FINAL
WETLAND VEGETATIVE INJURY ASSESSMENT PLAN
SWANSON CREEK OIL SPILL

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1. INTRODUCTION

1.1. INCIDENT OVERVIEW

On April 7, 2000, approximately 126,000 gallons of a mixture of #2 and #6 fuel oil were released from a pipeline break from the 12 mile branch of the 51.5 mile pipeline providing fuel oil to the Chalk Point Generating Station operated by Potomac Electric Power Company (PEPCO). The pipeline normally transports No. 6 fuel oil used to generate electricity. At the time of the release, the pipeline also carried No. 2 fuel oil which was being used to flush the line. PEPCO owns the pipeline; Support Terminal Services Operating Partnership, LLP (ST Services) operates it. The spill initially leaked into Swanson Creek, however, high winds, rain, and tides resulted in the oil being spread into the Patuxent River and several tributaries, including Swanson Creek, Indian Creek, Trent Hall Creek, Washington Creek, and Cremona Creek, among others. Further details of the spill and response actions taken are summarized in the Response Action Plan (PEPCO, 2000). Much of the shoreline habitats affected by the spill consisted of vegetated brackish-to-freshwater wetlands. As a result of the incident, the natural resource Trustees are conducting a wetland injury assessment as part of the natural resource damage assessment (NRDA) of the Chalk Point Oil Spill. This document presents the methodology for conducting the vegetative wetland injury assessment and beach habitat oil exposure components of the NRDA.

1.2. STUDY OBJECTIVES

The primary objectives of the wetland injury assessment study are to:

- Document the spatial extent and degree of oiling of wetland and beach habitats; and
- Quantify the degree, and spatial and temporal extent, of injuries to wetland habitats.

Wetland injuries will be quantified by comparing the condition of the oiled wetland vegetation to baseline (pre-spill) conditions. The information provided by this study will be used to provide the technical basis for evaluating the need for, type of, and scale of restoration, using the Habitat Equivalency Analysis (HEA) model methodology (NOAA, 1999). HEA calculates the injury to wetlands, in terms of acre-years of lost ecological services, and calculates the scale of restoration needed to restore these injured ecological services. To develop the restoration plan, the Trustees must determine and quantify injury, develop restoration alternatives that consist of primary and compensatory actions, scale restoration alternatives, and select a preferred restoration alternative. The principal concept underlying the method is that the public can be compensated for losses of habitat resources through habitat replacement projects providing additional resources of the same type. Under these conditions, HEA applies as a framework for scaling compensatory restoration. The basic steps for implementation include:

1. Document and estimate the duration and extent of injury, from the time of injury until the resource recovers to baseline, or possibly to a maximum level below baseline;
2. Calculate the size of the replacement project for which the total increase in services provided by the replacement project equals the total interim loss of services due to the injury; and
3. Calculate the costs of the replacement project, or specify the performance standards in cases where the responsible party will be implementing the compensatory habitat project.

This wetland injury assessment will generate the data inputs for the first step of the HEA process.

1.3. STUDY APPROACH

The methodology for this study was developed cooperatively by the wetland assessment study team which includes representatives from PEPCO, the National Oceanic and Atmospheric Administration (NOAA), the U.S. Fish and Wildlife Service (USFWS), Maryland Department of Environment (MDE), and Maryland Department of Natural Resources (MDNR). Technical representatives from each of these organizations have formed the Wetlands Assessment Team. The proposed study plan is based on approaches used at previous oil spill assessment studies, such as Mendelssohn et al. (1993) Winfield and Mendelssohn (1994), and Michel et al. (1998). The proposed study includes two components:

- Mapping of the areal extent of oiled wetland vegetation, by species, physical setting, and degree of oiling; and
- Quantitative measures of the injury to wetland vegetation through the use of quadrats at selected sites representative of the categories of oiling degree, species, and physical setting, compared to un-oiled, reference sites.

2. MAPPING THE EXTENT AND DEGREE OF OILED WETLAND HABITATS

2.1 INTRODUCTION

Mapping of the extent and degree of oil exposure for wetland habitats will be accomplished by a combination of aerial photograph interpretation, analysis of video and still photography, observations of shoreline oiling reported by the Shoreline Cleanup Assessment Teams (SCAT), and ground-truth surveys conducted by the Wetlands Assessment Team.

2.2 AERIAL PHOTOGRAPH INTERPRETATIONS

True color aerial photographs (scale of 1 inch = 500 feet and 1 inch = 300 feet) were taken of priority oiled wetland areas and selected reference areas on April 24, 2000. The 1 inch = 300 feet photographs have been scanned and registered to ground-control points, creating a photomosaic base map. The aerial photographs will be used to map the extent of oiling of wetland vegetation where the width of oil is large enough to be visible. The aerial photographs are necessary to map areas of interior oiling, in areas inaccessible to shoreline survey teams. Based on preliminary surveys conducted by the Wetlands Assessment Team, three degrees of oiling categories have been defined:

> Light: oil deposited on wetland vegetation as a film or stain (less than approximately 0.01 cm thick).
>
> Moderate: oil deposited on wetland vegetation as a coat or thicker (approximately 0.01 cm or thicker) without extensive oiling of the substrate.
>
> Heavy: oil deposited on wetland vegetation as a coat or thicker with evidence of extensive oiling in the substrate.

The aerial photograph interpretations of oil exposure will be ground-truthed, as discussed under Section 2.5.

The aerial photographs, information from McCormick habitat maps, and ground truthing will be used to determine the community type for all oiled areas. Based on preliminary surveys by the Wetlands Assessment Team, wetland species/communities affected by the oil spill include *Spartina alterniflora, S. cynosuroides, Typha angustifolia, Iva frutescens,* and a fresh-water community composed of *Scirpus*, *Juncus*, and other herbaceous plants. The physical setting on the shoreline fringe (thus exposed to natural removal processes by tidal flushing and wave action) or interior (thus sheltered from these processes) is another important component of the

habitat and duration of oil injury. Aerial photography will be obtained in the fall, 2000, to document the areal extent of vegetative response (both stress and mortality) to the oil spill, unless deemed unnecessary by the Trustees.

All of the mapped data on oil exposure and species/community distributions will be entered into a Geographic Information System (GIS) for integration with other data sources, to create maps and calculate areas of degree of oiling by species/community.

2.3 VIDEOTAPE AND STILL PHOTO ANALYSIS

Videotape and still photos taken during helicopter overflights and field visits during the cleanup phase of the spill response will be examined to provide additional information on the extent of oiling in the marsh and delineation of wetland types where necessary for this study. A detailed videotape survey of wetland habitats was conducted on 20 April 2000 and at other times; these surveys will provide comprehensive data on the extent of oiling in wetland habitats.

2.4 SCAT INFORMATION

SCAT surveys were conducted by boat and foot of most areas affected by the Chalk Point oil spill to document the extent and degree of oiling of shoreline habitats. The surveys used systematic terminology for shoreline type, percent oil cover, oil thickness, and width of the oiling band along the shoreline (NOAA, 1998). The information collected by the SCAT teams will be used to determine the width and type of wetland and beach habitat that was exposed to oiling, particularly for narrow outer fringes of oiling not readily visible on the aerial photographs or videotapes or hidden by overhanging vegetation. The SCAT data were recorded onto forms for specific shoreline segments. These data will be overlain on to 1993 digital orthophoto quarter quads and merged with the aerial photomosaics to create maps of the entire oiled area.

2.5 GROUND-TRUTH SURVEYS

All of the above data will be compiled onto work maps for ground-truthing by the Wetlands Assessment Team. Some preliminary ground-truth surveys were conducted in May and June 2000. Once the ground-truth surveys have been completed, the mapped data on oiling categories and species/communities distribution will be edited to create final maps.

3. VEGETATIVE INJURY MEASUREMENT

3.1. INTRODUCTION

One of primary measures of injury to wetland vegetation resulting from the oil spill will be change to the above-ground biomass, as measured by stem density and stem height. Although these parameters measure only one component of the ecological service flows of wetlands, the Wetlands Assessment Team has focused on them as key indicators of the extent and duration of injury to wetlands. Injuries to ecological functions of wetlands will be extrapolated from the vegetative injury, degree of oiling categories, and previous studies on impacts resulting from oil spills. Field assessment will be conducted in early Summer 2000, Fall 2000, and Summer 2001.

3.2. STUDY DESIGN

Using the maps on degree of oiling categories, vegetation species/communities, and physical setting (degree of exposure to waves, tidal flushing, and sunlight), sites will be selected as representative of these combinations in both oiled and un-oiled locations. It is acknowledged that placement of these sites will not be randomly selected. Rather, the sites will be selected as most representative of these conditions, based on the mapped data and field observations. However, it is agreed that the quadrats will used as the basis for determining the extent and duration of injury to the wetland conditions they represent, compared with similar un-oiled sites.

3.3 FIELD METHODOLOGY

3.3.1 Quadrat Locations

At each of the selected sites, quadrats will be established in the exposed and reference areas. The Wetlands Assessment Team agreed that lightly oiled wetlands are unlikely to show differences in vegetative response to oiling that could be measured (Michel et al., 1998), therefore no quadrats will be established in lightly oiled areas. Injury in lightly oiled areas will be estimated based on the literature on wetlands ecology and oil spill impacts.

The wetlands in the immediate vicinity of the pipeline break in Swanson Creek were exposed to large amounts of unweathered oil and intensive cleanup activities (e.g., construction of catwalks, trenching, flushing, and nutrient augmentation during Phase I of the response, and re-filling of trenches, re-planting, and other planned actions in Phase II of the response, per the Response Action Plan), making it unique in terms of the degree of oiling and the degree and duration of impacts associated with cleanup. A plan for injury assessment of this area will have to be

developed once the response phase is completed because the monitoring of the re-planting effort by EPA will not provide the information needed for injury assessment. These wetlands will be assigned to different oil exposure categories due to the nature and extent of the exposure and cleanup.

Wetlands in Swanson Creek appeared to be more heavily oiled than in the main stem and other tributaries of the Patuxent River. In addition, the wetlands in Swanson Creek appear to have more oil penetration into the sediments. The exposure categories in Swanson Creek will therefore be:

Typha angustifolia

1. Heavily oiled interior
2. Heavily oiled shoreline

Spartina alterniflora

3. Moderately oiled interior
4. Heavily oiled interior
5. Heavily oiled shoreline

Spartina cynosuroides

6. Heavily oiled interior
7. Heavily oiled shoreline

Three quadrats will be located in each of these categories, with the exception of the moderately oiled interior *S. alterniflora* category that was created as a 15-ft. band around the heavily oiled interior areas, as interpreted from the aerial photography. Based on preliminary field surveys, it was estimated that about half of the habitat within 15 feet of the heavily oiled interior areas was oiled, with the oil concentrated in small channels in a highly heterogeneous manner. Because of the difficulty of locating quadrats in such a complex area, the Trustees have proposed to estimate the injury as being half of that measured in the heavily oiled quadrats.

In areas outside of Swanson Creek, the degree of oiling is known to be less severe, thus there are only two degrees of oiling categories: moderate and light. Based on the preliminary field surveys, the injury to *Iva frutescens* is expected to be similar in all areas and therefore only one oiling category will be established with quadrats sampled in Swanson Creek and other areas. *Typha angustifolia* does not occur extensively in oiled wetlands outside of Swanson Creek. The species/oiling categories in other creeks will be:

Spartina alterniflora

8. Moderately oiled shoreline

Spartina cynosuroides
9. Moderately oiled shoreline
Iva frutescens (including *I. frutescens* in Swanson Creek)
10. Moderately oiled all locations

Reference sites will be selected as representative of the exposed sites as closely as possible in terms of wave energy, location (i.e., interior, fringe, island), species present, and visual indications of non-incident related loss of vegetation (e.g., eroding edges, sparse undefined edge). Reference quadrats will include:

11. *Typha angustifolia* interior reference
12. *Typha angustifolia* shoreline reference
13. *Spartina alterniflora* interior reference
14. *Spartina alterniflora* shoreline reference
15. *Spartina cynosuroides* interior reference
16. *Spartina cynosuroides* shoreline reference
17. *Iva frutescens* reference

There will thus be 16 species/oiling/setting categories including the reference areas with 3 quadrats for each category for a total of 48 quadrats (note that no quadrats will be established in category No. 3 (moderately oiled interior *S. alterniflora* marsh).

All quadrats will be marked using flagged PVC stakes. The flagged stakes will enable the field teams to return to the same locations for the duration of the study. In addition, during the first field effort, latitude and longitude data will be collected using a differential Global Positioning System (GPS). This GPS data will serve as a permanent record of the site locations, and will be used to map the quadrat locations. In the event that flagged stakes are missing upon subsequent field visits, new stakes will be placed in the general vicinity of the GPS-recorded site locations for continued data collection purposes.

For each exposure category of herbaceous species, three 1 m by 1 m quadrats will be established. The exact location of each marsh quadrat will be marked by a stake placed at the upper left corner of the quadrat. During data collection, a one-meter square frame made of PVC pipe will be placed around the stake to clearly outline the area.

For *Iva frutescens* habitat, 3 circular plots, each with a 2 meter radius will be sampled in both the injured habitat and reference areas. The exact location of each marsh quadrat will be marked by a stake placed at the center of the circular plot.

The following parameters will be recorded at each quadrat:

- Vegetative Injury;
- Vegetation Oiling; and
- Sediment Oiling.

3.3.2 Measures of Vegetative Injury

The distance of the quadrat from the nearest open water will be measured and recorded, as a measure of its exposure to wave action and tidal flushing. For the summer surveys, vegetation within each quadrat will be identified to species, and dominant plant specie(s) noted. If more than one species is present, the percent composition of each species will be estimated and recorded. Canopy height for the tallest five plants for each species present will be measured for each quadrat. Stem density will be estimated by conducting a vegetative stem count by species over the entire 1-m square quadrat or in a 0.25 m^2 subarea of the quadrat. This measurement will include all plant species present in the quadrat. For the fall survey, the number of flowers and fruits for each species will be recorded.

The general condition and appearance of the vegetation will be recorded for each quadrat. Vegetative health and/or indicators of stress or disease, such as the presence of fungus and/or chlorosis will also be observed and documented. If chlorosis is observed, the relative degree of chlorosis will be described.

Two photographs will be taken of the quadrat: one close-up taken at a 45 angle (e.g., looking down on the quadrat at an approximate 45° angle), and an overview taken approximately 10-20 feet away. The photographs may vary slightly at each quadrat depending upon logistical and environmental constraints (e.g., sediment stability, tide/water depth). A field label identifying the quadrat identification code and date will be held next to the quadrat during the photography, and information for each photograph will be recorded on the data sheet.

3.3.3 Vegetation Oiling Descriptors

Observations of oiling of the vegetation and location of oil on the plant surfaces will be recorded using the following descriptors:

Oiling Interval (__ cm to __cm above the ground surface)
Percent cover (% of the plant surface in the oiling interval covered with oil)
Oil thickness (film, coat, cover, etc. per SCAT terminology)
Oil Location on Plant (All, stems only, leaves only)

Oil Descriptor (tacky, dry, others?)

3.3.4. Sediment Sampling and Oiling Descriptors

In support of the marsh assessment, sediment samples will be collected during the summer marsh field survey for hydrocarbon (TPH and PAH) analysis.

Sediment core samples (up to 1 foot in depth) will be collected at all quadrats including reference sites. These samples will be sectioned into 0-2 inch , 2-6 inch and 6-12 inch intervals. One sample from each species/oiling/setting category will be selected for analysis. The surface (5cm) sections will be analyzed for total hydrocarbons (TPH) and the 2- to 6-ring polycyclic aromatic heterocyclic hydrocarbons (PAHs) that include the alkyl-substituted PAH homologues, in addition to the standard priority pollutants PAHs. The samples will be also analyzed for total organic carbon (TOC). The subsurface samples will be archived for possible later analysis. TPH provides information on the residual oil composition and the degree of weathering of the released oil. The individual PAH analysis identifies the concentrations of major components of residual oil that contribute to oil toxicity.

The TPH analysis will follow modified EPA Method 8100 procedures (EPA SW-846, 1986) which involves extraction of the sample with a solvent, cleanup of the extract for non-hydrocarbon (polar) compounds and material, and analysis by GC/FID instrumentation. The analysis will include the determination of selected saturated hydrocarbons (n-alkanes and isoprenoids). The PAH analysis will use the extract from the TPH analysis and follow EPA Method 8270 (EPA SW-846, 1986) modified for GC/MS instrumental analysis in the selective ion monitoring mode (SIM). Method detection limits for individual PAHs will be approximately 1 ug/kg.

These hydrocarbon data will be valuable in the marsh assessment for a number of reasons. TPH and PAH results will be used to monitor the change in oil composition with time due to weathering processes and the loss of those compounds that would contribute to the toxicological effects on the marsh. These data will be useful in helping predict the recovery period for oiled marsh that shows slower rates of recovery and support injury assessments of the marsh habitats.

As part of the field surveys, oiling of the sediments and soils will be recorded if oil or oil sheen is observed or if hydrocarbon odors are present. The following terminology will be used:

SURFACE OIL

Oil thickness (film, coat, cover, etc. per SCAT terminology)
Percent cover (% of the sediment surface covered with the oil)

SUBSURFACE OIL

Depth of penetration
Oil Descriptors (oil-filled pores, partially filled pores, oil residue, etc.)

Where significant subsurface oiling is observed, sediment samples will be collected for detailed chemical characterization, specifically analysis of the polynuclear aromatic hydrocarbons (PAH), since most of the toxicity in oil is due to the PAHs. The analytes must include the alkyl-substituted PAH homologs, in addition to the standard PAH "priority pollutants". This method is referred to as Modified EPA Method 8270, because the list of PAHs is expanded to include the alkylated homologs, using GC/MS in the selected ion monitoring mode. Detection levels should be 1 ppb for individual PAHs to support injury assessment using toxicity thresholds. Sediment samples will be collected from the un-oiled sites for comparison.

3.3.5 Observations of Impacts to Epifauna

For each quadrat, the presence and relative abundance of intertidal epifauna (e.g., snails, mussels, crabs) will be recorded by species and life stage. Although these observations will be not be quantitative enumerations, they will document the absence of these species and life stages in oiled versus un-oiled quadrats.

The presence and oiling of wrack will be recorded for each quadrat, as this can affect the density of plants regardless of the degree of oiling and /or injury

3.3.6 Infauna Sampling

During the summer 2000 field effort, sediment cores (four inch in diameter and twelve inches deep) will be collected at each quad station and examined for the presence of infauna. Additional cores may be taken during later assessments if the marsh assessment group feels they are warranted. The samples will be sent to the Academy of Natural Sciences for characterization.

3.3.7 Measurements of Shoreline Erosion

One of the shoreline cleanup techniques used was low- to moderate-pressure flushing. There is concern that shorelines that were flushed and exposed to long fetch distances will experience accelerated erosion. In some of the flushed areas, the sediment between plant hummocks was washed away exposing the base of the hummocks to increased wave action. The loss of sediment between hummocks may be part of a normal erosional process in some areas but the

flushing of oiled shorelines may have created additional areas of erosion. These areas will be identified during the ground-truth survey and targeted for measurement of increased shoreline erosion. Shoreline erosion will be measured at these selected locations by installing three PVC stakes in a straight line approximately perpendicular to the shoreline. One stake will be placed along the shoreline at the edge of the vegetation. The distance from that stake to the two additional stakes will be measured and recorded. The distance to the edge of the vegetation can be measured at any time even if the shoreline stake is lost. These measurements will be used to estimate the rate of shoreline erosion only at those selected locations; no reference locations will be established. Additional erosion monitoring locations may be established if the wetlands assessment team determines that they are warranted.

A photograph at each erosion monitoring station will be taken from one end of the transect facing toward the opposite end. Additional photographs and video may be taken at some quadrats to document conditions in the general area, disturbances and measurement methods.

4. DELIVERABLES, REVIEW PROCESS, TIMELINE

The Trustees and PEPCO are working cooperatively on the wetland injury assessment studies. PEPCO will be responsible for compiling the data to be used to map the oiling categories and species/community distributions, and for distributing the draft and final mapped data, in digital and hardcopy formats to each of the Trustees. They will submit field survey data reports within 45 days after completion of each field survey that include all copies of field data forms and photographs, tabular data (hardcopy and digital) for all field measurements, and location maps and GPS coordinates for all quadrat locations. The Trustees will review these reports and provide comments within 30 days. PEPCO will revise the reports, if necessary, and submit final copies within 30 after receipt of comments. After the July 2001 field survey, PEPCO will prepare an interpretative Technical Report on the HEA inputs for injury quantification and restoration scaling, which also identifies, with Trustee input, potential restoration projects. These deliverables and a tentative schedule are outlined below:

July 2000 Draft Field Report	31 August 2000
September 2000 Draft Field Report	15 October 2000
July 2001 Draft Field Report	31 August 2001
Interpretative Technical Report on HEA Inputs with Identification of Restoration Projects	15 September 2001

5. REFERENCES CITED

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Addendum: W1A Vegetative Assessment

Compared to other oiled wetland areas, segment W1A was the most heavily oiled area and subjected to the most intensive cleanup including placement of an extensive network of boardwalks, moderate pressure flushing, the creation of ditches to increase recovery of oil, and nutrient augmentation. In May-August 2000, most areas showing little natural regrowth were planted with *Spartina alterniflora* plugs on 18 inch centers. The cleanup and restoration operations were ongoing during our last marsh assessment and this area was excluded from that study plan. Nevertheless, recovery will be estimated in the same manner as other oiled marsh areas, by comparison of representative quads with unoiled reference areas.

The marsh assessment team has determined that three areas that are expected to recover at different rates exist in W1A.

1) Areas of natural re-vegetation. Areas that have already begun to revegetate on their own without the installation of new plants. These areas contain primarily *Spartina alterniflora, Typha angustifolia*, or *Scirpus spp*. The areas of *S. alterniflora* and *T. angustifolia* in W1A are expected to recover at rates similar to other areas of heavily oiled interior marsh in Swanson Creek so no new quads will be established. Three new quads will be established in areas of oiled *Scirpus* and three reference sites will be established for comparison. There is some concern that areas that were originally populated by *S. alterniflora* are revegetating as *Typha* marsh. The group will try to locate recent prespill photographs from which an estimate of habitat conversion can be made.

2) Ditches that were filled and re-planted. The drainage ditches were filled with sand and excavated soils, then planted with *S. alterniflora* on 18 inch centers. Three quads will be established in these areas, for comparison with previously established *S. alterniflora* interior reference quads.

3) Wetland areas that were re-planted. Areas of native marsh soil showing poor vegetative re-growth in May were planted with *S. alterniflora* on 18 inch centers. Three quads will be established in these areas, for comparison with previously established *S. alterniflora* interior reference quads.

The area represented by each of these categories will be determined from aerial photographs to be taken in September 2000 in conjunction with the first assessment for these sites. The ditches are clearly visible on oblique photographs taken from helicopter and we expect to be able to measure the size of each category on aerials taken this fall. The same parameters will be measured at these sites as at other quads established previously. Sediment samples will be collected from all newly established quads.

Separate recovery curves will be established for each of the three areas to determine how much restoration is needed to fully compensate for the injured marsh in the W1A area.

New exposure categories

- *S. alterniflora* planted in ditches
- *S. alterniflora* planted in marsh soil
- *Scirpus spp*. (Heavy interior oiling)
- *Scirpus* reference