV for the years preceding the study (EA 2003). Wetland plants and SAV were not identified as abundant at the site (EA 2003), but phytoplankton was detected in the water column (EA 2004).

Studies indicated that the Patapsco River is subject to factors that may decrease the overall quality of aquatic environments (EA 2003). The Coke Point Peninsula has somewhat poor shoreline and aquatic habitats, although birds and fish do utilize the area. The health of the benthic community varies, but shows signs of degradation. SAV is not present, and wetland plants are limited to opportunistic species along the shoreline.

2.4.2. Assessment Endpoints

Assessment endpoints are clear statements of an environmental value to be protected from impacts (USEPA 1997a). Assessment endpoints are usually defined in terms of an ecological entity and its attributes. The selection of assessment endpoints is based on the fundamental knowledge of site ecology, and incorporates consideration of the COPCs, exposure pathways, toxic mechanisms and potentially important exposure groups. Per USEPA guidance (USEPA 1999b,c), the focus of the Ecological Risk Assessment (ERA) is to protect the ecological values at the site-wide population or community level except where threatened or endangered species are concerned.

The following preliminary assessment endpoints were defined to reflect the potential impacts of complete and significant exposure pathways and to aid in selecting representative receptor species:

- Viability of aquatic and benthic organism communities.

- Viability of wildlife communities, including a variety of feeding guilds and taxa likely to use site habitats.

These assessment endpoints are general and should be refined and revised if additional data become available that change the CSM. Given the poor shoreline habitat, water depth, and poor water quality, the current offshore environment around the Coke Point Peninsula is considered unlikely to support SAV or wetland plants. Therefore, viability of wetland plants/SAV was not considered as an assessment endpoint. Phytoplankton have been found at the site; these are considered part of the aquatic and benthic community.

The assessment endpoint for wildlife includes feeding guilds or taxa likely to use site habitats. Previous studies have identified several species of fish as utilizing the site. Therefore, piscivorous species which may consume crabs or fish are appropriate as potential wildlife receptors for wildlife. Because the site is not expected to support SAV or wetland plants, herbivorous wildlife are not considered potential receptors.

Birds have been observed using the site (EA 2003), and mammals, while they were not observed during habitat surveys (EA 2003) could be expected in nearshore environments. Therefore, birds and mammals are considered potential receptors. Given the poor shoreline quality habitat, mesohaline conditions, and poor water quality, reptiles and amphibians are considered unlikely to frequent the site. In addition, there are limited methods to assess risks to reptiles and amphibians quantitatively. Therefore, reptiles and amphibians are not included in the selection of representative receptors.

2.4.3. Exposure Pathway Analysis

Ecological receptors of concern that are potentially present at the site include aquatic wildlife (birds and mammals), and aquatic/benthic organisms (fish, invertebrates, and plankton). The major routes of exposure and their applicability to each of these receptor groups are presented in **Figure 3** and discussed below:

Ingestion

The most significant exposure route for wildlife is ingestion of chemicals in impacted media (USEPA 2003a). Wildlife may ingest chemicals in environmental media by drinking surface water or by incidentally ingesting soil and sediment while grooming or foraging. Chemicals may bioaccumulate in the tissue of plants and animals. Wildlife may also ingest chemicals accumulated in plants and animals that they consume as food. The Coke Point Peninsula site is expected to support a range of wildlife, including species which consume invertebrates, small birds and mammals, and fish or aquatic organisms. Ingestion of chemicals in sediment, surface water, and/or food is considered a complete and potentially significant exposure pathway for aquatic and benthic organisms and wildlife.

Direct Contact/Dermal Contact

Aquatic and benthic organisms may be exposed to chemicals in sediment and surface water through direct contact and absorption through the skin and gills. Based on this information, direct exposure to sediment and surface water is considered a complete and significant pathway for aquatic and benthic organisms.

Wildlife may be exposed to chemicals in air, soil (both surface and subsurface), sediment, or water via direct contact during foraging or burrowing. USEPA guidance identifies that, in most cases, dermal exposures are likely to be less significant than exposures through ingestion and their evaluation involves considerable uncertainty (USEPA 2003a). Given that fur and feathers are likely to limit dermal absorption of many chemicals, this exposure route is considered complete but relatively insignificant for wildlife. Therefore, dermal exposures for wildlife will not be quantitatively evaluated in the ERA.

Inhalation

Inhalation is a potentially complete pathway for wildlife. Animals may inhale chemicals which have volatilized or which are adsorbed to airborne particulates. USEPA guidance indicates that, in general, inhalation pathways are likely to be insignificant compared to ingestion pathways (USEPA 2003a). Given the low importance given to both airborne fate and exposure, inhalation exposures will not be quantitatively evaluated in the ERA.

2.4.4. Selection of Representative Receptor Species

Ecological receptors potentially present at the site include wildlife (birds, mammals) and aquatic and benthic organisms. Because ERA cannot quantitatively evaluate all of the species/receptors potentially present at a site, representative receptor species are selected. These species act as surrogates for other species within their taxa that have similar diets/feeding habitats.

Selection of representative receptor species is based on several factors:

1) the likelihood of a species to use the site and the area immediately surrounding the site,

2) the potential for exposure to site-related chemicals based on the feeding habits and life history of the organisms/guild represented by the receptor species,

3) the availability of life history and exposure information for the selected receptor species, and

4) the availability of toxicity information for the representative receptor species.

To identify potentially affected species, groups, or guilds, the feeding guilds of the organisms known to occur in the area were reviewed. Previous studies indicated that fish and crustaceans are present at the site (EA 2003); therefore, aquatic and benthic organisms as well as crab- or fish-eating (piscivorous) wildlife are potential receptors. Based on this information and the determination of the assessment endpoints, the receptors of concern in this ERA will be:

- aquatic organisms including crustaceans, fish, and algae,
- benthic organisms including crustaceans, fish, and algae,
- piscivorous birds, and
- piscivorous mammals.

Aquatic and Benthic Organisms – Toxicological benchmarks used for the evaluation of aquatic and benthic organisms are based on a wide variety of species and taxa, including crustaceans, fish, and algae. Therefore, the overall aquatic community or benthic community is identified as the representative receptor. The benchmarks used in the evaluation are highly precautionary and are typically based on organism exposures to environmental media through a variety of pathways, including direct exposure and ingestion. Therefore, both of these pathways will be examined in the assessment.

Piscivorous Wildlife - The osprey (Pandion haliaetus) is selected as the avian receptor species for evaluating potential adverse effects to birds from the ingestion of aquatic prey at the Coke Point Peninsula. Osprey were observed at the site, a large proportion of the osprey's diet is comprised of fish and larger aquatic invertebrates, and exposure data are available for quantitative evaluation of osprey food chain exposures. As representative receptors, ospreys act as surrogates for other piscivorous birds including herons, gulls, and terns.

The river otter (Lontra canadensis) is selected as the small mammalian receptor species for evaluating potential adverse effects to small mammals from the ingestion of fish and aquatic invertebrates. A river otter's diet consists primarily of fish and occasionally other aquatic organisms, and exposure data are available for quantitative evaluation of otter food chain exposures. As representative receptors, otters act as surrogates for other piscivorous mammals such as raccoon and all other mammals that may eat fish. While piscivorous mammals have not been directly observed utilizing the site, otter will be evaluated as a precautionary measure. In addition to the ingestion of chemicals in food items (water, sediment, and prey), the inadvertent ingestion of chemicals in sediment and direct consumption of chemicals in surface water will be evaluated for the above species.

It is important to note that, while the risk assessment typically quantifies the potential for adverse effects to individual organisms, the objective is to be protective of the populations that use the areas around the Coke Point Peninsula. Because few methods are available to extrapolate the potential for adverse effects from the individual level to the population level, it will be assumed that if there is no potential for direct adverse effects to individual organisms, then it is also unlikely for there to be the potential for direct adverse effects to populations. Similarly, it will be assumed that if there is the potential for adverse effects to individual organisms, then there is also the potential for adverse effects to populations. The methodology used to evaluate exposure scenarios for these receptors is discussed further in Section 3.2.

2.5. HUMAN HEALTH RISK – EXPOSURE PATHWAYS AND RECEPTORS

The CSM for the Human Health Risk Assessment (HHRA) is based on a determination of expected activities for the offshore environment. The CSM focuses on current conditions of the site. Based on the types of activities expected in the offshore environment, representative receptor populations and their activities are selected for evaluation in the risk assessment.

2.5.1. Current Land Use

The onshore area of the Coke Point Peninsula was evaluated in a RCRA Corrective Action Environmental Indicator (EI) determination for current human exposures. The EI determined that current human contact is under control and additional actions are not needed (ISG 2005). However, the EI also noted that the offshore environment is a potential area for human contact (ISG 2005). The offshore environments are not controlled and access to these areas is not limited - people may use the area for boating, swimming, or fishing. Therefore, there is a potential for human contact and complete exposure pathways do exist.

2.5.2. Potential Receptors and Exposure Scenarios

Based on the documented and potential human uses at the site, two populations were identified as potential receptors: recreational users and commercial watermen. Complete exposure pathways for the Coke Point Peninsula are presented on **Figure 4**.

Recreational Users - Recreational users can access the offshore environment of the Coke Point Peninsula by boat. Recreational users could use the surface water bodies adjacent to the Peninsula for swimming or fishing. This results in a complete contact point with chemicals identified in surface water. Because of the brackish nature of the surface water, ingestion is not expected to occur, and incidental ingestion while swimming would be minimal. Surface water dermal contact with the skin surface is the primary contact point. Surface water depths are greater than 5 feet throughout most of the offshore area. The potential dermal contact with sediment is considered a complete exposure pathway for recreational users as a conservative measure. Recreational users are assumed to fish in the area and consume their catch. Recreational users will be evaluated for three age ranges: a child (0 to 6 years), an adolescent (age 7 to 16), and an adult (>16 years).

The following exposure routes are considered complete for recreational users:

- Dermal contact with surface water,
- Dermal contact with sediment, and
- Ingestion of fish or crabs.

Commercial Watermen - Commercial watermen may also use the area. Based upon fishing methods, it is assumed that the fishermen will come in contact with surface water and sediment during fishing activities. Therefore, surface water and sediment dermal contact with the skin is a complete exposure route. The dermal area exposed to surface water and sediment is the hands and forearms only. Dermal contact with sediment is considered to be minimal for any receptor in the area based on water depth; however, the potential dermal contact with sediment is considered a complete exposure pathway for commercial watermen as a conservative measure. Incidental ingestion of surface water and sediment while fishing is likely to be non-existent to minimal and is not considered a complete exposure route. In addition, it is assumed that the watermen will ingest fish collected from the area around the Coke Point Peninsula. The commercial watermen is assumed to be an adult (>16 years).

The following exposure routes are considered complete for the commercial watermen:

- Dermal contact with surface water,
- Dermal contact with sediment, and

- Ingestion of fish or crabs.

The methodology used to evaluate exposure scenarios for these receptors is discussed further in Section 3.3.

3. RISK ASSESSMENT METHODS

Based on the results of the CSM, ecological and human health risk assessments will be completed to determine if there are potential concerns for ecological and human receptors using the Coke Point Peninsula offshore environment. The following sections review the data available for these assessments and associated data gaps, and summarize the specific methodologies that will be used in the assessments.

3.1. AVAILABLE DATA REVIEW

The previous studies conducted at the site primarily focused on the quality of the groundwater and soils in the onshore environment. Although the Site Assessment (EA 2009b) and the Pre-Pilot Study (EA 2009a) included samples from the offshore environment, data gaps related to the site exist.

3.1.1. Results of Previous Offshore Studies

To characterize the extent of the data gaps, previous studies conducted in the vicinity of the Coke Point Peninsula were reviewed, including:

- EA Engineering, Science, and Technology (EA). 2009b. *Site Assessment for the Proposed Coke Point Dredged Material Containment Facility at Sparrows Point*. Prepared for Maryland Port Administration. November.
- EA Engineering, Science, and Technology, Inc. 2009a. Technical Memo: Sparrows Point Pre-Pilot Sediment Assessment. November. Internal Draft. Prepared for the MPA.
- EA Engineering, Science, and Technology, Inc. 2003. *Reconnaissance Study of Sparrows Point as a Containment Site for Placement of Harbor Dredged Material: Environmental Conditions*. Prepared for the MPA. December.
- EA Engineering, Science, and Technology, Inc. 2004. *Feasibility Studies of Sparrows Point as a Containment Site for Placement of Harbor Dredged Material: Environmental Conditions.* Prepared for the MPA. March.
- EA Engineering, Science, and Technology, Inc. 2007b. *Sparrows Point Confirmatory Sampling (Dredged Material Characterization).* Prepared for the MPA. February.
- EA Engineering, Science, and Technology, Inc. 2009c. *FY08 Evaluation of Dredged Material: Baltimore Harbor Federal Navigation Channels*. Prepared for USACE – Baltimore. July.
- EA Engineering, Science, and Technology, Inc. 2007a. *FY05 Evaluation of Dredged Material: Baltimore Harbor Federal Navigation Channels*. Prepared for USACE – Baltimore. November.

The reconnaissance study (EA 2003), the Pre-Pilot study (EA 2009a), and the Shipyard Channel study (EA 2007b) included sampling locations in the area immediately around the Coke Point Peninsula, representing chemical concentrations that may be related to source areas on the Peninsula. Samples collected for the Feasibility Study (EA 2004) and the USACE Federal navigation channel samples from Brewerton Channel and Brewerton Angle (EA 2009c, 2007a) represent samples with chemical concentrations of typical sediments in the Patapsco River expected to be outside the direct influence of the site.

The Site Assessment (EA 2009b) included sampling at a total of 24 locations around the entire Peninsula. VOC and PAH concentrations were determined in surface water samples, and VOC, PAH, and metal concentrations were determined in the surface and subsurface sediment samples.

The Pre-Pilot Study (EA 2009a) included sampling at a total of 6 locations oriented in a transect at the southeastern portion of the site, with analysis of:

- Sediment (surface and subsurface): metals, polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), dioxins, VOCs, PAHs, and pesticides
- Site Water: metals, PCBs, SVOCs, VOCs, PAHs, and pesticides

The Reconnaissance Study (EA 2003) included 5 locations to the west, south, and east of the Peninsula. Surface sediment samples were analyzed for metals, PCBs, SVOCs, PAHs, dioxins, pesticides, and organotins.

The Feasibility Study (EA 2004) included sediment sampling at 4 locations at multiple depths, and samples were analyzed for metals, PCBs, SVOCs, VOCs, PAHs, pesticides, dioxins, and organotins.

Sampling from the Baltimore Harbor navigational channel sampling (EA 2009c, 2007a) included chemical analysis of surface sediments from 5 locations in Brewerton Channel and 5 locations in Brewerton Angle and chemical analysis of 2 site water samples in each channel reach. Samples were analyzed for metals, PCBs, SVOCs, PAHs, pesticides, dioxins, and organotins.

An additional sampling event took place in March 2010 to supplement the Site Assessment, to delineate the offshore extent of the impacted sediments, and to sample in locations in areas proposed for channel improvements, environmental dredging, and/of turning basin/berthing area construction (EA 2010).

3.1.2. Data Gap Determination

EA conducted a comparison between concentrations of chemicals detected in past nearshore sampling to those in the past background samples relatively far from the sites influence in order to determine which chemicals are likely to be associated with releases from Coke Point Peninsula and should therefore be the focus of further assessment. The risk assessment will evaluate the risks associated with all chemicals that are potentially source-related. Results from the previous studies indicated that elevated concentrations observed in the surface sediments may be related to sources on the Coke Point Peninsula (**Table 2**). Compounds that may be source-related include metals, VOCs, PAHs, PCBs, pesticides, dioxins, SVOCs, and organotins.

- Results of the Site Assessment and the additional offshore delineation will be used to evaluate risks from VOCs, PAHs, and metals in surface water and surface sediment.

- Concentrations of PCBs and dioxins detected in the previous studies were substantially higher than in samples outside the direct influence of the Coke Point Peninsula. The Environmental Indicators Determination concluded that PCBs were constituents of interest for Sparrows Point (USEPA 1999a). Because dioxins are known combustion byproducts of PCBs and other organic compounds, the elevated concentrations of dioxins observed in the surface sediments were also considered potentially source-related. Therefore, additional information about the lateral extent of the PCB and dioxin concentrations in the surface sediment is necessary to complete the risk assessment. Risk assessment models for uptake of PCBs and dioxins into fish will require the collection of total organic carbon data for all sediment samples.

- Organotins are highly toxic compounds that were historically used in anti-fouling paints on large marine vessels. The historical and current use of the Graving Dock area for large-scale ship construction and repair make this northwestern portion of the site a potential source area for organotins. Organotins have been detected in this area previously (EA 2004). Therefore, surface sediment data for organotins in the northwestern portion of the site will be necessary to complete the risk assessment.

- PCBs, dioxins, and organotins in surface water will not be evaluated in the risk assessment. These compounds are hydrophobic and unlikely to dissolve in water. Because these compounds tend to stay tightly bound to sediment particles, it is unlikely that PCBs, dioxins, and organotins would be observed in surface water at elevated concentrations. These chemicals are typically transported by erosion of contaminated soil which is deposited as sediment.

- SVOCs other than PAHs and pesticides will not be evaluated in the risk assessment. These constituents were infrequently detected in the previous studies, and the low concentrations that were detected were comparable to concentrations detected in typical sediment sampled throughout Baltimore Harbor. Additionally, a review of the site history does not indicate that the onshore environment is a source area for non-PAH SVOCs and pesticides.

Although additional, non-validated data are available from other studies (e.g. EA 2003, 2004, 2007b, 2009a), only validated chemical analytical data will be used for quantitative assessment per standard risk assessment practice. However, chemical analytical methods used in the studies were similar, and non-validated data may be used qualitatively in conjunction with quantitative results. It should be noted that data from efforts prior to the Site Assessment (EA 2009b) did not undergo data validation. In the case of most studies (EA 2003, 2004, 2007b), this does not represent a significant data gap as data are several years old, outside the current area of interest, or have been replaced by more recent samples in the same vicinity. However, this is not the case for the Pre-Pilot Study data collected in 2009 (EA 2009a). Sediment samples that were collected as part of this study were analyzed for a broad suite of chemical compounds, including PCBs and pesticides. These data occupy an area at the mouth of the Turning Basin that has no other current sample representation. Samples from this study appear to contain elevated concentrations of chemicals associated with Coke Point, and therefore would be appropriate for inclusion in the risk assessment. Lack of validation of these data is identified as a potential data gap.

Validated chemical analytical data are available from the following site investigations:

- EA Engineering, Science, and Technology (EA). 2009b. *Site Assessment for the Proposed Coke Point Dredged Material Containment Facility at Sparrows Point*. Prepared for Maryland Port Administration. Prepared for the MPA. November.

- EA Engineering, Science, and Technology (EA). 2010. *Work Plan Addendum, Coke Point Peninsula Additional Offshore Delineation and Risk Assessment Sampling, Baltimore, Maryland*. Prepared for the MPA. February.

Analytical data, as well as biological survey results, are available from other studies (e.g., EA 2003, 2004, 2007b, 2009a), and information from these studies will be evaluated qualitatively as part of the weight of evidence in risk characterization.

3.2. ECOLOGICAL RISK ASSESSMENT METHODS

The ERA for the Coke Point offshore environment will be conducted in accordance with USEPA guidance applicable to RCRA sites (USEPA 1997a). An ERA is a process in which exposure and toxicity data are combined to develop an estimate of the potential for adverse impacts on ecological receptors from chemicals in the environment. Per EPA guidance, an ERA begins with an initial, precautionary evaluation of the potential for risks using chemical analytical data from environmental media at the site and literature-based information regarding toxicity and exposure (USEPA 1997a). This is called a screening level ERA. The ERA effort for the Coke Point Peninsula offshore environment will consist of a screening level ERA, which typically consists of basic benchmark comparisons and precautionary exposure modeling, but will also include a refinement of the screening, which uses more realistic, less precautionary assumptions, site-specific qualitative information, and consideration of background concentrations. Where results of this level of ERA are not conclusive, USEPA guidance provides for further tiers of analyses that require specific collection of on-site ecological and toxicological data. Methods of further study, if warranted by the findings of the ERA, will be detailed in a Work Plan addendum.

3.2.1. Measurement Endpoints

The ERA will apply a weight of evidence approach in which multiple lines of evidence are evaluated, and their individual significance, or weight, is considered to derive a conclusion. In the case of ERA, each line of evidence is a measurement endpoint. Measurement endpoints are quantifiable ecological characteristics that are related to each assessment endpoint (USEPA 1989). Because assessment endpoints are often defined in terms of ecological characteristics that are hard to measure (i.e., the health of a population or community), measurement endpoints are selected to provide a quantifiable means of characterizing risks.

These measurement endpoints for this ERA were selected based on standard risk assessment methodology (USEPA 1997a) with consideration of the readily available data (Section 3.1).

Quantitative and qualitative measurement endpoints are presented in **Table 3** and summarized in the sections below.

3.2.1.a Aquatic and Benthic Organisms. Potential risks to aquatic and benthic organisms (plankton, invertebrates, fish) will be evaluated by comparing exposure point concentrations in surface water and sediment to toxicological benchmarks called toxicity reference values (TRVs) from the scientific literature. Benchmarks represent the threshold above which effects are expected and below which either no effect or a low effect is expected. EA has selected conservative benchmarks to ensure that all chemicals that may pose a risk are accurately identified. Comparisons will initially be made using maximum exposure point concentrations as a precautionary initial screen. Comparisons will then be refined using mean and point-by-point concentrations as exposure point concentrations. Where samples have been collected from multiple surface water depths, the maximum concentration in the water column will be utilized for precautionary initial comparisons, and the average of all depths will be used for refined comparisons. Results from individual depth samples will be evaluated qualitatively with respect to each other to identify potential hot spots or anomalies.

> **Aquatic organisms** – The primary route of exposure for aquatic or free swimming organisms is through direct contact with, ingestion of, and respiration of surface water. To determine the potential for risks, surface water concentrations will be compared directly to benchmarks protective of aquatic life. For comparisons involving surface water, Federal Ambient Water Quality Criteria (AWQC) developed by USEPA (2009a) for the protection of aquatic life will be used to assess potential impacts to benthic and aquatic organisms from surface water. These values are developed to be protective of a broad range of taxa, feeding habits, and life stages of aquatic receptors. When a chronic AWQC is not available for a particular chemical, the Tier II chronic value from Suter and Tsao (1996) will be used as the TRVs. These values are also highly conservative.
>
> **Benthic organisms** – The primary route of exposure for benthic organisms is through direct contact with and ingestion of sediment. Benchmarks for comparison against sediment concentrations will be derived from a number of sources. Effects-Range Low (ER-L) values reported in Long et al. (1995) and Long and Morgan (1990) will be employed as TRVs. Threshold effects levels (TELs) for coastal sediments derived by MacDonald et al. (1996) will be used in the absence of ER-Ls. In the absence of these TRVs, the lowest value will be chosen from sediment quality benchmark (SQB) values in Jones et al. (1997), ecotoxicological threshold (ET) values from USEPA (1996), and Washington State sediment quality standards (SQS) from Jones et al. (1997).

The refined assessment for both aquatic and benthic organisms will also include a comparison of offshore concentrations to background concentrations to determine the source-relatedness of risks. It will include a qualitative discussion of habitat quality and other factors such as bioavailability and physical factors that may influence results. Finally, the assessment will consider qualitative information available from past studies, including benthic community survey results, vegetation surveys, and fish surveys. These are potentially strong weights of evidence for or against potential risks.

3.2.1.b Wildlife. For wildlife, measurement endpoints are based on the results of food web models that predict the dose of chemicals ingested by wildlife. These doses will be compared to TRVs for wildlife. The first measurement endpoint evaluated will be a comparison of doses based on maximum exposure point concentrations to no-effects TRVs. Refinement of the models will be conducted using mean exposure point concentrations. As part of refinement, doses will be compared to low-effects TRVs as well as modeled doses for background areas. Comparison to doses modeled using background concentrations aids in determining source-relatedness of risks. The refinement will include a qualitative discussion of habitat quality and other factors such as bioavailability and physical factors that may influence results. The refinement for wildlife will also include qualitative evaluation of information available from past studies regarding habitat quality.

The exposure assumptions used in wildlife exposure models are derived from data presented in Sample et al. (1996), USEPA Ecological Soil Screening Levels (EcoSSLs), and USEPA's Exposure Factors Handbook (1993). TRVs for wildlife are generally derived based upon measurements of survival, growth, or reproduction in the laboratory. Most of the toxicity data for these calculations was derived from Sample et al. (1996) and USEPA EcoSSLs. Bioaccumulation factors relating surface water concentrations to fish tissue concentrations and relating sediment concentrations to benthic invertebrate tissue concentrations will be derived from USEPA guidance (USEPA 1999c), USEPA software and databases (USEPA 2009b, Computer Sciences Corporation 2008), consensus based studies (Bechtel 1998), and the scientific literature. While the EcoSSLs were developed for soil exposures, the models used to develop these benchmarks include ingestion rates, dose-based toxicity values, and other useful information for use in assessing aquatic exposures. When necessary, surrogate organic chemical TRVs can be used for the evaluation of potential adverse effects to wildlife. In cases where toxicological benchmarks or appropriate surrogates are not available for chemicals, the scientific literature will be reviewed for oral toxicity data.

3.2.2. Risk Characterization

Based on the results of modeling for both aquatic and benthic organisms and wildlife, a risk characterization will be prepared. The risk characterization will summarize the weight of evidence for each receptor and draw conclusions regarding the overall potential for ecological risks at the site. The risk characterization will also compare the risk findings for the site to risk findings for background areas to determine the source-relatedness of risks and relative risk contributions.

The risk characterization will also provide a spatially explicit evaluation of risk results quantifying the risks for receptors over different geographic areas. The spatial extent of elevated chemical concentrations will be examined to determine which areas contribute the greatest exposure/greatest risk to ecological populations at the site. This effort will delineate the lateral extent of offshore area that would need to be remediated to remove risk associated with the site.

The risk characterization may identify additional studies that may be useful in further understanding risks or managing the site. The risk characterization will include a discussion of uncertainties associated with the risk assessment results.

3.3. HUMAN HEALTH RISK ASSESSMENT METHODS

As shown in the CSM, there is a potential for humans to contact chemicals within the Coke Point offshore environment. Therefore, an HHRA will be completed to quantify potential current risks for human health. The HHRA will follow methods set forth in the following USEPA guidance:

- Risk Assessment Guidance for Superfund (RAGS), *Volume 1: Human Health Evaluation Manual (Part A) (Interim Final)*, USEPA 1989.

- Risk Assessment Guidance for Superfund (RAGS), *Volume 1: Human Health Evaluation Manual Supplemental Guidance – "Standard Default Exposure Factors" (Interim Final)*, Publication 9285.7-01B, USEPA 1991.

- *Guidelines for Data Usability in Risk Assessment (Part A)*. Office of Solid Waste and Emergency Response, Publication OSWER9285.7-09A, USEPA 1992.

- *Exposure Factors Handbook*, Volumes I, II, and III, USEPA 1997b.

- Risk Assessment Guidance for Superfund (RAGS), *Volume 1: Human Health Evaluation Manual (Part D, Standardized Planning, Reporting and Review of Superfund Risk Assessments)*. Office of Emergency and Remedial Response, Washington, DC, USEPA 2002.

- *Human Health Toxicity Values in Superfund Risk Assessments*. OSWER 9285.7-53. Office of Emergency and Remedial Response, USEPA 2003b.

- Risk Assessment Guidance for Superfund (RAGS), *Volume 1: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment)* Final, USEPA 2004.

The HHRA methodology will follow a four-step process: data collection and evaluation, exposure assessment, toxicity assessment, and risk characterization.

3.3.1. Data Collection and Evaluation

To ensure the quality of available data, only validated data identified in Section 3.1.2 will be used in the HHRA. Surface water and surface sediment analytical results from the previous assessments identified in Section 3.1.2 will be compared to human health risk-based criteria. State and Federal risk-based criteria are not available for the specific receptors and media identified for the Coke Point Peninsula offshore environments. As a result, site-specific risk-based criteria will be determined for the complete exposure pathways identified in the CSM. The site-specific risk-based criteria will be based upon a carcinogenic risk level of 10^{-6} or non-carcinogenic hazard quotient of 0.1. Maximum detected concentrations in surface water and surface sediment will be compared to the risk-based criteria to determine chemicals of potential concern (COPCs). COPCs identified will be evaluated further to assess current offshore site risks.

3.3.2. Exposure Assessment

The exposure assessment estimates the magnitude of potential human contact to COPCs in surface water and sediment. Each complete exposure pathway identified in the CSM (**Figure 3**) will be evaluated in the exposure assessment. The COPCs identified in surface water and surface sediment will be converted into systemic doses, taking into account rates of contact (e.g., dermal exposure areas) and absorption rates of different COPCs. The magnitude (i.e., COPC concentrations), frequency (i.e., number of days per year), and duration of these exposures are then combined to obtain estimates of daily intakes over a specified period of time (i.e., lifetime, activity-specific duration). To assess intake, an exposure point concentration (EPC) for each COPC will be determined. For the HHRA, the EPC will represent the 95% upper confidence limit on the mean (UCLM) (USEPA 1989). The EPC represents a reasonable estimate of the COPC concentration that will likely to be contacted over time. The 95%UCLM is used because in most situations, assuming long-term contact with the maximum concentration is not reasonable (USEPA 1989). The 95%UCLM will be determined through the use of the USEPA ProUCL program version 4.00.02 (USEPA 2009b). For ingestion of fish tissue and crabs, the EPC will be determined through the use of bio-uptake modeling presented in Section 3.2.1b.

3.3.3. Toxicity Assessment

The toxicity assessment considers the types of potential adverse health effects associated with exposure to COPCs; the relationship between magnitude of exposure and potential adverse effects; and related uncertainties, such as the weight of evidence of a particular COPC's carcinogenicity in humans. The HHRA will rely on existing toxicity information developed for specific chemicals. Since existing toxicity information will be used in the HHRA, these values are selected based upon USEPA guidance (USEPA 1989 and 2003b).

Toxicity values used for exposures that involve dermal contact with chemicals typically require adjustment of the oral toxicity values (oral Reference Doses [RfDs] or Slope Factors [SFs]). This adjustment accounts for the difference between the daily intake dose through dermal contact as opposed to ingestion. Most toxicity values are based on the actual administered dose and must be corrected for the percent of chemical-specific absorption that occurs across the gastrointestinal tract prior to their use in dermal contact risk assessment (USEPA 1989, 1992 and 2004). USEPA recommends utilizing oral absorption efficiency factors in converting oral toxicity values to dermal toxicity values (USEPA 2004). The chemical-specific parameters utilized in assessing dermal exposure, gastrointestinal dermal absorption factor (GIABS) and the dermal absorption factor (ABS), are selected based on latest USEPA dermal guidance (USEPA 2004). Additional chemical-specific parameters not provided in the latest USEPA guidance will be taken from the Toxicity and Chemical-Specific Factors Database (USDOE 2010), which is updated regularly.

3.3.4. Risk Characterization

In the risk characterization, the toxicity values are compared with the calculated chemical intakes for the potential receptors to quantitatively estimate both carcinogenic and non-carcinogenic effects. The risk characterization results in a numerical expression of risk for human contact with COPCs in surface water and sediment. Non-carcinogenic and carcinogenic effects will be calculated for recreational users and commercial watermen. The risk characterization will be performed following USEPA guidance (USEPA 1989). The uncertainties associated with the risk assessment results will be discussed.

4. SUMMARY AND RECOMMENDATIONS

Elevated concentrations of chemicals are present in surface water and surface sediment in the offshore environment adjacent to the Coke Point Peninsula. Previous studies indicate that these chemicals are elevated above background concentrations and are related to site sources. In addition, the CSM indicated that there are complete exposure pathways for wildlife and human receptors in the offshore environment adjacent to the site. Based on these results, the potential risk of exposure to chemicals in surface water and surface sediment warrants further evaluation through ecological and human health risk assessment. Such risk assessment would provide necessary information to support the evaluation of remedial measures for the Coke Point Peninsula. The risk assessment described in this work plan will provide information needed to identify potential unacceptable site-related risks, liabilities, or remediation needs associated with the chemicals in the offshore environment. It will provide information that can be used to evaluate potential risk reduction associated with remediation efforts coordinated with construction of the proposed DMCF. It will also provide necessary information for evaluation of the type and footprint of remedial alternatives for the offshore areas and for use in the design of the DMCF to accommodate such remediation.

This work plan sets forth the basic approach for the risk assessment. The risk assessment will be conducted according to standard EPA guidance. The focus of the risk assessment is limited to the Coke Point Peninsula offshore environment, and extends from the shoreline to the potential outer edge of the sediments affected by the site that would require a corrective measure for remediation. The receptors of concern for ecological risk assessment are aquatic organisms, benthic organisms, and wildlife (specifically piscivorous birds and mammals). The receptors of concern for human health risk assessment are recreational users and commercial watermen. The media of concern are surface water and surface sediments. Based on an evaluation of site history and existing datasets, the following chemicals are expected to be source-related: metals, PAHs, VOCs, PCBs, dioxins, and organotins.

The product of the risk assessment will be a human health and ecological risk assessment report. The report will provide quantitative risk results for the receptors and pathways discussed above; characterize whether risks are greater than, less than, or comparable to off-site risks as represented by background sampling; and identify areas with elevated concentrations of chemicals that drive risks.

This work plan also identifies the data that will be used in the risk assessment, as well as data gaps. Currently, validated chemical analytical data are available for the area of the Coke Point Peninsula from the Site Assessment conducted in 2009. Additional chemical analytical data for background areas is available from other studies, and biological information is available from a variety of studies.

Additional site-specific information is necessary to completely evaluate the risks in the offshore environments adjacent to the Coke Point Peninsula. It is recommended that additional surface water and surface sediment sampling be conducted at near-field, far-field, and background locations to augment the existing information on VOC, PAH, and metal concentrations. Additional surface sediment sampling is recommended for near-field, far-field, and background locations to obtain information about the spatial distribution and concentrations of PCBs, dioxins, and organotins. Sampling for organotins should focus only on the Graving Dock area. Sampling for surface water should focus on ebb tide when detection of chemicals leached from slag or seeping from groundwater is most likely.

It is also recommended that that the surface water and surface sediment data from the Pre-Pilot study be validated so that no additional sampling in the southeastern portion of the site will be required. While all of the surface water and surface sediment data collected in the Site Assessment was validated, none of the data from the Pre-Pilot study was validated. At this time, only the data from the Site Assessment can be used in the risk assessment. Validating the Pre-Pilot Study data would be a cost- effective means of providing spatial coverage for an important area, and would provide additional samples to support the risk assessment.

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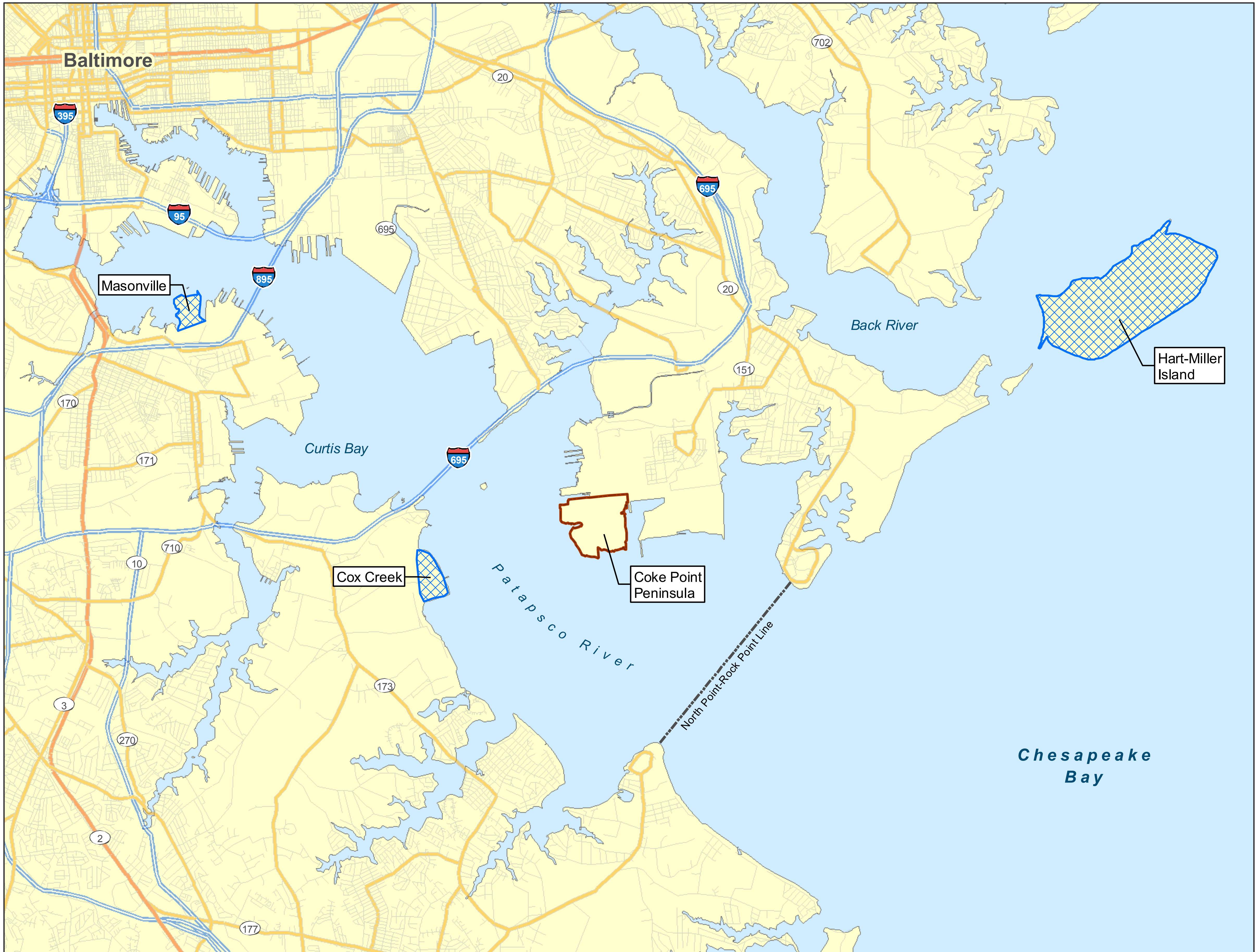
FIGURES



Work Plan

Risk Assessment of Offshore Areas Adjacent to the Proposed Coke Point Dredged Material Containment Facility at Sparrows Point

Legend

Coke Point Peninsula

Existing/Planned Dredged Material Placement Sites

Sources
Tele Atlas North America Inc., ESRI, 2006

Miles
0 1 2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

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Figure 1. Site Map, Coke Point Peninsula, Baltimore, Maryland

Work Plan

Risk Assessment of Offshore Areas
Adjacent to the Proposed Coke Point
Dredged Material Containment Facility
at Sparrows Point

Legend

Shallow Aquifer Groundwater Flow Direction

Area of Concern

Sources
ESRI, i-cubed, GeoEye, 2009
Tele Atlas North America Inc., ESRI, 2006

Feet
0 500 1,000

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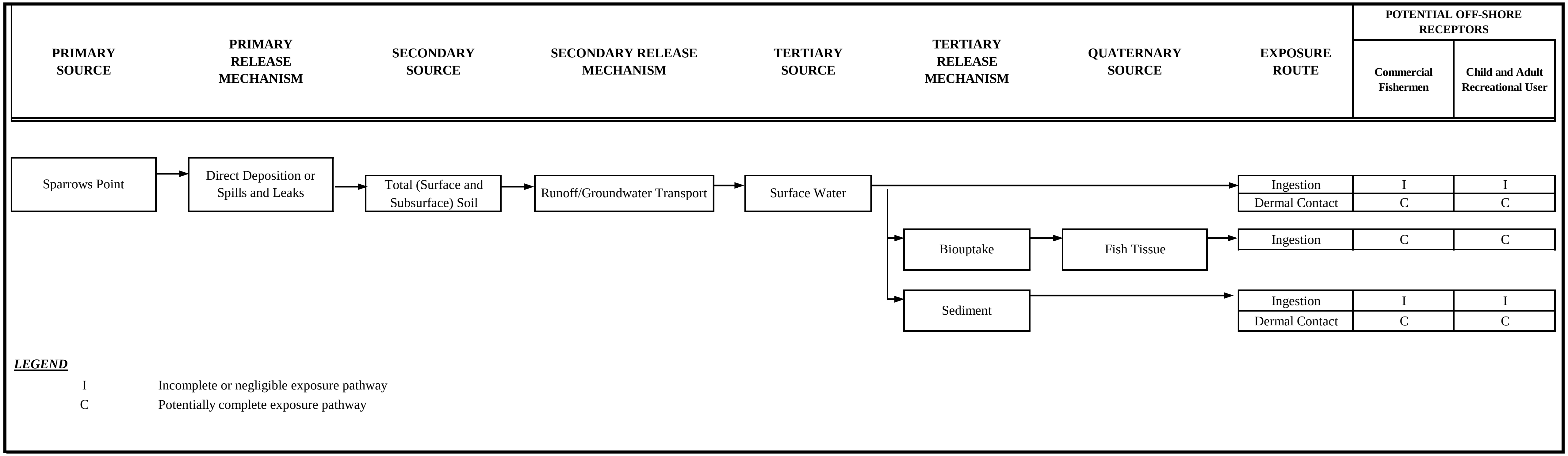
Figure 2. Areas of Concern, Coke Point Peninsula, Baltimore, Maryland

FIGURE 3
HUMAN HEALTH COMPONENTS OF THE CONCEPTUAL SITE MODEL
FOR COKE POINT OFFSHORE ENVIRONMENTS, SPARROWS POINT



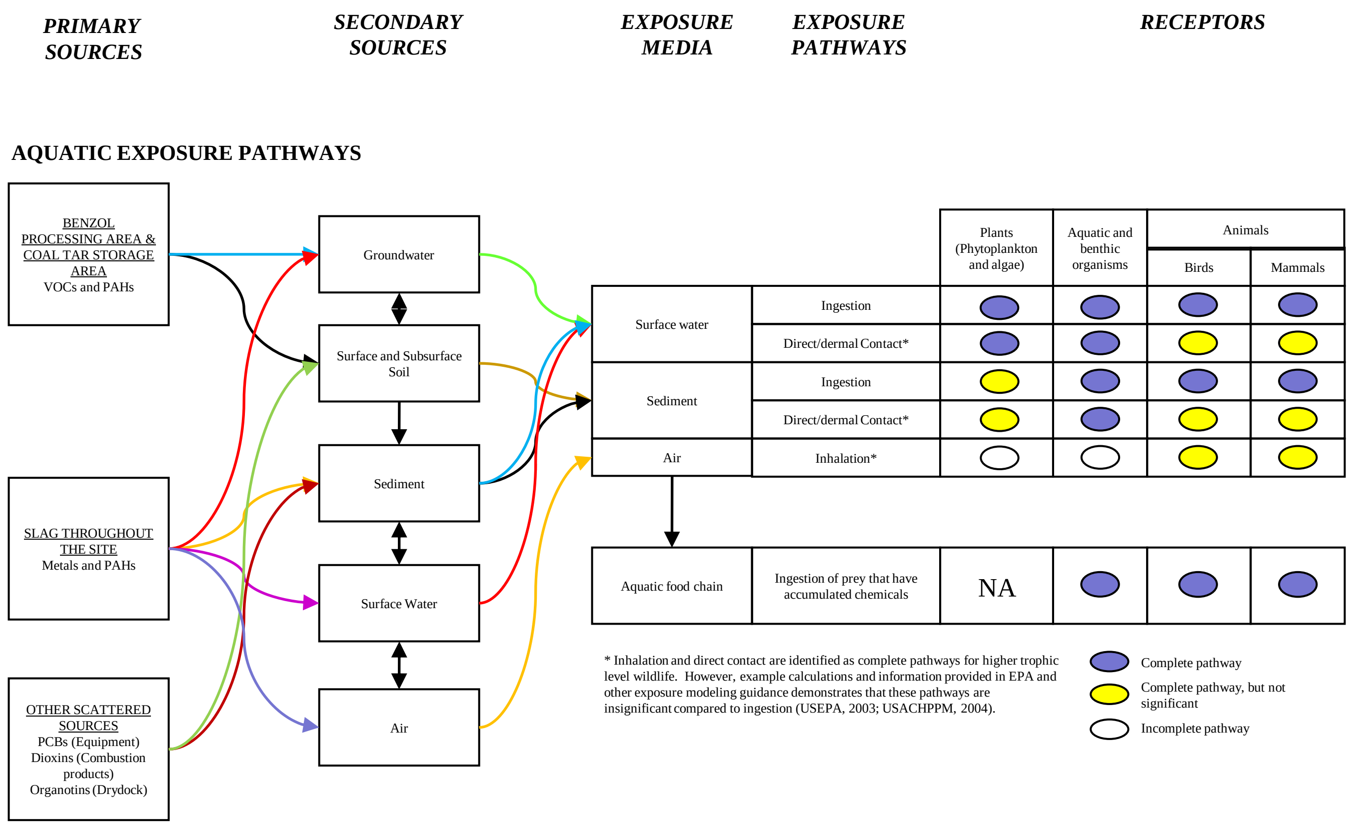


Figure 4. Ecological Components of the Conceptual Site Model for Coke Point Offshore Environments, Sparrows Point

TABLES

Table 1
Threatened and Endangered Species Identified as Potentially Occurring in or around Sparrows Point

T/E	Scientific Name*	Common Name
Federally Listed		
Mammals		
E	***Eubalaena glacialis***	**North Atlantic Right Whale**
E	***Megaptera novaeangliae***	**Humpback Whale**
E	***Balaenoptera physalus***	**Fin Whale**
E	***Physeter macrocephalus***	**Sperm Whale**
E	***Balaenoptera borealis***	**Sei Whale**
T	*Myotis sodalis*	Indiana Bat
Fish and Reptiles		
E	***Acipenser brevirostrum***	**Shortnose Sturgeon**
E	*Etheostoma sellare*	Maryland Darter
T	***Caretta caretta***	**Loggerhead Sea Turtle**
E	***Lepidochelys kempii***	**Kemp's Ridley Sea Turtle**
T	***Chelonia mydas***	**Green Sea Turtle**
E	***Dermochelys coricea***	**Leatherback Sea Turtle**
T	*Glyptemys muhlenbergii*	Bog Turtle
Insects		
T	*Cicindela dorsalis dorsalis*	Northeastern Beach Tiger Beetle
State Listed		
Birds		
T	***Haliaeetus leucocephalus***	**Bald Eagle**
T	***Stermula antillarum***	**Least tern**
Fish		
E	***Acipenser oxyrinchus***	**Atlantic Sturgeon**
T	*Percina caprodes*	Logperch
Invertebrates		
E	*Speyeria idalia*	Regal Fritillary
Plants		
E	*Polanisia dodecandra*	Clammyweed
T	*Polygala senega*	Seneca Snakeroot
T	*Scutellaria leonardii*	Leonard's Skullcap
E	*Sporobolus heterolepis*	Northern Dropseed
T	*Stenanthium gramineum*	Featherbells
T	*Talinum teretifolium*	Fameflower
E	*Aster depauperatus*	Serpentine Aster
T	*Sanguisorba canadensis*	Canada burnet
E	*Agalinis setacea*	Thread-leaved foxglove
T	*Elephantopus carolinianus*	Elephant's Foot
T	*Fimbristylis annua*	Annual Fimbry
T	*Scleria pauciflora*	Few-flowered Nutrush
E	*Sisyrinchium atlanticum*	Eastern Blue-eyed Grass
E	*Vernonia glauca*	Tawny ironweed
E	*Bromus latiglumis*	Broad-glumed Brome

Table 1 continued

T/E	Scientific Name*	Common Name
State Listed		
Plants		
T	*Hydrastis canadensis*	Goldenseal
E	*Carex hitchcockiana*	Hitchcock's Sedge
E	*Carex hystericina*	Porcupine Sedge
E	*Deschampsia cespitosa*	Tufted Hairgrass
T	*Ellisia nyctelea*	Ellisia
E	*Helianthemum bicknellii*	Hoary Frostweed
T	*Magnolia tripetala*	Umbrella Magnolia
T	*Chrysopsis mariana*	Maryland Golden-Aster

***** Names in **bold** indicate organisms that could potentially use mesohaline offshore aquatic habitats.
Source: Federal Energy Regulatory Commission (FERC). 2008. Final Environmental Impact Statement Sparrows Point LNG Terminal and Pipeline Project. Federal Energy Regulatory Commission, Office of Energy Projects. December 2008.

TABLE 2
COMPARISON OF SURFACE SEDIMENT CONCENTRATIONS FOR POTENTIALLY SOURCE-RELATED CONSTITUENTS

ANALYTE	UNITS	TEL[1]	PEL[1]	RSL[2]	BACKGROUND CONCENTRATIONS					COKE POINT CONCENTRATIONS FROM PAST STUDIES							
					BREWERTON CHANNEL[3]		BREWERTON ANGLE[3]	2004 FEASIBILITY STUDY (SAMPLES EH-2, EH-3, EH-4)[4]		2003 RECON STUDY (SAMPLES B1 THROUGH B4)[5]		2007 SHIPYARD CHANNEL[6]		2009 PRE PILOT STUDY[7]		2009 SITE ASSESSMENT[8]	
					Sample	Duplicate		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
METALS*																	
ARSENIC	MG/KG	7.24	41.6	16	19.4	15.8	14	2.2	3.3	14.6	42.5	4.7	56.9	8.2	72	4	105
CADMIUM	MG/KG	0.676	4.21	8,100	0.99	0.86	0.94	0.083	0.13	1.2	2.5	ND	1.6	0.36	7.7	0.19	9.1
CHROMIUM	MG/KG	52.3	160.4	14,000	107	76.3	82.2	24.5	34.2	93.1	391	31.5	328	42	362	15.7	806
COPPER	MG/KG	18.7	108.2	410,000	69.5	53	55.6	4.6	8.3	79.8	305	13	201	27.4	431	6.6	595
LEAD	MG/KG	30.24	112.18	8,000	102	82.2	77.1	6.8	8.5	197	470	14.9	203	43	1,280	7.2	2,990
MERCURY	MG/KG	0.13	0.696	280	0.29	0.25	0.25	ND	0.021	0.5	1.4	0.039	0.32	0.15	1.2	0.011	5.5
NICKEL	MG/KG	15.9	42.8	200,000	48.8	47.3	40.3	2.5	4.2	27.1	42.2	10.6	43.7	25.4	51.5	5.1	56.4
SILVER	MG/KG	0.73	1.77	51,000	0.67	0.56	0.58	0.038	0.1	0.84	2.2	0.18	1.5	0.12	2.8	0.037	4.2
ZINC	MG/KG	124	271	3,100,000	360	306	288	30.1	42.3	628	1,430	58.1	670	99.5	2,250	28.8	3,730
PAHs																	
TOTAL PAHs (ND=0 MDL)	UG/KG	1,684.06	16,770.40	--	3,927	3,550	2,640	46	127	18,346	229,530	466	13,980	6,457	458,900	8.4	7,354,200
TOTAL PAHs (ND=1/2 MDL)	UG/KG	1,684.06	16,770.40	--	3,927	3,555	2,653	52.7	129	18,346	230,430	2,041	13,980	6,473	460,000	260	7,354,295
PCBs																	
TOTAL PCBs (ND=0 MDL)	UG/KG	21.55	188.79	--	33.5	35.8	30.9	0.884	3.44	81	460.4	1.16	196	ND	451	--	--
TOTAL PCBs (ND=1/2 MDL)	UG/KG	21.55	188.79	--	34.3	36.6	31.5	1.51	3.8	87.4	474.5	22.6	202	28.8	461	--	--
ORGANOTINS																	
TRIBUTYLTIN	UG/KG	--	--	--	ND	ND	ND	ND	ND	ND	19	--	--	ND	ND	--	--
DIOXIN AND FURAN CONGENERS																	
DIOXIN TEQ (ND=0)	PG/G	--	--	--	--	--	--	0.137	0.329	14.6	64.6	--	--	--	--	--	--
DIOXIN TEQ (ND=1/2 DL)	PG/G	--	--	--	12.7	15.2	7.97	0.577	0.795	17.5	64.7	--	--	4.44	42.4	--	--
SVOCs																	
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	182.16	2,646.51	1,200,000	120	110	78	ND	ND	ND	1,700	ND	440	--	--	--	--
DIBENZOFURAN	UG/KG	--	--	--	47	44	34	ND	ND	ND	3,100	--	--	--	--	--	--
VOCs																	
BENZENE	UG/KG	--	--	--	--	--	--	ND	ND	--	--	ND	ND	ND	ND	4	36,000
ETHYLBENZENE	UG/KG	--	--	--	--	--	--	ND	ND	--	--	ND	ND	ND	ND	4.4	4,000
METHYLENE CHLORIDE	UG/KG	--	--	--	--	--	--	ND	3.4	--	--	7.1	31	ND	3.6	6.7	15
TOLUENE	UG/KG	--	--	--	--	--	--	ND	ND	--	--	ND	ND	ND	ND	2.4	3,600

(1) Source: MacDonald *et al.* 1996. Ecotoxicology 5: 253-278.
(2) Source: USEPA 2008. Regional Screening Levels (RSLs); industrial soil scenario
(3) Source: EA. 2009c. Final Report FY 08 Evaluation of Dredged Material: Baltimore Harbor Federal Navigation Channels, Patapsco River, Maryland. July.
(4) Source: EA. 2004. Feasibility Studies of Sparrows Point as a Containment Site for Placement of Harbor Dredged Material: Environmental Conditions.
(5) Source: EA. 2003. Reconnaissance Study of Sparrows Point as a Containment Site for Placement of Harbor Dredged Material: Environmental Conditions. March.
(6) Source: EA. 2007b. Final Report Sparrows Point Confirmatory Sampling (Dredged Material Characterization) Sparrows Point Shipyard, Baltimore Harbor, Baltimore, Maryland. February. December.
(7) Source: EA. 2009a. Coke Point Dredged Material Containment Facility Pre-Pilot Study Sediment Characterization. Draft.
(8) Source: EA. (EA). 2009b. Site Assessment for the Proposed Coke Point Dredged Material Containment Facility at Sparrows Point. Final. November.
***** For metals, table presents a subset of potentially source-related detected analytes.
"--" = compound not analyzed
ND = non detect

Table 3:
Measurement Endpoints for Ecological Risk Assessment of the Sparrows Point Facility

Assessment Endpoint	Measurement Endpoint	On Site-Measurements/Exposure Point Concentrations (EPC)	Evaluation Method	Risk Indicators
Receptor-Specific Evaluation (Screening Levek Ecological Risk Assessment & BRAPF)				
Viability of aquatic and benthic organism communities • Fish • Crustaceans • Algae	Comparison of sediment and surface water concentrations to benchmarks and to Region III BTAG Screening Levels	• Sediment and surface water concentrations measured at site in past and more recent sampling - Maximum Concentrations - Mean concentrations and concentrations on a sample by sample basis	• Direct comparison to aquatic organism benchmarks from literature-based studies • Direct comparison to background concentrations	• Exceedence of benchmarks indicates potential for risks • Exceedence of benchmarks and background indicates a more certain potential for risks
Viability of wildlife communities - piscivorous mammals and birds	Comparison of modeled food web doses to benchmarks • Osprey • Otter	• Sediment and surface water concentrations measured at site in past and more recent sampling - Maximum Concentrations - Mean Concentrations • Aquatic food item tissue concentrations modeled using literature-based equations - Maximum Concentrations - Mean Concentrations • Ingested dose based on literature-based exposure factors and uptake equations - Maximum Dose - Mean Dose	• Compare modeled wildlife doses to no-effects benchmarks • Compare modeled wildlife doses to low-effects benchmarks • Dose-based benchmarks from 1) USEPA EcoSSL 2) ORNL benchmarks (Sample et al., 1996) 3) Additional literatue-based sources as relevant	• Exceedence of benchmarks indicates a potential for risks • Exceedence of low-effects benchmarks indicates a more certain potential for risks
	Comparison of modeled food web doses on site to modeled food web doses for background concentrations • Osprey • Otter	• Sediment and surface water concentrations measured at site and in background areas - Maximum and Mean Concentrations • Aquatic organism food item tissue concentrations modeled using literature-based equations - Maximum and Mean Concentrations • Ingested dose based on literature-based exposure factors and uptake equations - Maximum and Mean Dose	• Compare modeled on-site wildlife doses to modeled background wildlife doses	• Exceedence of both benchmarks and background indicates a more certain potential for risks