# Bridgeport Rental and Oil Services (BROS) Superfund Site

## Wetlands Restoration: Implementing Adaptive Site Management to address Mitigation Restoration Requirements

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THE ELM GROUP

## BACKGROUND/INTRODUCTION


The Bridgeport Rental and Oil Services (BROS) Superfund Site is located in Southern New Jersey. Following a hurricane in the summer of 1972, a waste-oil lagoon located on the property breached and flowed into the adjacent forested wetland. Environmental remediation was comprised of contaminated sediment removal, placement of a sorptive layer, and clean fill backfilling which temporarily disturbed approximately 15.3 acres of wetland. Remediation was completed in 2010, after which restoration activities were initiated.

Due to changing/variable hydrologic conditions in the wetland areas, the mitigation/restoration plan consists of an integrated approach that includes Adaptive Site Management (ASM) measures. The ASM approach promotes restoration of a self-sustaining wetland, given hydrologic conditions/variation following remediation and restoration/mitigation goals provided in the State permit-equivalency (i.e., re-vegetation in-kind: forested wetland with some open water and emergent marsh).

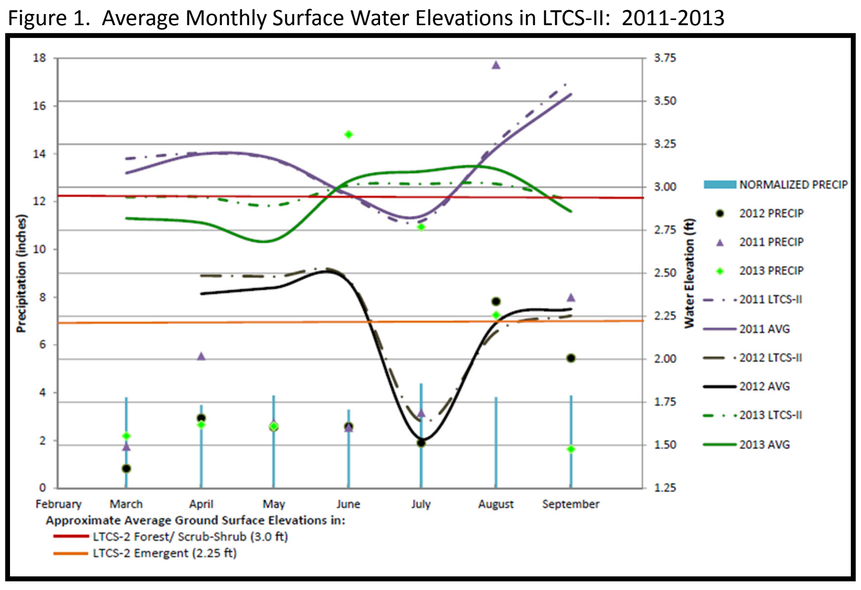

## RESTORATION CHALLENGES/ADAPTIVE SITE MANAGEMENT MEASURES

Table 1. Comparative Analysis of Annual Growing Season Precipitation & Surface Water Elevation

| | Precipitation Summary | | | Surface Water Elevations | | | |
|---|---|---|---|---|---|---|---|
| | Year | Total Precipitation (in) | +/- 30 Year Average [2] | Min | Max | Δ | Average |
| Annual | 2011 | 44.61 | + 2.56 | 2.45 | 5.54 | 3.09 | 3.17 |
| | 2012 | 38.98 | - 3.07 | 1.31 | 4.09 | 2.78 | 2.28 |
| | 2013 | 51.47 | +9.42 | 2.32 | 4.61 | 2.29 | 2.92 |
| Growing Season[1] | 2011 | 41.49 | + 14.92 | 2.80 | 3.62 | 0.82 | 3.14 |
| | 2012 | 24.10 | - 2.47 | 1.54 | 2.49 | 0.95 | 2.21 |
| | 2013 | 42.09 | +15.52 | 2.49 | 3.19 | 0.70 | 2.91 |

1: The growing season is the period between March and September.
2: 30 year average precipitation recorded is 42.05" for the year and 26.57" for the growing season based on data collected in Philadelphia by the Northeast Regional Climate Center (NRCC) (Cornell University, http://www.nrcc.cornell.edu/ccd/nrmpcp.html)

Figure 1. Average Monthly Surface Water Elevations in LTCS-II: 2011-2013




### Increased Intensity/Duration of Flood Events

Based on an analysis of local precipitation patterns and data (Marcus Hook, PA weather station), over the past 30 years there has been a 300% increase in the number of storms with greater than 5 inches of rain within the past 15 years.

### Compaction/Settling of Soils

Despite installation of a sorptive layer/liner prior to backfilling and the addition of extra topsoil to account for compaction, wetland restoration areas settled between approximately 4 and 11 inches below the target/design elevations for forest/scrub-shrub plantings.

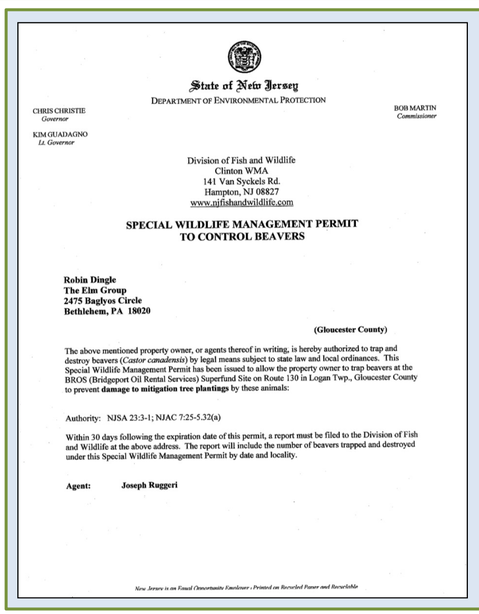
- Higher than normal precipitation amounts (Table 1) and inundation of restoration areas targeted for forest/scrub-shrub plantings (Figure 1).
- Limited ability to plant restoration areas per the restoration plan/species - use of live stakes and revision of containerized species to those more tolerant of hydrologic variability.
- Creation of elevated mounds/areas of topsoil addition to provide elevations suitable for forest/scrub-shrub species plantings.

### Water Management

- Due to variable water elevations, a Surface Water Monitoring Program was implemented to facilitate identification of areas most suitable for the respective cover types, and development of ongoing restoration activities.
- During periods of drier than normal Site conditions, recent plantings were watered.






State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

Division of Fish and Wildlife
Clinton WMA
141 Van Syckels Rd.
Hampton, NJ 08827
www.njfishandwildlife.com

**SPECIAL WILDLIFE MANAGEMENT PERMIT TO CONTROL BEAVERS**

**Robin Dingle**
**The Elm Group**
**2475 Baglyos Circle**
**Bethlehem, PA 18020**

**(Gloucester County)**

The above mentioned property owner, or agents thereof in writing, is hereby authorized to trap and destroy beavers (*Castor canadensis*) by legal means subject to state law and local ordinances. This Special Wildlife Management Permit has been issued to allow the property owner to trap beavers at the BROS (Bridgeport Oil Rental Services) Superfund Site on Route 130 in Logan Twp., Gloucester County to prevent **damage to mitigation tree plantings** by these animals:

Authority: NJSA 23:3-1; NJAC 7:25-5.32(a)

Within 30 days following the expiration date of this permit, a report must be filed to the Division of Fish and Wildlife at the above address. The report will include the number of beavers trapped and destroyed under this Special Wildlife Management Permit by date and locality.

**Agent: Joseph Ruggeri**

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### Wildlife Management

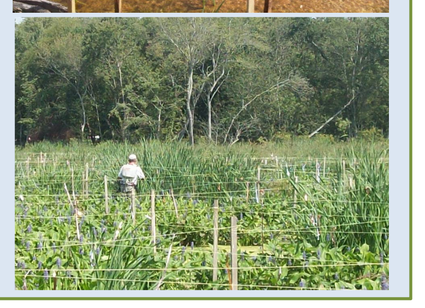
- Repeated/ongoing damage to restoration plantings by beaver and muskrat.
- Installation of varmint fence around the restoration areas to protect plantings.
- Coordination with NJDEP regarding trapping needs: Special Wildlife Management Permits.
- Routine inspections and trapping (as necessary).

### Algae/Duckweed

- Accumulation of algae/duckweed limited light available to recently planted emergent plants and contributed to mortality of previously planted individuals.
- Performed manual and mechanical removal.
- Applied barley pellets to limit growth.
- Implemented flow management actions (i.e., removal and realignment of protective fence and creation of additional flow paths).

### Invasive Species

- Completion of remediation activities late in the growing-season limited implementation of restoration planting activities.
- Unplanted /inundated areas began naturally revegetating with invasive species.
- Required manual removal and application of an herbicide, to prevent invasive species from out-completing native emergent plantings.



## RESTORATION PROGRESS

Table 2. Remediation Disturbance Cover Type Acreages and Restoration Acreages by Year.

| Wetland Cover Type | Remediation Wetland Disturbance Area | Initial Wetland Restoration Acreages (2011)[1] | Wetland Restoration Acreages (2012) | Wetland Restoration Acreages (2013)[1] |
|---|---|---|---|---|
| Open Water | 2.38 | 5.12 | 3.57 | 3.08 |
| Emergent Wetland | 4.32 | 4.29 | 4.84 | 5.11 |
| Forest/Scrub-Shrub | 7.80[4] | 0 | 3.82 | 3.94 |
| Scrub-Shrub | 0.80 | 5.89 | 3.05 | 3.15 |
| TOTAL | 15.30 | 15.28 | 15.28 | 15.28 |

Implementing an ASM approach for wetland mitigation/restoration activities allowed for natural succession and recruitment of desirable species and the identification of supplemental restoration activities based on changing/variable hydrologic conditions, facilitating progression toward restoration of self-sustaining wetland cover types disturbed during remediation activities .