Prepared for

District Department of Energy and Environment
1200 1st Street NE
Washington, D.C. 20002

SAMPLING AND ANALYSIS PLAN

Former Potomac River Generating Station
Alexandria, Virginia

On Behalf of

NRG Potomac River LLC
1400 North Royal Street
Alexandria, Virginia 22314

Prepared by

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1. INTRODUCTION

1.1 Terms of Reference

Geosyntec Consultants, Inc. (Geosyntec) has prepared this Sampling and Analysis Plan (SAP) on behalf of NRG Potomac River LLC (NRG) to address sampling activities being requested by the District of Columbia Department of the Environment (DDOE) to assess the potential migration of groundwater contamination at the former Potomac River Generating Station (Site) to the Potomac River. The Site is located at 1400 North Royal Street in Alexandria, Virginia (**Figure 1**).

This sampling and analysis plan describes procedures for performing various groundwater monitoring activities to assess potential hydrocarbon discharges to the Potomac River related to the on-going investigation and remediation at the Site.

Geosyntec has performed specific actions at the Site on behalf of NRG Potomac River, LLC in response to a 5 June 2014 DDOE directive issued to NRG. The 5 June 2014 DDOE directive requested that additional actions be taken by NRG Potomac River, LLC to assess potential hydrocarbon discharges to the Potomac River related to the on-going investigation and remediation at the PRGS. Previous assessment activities were proposed in *Work Plan 1– Former Potomac River Generating Station*, the work plan submitted to DDOE on 26 June 2014 (Work Plan 1), which addressed Directives 1 and 2 in the directive letter, and the *Supplemental Work Plan - Former Potomac River Generating Station*, which was submitted to DDOE in a letter dated 18 July 2014 and addressed the third and fourth Directives. Geosyntec performed the actions requested in the 5 June 2014 DDOE directive during the remainder of 2014, and summarized the results in a report titled *Assessment of Groundwater Discharges to the Potomac River* dated 1 January 2015.

1.2 Project Background

Pollution Complaint (PC) #2013-3154 was opened by the VDEQ in a correspondence dated 2 April 2013, following the detection of petroleum hydrocarbons during the closure activities associated with the two 25,000-gallon heating oil USTs. In that correspondence, VDEQ requested that a Site Characterization Report (SCR) be prepared to describe and characterize the nature and extent of the contamination from the two USTs. To address that requirement, a report was submitted to the VDEQ in the form of a Site Conceptual Model (SCM) Update on 28 June 2013. The SCM Update included a discussion of the initial detection of petroleum hydrocarbons during the closure of the two heating oil USTs, as well as descriptions of the various subsurface utilities in the vicinity of the USTs.

The VDEQ subsequently requested that a Site Characterization Report Addendum (SCRA) as stated in accordance with a directive letter dated 10 July 2013. An SCRA was submitted on 14

February 2014 by URS that described a subsurface characterization of the Site using laser-induced fluorescence (LIF), as well as the advancement of soil borings for soil sampling, and the installation and sampling of fourteen monitoring wells. A summary of the site history, recent field activities, laboratory analytical results, preliminary risk assessment, and an assessment of remedial options were also discussed in the SCRA.

Following their review of the SCRA, the VDEQ, in correspondence dated 4 March 2014, requested that a CAP be developed to address subsurface groundwater conditions at the site. In addition, on 14 June 2014 DDOE issued a Directive letter requesting supplemental activities to evaluate potential releases to the Potomac River. Pursuant to those requests and subsequent correspondence with the regulatory authorities, site assessment activities were conducted during the spring and summer of 2014. On 5 September 2014, PRGS submitted a document entitled *Corrective Action Plan* (CAP-I) to the VDEQ on behalf of NRG that (i) summarized the site characterization data and evaluations performed through August 2014; (ii) presented an updated SCM; and (iii) provided a presentation and evaluation of the viable remedial technologies that could be employed at the Site.

Following submittal of CAP-I, GES and Geosyntec performed additional site assessment and remedy evaluations pursuant to the 4 March 2014 VDEQ directive and the DDOE Directive. On 23 December 2014, PRGS submitted a document entitled Corrective Action Plan – Part II (CAP-II) on behalf of NRG that provided: (i) an update to the site conceptual model; (ii) the proposed remedial strategy to address VDEQ requirements; (iii) an estimate of the quantity of hydrocarbons present in the subsurface; (iii) an estimate of the amount of recoverable hydrocarbons by the selected remedial technology(ies); (iv) a time frame to achieve the remedial goals; and (iv) an estimate of the cost to achieve the remedial goals.

Geosyntec Consultants, Inc. (Geosyntec) recently performed specific actions at the Site on behalf of NRG Potomac River, LLC in response to the 5 June 2014 DDOE directive. The 5 June 2014 DDOE directive requested that additional actions be taken by NRG Potomac River, LLC to assess potential hydrocarbon discharges to the Potomac River related to the on-going investigation and remediation at the PRGS. Specifically, the 5 June 2014 DDOE directive requested the following actions:

- Submission of copies of construction or engineering as-builts of the bulkhead and former screen house structure located adjacent to the Potomac River;
- A complete evaluation of the bulkhead adjacent to the Potomac River Generating Station Pump House including a visual inspection and identification of seeps, if found; and
- An investigation of the extent of groundwater contamination along the Potomac River shoreline.

Geosyntec performed the actions requested in the 5 June 2014 DDOE directive during the remainder of 2014, including the monitoring of select near-shore wells, and summarized the results in a report titled *Assessment of Groundwater Discharges to the Potomac River* dated 5 January 2015. Geosyntec provided the following conclusions in the 5 January 2015 report:

- Evaluations of structural features, including a sheet pile wall and the pump house/screen house, were performed and indicate that those features extend far below the water table and serve as barriers and/or diversions to groundwater flow, thereby limiting direct discharge of groundwater to the Potomac River.
- Structural assessments also identified several structures, particularly subgrade piping leading to outfalls to the Potomac River, that likely have served as preferential flow paths facilitating migration of hydrocarbons toward the shoreline in the northeastern portion of the study area.
- Several seeps with very low flow rates (quantified at less than 0.03 gallons per minute) were occurring through holes in the sheet pile wall; however, the water quality of the seeps did not suggest that the water contained TPH or other constituents that posed a substantial risk to the Potomac River.
- Free phase product or LNAPL, has not been identified in any of the wells near the shoreline and, although dissolved hydrocarbons were detected in many of the wells along the shoreline, the concentrations of PAHs and VOCs for which surface water standards exists were either lower than the applicable standards or allowable groundwater standards at the point of discharge in all of the wells along the shoreline.

Upon review of the 5 January 2015 report, the DDOE provided their comments and made requests in a 12 May 2015 DDOE correspondence. More specifically, DDOE requested additional characterization of the following areas/sources:

- "The areas south of the screen house, and surrounding the end of the bulkhead where historic up-gradient data shows contaminant concentrations and a completed pathway for groundwater migration to the surface waters of the Potomac River."
- "The extent of groundwater contamination found in the areas directly along the bulkhead and areas traveling around the bulkhead have not been fully delineated."
- "Conventional contaminants, including heavy metals and polychlorinated biphenyl's, associated with power generation plants have the potential to be mobilized by a migrating plume of hydrocarbons. The presence of these contaminants has not been investigated or characterized."

In addition, the 12 May 2015 DDOE letter requested the following actions be taken by NRG Potomac River, LLC to address the data gaps:

- "Develop an additional shoreline work plan for review and approval, addressing the additional areas of concern, Study Area 5S and all the area directly along the extent of the bulkhead."

- "Develop a quarterly groundwater sampling and analysis plan (SAP) to be submitted for review and approval."

Geosyntec, on behalf of NRG Potomac River LLC, has prepared this SAP, which includes a *Quality Assurance Project Plan* (QAPP) as an appendix, as requested in the 12 May 2015 DDOE letter.

2. GROUNDWATER MONITORING PROCEDURES

2.1 Overview

This section describes the following groundwater monitoring procedures:

- Temporary direct push well installation and development
- Permanent well inspection and water level measurement
- Groundwater well purging
- Field groundwater quality measurement
- Groundwater well sampling

A geologist or environmental scientist will sample or oversee environmental technicians who install, develop, purge and sample the wells.

At present, the anticipated near term activities at the Site include the collection of additional characterization information (consisting of the installation of vertical profile temporary monitoring points) and the collection of groundwater monitoring data from existing monitoring wells. If additional characterization activities are deemed necessary at a later date, this SAP will be updated accordingly to account for the additional investigation methods if any.

2.2 Temporary Direct Push Well Installation and Development

2.2.1 Underground Utilities

Underground utilities should be located and marked prior to beginning any drilling. Public utilities should be located using Virginia 811. Private utilities should be located by a private utility locator with assistance from NRG personnel. Final boring locations would be adjusted in the field to maintain proper setbacks from public and private utility markings.

2.2.2 Temporary Direct Push Well Installation

Temporary groundwater samples will be collected using a Geoprobe® Screen Point Sampler (or equivalent), consisting of a 4 feet long, wire-wrapped, stainless steel screen (0.01-inch slot size) with a retractable protective steel sheath. The groundwater sampler will be threaded onto the leading end of a probe rod and advanced to the desired sample depth within a sealed steel sheath using the Geoprobe® direct-push drilling rig. At the desired depth, the protective sheath will be retracted to expose the stainless-steel screen for collection of groundwater samples.

The current proposed activities described in the Additional Characterization of Shoreline Work Plan call for the installation of temporary monitoring points utilizing a direct push technology (DPT) drilling rig. In the event that DPT is successful in penetrating a portion of the soil column, but cannot fully penetrate to the desired depth (for example, the case where refusal is encountered at 35 ft below ground surface), DOEE will be contacted to discuss and mutually arrive at the determined sample depths. If DPT cannot sufficiently penetrate beyond only several feet, the contingency will be enacted on a separate mobilization include the use of auger-equipped drilling methods, or a change in the location of sample points.

2.2.3 Temporary Direct Push Well Development

2.2.4 The temporary direct push well must be developed to remove residual materials left in the borehole from the drilling process and establish the natural hydraulic flow conditions of the formation. The temporary direct push well could be developed using a peristaltic pump and new disposable low density polyethylene (LDPE) tubing, or a tubing check valve assembly. Purge water will be pumped through a flow cell and a YSI Model 600XL multi-parameter monitoring device (or similar) will be used to monitor stabilization parameters including pH, temperature, specific conductance, dissolved oxygen, oxidation-reduction potential, and turbidity during the development of these monitoring points. Once gross solids are removed (<20NTU), it is not recommended to continue purging the temporary discrete monitoring points. Following minimal development the sample should be collected. A new temporary direct push well should be developed until the column of water in the well is free of visible sediment. Purge water will be containerized with decontamination fluids for off-Site disposal.Static Water-Level Measurements

Prior to purging for collection of groundwater samples, the static water-level must be measured from the ground surface, or other predetermined point of reference. Measurements should be made using a water-level indicator capable of measuring water-levels to a precision of 0.01 ft. The static water-level and reference point of measurement at each well must be recorded in the field log book. The water-level indicator should be decontaminated immediately after each use.

2.3 Permanent Well Inspection and Water Level Measurement

2.3.1 Inspecting and Opening the Groundwater Monitoring Well

Prior to opening the groundwater monitoring well, the protective casing should be inspected for signs of tampering, damage, or maintenance needs. Once the protective casing is opened, the inside of the well should also be inspected. Special notice should be made of well conditions, including the presence of insects or other conditions. Observations on the condition of the well should be recorded on the field log forms.

If opening the lock on the protective casing is a problem, the lock may be lubricated with graphite or mineral oil. Spray lubricants, such as WD-40®, should never be used. If a lock will not open after lubrication, the lock should be cut off and replaced.

2.3.2 Synoptic Round of Water Level Measurements

Prior to any groundwater sampling event, a synoptic round of water level measurements must be made in monitoring wells as listed on **Table 1**. Water level measurements must be made within as short a period of time as possible. The purpose of collecting the readings within a short time period is to avoid temporal variations in groundwater level which could preclude accurate determination of groundwater flow rate and direction, and groundwater quality characteristics. Water levels will be measured as described in Section 2.3.3.

2.3.3 Static Water-Level Measurements

Prior to purging and sampling a groundwater monitoring well, the static water-level must be measured from the top of the riser pipe, or other predetermined point of reference. Water-level measurements should be made using a water-level indicator capable of measuring water-levels to a precision of 0.01 ft. The static water-level and reference point of measurement at each well must be recorded in the field log book. The water-level indicator should be decontaminated immediately after each use.

2.4 Groundwater Well Purging

Following the static water level measurement, groundwater samples will be obtained from the direct push wells and groundwater monitoring wells using low-flow groundwater sampling protocols[1]. The purge water discharge will be routed to a flow-through cell and water quality measurements will be obtained using field instruments. Each well will be purged and sampled using either a peristaltic or electric pump with minimal drawdown of the water level until field groundwater quality parameters stabilize. The field groundwater quality measurement will be collected periodically during purging and immediately prior to sample collection. At a minimum, four distinct field measurements during purging will be used to evaluate stabilization and will include pH, temperature, specific conductance, DO, ORP, and turbidity.

In the event of low producing wells, the collection and analysis of stagnant water is not an acceptable practice. When the wells do not recover in a timely manner prior to collection of all containers for all analytes, the well will be allowed to re-equilibrate overnight and a field crew

1 e.g. USEPA, 2002; *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*, Groundwater Forum Issue Paper, Office of Solid Waste and Emergency Response, EPA 542-S-02-001, May 2002

will return to collect the remaining parameters. DOEE Water Quality Department (WQD) would be consulted if sufficient quantities are unavailable.

2.5 Field Groundwater Quality Measurements

The field parameters to be measured while purging include pH, temperature, specific conductance, DO, ORP, and turbidity. The recording of measurements should only begin once drawdown stabilizes and the discharge equals the recharge. The measurements should be recorded every 5 minutes thereafter (or after one full exchange of water in the flow-through cell and pump discharge tubing) until the parameters stabilize[2] with a minimum of three sets of measurements. Field parameters are considered to be stabilized based on the following criteria for three (3) consecutive readings:

- ±3% for temperature;
- ±0.1 units for pH;
- ±3% for electrical conductivity;
- ±10% for turbidity;
- ±0.3 milligrams per liter (mg/L) for DO; and
- ±10 millivolts (mV) for ORP.

All measurements, including the time measured, should be recorded on the field log forms. A variety of meters are commercially available for measuring these parameters and often one meter will be capable of measuring all parameters. The manufacturers' instruction manuals should be consulted for the appropriate operating instructions.

2.6 Groundwater Well Sampling

Groundwater samples will be collected from each well by filling pre-preserved, laboratory-provided sampling containers, directly from the effluent of the pump discharge tubing. Specific protocols for collecting, handling and analyzing the groundwater samples are provided in Section 3. Samples will be analyzed for the constituents listed on **Table 2**. Sample bottles should be filled as full as possible without overflowing so as not to dilute the sample preservative, if present. All relevant sampling information (e.g., sample point identification time and date of sampling, sampling personnel, analysis requested, preservatives, and filtering [if applicable]) should be recorded on the field log forms and on the sample identification label.

[2] *Ibid*

3. SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Sample bottles and chemical preservatives will be provided by the laboratory. The containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest U.S. EPA's Specifications and Guidance for Contaminant-Free Sample Containers.

Samples will be placed in coolers on ice to maintain the temperature at 4°C ± 2°C while in transit to the laboratory. Chain-of-custody forms and cooler seals will be used to document the custody of the samples throughout the collection, transportation, and analysis processes. The chain-of-custody will also serve to clearly document the requested analyses. Samples will be either hand delivered or shipped via overnight courier to the analytical laboratory. Custody seals on individual sample containers are not required. Custody seals on coolers are required when using a third party courier (i.e. FedEx).

Upon receiving the samples, the laboratory sample custodian will inspect the condition of the custody seal and samples, measure the temperature of a sample bottle or temperature blank, and compare the information on the sample labels against the chain-of-custody forms. The date and time of shipment receipt by laboratory and name and signature of person receiving samples will be recorded by the laboratory on the chain-of-custody form. The following shall be included on the sample receipt documentation:

- The identities of any damaged sample containers;
- Discrepancies between the sample label and information on the chain-of-custody form;
- Cooler temperature (if >6°C); and
- Condition of custody seal (if compromised).

The laboratory should provide a copy of the executed COC and sample receipt documentation to the Field Task Leader within 24-hours upon receipt of the samples by facsimile or electronic mail.

4. QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

A quality assurance/quality control (QA/QC) program is established to ensure that data collected and analyzed through the life of the project maintain an acceptable level of quality upon which project decisions can be made. The QA/QC program will be documented in accordance with a project Quality Assurance Project Plan (QAPP) which is included as **Appendix A** includes details of the identification and description of control parameters for the field collection and laboratory analysis phases, acceptance criteria for the controls, and corrective actions to be employed in the event that acceptance criteria are not met.

TABLES

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TABLE 1
CONSTRUCTION DETAILS FOR SELECT MONITORING WELLS

Former Potomac River Generating Station
Alexandria, Virginia

Well	Zone Monitored	Well Diameter (inches)	Depth to Bottom (feet)	Length of Casing (feet)	Length of Screen (feet)	Top of Casing Elevation (ft-msl)
TW-02	Deep	1	24	14	10	NS
TW-03	Deep	1	15	5	10	10.40
TW-04	Deep	1	15	5	10	9.49
TW-05	Deep	1	10	0	10	9.64
TW-06	Deep	1	15	5	10	9.86
TW-07	Deep	1	15	5	10	9.88
TW-14	Shallow	1	5.5	0.5	5	11.61

Notes:
ft msl feet above mean sea level
NS Not Surveyed

TABLE 2
GROUNDWATER ANALYTES

Former Potomac River Generating Station
Alexandria, Virginia

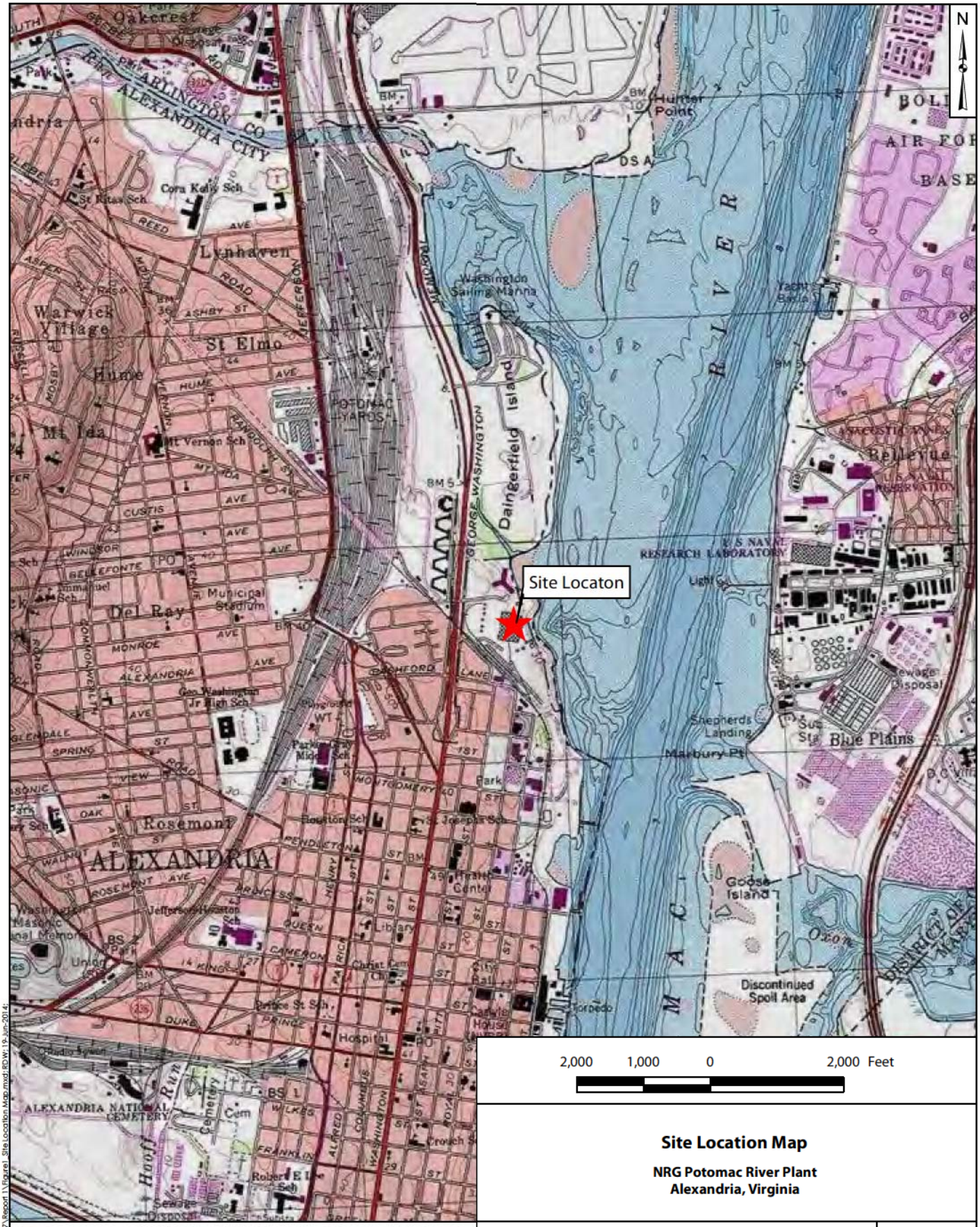
Analytical Group	Method Reference	Parameter	Quarter 1[1]	Quarter 2[2]	Quarter 3	Quarter 4
Standard Parameters	EPA 8015B	TPH, Diesel Range Organics C10-C28	●	●	●	●
	EPA 8015B	TPH, Gasoline Range Organics C6-C10	●	●	●	●
	EPA 1664A	Oil and Grease	●	●	●	●
	EPA 8260	Volatile Organic Compounds	●	●	●	●
	EPA 8270	Polycyclic Aromatic Hydrocarbons	●	●	●	●
Additional Parameters	EPA 200.7, 200.8, 245.1, 7470A	TAL Metals [3]	●	●		
	EPA 200.7	Hardness	●	●		
	EPA 8082	Polychlorinated Biphenyls	●	●		

Notes:
Assume the seasonal high flow cycles occurs in Q2 and the seasonal low flow cycles occurs in Q4.
1. MW-103, MW-104, TW-02, TW-03, TW-04, TW-05, TW-06, TW-07 and TW-14 will be sampled for analysis of both standard parameters and additional parameters.

2. MW-103, MW-104, TW-02, TW-03, TW-04, TW-05, TW-06, TW-07 and TW-14 will be sampled for analysis of standard parameters only. An additional high tide sample and low tide sample will be collected from a single well (TW-03) for analysis of both standard parameters and additional parameters.

3. Target Analyte List (TAL) Metals will be analyzed for the total recoverable.

FIGURES



Site Location Map

NRG Potomac River Plant
Alexandria, Virginia

Notes:
USGS Topographic Map accessed via ArcGIS Online and provided by Microsoft on 19 June 2014. Alexandriag Quadrangle (1965, photorevised 1983, bathymetry 1982).

Geosyntec consultants

Columbia, Maryland

Figure
1

P:\GIS\NRG Po River - MEM1067\Report 1\Figure1_SiteLocation Map.mxd RDW 19-Jun-2014

APPENDIX A

Quality Assurance Project Plan