Construction Sampling and Analysis Plan
Area 1, Phase 1 Development

Baltimore Works Site
Baltimore, Maryland

March 2014

By:
Environmental Resources Management Inc.
Harbor Point Development LLC

For:
U.S. Environmental Protection Agency – Region III
Maryland Department of the Environment

Construction Sampling and Analysis Plan for

Area 1, Phase 1 Development

Baltimore Works Site

Harbor Point Development, LLC

1300 Thames Street, Suite 110

Baltimore, Maryland 21231

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Harbor Point Development, LLC, Project Manager: Jonathan Flesher

Environmental Resources Management, Inc., QA Officer: Larry Hottenstein

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Region 3 Quality Assurance Manager

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1.0 INTRODUCTION

The Harbor Point, Area 1, Phase 1 Development will occur at a location (the site) that was formerly a chromium chemical manufacturing facility. The historical manufacturing processes at the site resulted in chromium impacts to soil and groundwater. Hexavalent chromium (CrVI) is considered by the EPA to be a known human carcinogen by the inhalation route of exposure (EPA 2013). Inhalation of CrVI dusts is also associated with non-cancer toxicity.

Phase 1 of the development project consists of the Exelon Tower and Trading Floor Garage, the Central Plaza Garage, modifications to the existing Transfer Station, general site development (streets, sidewalks, etc.) and utilities, foundations, roadways, and other related site development elements and remedy restorations for development.

Because of the dynamic nature of dust-disturbing activities during construction, providing real time information on concentration levels of particulates to project personnel during construction is necessary in order that dust-generating activities on site can be appropriately controlled.

Real-time instrumentation is available to measure ambient concentrations of total particulate matter (Total PM), but such instrumentation is not available for measuring CrVI concentrations in real-time. Therefore, air samples for measuring CrVI concentrations require laboratory analysis.

The goal of the construction air monitoring and sampling is to collect Total PM and CrVI data from six (6) permanent monitoring stations located at the perimeter of the site and off-site. One of the permanent locations will include a seventh (7) co-located sampler for CrVI and a duplicate monitor for Total PM. In addition, Total PM data will be collected from two or more mobile work zone locations established close to intrusive activities. The intended use of the construction air monitoring data from the fixed monitoring stations is to compare Total PM and CrVI concentration data collected during construction to the Total PM action level and CrVI background threshold value (BTV) established from the pre-construction air monitoring study. In addition, the fixed monitoring off-site location data may be used as necessary to refine the pre-construction action level and BTV, with the approval of EPA and MDE. The intended use of the work zone data is to compare work zone Total PM to the action level established during the pre-construction monitoring in

order that work activities can be adjusted as warranted to prevent dust exposures above the action level.

1.1 SITE NAME

Baltimore Works

1.2 SITE LOCATION

The site is located on a peninsula on the northeast shore of the Patapsco River of the Inner Harbor, in the Fells Point section of Baltimore City, Maryland (Figure 1).

1.3 RESPONSIBLE AGENT

Environmental Resources Management, Inc. (ERM) will be responsible for the implementation and conduct of the air monitoring program for this project. ERM is a leading global provider of environmental, health, safety, risk, social consulting services and sustainability related services with more than 5,000 people in over 40 countries and territories working out of more than 150 offices. ERM's Annapolis, MD office will provide the field and project management staff and the Irvine, CA office will provide quality control/assurance personnel for the project.

1.4 PROJECT ORGANIZATION

Table 1. Project Organization

Name	Title/Role	Organizational Affiliation	Responsibilities
Jonathan Flesher	Project Manager	Harbor Point Development, LLC (HPD)	• Oversees all project activities. • Directs the scope of work to the ERM Project Manager (PM). • Reviews and approves all documents and coordinates transmittal of documents to appropriate parties for review. • Communicates with stakeholders regarding project activities.
Lenny Rafalko	Partner-in-Charge	ERM	• Oversees entire program for ERM. • Reviews (or performed by designee under his direction) all final deliverables and invoices. • Seeks HPD feedback on performance of project managers. • Addresses program-level issues.
Darren Quillen	Project Manager	ERM	• Reports to ERM Partner-in-Charge (Leonard Rafalko) and HPD (Jonathan Flesher) • Directs ERM Technical Lead/Field Manager (FM) and subcontractors. • Communicates questions or issues to HPD for communication to Agency leads (Ed Dexter, MDE and Russell Fish, EPA). • Ensures that assigned staff has been trained in implementation of project control documents such as SOPs, SAP, etc. • Ensures that all key decisions and project deliverables are subjected to independent technical review by qualified personnel within the time frame of the project schedule.

Name	Title/Role	Organizational Affiliation	Responsibilities
Larry Hottenstein	QA/QC Manager	ERM	• Works with ERM PM and FM to monitor subcontractor (CrVI analysis) for compliance with both project and data quality requirements records, costs, and progress of the work and re-plan and re-schedule work tasks as appropriate. • Works with ERM FM to ensure and document that QC checks on field equipment are performed according to schedule and meet acceptance criteria, and the QA/QC • Works with ERM FM to resolve field QA/QC issues. • Audit sample preservation, handling, transport, and custody procedures throughout the project. • Review and approve all data reduction and reporting procedures for inclusion in deliverables. • Review and respond to audit assessment findings, determine the root cause for any nonconformance, confer with the ERM PM, ERM FM and Partner in Charge on the steps to be taken for correction, and ensure that procedures are modified to reflect the corrective action and are distributed to all field personnel, including subcontractors. • Report QA and any procedural problems to the ERM PM and Partner in Charge
Jeff Boggs	Technical Lead/ Field Manager (FM)	ERM	• Provide technical support to ERM's PM, QA Manager, and Field Technician as needed. • Reports to ERM PM. • Prepares and implements this SAP and deliverables. • Ensures data collection activities are consistent with approved SAP, SOP and QAPP requirements. • Oversees evaluation of data received from the laboratory in accordance with the project requirements. • Prepares or oversees the preparation of portions of the reports that summarize data results and present conclusions.

Name	Title/Role	Organizational Affiliation	Responsibilities
Charles McClellan	Primary Field Technician (other qualified personnel may support Field Technician as appropriate)	ERM	• Performs monitoring and collects samples according to project approved QAPP, SOPs and this SAP. • Reports to ERM Field Manager (if Field Manager not available, report to ERM PM). • Communicates any problems or deviations from project plans to ERM Field Manager. • Ensures that all data collection and handling activities comply with applicable SOPs, including audits conducted in the presence of Agency personnel. • Prepares and maintains field forms, notebooks, and equipment. • Implements technical procedures applicable to tasks. • Inspects and accepts supplies and consumables. • Coordinates and schedules sample shipment to analytical laboratory to meet holding times and analytical procedure specifications.
Julie Swift	Project Manager	ERG	• Reviews and implements analytical laboratory elements of this SAP with regards to the CrVI analysis. • Manages analytical chemists to complete the sample analyses selected in this SAP, according to the approved methods. • Monitors, reviews, and documents the quality of all analytical chemistry work performed by ERG under this SAP. • Oversees management of analytical data. • Transmits completed data packages to the ERM Quality Manager • Promptly informs ERM's QA/QC Manager of any laboratory analytical problems, data quality issues, or delays in sample analysis. • Promptly responds to any data quality issues identified through the independent data validation process.

1.5 STATEMENT OF THE SPECIFIC PROBLEM

The problem being addressed is to ensure that representative and accurate real-time particulate and airborne CrVI concentration data are collected to define the construction particulate population for comparison to the action

level for Total PM and the BTV for CrVI established during the pre-construction monitoring. This data will be used to ensure that the site perimeter and work zones are accurately monitored during construction intrusive activities so that control measures can be implemented in a timely manner in the event that monitoring indicates encroachment to or exceedances of the Total PM action level. For the purpose of this Plan, "intrusive activities" occur any time there is disturbance of the surface immediately below the synthetic layers of the existing MMC in Area 1.

2.0 BACKGROUND

Area 1 is the principal site of Honeywell's (formerly AlliedSignal) Baltimore Works Facility which included chromium processing production and support buildings on an area that covered approximately 14 acres. The principal contaminant of concern in Area 1 is hexavalent chromium (CrVI). An Environmental Remediation System (ERS) is maintained and operated by Honeywell International Inc. (Honeywell) to contain CrVI-impacted groundwater in Area 1 and control the potential for human exposure to affected soil.

The site development must not interfere with the efficacy of the corrective measures or Honeywell's ability to comply with the performance standards defined in the Consent Decree between Honeywell, the U.S. Department of Justice, U.S. Environmental Protection Agency and the Maryland Department of the Environment.

2.1 SAMPLING AREA DESCRIPTION

The site occupies approximately 14 acres in an urban area. The site is bordered on the north by the Living Classrooms, on the west by a marina, on the south by the Northwest Branch of the Patapsco River, and on the east by the Thames Street Wharf office Building. The specific location of the site is shown in Figure 1.

The original buildings and infrastructure associated with the Baltimore Works chromium plant have been removed from the site. The ERS is operated by Honeywell and consists of a Multimedia cap (MMC), Hydraulic barrier, Head Maintenance System (HMS), a groundwater storage and transfer system, and Outboard Embankment. A two-story building, the Transfer Station, is currently in use in support of the HMS.

2.2 OPERATIONAL HISTORY

There are no operations at the site other than those associated with the ERS. Those operations were initiated in 2002 following completion of corrective actions. Approximately 60,000 gallons of chromium contaminated groundwater are withdrawn annually by the HMS, temporarily stored the Transfer Station tank room and transported off-site for treatment at Environmental Quality of Pennsylvania.

2.3 PREVIOUS INVESTIGATIONS/REGULATORY INVOLVEMENT

This site has been the subject of numerous Agency-led investigations dating back to 1989. These investigations culminated in the approved corrective measures implementation and are included in the administrative record.

2.4 ENVIRONMENTAL AND/OR HUMAN IMPACT

The primary concern is the potential for particulates containing CrVI to be distributed on-site and transmitted off-site during the period of construction that involves the disturbance of contaminated materials below the MMC. CrVI is considered by the EPA to be a known human carcinogen by the inhalation route of exposure (EPA 2013). Inhalation of CrVI dusts is also associated with non-cancer toxicity.

3.0 PROJECT DATA QUALITY OBJECTIVES

This section formulates the problem that the sampling needs to solve and determines the level of data quality necessary to address the problem. Specifically, data quality objectives and indicators are developed to ensure that the collected data will be of sufficient quality to be able to adequately address the problem.

3.1 PROJECT TASK AND PROBLEM DEFINITION

The purpose of the construction air monitoring is to collect representative and accurate real-time airborne total PM and CrVI laboratory analytical data to define the construction particulate population for comparison to the action level for Total PM as defined by pre-construction air monitoring, and to the BTV for CrVI, also defined by pre-construction air monitoring.

3.2 DATA QUALITY OBJECTIVES (DQOS)

Data quality objectives (DQOs) are quantitative and qualitative statements that define study objectives, the appropriate type of data, specify tolerable levels of potential decision errors, and define the performance criteria limiting the decision errors.

This following describes decisions to be made based on the data and provides criteria on which these decisions will be made.

- Concisely describe the problem to be studied.

The problem being addressed is to ensure that representative and accurate real-time particulate and airborne CrVI data are collected to define the particulate population during construction intrusive activities for comparison to the action level for Total PM and BTV for CrVI.

- Identify what questions the monitoring and sampling will attempt to resolve, and what actions (decisions) may result.

  Are the real-time airborne Total PM and CrVI concentration data representative of the conditions present during construction intrusive activities?

Can the real-time total particulate monitors accurately detect particulate releases from on-site intrusive construction activity in order to avert off-site particulate transmission?

This data will be used to compare Total PM and CrVI concentration data during construction intrusive activities to the established Total PM action level and CrVI BTV to ensure that the site perimeter and work zones are accurately monitored during these activities to control any potential dust release in a timely manner.

- Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.

  Real-time Total PM (direct reading instrumentation), meteorological data (on-site station) and particulate CrVI data (laboratory analysis) using accurate, field and laboratory methods, including data quality review from multiple sampling locations (on site and off site) that are representative of conditions during construction intrusive activities for comparison to Total PM action level and CrVI BTV.

- Define study boundaries and when and where data should be collected.

  The study boundaries are the atmosphere at the site and adjacent urban area. Air monitoring stations will be located at the site perimeter to address conditions upwind and downwind of construction intrusive activities, and at off-site locations representative of urban conditions. In addition, a minimum of two (2) downwind DustTrak monitor sampling locations will be established at each separate and intrusive work zone. The construction air monitoring and sampling will be conducted during intrusive construction work days.

3.3 DATA QUALITY INDICATORS (DQIS)

Data quality indicators (accuracy, precision, completeness, representativeness, comparability, and method detection limits) refer to quality control criteria established for various aspects of data gathering, sampling, or analysis activity. In defining DQIs specifically for the project, the level of uncertainty associated with each measurement is defined.

ERM has reviewed, understands and agrees with the DQI's defined by the contract laboratory Eastern Research Group, Inc.'s (ERG) Standard Operating Procedures (SOP), dated 20 February 2014, for hexavalent chromium analysis per ASTM D7614. Based upon our review and understandings of the DQIs provided in ERG's SOP, ERM has determined that the laboratory can meet the project needs.

- Accuracy is the degree of agreement of a measurement with a known or true value. To determine accuracy, a laboratory value is compared to a known or true concentration determined by such QC indicators as: matrix spikes, surrogate spikes, laboratory control samples (blind spikes) and performance samples. For the Cr(VI) analyses covered under this SAP, accuracy will be determined according to the ASTM method – a filter method spike with acceptance criteria of 80% – 120%.

  Accuracy shall be calculated as percent recovery of spiked analytes as follows:

  $$\%R_i = \left(Y_i \div X_i\right) \times 100\%$$

  where:

  $\%R_i$ = percent recovery for compound *i*

  Y_i = measured spike concentration in sample *i* (sample concentration with the spike - original sample concentration)

  X_i = actual spike amount in sample *i*

- Precision is the degree of mutual agreement between or among independent measurement of a similar site setting. Precision is expressed in terms of analytical variability. For this project, analytical variability will be measured as the relative percent difference (RPD) between results of duplicate monitors and between results of co-located samplers.

  Precision will be calculated as the RPD as follows:

  $$\%RPDi = \frac{[Oi - Di]}{(Oi + Di)/2} \; x \; 100\%$$

  where:

$\%RPD_i$ = Relative percent difference for compound *i*

O_i = Value of compound *i* in original sample

D_i = Value of compound *i* in duplicate sample

Duplicate Total PM concentration data and co-located CrVI sample concentration results ("primary" and "duplicate") will be compared to determine the RPD. The acceptable RPD for real-time Total PM is <40% and for CrVI is <20%.

- Completeness is expressed as percent of valid usable data actually obtained compared to the amount that was expected. According to EPA guidance, completeness goals in the range of 75% - 95% are typical. The target goal for completeness for this project is 90% percent for all data, given the critical importance of the data in determining the efficacy of dust controls implemented during construction. Completeness will be calculated as follows:

$$\%C = \frac{A}{I} x100\%$$

where:

$\%C$ = Percent completeness (analytical)

A = Number of usable sample results reported (all results not rejected)

I = Total number of results reported

Non-valid data (i.e., data qualified as "R" rejected) will be identified during the data review and the reasons for rejection explained in the data review report.

- Representativeness is the expression of the degree to which data accurately and precisely represent a characteristic of an environmental condition or a population. It relates both to the area of interest and to the method of taking the individual sample.

Representativeness of the environmental conditions at the time of sampling will be achieved by selecting sampling locations, methods, and times so that the data describe the site and local, urban air conditions that the project seeks to evaluate during construction intrusive activities. Representative samples will also

be ensured through following proper protocols for sample handling (storage, preservation, packaging, custody, and transportation), sample documentation, and laboratory sample handling and documentation procedures.

- Comparability expresses the confidence with which one data set can be compared to another. The comparability goal will be achieved by maintaining consistency in sampling conditions, selection of sampling procedures, sample preservation methods, and analytical methods as provided in ASTM D7614.

  The method detection limit for CrVI as provided by the contract laboratory, ERG, is 0.0078 nanograms per milliliter (ng/mL) (0.0036 ng per cubic meter (M^3) based on 21.6 M^3 sample volume, i.e., 15 liters per minute for 24 hours).

Table 2 provides the summary of laboratory quality control procedures and corrective actions for evaluating laboratory QC samples.

Table 2. Summary of Quality Control Procedures for CrVI Analysis

Parameter	Frequency	Acceptance Criteria	Corrective Action
Initial 5-point calibration standards	Before every sequence	Correlation coefficient≥ 0.995	1) Repeat analysis of calibration standards. 2) Prepare calibration standards and reanalyze.
Initial Calibration Verification (ICV)	Before every sequence, following the initial calibration	Recovery 85-115%	1) Repeat analysis of initial calibration verification standard. 2) Repeat analysis of calibration standards. 3) Prepare calibration standards and reanalyze.
Initial Calibration Blank (ICB)	One per Batch, following the ICV	Below MDL	1) Reanalyze. 2) Prepare blank and reanalyze. 3) Correct contamination and reanalyze blank. 4) Flag data of all samples in the batch.

Parameter	Frequency	Acceptance Criteria	Corrective Action
Continuing Calibration Verification (CCV)	Every 10 samples and at the end of the analytical sequence	Recovery 85-115%	1) Repeat analysis of CCV. 2) Prepare CCV. 3) Flag data bracketed by unacceptable CCV.
Laboratory Control Sample	One per 10 samples	Recovery 80-120%	1) Reanalyze. 2) Prepare spike and reanalyze.
Replicate Analysis	Duplicate and/or Replicate samples only	RPD < 20% for concentrations greater than 5 x the MDL.	1) Check integration 2) Check instrument function 3) Flag samples
Continuing Calibration Blank (CCB)	After every CCV and at the end of the sequence	Below MDL	1) Reanalyze. 2) Prepare blank and reanalyze. 3) Correct contamination and reanalyze blank. 4) Flag data of all samples in the batch.

3.4 DATA REVIEW AND VALIDATION

This section describes data review, including what organizations or individuals will be responsible for what aspects of data review and what the review will include. Laboratory data (i.e., CrVI analyses) will be validated by an independent 3rd party reviewer following protocols per EPA requirements. Laboratory data review includes raw data such as standards used, log books, extractions logs, instrument print outs, chromatograms (ifapplicable), mass spectra (if applicable), etc. Calibration data, sample analysis data, and quality control data are all evaluated. Field data will be reviewed by ERM's QA/QC manager or their designee.

3.4.1 Field Data Review

The process of reviewing field data will involve evaluating field records for consistency and completeness (i.e., ensuring that each sample result is fully supported by accurate metadata), reviewing QC and calibration information, evaluating whether the SOPs were followed by conducting and documenting a field audit, summarizing deviations and determining

their impact on data quality, summarizing the samples collected, and providing a summary of the review in the project report.

Per ASTM Standard D7614-12, Section 13.6, the following conditions will render a CrVI sample invalid:

1) Filters that are dropped or become contaminated with any foreign matter (dirt, finger marks, ink); or

2) Filters with tears or pin holes; or

3) Start and stop flow rates differ by more than 10%: or

4) Filter samples collected by the samplers which operated less than 23 hours or more than 25 hours; or

5) A power failure occurs during a sample run which causes the stop time or sample duration requirements to be violated; or

6) Field blank fails if the concentration is greater than the method detection limit.

Field and laboratory analytical data will be summarized in tables as appropriate. ERM will perform a 100% check of all data presented on data summary tables, including review of all CrVI sampler total air volumes.

The following conditions will render daily, average real-time Total PM invalid or qualified uncertain:

1. Instrument malfunction as evidenced by no measurement data collected for more than one hour during any 24-hour period during construction monitoring possibly caused by power loss or other instrument component failure; and

2. Precision estimates exceeding the <40% RPD criteria for the duplicate monitoring data will render that entire 24-hour Total PM data set uncertain, and all of that data will be presented as J qualified. Following that event, all DustTrak monitors will be closely evaluated for calibration and maintenance. Continued precision failures will require contacting the manufacturer and possible replacement of monitors.

3.4.2 Laboratory Data Review and Validation

The laboratory will review the data internally in accordance with its SOP and established internal procedures prior to submitting the data to the ERM PM. Specifically, the laboratory will review the data package to ensure the following:

- Sample preparation information is correct and complete;
- Holding times have been met;
- Analytical information is complete and was generated within acceptable criteria;
- Any discrepancies/corrective actions identified during sample login, preparation or analysis have been addressed and documented;
- The appropriate SOPs have been followed;
- QC samples were within established control limits;
- Analytical requirements have been met (e.g., the correct analytical procedures were used as defined by the COC); and
- Documentation is complete and any QC issues are fully explained in a detailed case narrative.

Following receipt of the laboratory report for the CrVI analyses, ERM will send the report (including raw data and all QA/QC information) to the designated third-party, independent validator. The third party will perform Level II validation, including 40% raw data re-calculation, as described in EPA's *Guidance on Environmental Data Verification and Data Validation* (2002).

3.5 DATA MANAGEMENT

All data will be reviewed and verified by the ERM QA/QC Officer/PM or qualified designee (interchangeable herein throughout this document with "ERM PM"). The ERM PM will ensure that the field and technical data obtained for the project will provide the end user with acceptable data. All field and technical data shall be reviewed, by the ERM PM or a qualified designee, such as the ERM QA/QC Officer, to ensure that the data is accurate prior to the inclusion in the project report.

Data processing is summarized as follows:

1. The field data sheets (real-time Total PM and CrVI sampler), real-time instrument data logs, log books, and COC forms are submitted (faxed, electronic, or hard copy) by field personnel to the ERM PM weekly. The ERM PM, or their designee checks all forms for accuracy and ensures that each unique sample ID is correctly transposed across forms and logs accompanied by the correct metadata, then stores the information electronically into ERM's project files.

2. Samples are sent to the laboratory under COC.

3. The laboratory enters the sample information into their tracking system and performs the analysis.

4. The laboratory electronically submits raw data, sample results, and their QA information to ERM.

5. ERM submits the laboratory data, results and information to an independent third party validator, who in turn performs Level II validation, including 40% raw data re-calculation, as described in EPA's *Guidance on Environmental Data Verification and Data Validation* (2002).

6. The third party validator electronically submits their validation report to ERM.

ERM PM or designee reviews the data validation report, and, if acceptable, stores all data into the project files. If the result(s) of a CrVI analysis is found unacceptable, ERM will request re-evaluation of the analytical dataset by the laboratory and then by the third-party data validator. ERM PM will bring any unacceptable analytical result to the attention of EPA and MDE prior to a re-evaluation of the analytical data and will follow-up with the findings of the re-evaluation results.

Real-time Total PM concentration data will be provided as 15-minute averages based on one (1) minute frequency data collection. The 15-minute average real-time Total PM concentration data will be used for comparison to the Total PM action level, i.e., the background threshold value. The DustTrak datalogs will be uploaded to a personal computer daily on the next business day, as practicable, following the 24-hour sampling period and will be uploaded to ERM's project files and website the following business day.

Meteorological data will be provided as hourly averages based on 15-minute frequency data collection. The hourly averages for wind speed, wind direction, relative humidity and rainfall will be reported on the Total PM hourly summary table the next business day, as practicable, following the 24-hour sampling period and will be uploaded to ERM's project files and website the following business day.

3.6 ASSESSMENT OVERSIGHT

The QA program is described in the QAPP and is overseen by ERM's QA/QC Manager for the project, Larry Hottenstein. All audit and assessment reports will be part of the project record and included in the data quality assessment reports. The QA/QC Manager, or their designee will ensure that audits of data quality are being performed as follows:

- Four (4) field audits are planned approximately every six (6) weeks (i.e., approximately 15% of the construction monitoring period) during the construction intrusive activity period scheduled for 25 weeks. The first audit will be conducted within the first two weeks of the intrusive construction period. The audits will be conducted by the ERM QA/QC Manager and audit reports and corrective action(s), if any, will be submitted to the ERM PM. The field audits will include monitoring station siting, instrument maintenance and calibration and the initiation and recovery of a minimum of one CrVI sample.

- The laboratory's results of their latest laboratory audit and performance evaluation (PE) sample are appended to the QAPP to demonstrate laboratory compliance with QAQC requirements.

- The QA/QC Manager will review the field and lab quality assessments conducted as described in Sections 3.4.1 and 3.4.2, to ensure appropriate corrective actions are being taken, if warranted, and direct additional corrective measures if deemed necessary.

4.0 SAMPLING RATIONALE

Air quality data for monitoring for Total PM and sampling for particulate CrVI concentrations will be collected throughout the construction intrusive activities at six (6), fixed station locations and multiple mobile work zone locations, daily; one permanent location, PAM-1, will include a duplicate Total PM monitor and a co-located CrVI sample (Figure 2) as follows :

- Perimeter Air Monitor #1 (PAM-1) will be located approximately 400 feet east of Area 1, immediately adjacent to S. Caroline Street, targeting the urban neighborhood;

- PAM-2 will be located at the southeastern Area1 boundary targeting site perimeter air conditions;

- PAM-3 will be located at the western Area 1 boundary targeting site perimeter air conditions;

- PAM-4 will be located at the northern Area 1 boundary targeting site perimeter air conditions;

- Off-Site Air Monitor #1 (OAM-1) will be located approximately 0.5 miles west of the site at the Baltimore National Aquarium, targeting Baltimore Inner Harbor waterfront ambient air conditions;

- OAM – 2 will be located approximately 1.0 miles north of the site at the Old Town monitoring station established by MDE, targeting urban ambient air conditions;

- Multiple mobile work zone sampling locations will be established at each separate and intrusive work zone by siting real-time Total PM monitors immediately adjacent to, within a safe distance, and downwind of the construction Work Zone intrusive activities. These Work Zone monitors will be repositioned each day as necessary, depending on wind direction and site activities, to ensure measurement downwind from construction intrusive activities. If the actual work zone is a large area, such as the larger excavations for slab construction, an additional instrument will be deployed to ensure the downwind area is adequately monitored; and

- Mobile work zone sampling locations will be established, daily, downwind of the Cover Soil Stockpile Area to monitor Total PM

concentrations during the time that the stockpile is uncovered. The monitoring station will be repositioned each day as necessary, depending on wind direction and field activities, to ensure the measurement of downwind from cover soil stockpile activities.

4.1 TOTAL PARTICULATE MATTER MONITORING

Real-time instrumentation is available to measure ambient concentrations of total particulate matter (Total PM). DustTrak Model 8533 real-time dust monitors have been selected for this monitoring and are reported to measure Total PM concentrations for particle sizes ranging from approximately 0.1 microns to 15 microns in diameter and reported to measure Total PM concentrations ranging from 1.0 $\mu g/M^3$ to 150 mg/M^3. The DustTrak monitors will operate for 24-hour periods during intrusive construction work days, measuring particulate concentrations at one-minute frequencies, reported in hourly and daily averages.

4.2 HEXAVALENT CHROMIUM SAMPLING

Concurrently with real-time monitoring for Total PM using the DustTrak Model 8533, at each permanent fixed monitoring station location described above, airborne CrVI concentrations will be determined from 24-hour air samples collected using BGI Model PQ-100 samplers. CrVI air samples will be analyzed in accordance with the *Standard Operating Procedure for the Preparation and Analysis of Hexavalent Chromium by Ion Chromatography* as prepared by ERG, dated 20 February 2014. A copy of the ERG SOP is provided in the QAPP, Appendix C.

5.0 REQUEST FOR ANALYSES

This section describe the analytical support for the project depending on several factors including the analyses requested, analytes of concern, turnaround times, available resources, available laboratories, etc.

5.1 ANALYSES NARRATIVE

Air samples will be collected at the six (6) permanent fixed locations, one of which will include duplicate monitoring with co-located sampling equipment. CrVI 24-hour duration sampling will be performed at the fixed station locations during intrusive construction work days. During the first two weeks of intrusive work, the most rapid laboratory turn-around- time (3 business days) will be requested for the CrVI samples, and analytical results submitted to the agencies as soon as they are available. The third party data validation reports for this data will also be submitted to the Agencies as soon as they are available. If during this period CrVI concentrations are consistently at or below the background threshold level, the analytical frequency may be adjusted, subject to approval by EPA and MDE.

Air samples (including QC samples) will be analyzed for CrVI per ERG's SOP as provided in the project QAPP, Appendix C.

5.2 ANALYTICAL LABORATORY

ERG is an EPA contract laboratory and has provided their *Standard Operating Procedure for the Preparation and Analysis of Hexavalent Chromium by Ion Chromatography*, dated 20 February 2014, and provided in the QAPP, Appendix C

6.0 FIELD METHODS AND PROCEDURES

Descriptions of the equipment, methods and procedures that will be used to accomplish the air sampling goals are provided in this section. Descriptions of sample tracking and shipping are provided in Section 7.

6.1.1 List of Equipment Needed

The equipment and materials that will be used in the field to collect samples are listed below:

- DustTrak Model 8533 monitors will be operated in the field to collect real-time Total PM concentration data. One (1) back-up DustTrak Model 8533 monitor will be available throughout the period of intrusive construction activities;
- BGI PQ-100 samplers will be used to collect air samples for CrVI laboratory analysis. One (1) back-up BGI PQ-100 sampler will be available throughout the period of intrusive construction activities;;
- BGI TetraCal primary flow calibrator;
- Bios Defender 510-H primary flow calibrator;
- Laboratory prepared filters mounted in holders;
- Teflon tubing and connectors;
- Shipping coolers and packing/sealing supplies;
- Secure freezer located in the site construction office trailer or other secure location;
- Electric extension cords and ground fault interrupter/surge protectors;
- Weather proof equipment cases and tripods;
- Disposable, powder-free, nitrile gloves;
- Maintenance tool kit; and
- First Aid kit.

6.1.2 Calibration of Field Equipment

The DustTrak Model 8533 monitors will be calibrated daily at the beginning and end of each 24-hour sampling period utilizing a BIO Defender 510-H primary air flow calibration meter. The BGI-PQ100 samplers will be calibrated daily at the beginning and end of each 24-hour sampling period utilizing a BGI TetraCal primary air flow calibration meter. The DustTrak Model 8533 monitor beginning flow rate will be calibrated to two (2) Lpm and the BGI-PQ100 sampler will be calibrated to 15 Lpm, with the air sampling media attached to the sampler.

Equipment maintenance and calibration records for the project will be maintained at the site office and in project files stored on ERM's server for one year after the end of the construction intrusive activities.

Details of calibration methods are included in the SOPs for each instrument being utilized for the project in the QAPP, Appendix B. All calibration information will be recorded daily on the field data sheets also provided in the project QAPP, Appendix B. Field data sheets will be transmitted weekly to the ERM office, checked as described above, and stored on ERM's secure server for one year after the conclusion of construction intrusive activities.

6.2 AIR

6.2.1 Total Particulate Matter

Total PM fixed, monitoring locations will be established in the field as shown on Figure 2. DustTrak Model 8533 real-time dust monitors will be operated continuously 24 hours per day during intrusive construction work days at the six (6) fixed monitoring station locations for measurement of Total PM concentrations. DustTrak Model 8533 monitors will be operated at two (2) Lpm and will be calibrated daily at the time of the CrVI sample recovery. Total PM concentration data will be acquired via telemetry provided at each of the fixed stations to document the efficacy of the implemented dust controls.

Air sampling inlets will be set at a height of no less than two (2) meters above ground surface. The siting requirements described in 40 CFR Part 58, Appendix E will be used as guidance. The duplicate DustTrak Model 8533 monitors at PAM-1 will be connected to a "T" to ensure the same air stream is being monitored by both instruments.

Specific monitoring station siting information including exact locations, labeled aerial and ground level photographs, and electric power and security provisions is provided in Appendix A.

6.2.2 Hexavalent Chromium Sampling

CrVI fixed, sampling locations will be established in the field as shown on Figure 2. BGI-PQ100 air samplers will be operated to collect 24-hour duration samples during intrusive construction work days at the six (6) fixed, monitoring station locations. BGI-PQ100 air samplers will be operated at 15 Lpm and will be calibrated daily at the time of the CrVI sample recovery. For at least the first two weeks of construction intrusive activities, CrVI samples collected during work days, and the field and trip blanks will be shipped daily via overnight, next day delivery to the laboratory. The turn-around-time for laboratory analysis of CrVI concentrations during this initial period will be three (3) business days. Thereafter, and following the approval of the agencies, CrVI samples collected during work days will be held and kept frozen in an on-site, secure freezer for two weekly shipments (expected to be Monday and Thursday of the work week) to the laboratory with the expectation of five (5) business day turn-around-time for laboratory analysis.

Air sampling inlets will be set at a height of no less than two (2) meters above ground surface. The siting requirements described in 40 CFR Part 58, Appendix E will be used as guidance. The co-located BGI-PQ100 air samplers at PAM-1 will be sited two (2) to four (4) meters apart.

7.0 SAMPLE CONTAINERS, PRESERVATION AND STORAGE

Hexavalent chromium particulate samples will be collected using laboratory provided nitric acid and sodium bicarbonate pre-treated filters mounted into filter holders. Laboratory prepared filters/holders will be shipped from the laboratory, maintained in the field, and returned to the laboratory frozen at 0°C.

The following procedure will be used for installation and recovery of the filter holder containing the sample filter and sample inlet apparatus.

1) Ensure that the sample media are delivered to the sample site within a cooler with ice packs to keep the filters cold and protected from the elements.

2) Prior to installation of the filter holder and glass funnel apparatus onto the PQ100 sampler, ensure that the sampler is free of dust and debris buildup. Wipe the sampler down with a damp cloth as appropriate.

3) Wearing powder-free nitrile gloves, remove the filter holder and corresponding glass funnel inlet assembly from its container provided by ERG. Note the filter ID (as identified by the laboratory) sample location, date and time. Record all sample media identification on the field data sheet and Chain-of-Custody (COC). The field data sheet and the COC provided for each sample to be submitted to ERG are included as attachments to the CrVI Field SOP (QAPP, Appendix B) as is the Chain-of-Custody.

4) Loosen the nut on the filter holder outlet fitting and remove the Teflon plug. Store the Teflon plug in the filter holder packaging to protect it from contamination. Install the filter holder onto the end of the stainless steel side-arm-tube by inserting the tubing into the filter holder outlet fitting and tightening the nut.

5) Leave the Teflon plug in the inlet side of the filer holder until ready to perform the initial flow rate calibration.

6) After ensuring all sample run data has been collected from the PQ100 unit, including the total sample volume, replace the Teflon plug in the filter holder inlet and tighten the nut.

7) Remove the filter holder from the sampler by loosening the nut on the outlet fitting and removing from the stainless steel side-arm.

8) Replace the Teflon plug at the filter holder outlet and tighten the nut.

9) Place the sample holder into a labeled, plastic container provided by ERG and place in the cooler with ice packs or a secure freezer as soon as possible to maintain sample integrity during storage and shipping.

8.0 DISPOSAL OF RESIDUAL MATERIALS

In the process of collecting environmental samples during the air monitoring study, the ERM sampling team will generate different types of investigation derived waste (IDW) that include the following:

- Used personal protective equipment (PPE) in the form of used, powder-free nitrile gloves; and

- Disposable sampling supplies.

The EPA's National Contingency Plan (NCP) requires that management of IDW generated during sampling comply with all applicable or relevant and appropriate requirements (ARARs) to the extent practicable. The sampling plan will follow the Office of Emergency and Remedial Response (OERR) Directive 9345.3-02 (May 1991), which provides the guidance for the management of IDW. In addition, other legal and practical considerations that may affect the handling of IDW will be considered.

- Used nitrile gloves and disposable sampling supplies will be double-bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill.

9.0 SAMPLE DOCUMENTATION AND SHIPMENT

9.1 FIELD NOTES

Field records (sample collection sheets and field logs of daily activities) will be maintained in the field office and on ERM's server and will include logbooks, preprinted sampling data forms, photographs, sample shipment tracking logs and copies of sample Chain of Custody.

9.1.1 Field Logbooks

Field logs will be used to document daily field activities and will be prepared and maintained by the Field Technician responsible for air monitoring. At a minimum, the following information will be recorded during the collection of each sample:

- Sample location and description
- Sampler's name(s)
- Date and time of sample collection
- Designation of sample as composite or grab
- Type of sample (air)
- Type of sampling equipment used
- Field instrument readings and calibration
- Field observations and details related to analysis or integrity of samples (e.g., weather conditions, damaged filter media, etc.)
- Sample preservation
- Lot numbers of the sample containers, sample identification numbers and any explanatory codes, and chain-of-custody form numbers
- Shipping arrangements (overnight air bill number)
- Name of recipient laboratory

In addition to the sampling information, the following specific information will also be recorded in the field logbook for each day of sampling:

- Team members and their responsibilities
- Time of arrival/entry on site and time of site departure
- Other personnel on site
- Summary of any meetings or discussions with tribal, contractor, or federal agency personnel
- Deviations from sampling plans, site safety plans, and QAPP procedures
- Changes in personnel and responsibilities with reasons for the changes
- Levels of safety protection
- Calibration readings for any equipment used and equipment model and serial number

9.1.2 Photographs

Photographs will be taken daily at the fixed, monitoring and sampling locations. They will serve to verify information entered in the field logbook. For each photograph taken, the following information will be written in the logbook or recorded in a separate field photography log:

- Time, date, location, and weather conditions
- Description of the subject photographed
- Name of person taking the photograph

9.2 LABELING

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. The samples will have preassigned, identifiable, and unique numbers. At a minimum, the sample labels will contain the following information: station location,

date of collection, analytical parameter(s), and method of preservation. Every sample will be assigned a unique sample number.

9.3 SAMPLE CHAIN-OF-CUSTODY FORMS AND CUSTODY SEALS

All sample shipments for analyses will be accompanied by a COC record. COC's will be completed and sent with the samples to the laboratory with each shipment.

The COC form will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel.

Samples will be maintained prior to and following sampling in a dedicated, secured freezer or cooler with ice packs inside the Honeywell Transfer Station at the project site. Until the samples are shipped, the custody of the samples will be the responsibility of ERM. The sampling Field Technician or ERM FM will sign the chain-of-custody form in the "relinquished by" box and note date, time, and air bill number.

The sample numbers for all filter media blanks, field handling blanks and duplicates will be documented on the COC (see Section 10.0). A photocopy will be made for the EPA's and MDE's project files.

A self-adhesive custody seal will be placed across the top of each sample filter holder. The shipping containers in which samples are stored will be sealed with self-adhesive custody seals any time they are not in someone's possession or view before shipping. All custody seals will be signed and dated.

9.4 PACKAGING AND SHIPMENT

All sample containers will be placed in a sturdy cooler for shipping to the field and back to the laboratory. The following outlines the packaging procedures that will be followed:

1. Ice packs will be used to eliminate melting ice from damaging the sample holders.

2. The bottom of the cooler should be lined with bubble wrap or similar to prevent breakage during shipment.

3. Check filter holder inlet and outlet caps for tightness.

4. Secure container tops with clear tape and custody seal all container tops.

5. Affix sample labels onto the containers with clear tape.

6. Seal all sample containers in the heavy duty plastic zip-lock bags in which they were received from the laboratory. Write the sample numbers on the outside of the plastic bags with indelible ink.

7. Place samples in a sturdy cooler lined with plastic bubble wrap or other appropriate cushioning material or design. Enclose the appropriate COC(s) in a zip-lock plastic bag affixed to the underside of the cooler lid.

8. Fill empty space in the cooler with bubble wrap or similar and ice packs to prevent movement and breakage during shipment.

9. Ice packs will be used to maintain the $0^{o}C$ temperature requirement during shipping.

10. Each cooler will be securely taped shut with plastic strapping tape, and custody seals will be affixed to the front of each cooler lid.

11. During the first two weeks of intrusive construction monitoring, samples will be shipped in coolers with frozen ice packs, daily.

12. Following the first two weeks of intrusive construction monitoring, and with the approval by EPA and MDE, samples will be maintained in an on-site, secure freezer two weekly (expected to be Monday and Thursday) shipments to the laboratory in coolers with frozen ice packs, with the expectation of five (5) business day turn-around-time for laboratory analysis.

13. Upon receipt in the field from the laboratory, the sample containers will be removed from the coolers, logged in the freezer chain of custody and stored in the on-site secure freezer. The freezer chain of custody will include date and time placed into the freezer with the signature of the Field Manager or designee placing them into the freezer, and the same information will be recorded upon retrieval from the freezer as discussed below.

14. At the beginning of each sampling day, sample containers retrieved from the on-site secure freezer for that day's sampling will be recorded as logged-out on the freezer chain of custody and will be placed in coolers with ice packs for transit from the site to the sampling locations. At the conclusion of each day's sampling, the sample media will be recovered, placed in the sealed sample containers, temporarily stored in coolers with ice packs during transit from the sampling stations to the on-site secure freezer, logged in to the freezer chain of custody and placed in the on-site, secured freezer to maintain a nominal temperature of 0^{o} C or less.

15. For shipment of samples to the laboratory from the field, the sample containers will be logged out on the freezer log. The sample containers will then be shipped back to the laboratory inside the sealed zip lock-sealed bag with the sample chain of custody and will be maintained at or below 0^{o} C at all times in the sealed shipping coolers with frozen ice packs. The shipping coolers will be sealed with tape and a chain of custody seal for shipment to the laboratory.

Records will be maintained by ERM's PM or designee of the following information:

- Sampling contractor's name (if not the organization itself).
- Name and location of the site.
- Total number of samples shipped to the laboratory.
- Carrier, air bill number(s), method of shipment (priority next day).
- Shipment date and when it should be received by lab.
- Irregularities or anticipated problems associated with the samples.
- Whether additional samples will be shipped or if this is the last shipment.

10.0 QUALITY CONTROL

This section describes the quality control samples that are being collected to support the sampling activity, including field and trip blank samples. All quality control samples will be sent to the laboratory blind.

10.1 FIELD QUALITY CONTROL SAMPLES

Field quality control samples are intended to help evaluate conditions resulting from field activities and are intended to accomplish two primary goals: assessment of field contamination; and assessment of sampling variability. The former assesses for substances introduced in the field to the samples due to environmental or sampling equipment and is assessed using blanks of different types. The latter assesses variability due to sampling technique and instrument performance as well as variability possibly caused by the heterogeneity of the matrix being sampled and are assessed using replicate sample collection. The following sections cover field QC samples.

10.1.1 Assessment of Field Contamination (Blanks)

Field contamination is usually assessed through the collection of different types of blanks. Field blanks are sample containers handled in the field. Trip blanks are prepared by the laboratory and shipped to and from the field in plastic containers inside heavy plastic zip lock bags, but not opened.

10.1.1.1 Field Blanks

Field blanks are collected during CrVI particulate sampling. One (1) field blank is prepared each day sampling occurs in the field. These blanks are submitted "blind" to the laboratory, packaged like other samples and each with its own unique identification number.

The field blanks will be preserved, packaged, and sealed in the manner described for the CrVI particulate samples. A separate sample number and station number will be assigned to each field blank sample.

10.1.1.2 Trip Blanks

Trip blanks will be prepared to evaluate if the shipping and handling procedures are introducing contaminants into the samples. One (1) trip blank will be submitted to the laboratory for analysis with every shipment

of samples for CrVI analysis. Trip blanks are filter media that have been shipped to the site prior to sampling. The sealed trip blanks are not opened in the field and are shipped to the laboratory in the same cooler with the samples collected for CrVI analyses. The trip blanks will be preserved, packaged, and sealed by the laboratory in the manner described for the CrVI samples. A separate sample number and station number will be assigned to each trip sample and it will be submitted blind to the laboratory.

10.1.2 Assessment of Field Variability

Co-located CrVI particulate samples will be collected at the PAM-1 fixed station simultaneously on separate sample filter cassettes using a co-located sampler. Each co-located sample will be assigned its own sample number so that it will be blind to the laboratory. A co-located sample is treated independently of its counterpart in order to assess laboratory performance through comparison of the results by calculating the relative percent difference (RPD). At least 10% of CrVI particulate samples collected per sampling event will be co-located samples. Specifically, seven samples, six primary samples and one co-located sample (14%) will be collected daily.

Co-located samples for CrVI will be preserved, packaged, and sealed in the same manner as the other CrVI particulate samples. A separate sample number and station number will be assigned to each co-located sample, and it will be submitted blind to the laboratory.

Duplicate Total PM concentration data will also be collected at monitoring station (PAM-1) by siting two (2) DustTrak monitors connected to the same sampling inlet by splitting the sample air stream using a "T" connector. The Total PM results from the two instruments will be compared for precision by calculating the RPDs as described in the QAPP.

10.2 LABORATORY QUALITY CONTROL SAMPLES

Laboratory quality control (QC) samples are analyzed as part of standard laboratory practice. The Laboratory SOP for the ASTM Standard Test Method D7614-12 (Determination of Total Suspended Particulate (TSP) Hexavalent Chromium in Ambient Air Analyzed by Ion Chromatography and Spectrophotometric Measurements is included with this QAPP in Appendix C. This SOP includes procedures and criteria for lab blanks, spiked samples, and duplicate analyses.

11.0 FIELD VARIANCES

As conditions in the field may vary, it may become necessary to implement minor modifications to sampling as presented in this plan. When appropriate, ERM's QA Manager, EPA and MDE representatives will be notified and a written approval will be obtained before implementing the changes. Modifications to the approved plan will be documented in the sampling project report.

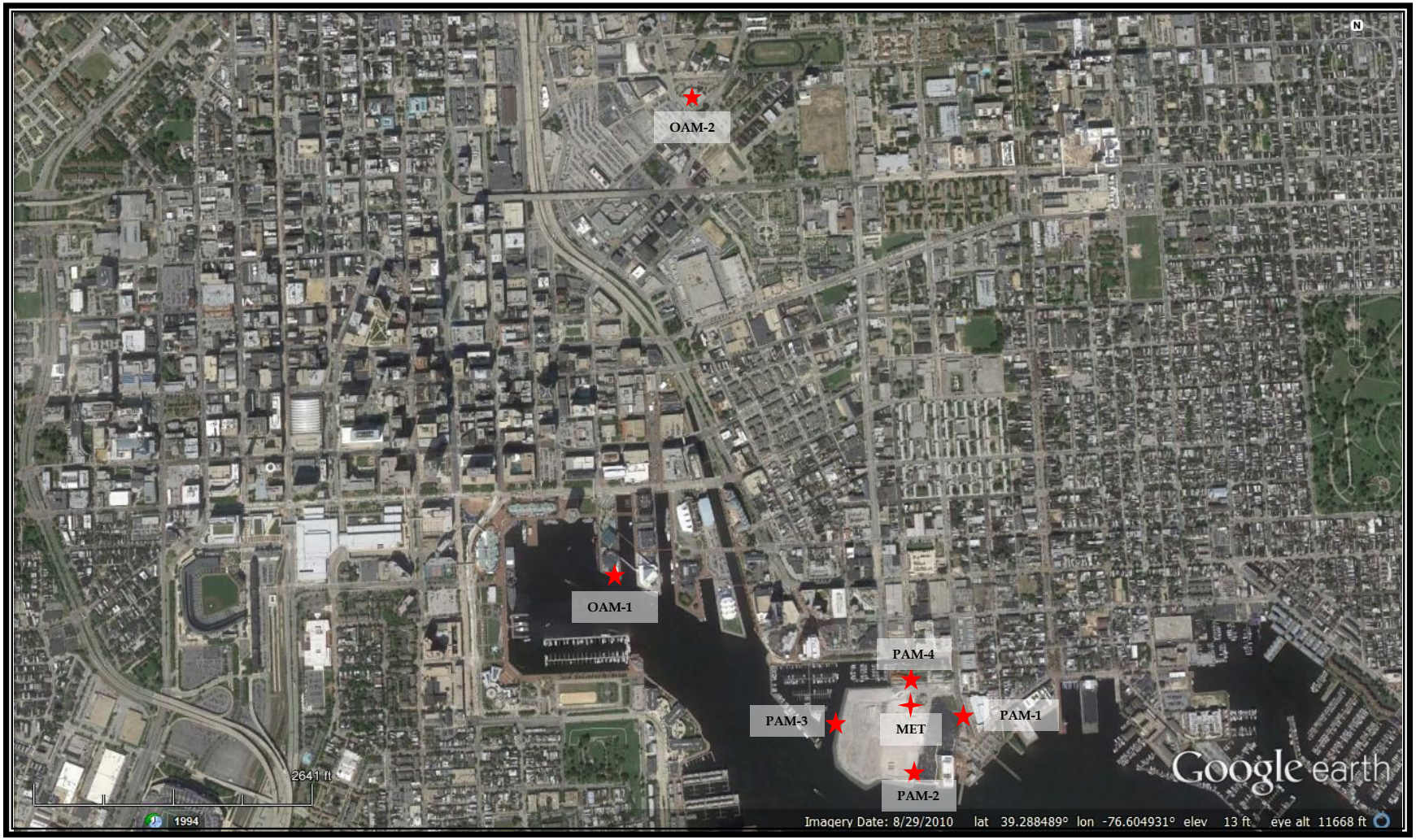
12.0 FIELD HEALTH AND SAFETY PROCEDURES

Project-specific health and safety procedures that must be followed in the field include the use of clean, disposable, powder-free, nitrile gloves whenever handling the sampling tubing, connectors or sample filter media. Potential hazards that may be encountered are electric shock caused by contact with operating electronic monitoring or sampling equipment during wet sampling periods. Caution must be taken at all times to maintain dryness inside the water proof cases protecting the electronic equipment, thereby protecting field personnel from possible electric shock.

FIGURES

Figure 1
Site Location Map

Figure 2
Construction Air Monitoring Locations
Harbor Point
Baltimore, Maryland

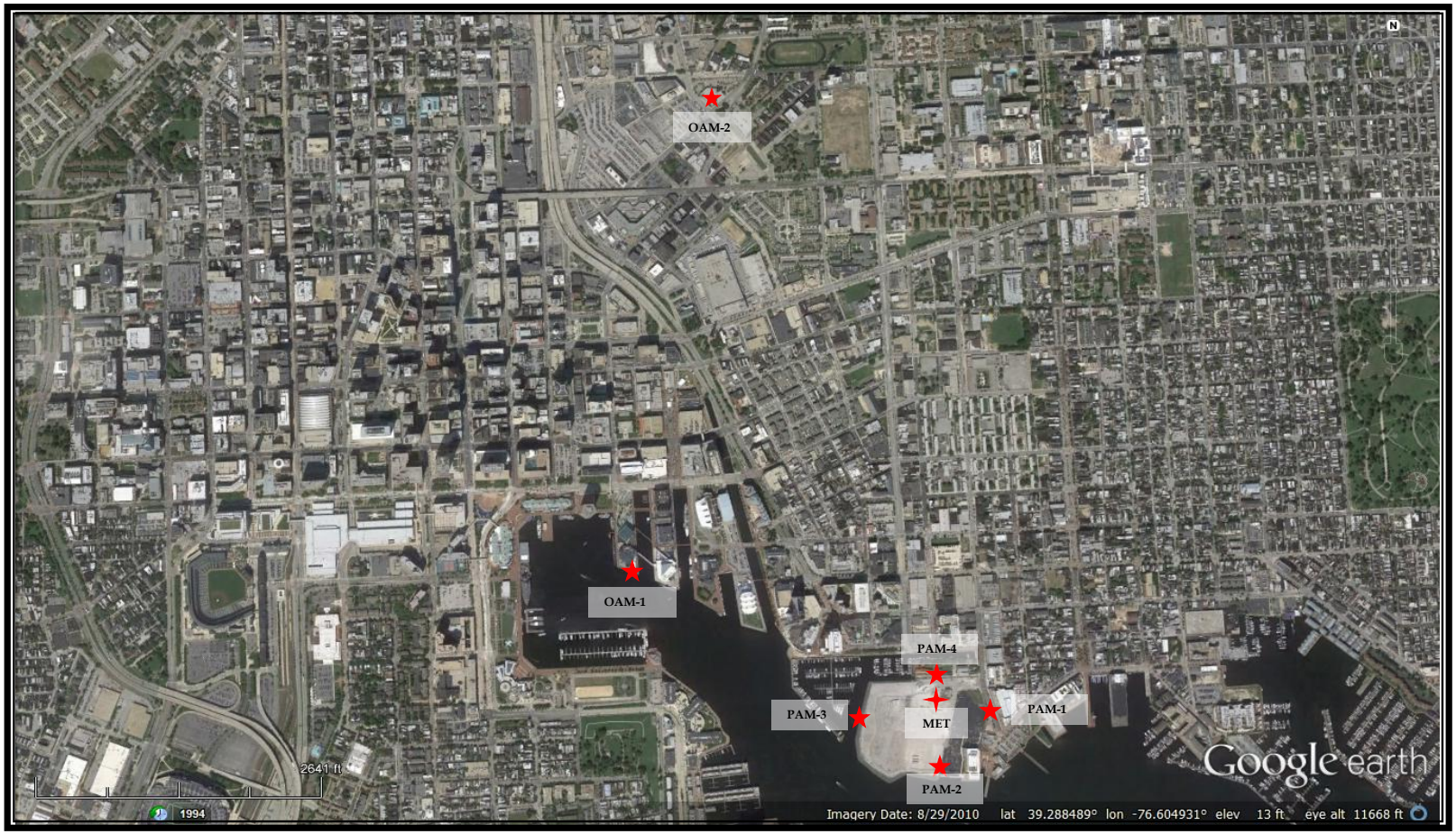


MET – Meteorological Station
PAM – Perimeter Air Monitor
OAM – Off-site Air Monitor
1 – Baltimore National Aquarium
2 – MDE's Old Town Station

APPENDIX A

STATION SITING INFORMATION

Construction Air Monitoring Locations
Harbor Point
Baltimore, Maryland



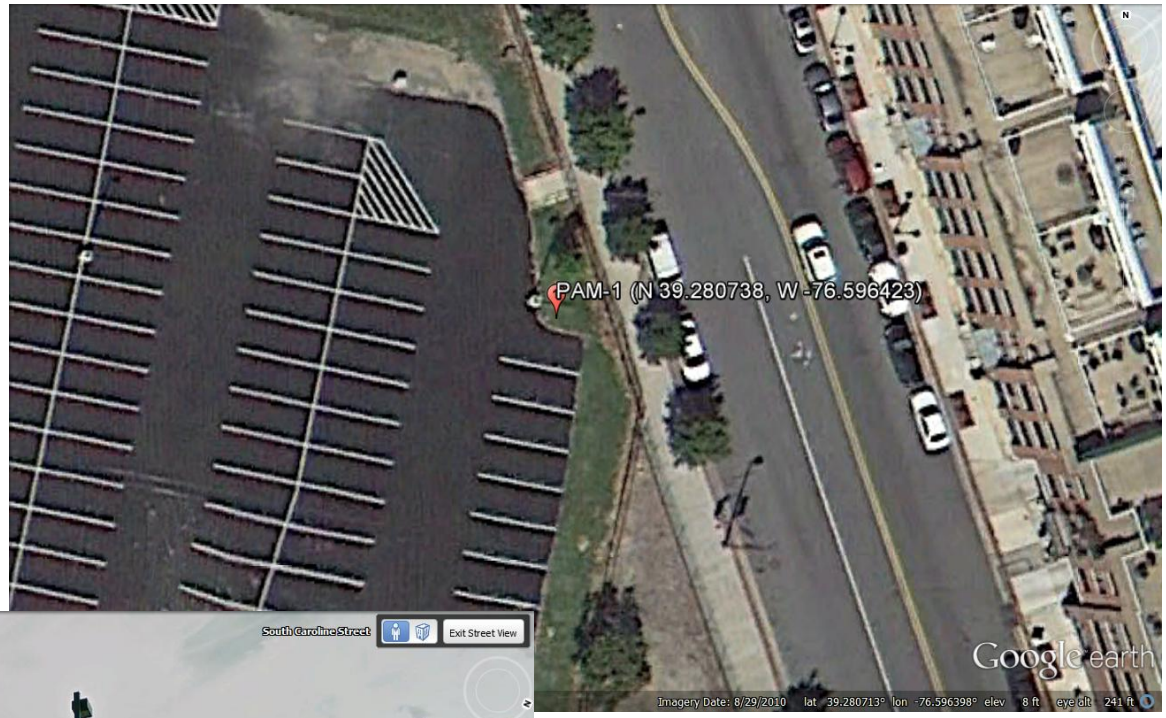
MET – Meteorological Station
PAM – Perimeter Air Monitor
OAM – Off-site Air Monitor
1 – Baltimore National Aquarium
2 – MDE's Old Town Station

Perimeter Air Monitor (PAM-1)
900 Block S. Caroline Street
Baltimore, MD 21231

Lat./ Long. provided

Electric power from and secure to parking lot light pole

(Same location as AM-3 during Apr. – Jun. 2013 study.)

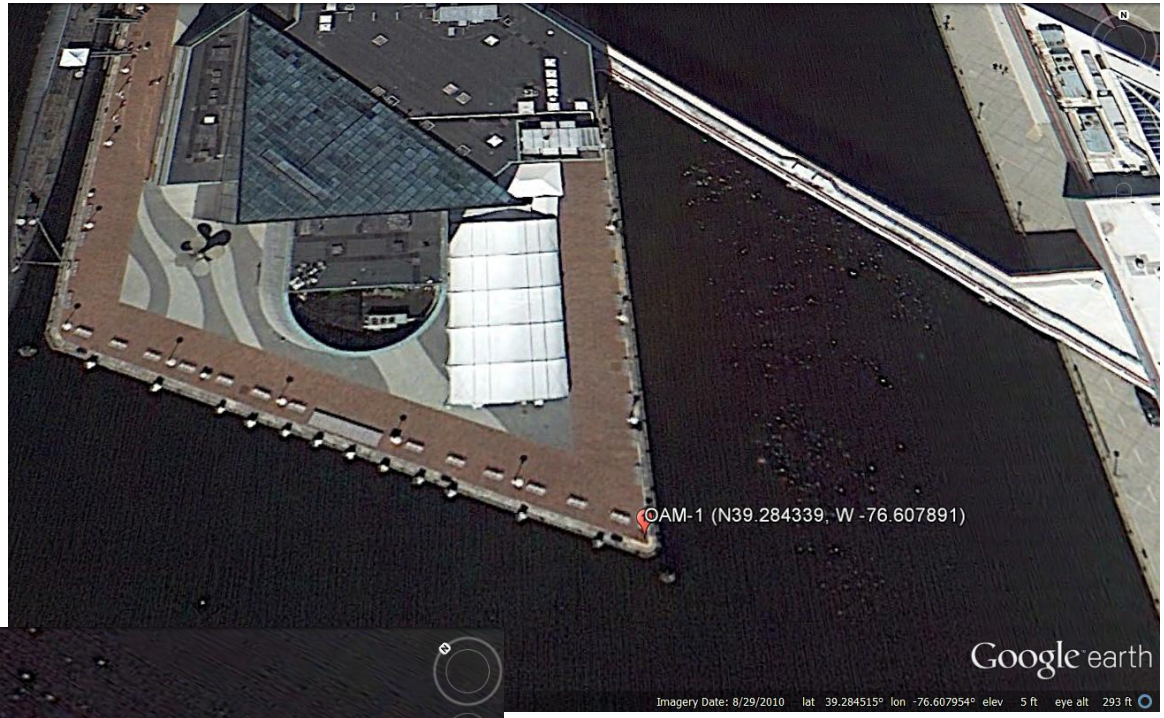


Off-Site Air Monitor (OAM-1)
Baltimore National Aquarium
501 E. Pratt Street
Baltimore, MD 21202

Lat./ Long. provided

Electric power from light pole. Site behind and secure to concrete bench.

(Same location as OAM-2 during Jun. – Jul. 2013 study.)



Off-Site Air Monitor (OAM-2)
Thomas J. Burke Fire Station
1100 Hillen Street
Baltimore, MD 21202

Lat./ Long. provided

Electric power from MDE shelter. Site inside fenced area and secure to chain link fence.

(MDE Monitoring Location)