EGYPT ROAD STORMWATER MONITORING PLAN

Prepared for

Power Plant Research Program
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1 INTRODUCTION

1.1 PURPOSE

This monitoring plan describes the assessment of the performance of recently installed best management practices (BMPs) in the reduction of pollutants to the Egypt Road Maple Dam Branch and Little Blackwater River. Specifically, this project aims to characterize the ability of the wetland restoration project to reduce loads of pollutants typically found in stormwater runoff and the effectiveness of the restoration in protecting receiving channels from potentially polluted runoff from existing conditions and future development of a solar electric power generation facility.

1.2 STUDY AREA

The Egypt Road Maple Dam Branch and Little Blackwater River Restoration Project is located southwest of the city of Cambridge (Figure 1).

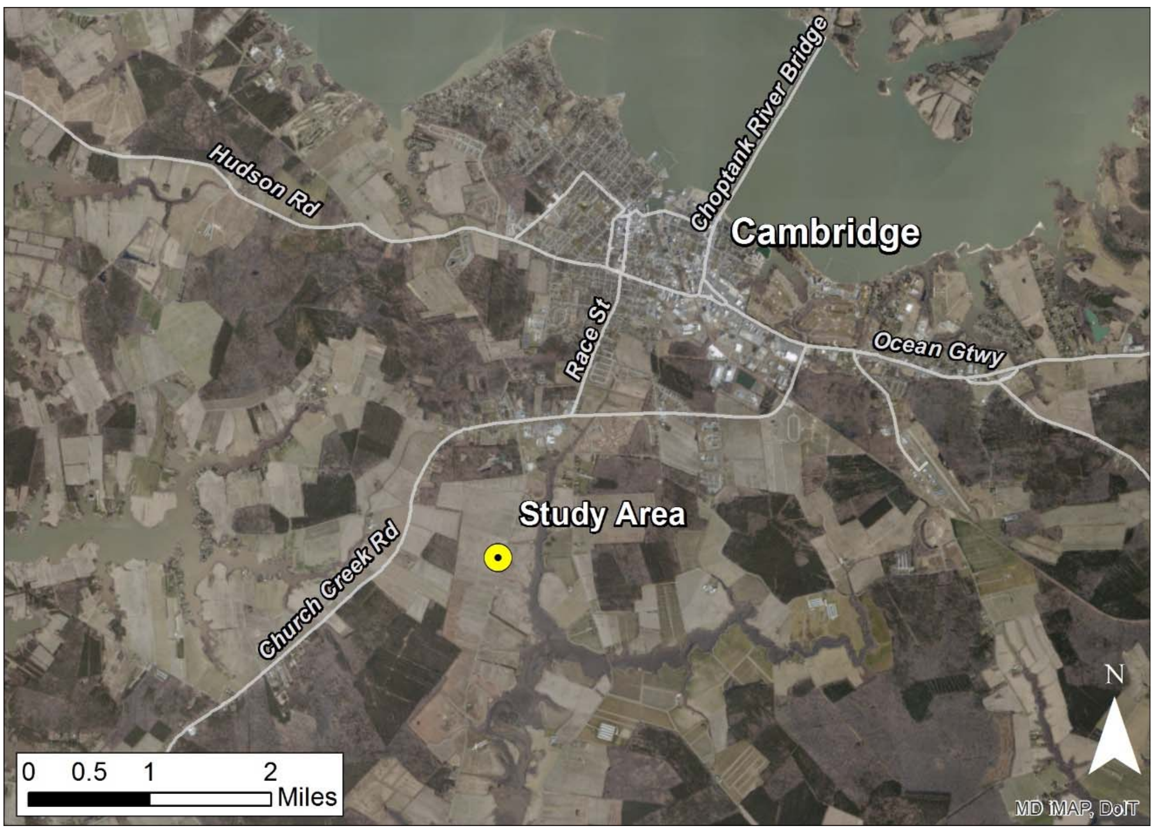

Figure 1. Aerial map of the study location in relation to Cambridge, MD

The area was originally designated for the development of a residential community and golf course, but has since been divided into approximately 320 acres owned by Egypt Road Solar, LLC for the installation of a solar energy facility and 728 acres purchased by the State of Maryland in

2007 (Figure 2). Within the State owned property, restoration efforts were employed to improve stormwater water quality as it flows from the proposed solar facility and makes its way to the adjacent streams and rivers, as well as to improve wildlife habitat for various species of songbirds, waterfowl, and mammals in the area. Restoration efforts for the 728 acres included restoring approximately 200 acres of wetlands, reforesting approximately 253 acres, establishing approximately 40 acres of grassy meadow buffers, and maintaining approximately 235 acres of agricultural land. Restoration efforts began in the summer of 2008 and were completed in the spring of 2009; reforestation efforts occurred between the summer and fall of 2009 (MD DNR 2010). The solar facility will utilize existing agricultural ditches to convey stormwater flows off their property and across Egypt Road via culverts to the restored State-owned property. These stormwater flows will then be transported to adjacent streams and rivers via constructed swamp runs, which are designed to allow greater connectivity to the flood plain, and slow water flows through the system to deliver these flows over a longer period of time to the adjacent water bodies. Two of the constructed swamp runs will have stormwater flows monitored: one swamp run designated as a control and one designated as indicator location (Figure 3).

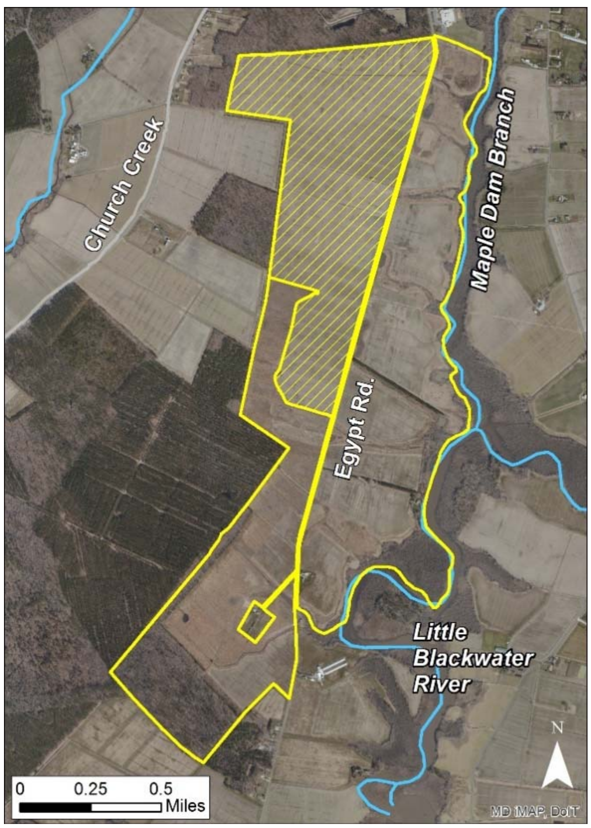

Figure 2. Egypt Road Maple Dam Branch and Little Blackwater River study area. Yellow outlined area is the property owned by the State of Maryland; yellow shaded area is private property for the solar energy facility site

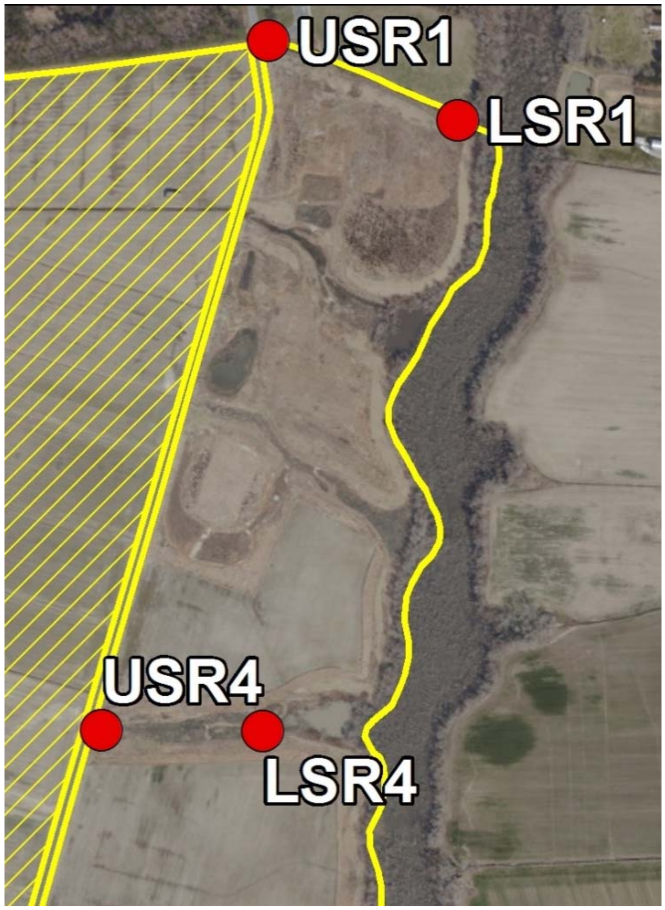

Figure 3. Swamp run locations for stormwater monitoring. USR1 and LSR1 are control stations, and USR4 and LSR4 are indicator stations

1.3 BACKGROUND

The Department of Natural Resources (DNR) has identified the Egypt Road Maple Dam Branch and Little Blackwater River restoration project as a location to evaluate and detect water quality and wetland habitat changes, if any, in the surrounding watershed and potentially to receiving waters of these two systems.

Development within a watershed often alters the hydrologic flow regime, water chemistry, and temperature of aquatic ecosystems, which consequently affects the physical habitat and health of the biological community. Restoration efforts are designed to re-establish hydrological conditions that were disrupted as a consequence of development, introduce stormwater treatment using natural processes provided by wetlands, and improve local habitat. The development of solar energy facility at Egypt Road will increase impervious cover and potentially contribute additional polluted runoff to the local stream networks. The purpose of this monitoring plan is to establish procedures that will enable DNR to evaluate the performance of the constructed swamp runs in mitigating downstream impacts from the proposed Egypt Road solar facility and promoting a healthy stream ecosystem.

2 STUDY DESIGN

Primary indicator sites were selected in a swamp run area that is primarily impacted by drainage from the planned solar facility development to eliminate the confounding influence of drainage from other types of land use in the area. A nearby swamp run system with no or limited impact from development was selected to serve as a control. By adding a control site, a Before-After Control-Impact (BACI) study design, or a variation of a BACI (depending on the metric) can be employed to statistically compare data and estimate effect size.

A BACI study design can be employed for automated stormwater chemistry and wetland habitat assessment. A Control-Impact (CI) study design can be used to examine flow rate, and a Before-After (BA) study design can be used to examine pre- and post-construction data at the indicator sites.

3 MONITORING PLAN

The design and implementation of a scientifically rigorous, comprehensive monitoring plan to detect and assess the effects of development on streams requires the incorporation of several different components. These components are listed below and are discussed in the following sections.

The plan components are as follows:

- Stream monitoring stations
- Wetland habitat assessment
- Automated water chemistry sampling
- Continuous flow rate data collection
- Program schedule
- Recordkeeping

3.1 STREAM MONITORING STATIONS

Fixed monitoring stations will be established in reaches that are both anticipated to be affected by the presence of the development, and in a control location. Since the objective of the monitoring is to detect changes in water quality over time resulting from the developed area, the indicator monitoring stations have been strategically placed to isolate impacts from the development of the solar energy facility. This placement will allow for comparisons between upstream and downstream monitoring stations, as well as among monitoring stations, to determine if water quality has been improved as flows traverse the swamp run systems and to evaluate the overall efficiency of the restoration project. Chemical and wetland assessment data will be collected from these watershed monitoring stations in various combinations. Each station will be appropriately marked, and their locations recorded using sub-meter GPS.

3.1.1 Indicator Sites

Indicator sites will be sampled within one of the constructed swamp runs. The swamp run being sampled will have two monitoring stations along its reach; one station will be located along the upper extent along Egypt Road to determine water chemistry impacts from the developed area before entering the swamp run systems, and one station will be located along the lower extent of the swamp run to characterize water chemistry as it leaves the swamp run system and enters the adjacent water bodies.

3.1.2 Control Site

Control stations will be located at the northern extent of the property away from development impacts. The proposed control locations drain from undisturbed forested areas. Similar to the indicator sites, the control stations will be located along the upper extent along Egypt Road to characterize water chemistry from the undeveloped area before entering the swamp run system and along the lower extent of the swamp run as it leaves the swamp run system and enters the adjacent water bodies.

3.2 MONITORING ELEMENTS / PLAN COMPONENTS

3.2.1 Wetland Habitat Monitoring

The State has restored and enhanced the wetlands at the Egypt Road site adjacent to the receiving waters of Maple Dam Branch and Little Blackwater River. To characterize the wetland habitat and community at this location, one pre-construction and one post-construction assessment will be conducted around both the control and impacted sites. During these visits, Versar will identify native and non-native vegetation growing in the restored wetlands, as well as any birds, mammals, and herpetofauna encountered in the area. By employing a BACI study design, these sites can also be compared directly to determine changes in wetland habitat composition between pre- and post-installation phases of the solar energy facility.

3.2.2 Rainfall

Versar will affix one Onset HOBO electronic tipping-bucket rain gauge on top of a pressure-treated 4x4 post fitted with a plywood platform within the restoration project bounds to capture continuous rainfall data during the sampling period. The gauge will be installed at a lateral distance of at least one-half the height of the closest structure or trees, ensuring accurate collection of precipitation over time. The gauge will be programmed to log data at 5-minute intervals or as required by DNR and will be serviced monthly to check instrument performance and power-up status. Technicians will download and plot the continuous rainfall data on a field laptop to verify gauge functionality and to identify data recording problems.

3.2.3 Flow Rate

Flow logging will be implemented to assess baseflow conditions at the site and the effectiveness of the swamp runs in controlling stormflow volume in the potentially impacted drainage downstream of the solar energy facility. Indicator site and control site data can be compared in a BACI fashion. Flow rate data will also be used in conjunction with automated storm runoff sampling (see Section 3.2.4) to determine proportional aliquots and compute storm load per pollutant.

Versar will install one ISCO 4230 series bubbler flowmeter at each indicator and control monitoring station, four total, to measure continuous flow rate; if it is determined that there is not enough drop at the upstream control station to prevent water from backing up into the culvert pipe, an area-velocity sensor will be used in place of the bubbler flowmeter at this station. Each flowmeter, power supply, and associated cabling and tubing will be secured inside locked, plastic storm boxes mounted on plywood decks. At the upstream monitoring stations and where practical, staff will install flow sensors within culverts so that flow rate can be readily estimated from stage using Manning's equation. If necessary, staff will install weirs at the downstream monitoring stations to facilitate accurate flow rate readings. Rating curves will be prepared by staff to convert stage to flow rate to verify the flow rate model. Stage height will be referenced to a permanent staff gauge that will be placed as part of the permanent installation. Field technicians will travel monthly to the monitoring stations, perform electronic and mechanical checkout of all equipment, change batteries, update equipment maintenance logs, and recalibrate equipment (e.g., set level, effect repairs) as necessary. All inspection activities and observations will be recorded in a field binder. During each visit, the flowmeters will be downloaded, and the flow data archived. Staff will review and evaluate continuous flow rate data do identify data accuracy problems.

3.2.4 Storm Runoff Monitoring

As described above, automated sampling stations will be co-located with flow monitoring stations to facilitate volume-weighted sample compositing and chemical load computation. Automated sampling for storm runoff monitoring will take place at both the upstream and down-stream ends of the control and indicator swamp run stations to compare water chemistry con-centration and loads.

The automated sampler to be used at each station will be an ISCO Model 6712 full-size portable sampler capable of collecting up to 24 1000-mL water samples in polyethylene bottles. The size of the samples and number of bottles will enable representation of the entire storm hydrograph so that rising, peak, and falling limb event mean concentrations (EMCs) can be determined per station per storm.

Pending DNR approval, the installation team will attach a weatherproof storm box on a platform, constructed of 4 x 4 pressurized lumber footers and plywood deck, in the vicinity of each target stream segment. As described in Section 3.2.3, the storm box will enclose and secure the automated sampler, flowmeter, ancillary equipment, and power supply for long-term deployment.

The sampler strainer will be anchored within the culvert using cable ties, or within the stream channel using rebar.

Field teams will conduct automated storm event monitoring by obtaining volume-weighted composite samples during storm events at each station using the automated equipment. The composites will consist of discrete samples taken during the rising, peak, and falling limbs of the monitoring event. Autosamplers will be programmed to operate over an appropriate duration as determined by field staff, sampling all portions of the hydrograph to the maximum extent practical. A valid storm event is defined as a quantity of rainfall equal to or exceeding 0.5” within a 24-hour period, that have a 30-minute duration, and that creates sufficient volume of stormwater runoff for chemical analysis. Field crews will monitor up to a maximum of two storms per site per quarter (i.e., eight per year at each station). and a good faith effort to capture all limbs of the target storm at all stations. The failure of one station shall not be grounds for voiding the storm at all stations.

After the storm event and sampling sequence have concluded and storm acceptability is verified, field staff will determine proportional aliquots to be taken from the autosampler’s discrete samples to composite each limb of the storm flow. The composite samples will be stabilized and transported to a certified laboratory for analysis of total phosphorus, total suspended solids, nitrite/nitrate, and total Kjeldahl nitrogen. Method references and detection limits are presented in Table 1. Additionally, staff will record pH and specific conductivity in each composite sample using a Yellow Spring Instruments (YSI) ProDSS or ProPlus Multiparameter Sonde or equivalent. Sondes will be calibrated prior to monitoring events, per manufacturer recommendations.

Table 1. Method references for chemical parameters

Analyte	**Method**	**Reportable Detection Limit (mg/L)**
Total Suspended Solids	SM 2540 D-97	1 mg/L
Total Phosphorus	SM 4500-P E99	0.01 mg/L
Nitrite/Nitrate-N	SM 4500-NO3 H00	0.05 mg/L
Total Kjeldahl Nitrogen	SM 4500-NH3 C97	0.5 mg/L

3.2.5 Baseflow Monitoring

Staff will perform baseflow monitoring twice quarterly during low-flow periods. Baseflow monitoring will occur with a dry time requirement of 72 hours after the last recorded rainfall of ≤ 0.03 inches. If flow is present at the time of baseflow monitoring, samples will be collected and delivered to the laboratory for analysis of the chemical parameters outlined in Table 1.

3.3 RECORDKEEPING

Data generated throughout the life of this monitoring program will be compiled into an MS Access database, where practical, to aid in record keeping, data analysis, and reporting. ISCO instrumentation will be downloaded to Flowlink databases and exported, as applicable, to spreadsheets for analysis and delivery to DNR. Rain gauge data will be downloaded using HOBOWare and similarly exported to spreadsheets. Field data will be recorded on pre-printed field data sheets and scanned upon return to the office.

3.4 SCHEDULE

Changes in environmental conditions over time can be gradual. In order to capture these changes, the development of a scientifically rigorous monitoring program is required, ensuring the sufficient and thorough accumulation of data needed for analysis and reporting. As part of the long-term monitoring of the Egypt Road Maple Dam Branch and Little Blackwater River restoration project, the monitoring stations will be sampled according to the annual schedule in Table 2.

Table 2. Timeline for implementation of monitoring and reporting

Subtask	Required Time Period
Water quality monitoring	Continuous
Rainfall and flow logging	Continuous
Wetland habitat monitoring	Fall 2020 (pre-construction), TBA (post-construction)
Draft annual report	October 1, 2021
Final report	December 1, 2021

4 REFERENCES

MD DNR. 2010. Egypt Road/Little Blackwater Restoration Project. Maryland Department of Natural Resources, Annapolis, Maryland.