INTEGRATING PRIMARY AND COMPENSATORY RESTORATION FOR AN OIL SPILL THROUGH USE OF HABITAT ENHANCEMENT

Christopher E. Pfeifer
ENTRIX, Inc.
10 Corporate Circle, Suite 300
New Castle, Delaware 19720

Cheryl A. Hess
Conectiv Energy
P.O. Box 6066
Newark, Delaware 19714

ABSTRACT

Natural resources along the shoreline of a tidal estuary were injured by oiling and physical disturbance following the accidental release of No. 6 fuel oil from a power plant in New Jersey, USA. Operation of heavy equipment on the shoreline during the emergency response entrained oil into sediments and physically damaged shoreline vegetation dominated by the low-value specie Phragmites australis.

In response to this incident, the New Jersey Department of Environmental Protection (NJDEP) and the responsible party (RP) conducted a cooperative natural resource damage assessment (NRDA). During NRDA discussions, the NJDEP proposed that compensatory restoration for injured natural resources be provided at a ratio of 3:1 (restored-to-injured) based on the acreage of physically impacted vegetation. Since in-kind restoration of Phragmites was undesirable, native salt marsh vegetation was planted instead, resulting in enhancement of the injured habitat. Since the primary restoration actions yielded improvements beyond the baseline condition, the RP successfully negotiated a 1:1 replacement ratio for components involving habitat enhancement. By incorporating habitat enhancement into the design of primary restoration, the amount of the compensatory restoration was reduced. By expanding the primary restoration to include enhancement of adjoining degraded habitat that was not impacted by the incident, the RP was able to satisfy both primary and compensatory restoration obligations simultaneously by integrating these components into a single restoration project. The combined primary and compensatory restoration project was then implemented as emergency restoration 4-5 months after the incident.

This integrated restoration approach enabled the RP to: (1) decrease compensatory restoration requirements by incorporating habitat enhancement into primary restoration; (2) reduce restoration costs by avoiding separate primary and compensatory restoration projects; and (3) expedite restoration by performing actions under the scope of emergency restoration. This strategy benefited the trustees by simplifying the assessment and reducing oversight burdens. The public and the environment benefited by receiving restoration on an accelerated timeframe.

INTRODUCTION

This paper presents a case history illustrating the use of habitat enhancement to integrate primary and compensatory restoration performed by the responsible party (RP) as part of a cooperative natural resource damage assessment (NRDA) for a recent oil spill. By incorporating habitat enhancement into the design of primary restoration and expanding the project slightly to include an adjoining area unaffected by the incident, it was possible to combine the primary and compensatory restoration into a single project. The combined primary and compensatory restoration project was then implemented as emergency restoration 4-5 months after the incident. This approach expedited restoration of injured natural resources and saved the RP time and money in satisfying its NRDA obligations.

BACKGROUND

The NRDA process (14 C.F.R. Part 990 *et seq.*) established under the Oil Pollution Act of 1990 (OPA) provides a framework for restoring natural resources and services injured (e.g., lost or temporarily diminished) by incidents involving the discharge of oil. The NRDA process seeks to: (1) return injured natural resources and services to the condition that would have existed had the incident not occurred (known as "baseline"); and (2) compensate the public and the environment for the interim loss of services that would have been provided by those resources from the date of the incident until recovery to baseline is complete.

These goals are accomplished through primary and compensatory restoration. Primary restoration refers to actions taken to return injured natural resources and services to baseline. Primary restoration may entail human intervention and/or natural recovery and is typically performed at the site of the injury. Compensatory restoration refers to actions directed at replacing interim lost services through restoration, rehabilitation, replacement or acquisition of equivalent natural resources and services. Compensatory restoration usually takes in close proximity to the injured natural resources at sites not directly impacted by the incident.

INCIDENT SUMMARY

The incident occurred at the B.L. England Generating Station located near Beesley's Point in Cape May County, New Jersey, USA. The facility is situated on the southern shore of Great Egg Harbor Bay, a meso-haline tidal estuary separated from the Atlantic Ocean by barrier islands along the southeastern coast of New Jersey. The plant is owned and operated by the RP, Atlantic City Electric Company, a wholly owned subsidiary of Conectiv Energy (Conectiv).

On December 7, 2003, No. 6 fuel oil was discovered leaking from piping associated with the burner transfer pumps. Most of the released oil was held in the containment area. However, approximately 300 gallons overtopped the containment and escaped into the surrounding environment, with an estimated 20-25 gallons of oil reaching Great Egg Harbor Bay. Prior to entering the water, the released oil migrated a short distance overland, seeped downhill through riprap bank stabilization and then flowed into a narrow band of salt marsh fringing the shoreline.

Once product entered the water, onshore winds and sheet piling at the plant's water intake helped restrict movement of floating oil to nearshore areas proximal to the source. Oil was primarily distributed along a 500-foot segment of the facility shoreline containing a mix of unvegetated sand and gravel beach, native salt marsh vegetation, and *Phragmites australis* or common reed, an invasive, non-native plant typical of low-quality wetlands and disturbed areas.

EMERGENCY RESPONSE & SHORELINE CLEANUP

Upon discovering the leak, plant personnel isolated the source and deployed boom to restrict movement of the released oil. Shortly thereafter, response contractors deployed additional containment boom and sorbents to recover the released product.

Emergency cleanup operations were focused in the area of heaviest shoreline oiling located near the leak source. To facilitate cleanup, heavy equipment was used to remove sorbents, debris and a thin layer of oiled sand from the beach. The use of heavy equipment within the oiled portion of shoreline and an access corridor leading to the plant entrained surface oil into the sandy substrate and physically damaged vegetation.

NATURAL RESOURCE DAMAGE ASSESSMENT

Personnel from the New Jersey Department of Environmental Protection (NJDEP) Bureau of Emergency Response and Office of Natural Resource Restoration responded to the incident. Shortly after the release, the NJDEP, acting as the natural resource trustee (trustee) on behalf of the public, discussed its intention to pursue a claim for natural resource damages and invited the RP to participate in a cooperative NRDA. Conectiv agreed and took a lead role in conducting the cooperative NRDA activities under the direction and decision-making authority of the NJDEP. Given the small volume of oil released and apparent limited injury to natural resources, the parties agreed to conduct the cooperative assessment following an informal, expedited approach.

During the initial discussions, the NJDEP requested that Conectiv: (1) evaluate the need for removing additional sediment potentially containing entrained oil; (2) restore vegetation within physically disturbed portions of the oiled shoreline and access corridor (e.g., conduct active primary restoration); and (3) provide compensatory restoration for injured or potentially injured natural resources at a ratio of 3:1 (restored-to-injured) based on the acreage of physically disturbed shoreline habitat.

EMERGENCY RESTORATION

Shortly after the release, an investigation was performed to determine the need for additional sediment removal. Various degrees of residual oil were observed entrained within shallow subsurface sediments in the area of shoreline oiling, but not in the access corridor. Based on these findings, and the need to restore impacted vegetation, Conectiv developed and submitted a plan to conduct emergency restoration as part of the cooperative NRDA.

The objectives of emergency restoration were to: (1) remove sediment and riprap containing residual oil to mitigate the threat of oil remobilization; and (2) reestablish physically impacted wetland vegetation to return ecological services to baseline as quickly as possible. These actions are consistent with OPA's goal of minimizing on-going injury to natural resources and preventing additional injury in the future through the use of emergency restoration.

The schedule for emergency restoration specified performing sediment removal in early-March 2004. Planting of native vegetation would take place beginning in May 2004, with any grading to be conducted shortly before planting.

INJURY QUANTIFICATION

The extent to which shoreline vegetation present at baseline was injured by physical disturbance was quantified to support both primary restoration planning and compensatory restoration scaling. The area of oiled but otherwise undisturbed marsh vegetation was not included in the injury quantification because both parties agreed that natural recovery would be rapid, given that the spill occurred while vegetation was dormant and oil did not penetrate into the substrate.

Prior to performing additional sediment removal, the extent of baseline vegetation within the physically disturbed area was determined through observation of adjacent stands, examination of plant remains (e.g., rhizomes), review of historic aerial photos, and interviews with facility personnel. This information was added to a site plan depicting shoreline topography after the oil spill, but prior to any additional sediment removal.

Table 1 provides a breakdown of the physically disturbed area by baseline vegetation type. Of the total area impacted (15,784 ft^2 or 0.36 acres), 73 percent was a monoculture of *Phragmites* at baseline. Only 7 percent of the area contained native salt marsh vegetation (*Spartina alterniflora* and *S. patens*) prior to the incident. Nineteen percent (19%) was unvegetated before the spill. Areas of oiled riprap (829 ft^2) and a concrete discharge pipe (20 ft^2) were not included in the injury quantification since these man-made features provide minimal ecological services.

Table 1. Vegetation Composition of Physically Disturbed Area at Baseline

Baseline Vegetation Type	Area Injured (ft^2)	% Total
Phragmites australis	11,561	73
Spartina patens	975	6
Spartina alterniflora	228	1
Unvegetated	3,020	19
Total	15,784	

RESTORATION SCALING

As mentioned, the NJDEP requested that compensatory restoration be scaled at a 3:1 ratio based on the acreage of physically disturbed shoreline. Conectiv did not necessarily agree that the use of a mitigation-type replacement ratio was the most appropriate method for scaling restoration in a NRDA. Replacement ratios are typically employed where loss of habitat is permanent and often build-in additional acreage as a contingency against project failure. Methods such as habitat equivalency analysis (HEA), albeit more complex, were developed and are widely employed to scale compensatory restoration for NRDAs. HEA considers factors such as the area of injury, degree of initial service loss, recovery through time, functional equivalency of the proposed restoration, and assurances for project success provided by monitoring and performance standards. However, for the purpose of expediting settlement and reducing transaction costs, the RP agreed to accept a replacement ratio approach, particularly given the small scope of the assessment.

The trustees' 3:1 compensatory restoration approach was proposed prior to quantifying vegetation injury and confirming baseline conditions. Once the baseline vegetation survey was completed, Conectiv realized that strict interpretation of the 3:1 ratio would require in-kind restoration of *Phragmites* as a major component of primary and compensatory restoration. This objective seemed undesirable given current efforts by public agencies and resources managers to eradicate this invasive, non-native specie.

Conectiv instead proposed restoration of the areas colonized by *Phragmites* at baseline by establishing appropriate native plant species including *S. alterniflora*, *S. patens* and *Distichlis spicata* (salt grass). The conversion of *Phragmites*-dominated habitats to plant communities containing a diversity of native species should yield a net increase in ecological services, and was therefore viewed as habitat enhancement. Given that the majority (73%) of the vegetation injury was to a degraded wetland plant community, and that primary and compensatory restoration for such injuries would result in enhancement of this degraded habitat, the RP no longer believed that 3:1 replacement was appropriate. Conectiv did not dispute applying the 3:1 scaling ratio to the area of physically disturbed native vegetation (*S. alterniflora* and *S. patens*) that would be restored in-kind. However, they believed that replacing low-quality *Phragmites* habitat with higher-quality habitat containing native species at a 3:1 ratio would over-compensate for the injury.

To address this concern, Conectiv developed a modified scaling approach that incorporated habitat enhancement, yet still accomplished the implied ecological service objectives underlying the trustees' proposed 3:1 scaling factor. Table 2 shows the required acreage of compensatory restoration based on Conectiv's modified scaling approach. A 3:1 ratio was applied to the acreage of impacted native vegetation (*Spartina alterniflora* and *S. patens*) to be restored in-kind. However, a 1:1 ratio was applied for areas of impacted *Phragmites* and unvegetated areas to be enhanced by planting native marsh species. The RP believed that a 1:1 ratio was more appropriate considering that the post-restoration services of the enhanced components would be considerable greater than the services provided by these components at baseline. The implicit assumption is that the services of the enhanced plant community are at least three times greater than those provided at baseline.

Using the 3:1 ratio, approximately 3,600 square feet of in-kind restoration is required to offset disturbance impacts to baseline *Spartina alterniflora* and *S. patens* areas. An additional 11,561 and 3,020 square feet of native vegetation enhancement is required to offset disturbance impacts to baseline *Phragmites* and unvegetated areas, respectively, using the 1:1 ratio. Collectively, a total of 18,190 square feet (0.42 acres) of native marsh vegetation must be restored and enhanced to satisfy the restoration requirement. Note that the acreage of primary restoration is credited towards achieving the total amount of restoration owed.

Table 2. Calculation of Restoration Owed

Baseline Vegetation Type	Area Injured (ft^2)	Form of Restoration	Ratio	Restoration Owed (ft^2)
Spartina patens	975	In-kind restoration	3:1	2,925
Spartina alterniflora	228	In-kind restoration	3:1	684
Phragmites australis	11,561	Enhancement	1:1	11,561
Unvegetated	3,020	Enhancement	1:1	3,020
Total	15,784			18,190

Table 3. Comparison of Restoration Owed and Restoration Provided

Baseline Vegetation Type	Restoration Owed (ft^2)	Proposed Restoration Action	Restoration Provided (ft^2)
Unvegetated	3,020	Plant *S. alterniflora* & *S. patens*	3,020
Phragmites australis (Disturbed)	11,561	Plant *Spartina patens*	11,561
Spartina alterniflora	684	Plant *Spartina alterniflora*	228
Spartina patens	2,925	Plant *Spartina patens*	975
Phragmites australis (Undisturbed)		Plant *S. patens* & *Distichlis spicata*	4,610
Total	18,190		20,394

INTEGRATING PRIMARY & COMPENSATORY RESTORATION

Since the total amount of required restoration (18,190 ft^2) could not be provided within the original footprint of physical disturbance (15,784 ft^2), the RP was faced with identifying an additional site to perform the balance of the restoration. This situation was undesirable because a second restoration project would add additional complexity, increase assessment and transaction costs and potentially delay implementation of off-site restoration.

However, in the course of project planning and design, an opportunity to expand the primary restoration project area was identified. By lowering the grade of land adjoining the upland side of the access corridor and replacing the existing stand of *Phragmites* with native species (as in other areas of the primary restoration), the amount of habitat enhancement at the primary restoration site could be increased by approximately 4,600 square feet. This approach, which integrates the area required for both the primary and compensatory components of restoration into the same project site, was adopted and the plan for revegetation was adapted accordingly.

Table 3 presents a comparison of the amount of restoration owed (from Table 2) and the amount to be provided for each of the disturbed cover types, as well as the area of undisturbed *Phragmites* being converted to native vegetation.

As illustrated, a total of 20,394 square feet (0.47 acres) of restoration are provided. This amount exceeds the target acreage of restoration needed to restore injured natural resources and replace interim lost services.

IMPLEMENTING RESTORATION

The integrated primary and compensatory restoration project was implemented as part of the emergency restoration effort. The sediment removal component was completed in March 2004, with initial planting of the site following in early-May at the start of the growing season. Immediately prior to planting, the site was graded to lower the elevation of the expansion area and to provide a smooth surface on which to install plant material.

Conectiv is required to monitor the restoration project for a minimum of three years. In order to demonstrate successful restoration, the project must achieve at least 80 percent vegetative cover by native salt marsh vegetation within the minimum required area to be restored and enhanced (18,190 square feet) by October 2006. The RP will be relieved of further restoration obligations once this performance standard has been met. Additional monitoring and/or corrective actions could be required if the performance standard is not met within this timeframe.

At the end of the first growing season, vegetative cover by native species averaged 41 percent for the site. Development of planted vegetation was progressing nicely throughout most of the project area. *Spartina patens* planted in the irregularly flooded high marsh zone has exhibited the greatest growth, achieving 100 percent cover in some places. Conversely, *Spartina alterniflora* planted at intertidal elevations within the sediment removal area has not flourished to the degree expected. The difficulty establishing vegetation at this location is attributed to factors such as small transplant size (e.g., 2-inch plugs vs. larger plant material), wave energy, smothering by detritus, and waterfowl predation. Poor establishment of *S. alterniflora* transplants is not believed to be associated with trace amounts of residual oil in the sediment. Alternative methods for establishing *S. alterniflora* will be implemented in Spring 2005 as a corrective measure. Some regrowth of *Phragmites* has occurred; however, treatment with glyphosate-based herbicide appears to be effective is controlling its proliferation.

SUMMARY & CONCLUSIONS

The NJDEP and Conectiv conducted an expedited cooperative NRDA in association with the December 2003 release of a small amount of No. 6 fuel oil at the B.L. England Generating Station in southern New Jersey. Natural resources along the shoreline of Great Egg Harbor Bay adjoining the facility were injured as a result of oiling and subsequent cleanup involving heavy equipment, which entrained oil into the sediments and physically disturbed vegetation. To minimize and avoid on-going and potential future injury, Conectiv performed emergency restoration. Emergency restoration actions entailed removing sediment containing oil and reestablishing vegetation physically disturbed by heavy equipment operations.

The revegetation component of emergency restoration constituted active primary restoration. However, to avoid reestablishing *Phragmites*, an undesirable plant that colonized most of the physically disturbed area at baseline, Conectiv instead planted native plant species typical of salt marsh habitat. In doing so, the quality of a significant portion of the affected habitat was enhanced beyond its baseline condition. Through the use of habitat enhancement, the required acreage of restoration, which was based on a variation of the NJDEP's replacement ratio approach, was substantially reduced. Conectiv was then able to expand the primary restoration project site to incorporate the total amount of required restoration, effectively integrating primary and compensatory restoration into a single project.

Conectiv's approach of integrating primary and compensatory restoration into a single project and then implementing the combined project as emergency restoration yielded benefits to the both RP and the trustees, as well as the public and the environment. Both the trustees and the RP benefited from the reduced complexity afforded by the streamlined approach. Consequently, each party's transaction and assessment costs, both of which are ultimately paid for by the RP, were reduced.

By eliminating the need for a separate compensatory restoration project, the RP was able to avoid costs associated with a second restoration project, which could have been substantial for even a small restoration project since certain fixed-costs (e.g., permitting, contractor mobilization) may not be proportional to project size.

Implementing the combined primary and compensatory restoration project as emergency restoration also expedited the return of injured natural resources to baseline and compensation for interim losses. As a result, the public and the environment benefited from the prompt and efficient return of injured natural resource to baseline conditions. Performing primary and compensatory restoration simultaneously shortens the length of time required to complete the NRDA process. Furthermore, by including the emergency restoration in what essentially was an extended emergency response phase, potentially permitting delays were avoided through the use of general permits developed for oil spill emergency response, cleanup and restoration. Use of these permits helped avoid procedural delays associated with the normal permit application and review process.

Lastly, based on this experience, it appears that active and early involvement in the restoration process (e.g., advocating emergency restoration, if applicable) can improve the RP's negotiating position with trustees because good intentions have been translated into positive action. Conectiv's proactive approach helped establish credibility and rapport with the trustees early-on by signaling that, as the responsible party, they were serious about cooperation and committed to stewardship of natural resources.

In closing, it is important to recognize that the opportunity to combine primary and compensatory restoration into a single project, and them implement that project in an expedited manner via emergency restoration will not exist for every incident. The circumstances that allowed Conectiv to pursue this specific resto-

ration strategy are rather unique. However, RPs are encouraged to seek opportunities to expedite primary restoration by performing appropriate actions under the scope of emergency restoration; reduce compensatory restoration requirements by incorporating habitat enhancement into primary restoration; and decrease overall restoration costs by integrating primary and compensatory restoration into a single project.

BIOGRAPHY

Chris Pfeifer is an environmental consultant with ENTRIX, Inc. in New Castle, Delaware with over 10 years' experience in the areas of oil spill emergency response, natural resource damage assessment, wetland science, and restoration ecology. Mr. Pfeifer holds an MS in Environmental Science and Engineering from the University of North Carolina at Chapel Hill.