DAMAGE ASSESSMENT STUDY PLAN: PRYOR OIL WELL FIRE AND SPILL, OBED WILD AND SCENIC RIVER

Submitted to:

National Pollution Fund Center
Arlington, VA

Submitted by:

Department of the Interior
Lead Administrative Trustee on behalf of:

State of Tennessee
National Park Service
U.S. Fish and Wildlife Service

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LIST OF ACRONYMS

ANOVA	Analysis of Variance
BTEX	benzene, toluene, ethylbenzene, and xylene
EPT	Ephemeroptera, Plecoptera, and Trichoptera
DARP	Damage Assessment and Restoration Plan
EROD	7-Ethoxyresorufin-O-deethylase
FAC	Federal Administrative Charge
GIS	Geographical Information Systems
GSI	gonadal somatic index
HEA	Habitat Equivalency Analysis
IBI	Index of Biotic Integrity
ug/L	micrograms per liter
NCBI	North Carolina Biotic Index
NPS	National Park Service
NRDA	Natural Resources Damage Assessment
OBRI	Obed Wild and Scenic River
ORNL	Oak Ridge National Laboratory
PAH	polynulcear aromatic hydrocarbons
RPI	Research Planning, Inc.
TDEC	Tennessee Department of Environment and Conservation
TPH	total petroleum hydrocarbon
TWRA	Tennessee Wildlife Resources Agency
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

DAMAGE ASSESSMENT STUDY PLAN: PRYOR OIL WELL FIRE AND SPILL, OBED WILD AND SCENIC RIVER

INTRODUCTION

On 19 July 2002, the Howard/White Unit No. 1 oil well was being drilled to test for commercial oil production from the geologic formation called the Nashville Group in northeastern Tennessee. The oil well is located in Morgan County on High Point Road, accessible via State Road 62. After drilling to a certain depth, oil flow occurred. The pressure of the flow increased and began to spill oil around the well and outside of the containment area at an estimated 200-500 barrels per hour. At approximately 2400 hours, the oil well caught fire. The spilled oil had flowed downhill from the wellhead into White Creek, at approximately 0.21 mi above its confluence with Clear Creek, and into Clear Creek, at approximately 0.37 mi above Barnett Bridge. The fire followed both oiled paths, burning the vegetation and the oil-soaked soils. Some of the large boulders on the slope fractured from the heat of the fire. The oil adjacent to the banks in both creeks caught fire as well. After the initial spill, oil continued to seep from the creek bank into Clear Creek, with sheens continuing to be released as late as August 2003.

The Department of Interior and the State of Tennessee are co-Trustees for the damage assessment of this river system. The agencies assisting the Trustees include the National Park Service (NPS), U.S. Fish and Wildlife Service (USFWS), the Tennessee Wildlife Resources Agency (TWRA) and the Tennessee Department of Environment and Conservation (TDEC). The Trustees have completed the Preassessment Phase, collecting ephemeral data that were necessary for determining the fate and effects of the spilled oil, reviewing the results and analyzing the data, compiling the Administrative Record, and making a determination that there is injury or potential injury to Trust resources or services potentially affected. They have prepared a Preassessment Phase report dated April 2003 (Research Planning, Inc., 2003) and issued the Notice of Intent to Conduct Restoration Planning, pursuant to 15 C.F.R.§ 990.44 (61 Fed. Reg. 440, January 5, 1996). For the reasons discussed in these two documents, the Trustees have made the determination required by 15 C.F.R. § 990.42 (a) and are proceeding with injury quantification and restoration planning to develop alternatives that will restore, replace, or acquire the equivalent of natural resources injured and/or natural resources (including natural resource services) lost as a result of this incident. This document outlines the Damage Assessment Study Plan to collect the data necessary to conduct an injury assessment in accordance with the Oil Pollution Act (33 U.S.C. 2701, *et seq.*) and guidance provided at 15 CFR Part 990 and to determine appropriate restoration measures.

Restoration actions under OPA are termed primary or compensatory. Primary restoration is any action taken to accelerate the return of injured natural resources and services to their baseline condition. Trustees may elect to rely on natural recovery rather than primary restoration actions where feasible or cost-effective primary restoration actions are not available, or where the injured resources would recover relatively quickly without human intervention.

Compensatory restoration is any action taken to compensate for interim losses of natural resources and services pending recovery. The scale of the required compensatory restoration depends on the extent and severity of the initial resource injury and how quickly each resource

and associated service returns to baseline. Primary restoration actions that speed resource recovery will reduce the requirement for compensatory restoration.

Following the Restoration Planning Guidance Document (NOAA, 1996), the Trustees will identify and evaluate potential restoration options using the following criteria:

1. Cost to carry out the alternative
2. Extent to which each alternative is expected to meet the trustee's goals and objectives in returning the injured resources and services to baseline and compensating for interim losses
3. Likelihood of success of each alternative
4. Extent to which each alternative will prevent future injury as a result of the incident, and avoid collateral injury as a result of implementing the alternative
5. Extent to which each alternative benefits more than one natural resource or service
6. Effect of each alternative on public health and safety.

POTENTIALLY AFFECTED RESOURCES

Based on the Preassessment Phase report, the potentially injured resources include:

- Air quality
- Benthic algae
- Benthic invertebrates
- Fish
- Forest vegetation and soils
- Ground water/geologic sources
- Riparian wetlands and habitat
- Sediment quality
- Surface water quality
- Vertebrates (Terrestrial and aquatic)
- Visitor use

It is important to note that there have been continuing releases of oil from seeps into Clear Creek at the base of the burned slope. Personnel with the TDEC reported that sheens were observed during the macroinvertebrate sampling activities on 10 October 2003. Personnel from the U.S. Environmental Protection Agency (USEPA) reported and photographed sheens during visits to the spill site on 16 July 2004. Because of the continued oil releases from the bank at the spill site, USEPA determined that it was necessary to maintain the boom at the spill site in Clear Creek. On 17 August 2004, staff from NPS and TDEC surveyed the impact area from Barnett Bridge to the spill site on both Clear Creek and White Creek. They reported sheens extending to just above Barnett Bridge and active oil releases from the base of the slope at the spill site. The boom was filled with liquid oil and paraffin. Refer to the Site Visit Report in Appendix A.

The Trustees have reviewed all available data and identified the following additional studies that are needed to quantify injury to affected resources and to determine appropriate restoration options to restore injured resources. The proposed studies are outlined below.

Air Quality

The oil spill and fire resulted in the release of volatile organic compounds, combustion gases, and particulates. The USEPA monitored air quality at the site, primarily to determine whether there were potential impacts to human health and safety. Although the Trustees acknowledge that the spill and fire had short-term impacts to air quality, no further studies are proposed for injury quantification or restoration planning.

Benthic Algae

Impacts to benthic algae were assessed during the Preassessment Phase through the sampling of natural substrates and short-term deployment of artificial tiles at control and impacted locations in Clear Creek. The results indicated that the natural substrate sampled in October 2002 appeared to be similar among all three stations sampled. The December 2002 samples analyzed from the artificial substrates indicated a change in the number of species between locations, with the highest number of species found at the upstream location in Clear Creek. These data suggest a change in the algal community as a possible response to the water quality impacts in Clear Creek after the oil spill. Therefore, the Trustees propose to use these data to quantify the injury to benthic algae in terms of changes in primary production, which is the lowest trophic level in the stream ecosystem. The proposed study will consider the spatial extent and temporal duration of the impacts to generate a measure of lost primary production as one component of the injury to benthic and aquatic resources that will be quantified using an overall stream Habitat Equivalency Analysis (HEA) model. These losses in primary production will be considered in the scaling of restoration options using HEA. Costs for these injury quantification efforts are part of the stream HEA study included in Appendix B.

Benthic Macroinvertebrates

Impacts to benthic macroinvertebrates were assessed during the Preassessment Phase by three types of studies: 1) mussels sampling in August and October 2002 for chemical analysis of tissues to measure the bioavailability of the oil; 2) benthic monitoring conducted to compare benthic species abundance and diversity between oiled and unoiled areas of Clear Creek; and 3) collection of crayfish samples in May 2003 that were not analyzed; they have been properly preserved and maintained under chain of custody.

All mussel tissues collected and analyzed in 2002 showed low or no detectable polynulcear aromatic hydrocarbons (PAH). Because of the continued oil releases to Clear Creek, the Trustees have determined that it is appropriate to analyze the crayfish collected in May 2003 and water samples collected in August 2004, and to collect additional mussel samples at two upstream and two downstream sites in November 2004. These samples are needed to determine whether the continued oil releases are bioavailable and a continuing source of injury to aquatic resources in Clear Creek.

The benthic macroinvertebrate community data collected in October 2002 showed impacts to the benthic macroinvertebrate communities in Clear Creek for the area above Barnett Bridge but not as far downstream as Jett Access. The Trustees determined that additional studies were needed to determine the spatial extent and duration of these impacts.

Benthic macroinvertebrate sampling was conducted at four sites on 10 October 2003. Samples were collected in accordance with TDEC's accepted protocols for Semi-Quantitative Riffle Kicks (Arnwine, 2002). The samples were sent to the Tennessee Department of Health Aquatic Biology Section for processing, benthic identification, and scoring. The results of the 2003 sampling indicated that the benthic community in the area above Barnett Bridge had returned to pre-spill levels. A new site 0.4 miles downstream of Barnett Bridge was sampled in October 2003 to determine the downstream extent of impact, and this site was also normal in terms of its benthic community. Sheens were released from both sites above and below Barnett Bridge during the October 2003 sampling efforts.

Because releases of oil from the spill site have continued through 2004, the Trustees decided to continue the sampling of benthic macroinvertebrates in early 2005. An additional sampling location between Barnett Bridge and the release site will be sampled, to provide more spatial resolution of the extent and degree of impact. The assessment of the continuing oil seepage will be key to determining the duration of injury and the recovery period. In 2004, Clear Creek, including the section of creek affected by the oil spill, was designated as critical habitat for five listed mussel species. Critical habitat identifies specific areas that are essential to the conservation of a listed species, and that may require special management considerations or protection. Therefore, two new supporting studies will also be conducted in 2005: 1) A quantitative evaluation of freshwater mussels in Clear Creek; and 2) Histopathological analysis of tissues to assess sublethal impacts to freshwater mussels in Clear Creek. The results of these two studies (described in detail in Appendix B) will be essential inputs to the stream HEA.

Once all of the benthic community data are collected and analyzed, the results will be used to quantify injury to benthic aquatic resources. Injury will be measured as the degree and duration of reductions in benthic community health and services as indicated by a benthic index score which is based on taxa richness, percent Ephemeroptera, Plecoptera, and Trichoptera (EPT), EPT richness, North Carolina Biotic Index (NCBI), percent Oligochaetes and Chironomids (OC), percent of dominant taxa, and percent of clinger taxa. Scores are recorded based on values developed for each category (i.e., taxa richness, EPT richness) under Bioregion 68a, where Clear Creek is located (Arnwine, 2002). These impacts to benthic community services will be one component of the inputs to the stream HEA model. The Trustees will take particular care to avoid double counting of injuries to fish during the development of the stream HEA. Restoration planning will evaluate potential restoration measures that will improve water and habitat quality to restore the benthic macroinvertebrate community and its associated services. Costs for the injury assessment quantification efforts are part of the stream HEA study included in Appendix B.

Fish Community Health

Fish were collected, counted, and observed for anomalies in 2002, 2003, and 2004 to determine the Index of Biotic Integrity (IBI) metric for Clear Creek, for comparison with data from 1996 and 1998, allowing time-series comparison of before and after the spill event. The IBI is a fish community assessment where species are assigned to trophic guilds and anomalies are noted in order to obtain a score based on values assigned to the Cumberland Plateau Ecoregion.

Fish samples were collected by fisheries toxicologists from the Oak Ridge National Laboratory (ORNL) at two reference sites and two oiled sites (Barnett and Jett Bridges) in 2002. For a portion of the 2002 samples, some preliminary analysis were conducted which indicated injury at various levels of biological organization to the health of both rock bass and redbreast sunfish (sentinel indicator species) collected from the oil spill site. Samples collected in 2002, 2003, and 2004 are being held in storage at ORNL until funding is available for analysis.

Because of the on-going seepage of oil into Clear Creek, the Trustees have determined that analysis of fish collected at the two reference and two oiled sites in 2002, 2003, and 2004 are needed to quantify the degree and duration of impacts to the health of fish populations as a result of the spill and continuing releases. These data will be used to quantify impacts to the fish population in Clear Creek in terms of reduced ability to survive, grow, or reproduce. The injury will be quantified as reduced fish biomass. This injury component is completely independent of the injury to the stream resources in that the injury will be related to fish injury resulting primarily from oil exposure rather than secondary production. Restoration options will be identified and scaled based on the assessment of the lost fish biomass. Costs for fish injury quantification are included in Appendix C.

Forest Vegetation And Soils

The Trustees conducted an initial study to document impacts to the forest structure by sampling vegetation within the burned site and a nearby reference site in January and February 2003. The study results showed high mortality of the vegetation in the footprint of the two slope areas (on both Clear Creek and White Creek) affected by the oil spill and fire. The soil was severely impacted by the oil spill and fire. The oil saturation and fire caused the loss of the fine roots, the seed bank, and the sources of vegetative reproduction, which will slow recovery of the burned area.

To further quantify the injury to forest vegetation and soils, the Trustees repeated the field data collection in September 2004. Within the study plot sampled at the burn area, all overstory trees and 74% of understory *Kalmia latifolia* shrubs were dead in 2004. Limited sprouting of top-killed individuals was observed. These data will be used to quantify the reduction in forest services. A model that describes woody biomass accumulation will be used to estimate the time required for woody biomass in the oiled/burned area to recover to the conditions at the reference area. HEA will be used to scale both the injury and restoration options. Costs for vegetation injury quantification are included in Appendix D.

Ground Water/Geologic Resources

There have been no studies of the extent and duration of groundwater contamination as a result of the oil spill, but the continued release of oil at the base of the slope indicates that there are potentially large amounts of oil in the subsurface. The Trustees believe that the quantity of this residual oil is substantial enough, it is sufficiently mobile, and it contains high enough concentrations of contaminants that it poses a significant risk of on-going exposure to aquatic resources in the form of continuous or episodic release of seeps at the creek edge. Staff from the U.S. Geological Survey (USGS) measured elevated levels of volatile organics (benzene, toluene, ethylbenzene, and xylene, or BTEX) in samples of water seeping from springs below the well site on 30 October 2003. In water samples collected at the edge of the bank below the spill site, benzene was 870 micrograms per liter (ug/L), toluene was 210 ug/L, and o-xylene was 400 ug/L. They also collected samples on 17 August 2004, but the holding time for BTEX analysis was exceeded because of instrument failure. Analytical results and photographs from these two site visits are available at: http://tn.water.usgs.gov/Clear_Creek/

The Trustees have requested an assessment of the extent and degree of oil contamination of the shallow subsurface at the spill site to the Federal On-Scene Coordinator from USEPA. The assessment request is included in Appendix E.

Riparian Wetlands And Habitat

During the Preassessment Phase, a botanist from the Division of Natural Heritage conducted surveys of the riparian habitat adjacent to and in Clear Creek, from the spill site to Barnett Bridge. Dead and stressed vegetation, consisting primarily of American water willow, *Justicia americana,* was observed along Clear Creek. Many occurrences of the royal fern, *Osmunda regalis*, which also occurs along the banks of Clear Creek, were observed to be damaged and dead. The botanist observed a coating of oil on the leaves on some surviving individual plants. Woody plants observed at the water's edge did not appear to be affected except for some browning of the leaves where the plant came in contact with oily water.

The Trustees do not propose to collect additional field data for injury determination of riparian wetlands and habitats. However, they do propose to assess the impacts to these habitats as a component of the aquatic HEA model and develop appropriate restoration options as part of their overall restoration planning effort. Costs for these efforts are part of the stream HEA study included in Appendix B.

Sediment Quality

Based on sediment sampling conducted in 2002, sediments in Clear Creek showed evidence of contamination from the oil spill, with elevated total petroleum hydrocarbon (TPH) concentrations in sediments from the point of entry site to Barnett Bridge. One sediment sample collected in August 2004 from Clear Creek just above the Barnett Bridge contained 1.2 ppm BTEX. Although there is potential for continued sediment contamination from continued oil releases, the Trustees propose to assess sediment injury in terms of impacts to the benthic community, as reflected in contamination of mussels and crayfish and the health of the benthic

macroinvertebrate community. Therefore, no additional injury assessment studies are proposed that directly measure contaminant levels in sediments.

Surface Water Quality

Water samples collected in July, August, and October 2002 showed evidence of contamination by oil that was fingerprinted as matching the source oil from the oil well. Additional water samples collected on 1-2 October 2003 also showed contamination with PAHs that were a match with the source oil. Analysis of water samples will provide evidence of on-going exposure of aquatic resources to the oil releases. Costs for water sample analyses and for injury quantification and restoration scaling of impacts to water quality are part of the stream HEA study included in Appendix B.

Vertebrates (Terrestrial And Aquatic)

One dead oiled duck was recovered from the spill site. No other oiled wildlife were reported. No further studies are proposed.

Visitor Use

Clear Creek was closed from Double Drop Falls to Jett Bridge for the period 23 July 2002 to 6 February 2003, when the stream between Barnett Bridge and Jett Bridge was reopened. Clear Creek from Double Drop Falls to Barnett Bridge remained closed until 25 May 2004. During the Preassessment Phase, ephemeral data on the potential impacts of the spill event on park visitors and baseline visitation levels of the affected areas were documented. These data will be used to quantify the economic losses using the benefits transfer methodology to value this lost and diminished visitor use and to scale the associated compensatory restoration. Costs for visitor use impact quantification are included in Appendix F.

OTHER INJURY QUANTIFICATION AND RESTORATION PLANNING COSTS

Trustee Council Activities

Since the completion of the Preassessment Phase in December 2003 and the submittal of this new plan in December 2004, the Trustees have met to plan injury assessment activities. They will continue to meet regularly and as needed through the end of 2005 to review damage assessment study plans and reports, conduct restoration planning, prepare the draft Damage Assessment and Restoration Plan, respond to public comments on the Plan, and prepare the final Damage Assessment and Restoration Plan. Agency costs for Trustee Council activities are included in Appendix G.

Technical Support to the Trustee Council

The Trustees hired a contractor (Research Planning, Inc.) in August 2004 to assist them in preparing the Damage Assessment Study Plan. They will also hire a contractor to assist in

restoration scaling for each injured resource, preparation of the draft Damage Assessment and Restoration Plan, compilation of public comments, and preparation of the final Damage Assessment and Restoration Plan. Costs for contractor services are included in Appendix H.

Data Management Support to the Trustee Council

The USFWS has provided and will continue to provide data management support to the Trustee Council by creating a spatial database of all the sampling locations linked to attribute data on the sample results. The data will be managed in a Geographical Information System (GIS) that was initiated during the Preassessment Phase (though no costs were recovered for the initial database development). This database will facilitate the use of data among injury assessment studies. Costs for the GIS data management system (past and future) are included in Appendix I.

SUMMARY OF COSTS FOR INJURY QUANTIFICATION AND RESTORATION PLANNING

The Trustees have determined that the following studies are required for injury quantification and restoration planning of the natural resource injuries resulting from the Pryor Oil Spill and Fire. A contingency of 15 % of the total estimated costs is requested to account for unanticipated costs, unforeseen or changed conditions, or unavoidable delays. The first five studies listed below will be implemented through a cooperative agreement with educational institutions (CESU); CESU fees are estimated to be 17.5% of project costs.

Quantification of Injury to Stream Services	$ 13,059.25
Quantitative Evaluation of Freshwater Mussels	2,385.00
Mussel Histopathology Study	6,497.50
Injury Scaling of Impacts to Fishery Resources	146,407.00
Injury Scaling of Impacts to Forestry Resources	12,879.20
CESU Fees (17.5% of project costs)	31,714.89
Quantification of Lost and Diminished Visitor Use	4,396.80
Trustee Council Activities	
Tennessee Department of Environment and Conservation	19,856.63
National Park Service	98,793.12
U.S. Fish and Wildlife Service	6,684.57
Department of Interior Solicitor's Office	7,122.15
U.S. Geological Survey	17,135.61
DOI Overhead on DOI Salaries	20,791.94
Technical Support to the Trustee Council	
Phase I	25,999.64
Phase II	171,475.12
Data Management Support to The Trustee Council	10,021.42
Subtotal	$ 595,219.84
Contingency (15% of total estimated costs)	89,282.29
TOTAL COSTS	**$ 684,502.82**

REFERENCES CITED

Arnwine, D., 2002. Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys. Division of Water Pollution Control, Department of Environment and Conservation, State of Tennessee.

NOAA, 1996. Restoration Phase Guidance Document for Natural Resource Damage Assessment Under the Oil Pollution Act of 1990. Damage Assessment and Restoration Program, NOAA, Silver Spring, Maryland.

Research Planning, Inc., 2003. Preassessment Phase Report. Submitted to the National Park Service, Atlanta, Georgia.

APPENDIX A
AUGUST 2004 CLEAR CREEK SITE SURVEY
HOWARD/WHITE UNIT NO. 1 OIL SPILL

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AUGUST 2004 CLEAR CREEK SITE SURVEY
HOWARD/WHITE UNIT NO. 1 OIL SPILL

INTRODUCTION

Part of the Research Planning Inc. (RPI) Statement of Work included conducting a site visit to the location of the oil spill. The site visit was conducted on 17 August 2004 by Nancy Keohane (NPS), Jonathon Burr (TDEC-WPC), Mike Bradley (USGS), and Jacqui Michel and Heidi Hinkeldey (RPI). This site survey was essential in determining the studies that are necessary to quantify the injury to the aquatic and terrestrial resources.

The specific objectives of the site visit was to:

1. Make visual observations on the condition (residual oil, physical disturbance, general condition of plants) of the impacted area;
2. Observe the extent of the oil by disturbing the bottom sediments in Clear Creek, downstream of the spill;
3. Observe whether oil was still seeping from the rocky slope;
4. Collect water samples along Clear Creek between Barnett Bridge and the location of the spill for temporal comparison with samples collected in 2002 and 2003.
5. Collect sediment samples downstream of the oil spill.

METHODOLOGY

The survey extended from Clear Creek at Barnett Bridge upstream to the location of the oil spill. While traveling upstream, sediments in the water and soil along the banks were disturbed, and sheen on the water surface was noted to determine the fate and extent of the oil. Sediment and surface water samples were taken at certain sites along Clear Creek and the Trustees recorded data on their observations of the impacted area.

RESULTS

Small amounts of sheen were observed at Barnett Bridge, downstream of the spill, when sediments were disturbed in Clear Creek. It was noted that the sheens that surfaced were not biogenic, as determined by trying to "break up" the oil with a stick or finger. The oil instead remained together making ribbon-like spirals on the surface of the water. Many fish (darters, minnows, etc.) were seen at this location along the creek. A sediment sample was taken downstream of the island at the confluence of Clear and White Creek, and a surface water sample was taken under Barnett Bridge.

There was an accumulation of oil at the first riffle that was encountered upstream of Barnett Bridge (Fig. 1). From this point on, the sheen on the surface of the water became more visible and widespread closer to the site of the spill (Fig. 2). An oil odor was also detected. Two more surface water samples were taken between Barnett Bridge and the spill site.



Figure 1. Oil (hazy blue-green color) accumulating at the first riffle upstream of Barnett Bridge in Clear Creek on 17 August 2004.



Figure 2. Sheen on the surface of the water in close proximity to the spill site, outside of the booms on Clear Creek, on 17 August 2004.

Thick oil and paraffin accumulations were seen inside the boom at the spill site, seeping out of the rocky slope (Figs. 3 and 4). The orange- and yellow-colored material is the coagulated paraffin, whereas the hazy bluish liquid is the fresh oil. There were noticeably less fish in this portion of the creek. A sample was taken of the bluish, liquid oil at the edge of the bank, for fingerprinting and weathering analysis.

There were oil stains on the rocks above the water line near the spill site. Surface water samples were taken approximately 30 ft upstream of the spill site. Sheens were visible approximately 30 feet upstream of the spill site. Beyond this point (further upstream of the spill site), no more sheening was evident.

The burned slope was inspected to observe the recovery of the vegetation that had been oiled and burned during the spill event. After two years, there has been little recovery of the vegetation in the area. Much of the area was bare with no vegetation (Figs. 5 and 6). There were some areas with blackened, hard crusts on the surface. It appeared that the soils were still unable to support any vegetation.

SUMMARY

The Trustees observed that, two years after the spill event, oil is still seeping from the rocky slope at the spill site into Clear Creek. The flow in Clear Creek was about 22 cubic feet per second, which is significantly lower than times of other site visits in 2004. During high water levels, the water levels were above the seeps, making it difficult to observe them.

Oil was found in sediments as far downstream as Barnett Bridge. One sediment sample was taken at Barnett Bridge and five surface water samples were taken between Barnett Bridge and the spill site. Selected samples will be sent to Louisiana State University for PAH analysis. The USGS will measure BTEX in the water and sediment samples. Additional studies are needed to determine the amount of oil remaining as a source of seepage into the river.

The vegetation on the burned slope has not recovered in much of the area. Additional studies will be necessary to determine how long it will take for the soils and vegetation to recover.



Figure 3. Oil accumulated within the boom at the spill site in Clear Creek. Photograph taken 17 August 2004.



Figure 4. Oil accumulated within the boom at the spill site in Clear Creek. Photograph taken 17 August 2004.



Figure 5. Areas on the burned slope that have had little or no re-growth since the spill event two years ago. Photograph taken 17 August 2004.



Figure 6. View looking down the slope towards Clear Creek. Vegetation in much of the burned zone has not recovered. Photograph taken 17 August 2004

APPENDIX B

QUANTIFICATION OF INJURY TO STREAM SERVICES

Study Description

Injury to the habitats and associated ecological services of Clear and White Creeks will be quantified using the Habitat Equivalency Analysis (HEA) approach, a well documented and widely accepted methodology for injury determinations and measurement. The injury assessment will evaluate impacts to benthic algae, benthic macroinvertebrates, mussels, riparian habitat, and water and sediment quality. The field data will be analyzed to develop both the temporal and spatial extent of the impacts to these resources resulting from the spill and fire. The Trustees will be careful to avoid double-counting.

Injury will be measured, in part, as the degree and duration of reductions in benthic community health and services as indicated in part by a benthic index score which is based on total taxa richness, percent Ephemeroptera, Plecoptera, and Trichoptera (EPT), EPT richness, North Carolina Biotic Index (NCBI), percent Oligochaetes and Chironomids (OC), percent of dominant taxa, and percent of clinger taxa. Scores are recorded based on values developed for each category (i.e., taxa richness, EPT richness) under Bioregion 68a, where Clear Creek is located (Arnwine, 2002). The benthic macroinvertebrate field data will also be analyzed to determine whether there were any significant changes in species composition and relative abundance, looking in particular at the more pollution-sensitive species. The degree and duration of oil exposure will be indicated by chemical analysis of water, sediment, and biota samples and field observations on the duration and extent of sheening. The life histories of the different species of benthic communities (e.g., algae, macroinvertebrates, mussels) will be considered in estimating the time of return to baseline conditions once oil exposure is terminated. The mussel histopathological study described below is key to the assessment of the sublethal impacts and the duration of the impacts from the chronic oil releases.

There are several on-going studies funded by the USFWS to determine the impacts of land-based disturbances in the Emory River watershed (of which Clear and White Creeks are tributaries) on stream water-quality and benthic and fish community health. Trustees will use these and other data to evaluate restoration options that will improve aquatic habitat in the affected watershed.

Inputs to the HEA model will include:

- Areal extent of the affected habitat
- Time path of percent lost services representing the overall diminishment of ecological services relative to the baseline conditions of the injured habitat
- Initial percent lost services at the time of the incident
- Time periods of each phase of recovery to baseline given the selected primary restoration measures
- Time path of percent replacement services to be provided by compensatory restoration relative to the baseline conditions of the injured habitat

- Time periods of each phase of maturation (or full functioning) of selected compensatory restoration measures
- Percent replacement services provided at project maturity, and whether that level would continue into perpetuity

The injury assessment to stream services and quantification studies will be conducted by Dr. Brad Cook of Tennessee Tech University. Dr. Cook is currently conducting studies of fish and benthic communities in the Emory River Watershed as part of a study entitled *A Comparative Study of the Historical and Present Ecological State of the Emory River Watershed*, for the USFWS.

Study Costs

Salaries

Fisheries Biologist - 15 days x 7.5 hrs/day x $37.80/hr	$ 4252.50
Graduate Technician - 30 days x 7.5 hrs/day x $10.00/hr	2250.00
Benefits - 17.65% of $4252.50	750.57
Indirect Costs - 47.00% of $6502.50 (Total Salaries)	3056.18
Total Costs for TTU	**$10,309.25**

Other Direct Costs

Analysis of crayfish collected in May 2003 – 3 @ $750 each	$2250.00
Analysis of seep oil collected August 2004 – 1 @ $500/each	500.00
TOTAL COSTS	**$ 13,059.25**

Supporting Study 1: Quantitative Evaluation of Freshwater Mussels in Clear Creek (Obed River System), Tennessee in Response to Oil Contamination

Study Objectives

The objectives of this study are to determine if there are any effects (presence of dead mussels in substrate, lack of juvenile recruitment) on freshwater mussels from ongoing exposure to oil seepage from the spill site in 2005. We will be able to determine this by quantitative mussel sampling in Clear Creek.

Materials and Methods

Freshwater mussels will be sampled by snorkeling at a minimum of 4 sites during optimum low-flow conditions. Quantitative sampling will consist of placing a metal-framed 0.25m^2 quadrat sampler on top of the substrate and excavating the substrate to a dept of 4-6 inches. A minimum of 10 quadrat samples will be collected at each site. All live mussels found within the confines of the sampler will be identified to species, enumerated, and shell lengths measured in millimeters using a dial caliper. This information will provide mussel population density estimates and shell measurement data will determine whether recruitment to the fauna has occurred based on the size-classes of individuals. Semi-quantitative sampling based on total sampling time will give Catch Per Unit of Effort (CPUE). This technique allows for spatial coverage for species that may be outside the sampling confines of quadrat sampling and works well in habitats that have abundant mussel populations or scarce mussel populations. All information, both quantitative and semi-quantitative will be recorded on field data sheets.

Budget for Supporting Study 1

6 person-days	$1680
Travel and per diem (4 days)	400
Mileage ($.45/mile) 400 miles	180
Equipment and Supplies	125

Total	$2385

Supporting Study 2: Tissue Evaluations for Determination of Sublethal Effects of Oil Contamination in Freshwater Mussels from Clear Creek, Tennessee

Assessments of histologically prepared bivalve tissues have provided valuable data for determinations of sub-lethal impacts due to oil products in aquatic environments. Widdows *et al*. (1987) and Moore *et al*. (1989) showed marked effects of hydrocarbon exposure to marine bivalves, such as impaired reproduction, reduced recruitment, population decline, and mortality, at polyaromatic hydrocarbons (PAH) concentrations as low as 10 μg /g of wet-weight tissue. Exposure to crude oil is associated with decreased feeding rates, and increased oxygen consumption and ammonia excretion rates (Axiak and George, 1987; Widdows *et al*., 1995). A decrease in energy intake, coupled with an increase in the energetic cost of metabolism, reduces energy available for vital body functions, such as cell repair, immunological defense, growth, and gametogenesis. Reduced fecundity and oocyte atresia have been linked to hydrocarbon exposure in bivalves (Lowe and Pipe, 1985).

Alterations in cell structures and physiological functions of internal organs and hemolymph (blood) due to contaminant exposures have been observed in bivalves (Seiler and Morse, 1988; Giamberini and Pihan, 1996 and 1997). Hemocytes are important in sequestering absorbed pollutants, particularly by acid phosphatase activity in lysosomes, and delivering them to filtration organs for body elimination (Seiler and Morse, 1988; Giamberini and Pihan, 1996 and 1997). Since pericardial glands and kidneys are important filtration and excretory organs in bivalves, contaminant accumulations in these organs can cause significant alterations in cellular anatomy that can be observed by electron and light microscopy (Seiler and Morse, 1988;

Giamberini and Pihan, 1996). In addition, changes in water quality may cause cellular disruption and lesions in the integument (skin) of freshwater mussels (B. Henley, unpublished data).

The objective of this study is to determine the effects of crude oil exposure on the microanatomy of vital organs of female wavyrayed lampmussels (*Lampsilis fasciola*) and rainbow mussels (*Villosa iris*) from Clear Creek, Tennessee. Histologically prepared tissues of exposed mussels will be compared to those of specimens from an upstream control site using electron and light microscopy. Organ tissues that will be examined include gonad, pericardial gland, kidney, and integument. Tissues from gonads will be examined to determine alterations in gametogenesis in exposed mussels. Also, lysosomal activity will be compared in organ tissues and hemocytes.

Five female *L. fasciola* and *V. iris* will be collected from a downstream exposure site and upstream control site on Clear Creek, Tennessee. The 20 specimens will be sacrificed for collection of gonads, pericardial glands, kidneys, integument, and hemocytes. Tissues will be fixed in 10% formalin, paraffin embedded, and stained with hemotoxylin and eosin (H and E) for light microscopy. Small samples of each tissue type will be preserved with 2.5% glutaraldehyde in Sorenson's buffer for examination using transmission electron microscopy (TEM). Lysosomal activity will be examined using light microscopy and TEM by demonstration of acid phosphatases by the azo-dye coupling method (Giamberini and Pihan, 1997).

Tissues from exposure and control mussels will be qualitatively compared for alterations in cell structure and function. Lysosomal activity in tissues and hemocytes from specimens will be evaluated for percentages of cell cytoplasm filled with positively stained acid phosphatase granules using the method of Giamberini and Pihan (1997). Data from acid phosphatase evaluations will be appropriately transformed and statistically analyzed for differences among species and river collection sites with analysis of variance (ANOVA).

This research will examine the health and physiological condition of freshwater mussels exposed to crude oil seepage in Clear Creek, Tennessee. Histological evaluations of tissues will reveal sublethal effects not otherwise observable. A detailed report to the U. S. Fish and Wildlife Service, Cookville, Tennessee will document whether alterations in cell structure and function of vital organs is linked to oil exposure. Assessment of gametogenesis and organ tissues will help to determine whether lingering effects of contamination still influence physiological condition of mussels downstream of the spill site.

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Budget for Mussel Histopathological Study

Costs	Totals
Direct Costs	
Operating Expenses	
Histological Services	1400.00
Supplies/Equipment	
Histological Supplies	220.00
Salaries	
Research Associate (1 mo)	3,100.00
Benefits (30%)	930.00
Subtotal	5650.00
University Overhead (15%)	847.50
Project Total	**6,497.50**

APPENDIX C

INJURY AND RESTORATION SCALING OF IMPACTS TO FISHERY RESOURCES

Study Description

Injury and restoration scaling of impacts to fish from the Pryor Oil spill and fire will be assessed through two related studies:

1. Assessment of the Short- and Long-term Damages to Fishery Resources Using Bioindicator and Reproductive Analyses – to be conducted by researchers at the Environmental Sciences Division of Oak Ridge National Laboratory
2. Quantification of Population-Level Impacts to Fishery Resources – to be conducted by researchers at Tennessee Tech University

Study 1 - Assessment of the Short- and Long-term Damages to Fishery Resources Using Bioindicator and Reproductive Analyses

The main purpose of this study is to assess the short- and long-term damages to fishery resources due to oil releases into Clear Creek through the following specific activities:

- Determine if there are causal relationships between oil exposure and measured biological effects.
- Determine the spatial (downstream) extent of fish injuries in Clear Creek.
- Determine if there are long-term reproductive and population-level impairments in fish.

Even though no acute toxicity or observable mortalities of aquatic organisms were immediately apparent, sublethal or latent effects could be manifested in the future as injury to individuals, populations, and communities. However, measuring such injury can be difficult using conventional biological monitoring approaches. The bioindicator approach, which involves measuring a suite of organism responses over several different levels of biological organization, can be used to establish causal relationships between the specific stressor agent (e.g., polynuclear aromatic hydrocarbon [PAH] compounds) and injury or damage to biological resources.

Reproduction is widely considered to be the most critical life function affected by contaminants. Furthermore, certain reproductive processes, including egg production and embryonic development, are among the most sensitive life stages to environmental toxicants. Reproduction (propagation) of aquatic life is a classified use of Clear Creek as determined by the State of Tennessee. The ability to successfully reproduce is essential for the establishment and continued maintenance of viable fish populations in Clear Creek.

Preliminary results of an investigation into fish reproductive health conducted three weeks after the oil spill suggest that fish reproductive tissues may have been adversely affected in the aftermath of the spill. The objective of the reproductive studies is the characterization of the reproductive condition of fish populations in Clear Creek downstream of the spill site in 2003, the first complete breeding season after the spill. Fish from the impacted site will be

compared with fish from an unimpacted upstream reference site on Clear Creek (and/or White Creek). For each site, the reproductive condition of adult fish collected just prior to the onset of their spring/summer breeding seasons will be examined.

The analyses listed below will be conducted for approximately 160 fish (redbreast sunfish, rock bass, hogsuckers) previously collected in 2002, 2003, and 2004 from Clear Creek upstream (Hwy 127 reference site) and downstream (Barnett Bridge) of the oil spill site. The 2004 samples have been included because of the on-going releases of oil from the site, as observed in the August 2004 site visit (Appendix 1).

1. Bioindicator analyses.

   - Health Assessment Index
   - Age and growth determinations
   - 7-Ethoxyresorufin-O-deethylase (EROD) activity in liver tissue as a measure of cytochrome P4501A induction
   - Somatic indices (visceral, liver, spleen)
   - Body condition (condition factor, gross lesions and parasites, fat levels)
   - Hematology (hematocrit, leukocrit)
   - Blood chemistry (cholesterol, triglycerides, creatinine, blood urea nitrogen, total protein, albumin, aspartate aminotransferase)
   - Histopathology (liver and gill tissue)
   - Data analysis, interpretation, and reporting

2. Reproductive analyses

   - Reproductive steroids in fish plasma (estradiol and testosterone in females, testosterone and 11-ketotestoserone in males; depends on sufficient plasma remaining after blood chemistry)
   - Female fish reproductive status (gonadal somatic index (GSI) batch fecundity, abundance of vitellogenic oocytes, incidences of oocyte atresia and ovarian parasites)
   - Male reproductive condition (GSI, histological condition of testes)
   - Data analysis, interpretation, and reporting

3. Population analysis
   - Age and growth
   - Size-frequency distribution of redbreast sunfish & rock bass populations
   - Sex ratio analysis

Quantitative and statistical analysis of the data will primarily involve the comparison of the various measured parameters between oil-impacted and reference sites using a variety of statistical and graphical procedures including Analysis of Variance (ANOVA) and canonical discriminant analysis. The multivariate discriminant analysis procedure considers all the individual biomarker responses together in one integrated analysis and provides a multi-dimensional color illustration of the overall health or injury status of each species at a particular site.

A written report will be provided to the Trustee Council consisting of an integrative analysis of fish health and reproductive condition at the two study sites over the two years within the context of regional conditions. After receipt of comments, a final report will be submitted. The study will be contracted to the Environmental Sciences Division, Oak Ridge National Laboratory, under the direction of Dr. Marshall Adams. He has over 25 years experience related to assessing the effects of various environmental stressors on the health of fish populations and communities. A significant percentage of his publication record of 90 scientific articles (scientific journals and book chapters) and three books reflects studies conducted on a variety of freshwater and marine systems that have investigated the effects of different types of environmental stressors on the health of various fish species.

Study 2 - Quantification of Population-Level Impacts to Fishery Resources

The results of Study 1 will be used, in combination with field data on numbers of fish and length-weight (by species) from pre- and post-spill surveys and life-history data on affected species, to calculate the extent and duration of any reproduction or population-level impacts to fisheries resources in the affected reaches of Clear and White Creeks, compared to reference sites. The normal survival rates per year and length-weight by age relationships will be used to construct a life table of numbers and kilograms for each annual age class, by species group. The results from Study 1 will be used to estimate reductions in survival and reproduction as a result of the oil spill. Injuries to fish with reduced survival will be quantified as the net growth normally expected if they would have survived, summed over their normal life span (termed lifetime production). Reproductive injuries to fish will be quantified as lost future reproduction, which would otherwise recruit to the next generation. The services provided by the injured fish will be measured in terms of production (i.e., biomass in kilograms wet weight) not produced each year, discounted at 3 percent annually.

The quantification of fish injury will be conducted by Dr. Larry Wilson of University of Tennessee-Knoxville. He has three projects underway within the region which deal with fisheries assessment:
1. Pigeon River Restoration Project - This project deals with the re-introduction of riverine species (fish, mussels, snails) into the Pigeon River in TN and NC. The work was begun in 2001: to date, twelve fish species totaling 8,145 individuals have been re-introduced including 6 genera of snails and 8 genera of mussels.
2. NPS Fish Inventory: Inventories of the fish fauna of streams/springs on four National Park Service properties in TN (Chickamauga/Chattanooga National Battlefields), AL (Russel Cave), and KY (Abe Lincoln National Birthplace)
3. TWRA Sturgeon Telemetry/Habitat project: Using radio-telemetry to monitor and track juvenile and sub-adult lake sturgeon that are being re-introduced into the French Broad River. He is assessing dispersal as well as the type of habitat utilized.

Study Costs

Fish Study 1

Labor	$ 108,000

Materials and Supplies	8,000
Subcontracts	9,000
Subtotal	$ 125,000
FAC*	3,000
Study 1 Total	$ 128,000

Included in the above totals are the following estimated LDRD costs:

ORNL LDRD**	$2,000

* FAC is the Federal Administrative Charge that is mandated by Section 3137 of the Strom Thurmond National Defense Authorization Act of 1999 (Public Law 105-261).

** LDRD is the DOE Laboratory Directed Research and Development charge. The LDRD is a normal component of DOE overhead charges to both DOE programs and reimbursable work performed for other federal agencies. It is shown above as a component of the overall subtotal charge to the project. The FY 2002 Energy and Water Development Appropriations Conference Report (HR 107-258) requires DOE to notify federal sponsors that the Department charges LDRD.

Fish Study 2

Salaries

Dr. Larry Wilson – one month	$7,500
Technician – one month	1,500
Wilson Fringe Benefits - 39% of $7,500	2,925
Technician Fringe Benefits - 32% of $1,500	480
Other Direct Costs	
Statistician	1,500
Travel	200
Indirect Costs - 30.5% of $ 14,105	4,302
Study 2 Costs	$ 18,407
Total Costs	**$ 146,407**

APPENDIX D

INJURY SCALING OF IMPACTS TO FORESTRY RESOURCES

Study Description

Injury to the habitats and associated ecological services of forestry resources impacted by the oil spill and fire path between the well and Clear Creek will be scaled using the Habitat Equivalency Analysis (HEA) approach. Impacts to the HEA model will be developed using the output from another model that describes woody biomass accumulation on both the burned site and the reference area. This biomass model will be used to estimate the time required for woody biomass in the oiled/burned area to recover. Additional review of scientific literature will be conducted to estimate the "lag time" in recovery resulting from conditions that are difficult to predict (i.e., soil formation and recovery, loss of native seed banks, and vegetative reproduction). The biomass model will utilize species-specific biomass equations and predict standing biomass accumulation through time based on tree growth measured as change in tree diameter.

During late September 2004, the oiled/burned and reference sites will be resampled to assess overstory mortality and herbaceous species composition. The condition of all overstory trees and the percent cover of all identifiable herbaceous species will be determined. In addition, understory trees and shrubs at the burned site will be resampled to determine if woody species have reestablished since the fire. All sampling will be done within the 10 m X 50 m permanent plots established at both the burned and reference sites. Soil samples will be collected at the same locations within the burned site using the same methods as in 2003, and they will be sent to Louisiana State University (the same laboratory that analyzed the samples collected previously) for chemical analysis of the PAHs. The chemical results will be used to characterize the degree of oil weathering in the soils and the potential for on-going impacts to vegetative recovery.

Growth data will be obtained from increment cores collected at both sites from a representative sample of trees of each species present. Ring widths will be measured to the nearest 0.01 using an electronic transducer and binocular microscope fixed over a moving stage. Prior to model development, published biomass equations for the southeastern United States will be reviewed to select those that best represent conditions at the impacted site. After initial runs, the woody biomass accumulation model will be calibrated to refine model predictions. This step will require several iterations of the model and consultation with NPS personnel. The researcher will work closely with NPS personnel on the writing of the draft and final reports to generate the inputs into the HEA model to calculate the injury. The scaling of restoration options will be conducted by the Trustees once they have compiled an initial list of restoration options.

Inputs to the HEA model will include:

- Areal extent of the affected habitat
- Time path of percent lost services representing the overall diminishment of ecological services relative to the baseline conditions of the injured habitat
- Initial percent lost services at the time of the incident

- Time periods of each phase of recovery to baseline given the selected primary restoration measures
- Time path of percent replacement services to be provided by compensatory restoration relative to the baseline conditions of the injured habitat
- Time periods of each phase of maturation (or full functioning) of selected compensatory restoration measures
- Percent replacement services provided at project maturity, and whether that level would continue into perpetuity

The fieldwork will be conducted by Dr. Mike Jenkins, a forestry ecologist at the Smokey Mountains National Park who conducted the initial post-burn surveys. Dr. Christopher R. Webster, Assistant Professor of Quantitative Ecology and Forest Management at Michigan Technological University, will be responsible for the modeling study, working closely with Dr. Jenkins.

Study Costs

Salaries

Dr. Mike Jenkins – 80 hours @$41.66hour	$ 3,332.80
Dr. Chris Webster – 80 hours @ $63.08/hour	5,046.40

Other Direct Costs

Travel for fieldwork by Jenkins	300.00
Field supplies/shipping to lab	200.00
Chemical analysis of 8 soil samples @$500/each	4,000.00
Total costs	**$ 12,879.20**

APPENDIX E

ASSESSMENT OF THE AMOUNT AND DURATION OF OIL SEEPAGE INTO CLEAR CREEK FROM THE PRYOR OIL SPILL AND FIRE SITE

The Federal and State Trustees for the Pryor Oil Spill and Fire case conducted a visit to the site on 17 August 2004, during which they observed substantial amounts of oil and oil-related by-products trapped in booms in Clear Creek adjacent to the spill site. The continuing release of oil into Clear Creek more than two years after the spill poses significant risks to aquatic resources in Clear Creek. Therefore, the Trustees request that the U.S. Environmental Protection Agency (USEPA) Federal On-Scene Coordinator conduct an assessment to determine the expected amount and anticipated duration of oil seepage from the spill site into Clear Creek. The key question we want to answer from an assessment of the site is: How long will the free oil from the site continue to seep into Clear Creek? We understand that a full site assessment and quantification of the amount of residual oil in the subsurface and its potential for/rate of discharge into Clear Creek would be very difficult and expensive, considering the complex hydrogeology and difficult site access. However, the Trustees would like for USEPA to develop a study approach that would provide a preliminary assessment and measurements that could, perhaps, be repeated over time to track changes in the amount or distribution of residual oil. The Trustees are primarily concerned with how much free oil may be in fractures and/or on the water table and likely to seep out as free oil or waxy precipitates, rather than the degree of contamination of groundwater. Free oil discharges will continue to expose aquatic resources to impacts. A better understanding of how long the oil seeps will continue is needed so that the Trustees can determine if additional site remediation is needed, which is critical to not starting restoration activities prematurely. The Trustees are interested in working with USEPA in the evaluation and selection of appropriate assessment methods.

The USGS has conducted site visits with the Trustees to assess the potential impacts to groundwater resources and the duration of oil seepage from the site. They collected water samples for BTEX analysis, which have been used by the Trustees to document the extent of water contamination. The USGS will continue to support the Trustees in review of the USEPA study plan and results from the assessment of the on-going oil releases from the site and other technical support in the assessment of impacts to groundwater and surface water. Costs for past and future work performed by the USGS in support of the Trustees are included in Appendix G.

APPENDIX F

QUANTIFICATION OF LOST AND DIMINISHED VISITOR USE

Study Description

The Pryor Oil Well incident negatively affected visitor use and enjoyment of OBRI resources (Industrial Economics, Inc., memorandum dated 2/21/03). As a result of this incident, certain visitor trips to OBRI were diminished in value or foregone altogether (Industrial Economics, Inc., memorandum dated 4/17/03). The natural resource Trustees must determine the scale of compensatory restoration that is necessary to compensate the public for this loss. In so doing, the Trustees determined that the "service-to-service" scaling approach (15 CFR §990.53(d)(2)) was not applicable due to the human use nature of this lost and diminished use. Furthermore, the Trustees rejected the "value-to-value" scaling approach (15 CFR §990.53(d)(3)(i)) since valuation of the replacement services provided by compensatory restoration could not be accomplished at a reasonable cost. Therefore, the Trustees selected the "value-to-cost" scaling approach (15 CFR §990.53(d)(3)(ii)). That scaling approach selects the scale of compensatory restoration that has an implementation cost equivalent to the economic value of lost and diminished use.

The Trustees will employ the benefits transfer methodology to value this lost and diminished visitor use and to scale the associated compensatory restoration. The benefits transfer methodology involves using economic values that have been previously estimated and reported in existing studies to address similar issues in other contexts. Specifically, per-unit value estimates from existing economic studies are combined with site-specific resource information to estimate the total economic value of a loss.

The obvious advantage of the benefits transfer method is the avoided cost of conducting site-specific economic studies. That cost could easily exceed the total economic value of the loss itself in certain situations. Moreover, site-specific economic studies take additional time to plan and implement the required data collection and analysis activities. The disadvantage of benefits transfer is that the scope of existing economic studies may limit the resulting valuation. In this regard, certain criteria should be applied to ensure that appropriate studies are selected for benefits transfer. Such criteria have been developed for natural resource damage assessments conducted under OPA. Those criteria, published in volume 61, page 499 of the Federal Register (January 5, 1996), are paraphrased below.

- Studies selected for benefits transfer must reasonably represent the injured resource in terms of physical characteristics, service flows, user characteristics, and available substitutes;
- Studies selected for benefits transfer must reasonably represent the change in the quantity or quality of the injured resource; and
- Studies selected for benefits transfer must be scientifically sound and use appropriate valuation methodologies.

The Trustees will use these criteria in applying the benefits transfer methodology to this incident. Bruce Peacock, economist at the National Park Service, will conduct the study.

In the event of a future river closure resulting from continuing discharges of oil, the Trustees may implement a boater survey in order to more accurately determine the value of lost boating use. A survey instrument and plan have been developed and are ready for implementation should that become necessary (Industrial Economics, Inc., memorandum dated 4/1/03). The costs to implement the boater survey using the existing survey instrument are not included in the study costs.

Study Costs

Salaries

Bruce Peacock – 80 hours @ $54.96/hour	$ 4,396.80
Total Cost	**$ 4,396.80**

APPENDIX G

TRUSTEE COUNCIL ACTIVITIES

Description

The Trustee Council is composed of representatives from the four agencies representing the co-Trustees, namely National Park Service (NPS), U.S. Fish and Wildlife Service (USFWS), the Tennessee Wildlife Resources Agency (TWRA), and the Tennessee Department of Environment and Conservation (TDEC). The Trustee Council will meet as needed to perform the following activities:

- Review data collected to date
- Approve final study plans
- Review draft and final study reports
- Quantify injury to impacted resources
- Analyze restoration options
- Review the draft Damage Assessment and Restoration Plan (DARP)
- Approve the final draft DARP
- Participate in the public comment process
- Respond to public comments on the draft DARP
- Review and approve the final DARP
- Prepare environmental compliance documents required for Restoration Plan implementation

Several members of the Trustee Council are also involved in field data collection efforts, such as the benthic macroinvertebrate sampling, fish surveys, and water and biota sampling. The costs include their time spent in the field.

Trustee Costs

DEPARTMENT OF INTERIOR

National Park Service for 2004-2005

Dave Anderson

6 meetings, 16 hours each (8 hour meeting with 4 hours travel each way)	96 hours
7 Injury reports, 3 hours each for review and comment	21 hours
Draft DARP Review and comment	10 hours
Draft EA Review and comment	2 hours
Final Draft Review and comment	5 hours
Public Comment period	10 hours
Trustee Council Misc. communications and activities (1 day/mo, 14 mo)	112 hours
Claim Presentation and coordination	24 hours
Cost Tracking reconciliation	40 hours
Total Hours	320 hours

2004 hourly rate $50.15 (salary with benefits)	Labor $16,048
Per Trip Cost, approx $300 ea	Travel $ 1,800
	Total $17,848

Phil Campbell (Meetings, reports review, Trustee Council Activities and cost tracking)

Estimate 8 hours of NRDA activity per two week pay period	Total Hours 208
2005 hourly rate $43.14 (salary with benefits)	Labor $ 8,973

Nancy Keohane (Meetings, report review, Trustee Council Activities, cost tracking, EA review, council communication, supervision of NRDA future GS-9 employee, assistance with restoration activities)

Estimate 32 hours of NRDA work per pay period	Total Hours 624
2005 hourly rate $37.71 (salary with benefits)	Labor $23,531

Steve Bakaletz (6 meetings @9 hours each, 12 report review @ 60 hours, public comment @ 9 hours, 6 days field investigations @54 hours)

Estimate 178 hours of NRDA work	Total Hours 177
2005 hourly rate $39.12 (salary with benefits)	Labor $ 6,924

Temporary GS-9 NRDA employee (Meetings, report review, Trustee Council Activities, cost tracking and coordination for federal agencies, EA review, council communication, assistance with restoration activities, coordination of day to day activities of NRDA, logistical coordination of DARP researcher activities, administrative history)

Estimate 48 hours of NRDA work for pay period	Total Hours 1248
2005 hourly rate $21.59 (salary with benefits)	Labor $26,944
GSA vehicle rental for 3 months during summer season	Rental $ 1,000

Audie Critchley and Matt Hudson Park Rangers (Assist in site reviews by researchers and NRDA staff activities)

Estimate 4 hours of NRDA work per pay period	Total Hours 104
2005 hourly rate $35.77 (salary with benefits)	Labor $ 3,720

Barbara Olmstead Obed WSR Administrative Support (Assist in cost tracking, hiring GS-9 temporary employee)

Estimate two weeks of NRDA work	Total Hours 80
2005 hourly rate $26.56 (salary with benefits)	Labor $ 2,125

Projected NPS Total Cost	**$91,065.00**

U.S. Fish and Wildlife Service

Steven R. Alexander

Meetings: 6 meetings @9.0 hours = 54 hours	$2,125.44
Report Review: 12 reports @ 44 hours	$1,731.84
Public Comments/Meetings: 1 day@9 hours	$354.24

Field Investigations: 3 days@9 hours = 27 hours	$1,062.72
Sub-total hours = 134 hours @ $39.36 hour	$5,274.24
Indirect Costs (22.0%)	$1,160.33
Other Direct Costs (Gasoline)	$250.00
Total USFWS Costs	**$6,684.57**

U.S. Department of the Interior, Solicitor's Office

Gerald Thornton, Attorney

1. Meet six times a year with Trustee Council in Wartburg, Tennessee to advise Trustee Council = 6 meetings.
   (a) Travel to/from Meetings in Wartburg, Tennessee:
   40 miles from office; two hour round trip. Personal vehicle @ $0.365 per mile x 80 miles = $29.20 per trip x 6 meetings = $175.20.
   (b) Meetings last average of three hours.
   Three plus two travel hours = Five hours x 6 meetings = 30 hours.

2. Review documents & comments; drafts documents for Trustees:

a. Draft assessment plan:	8 hours
b. Damage Assessment and Restoration Plan with Environmental Assessment:	24 hours
c. Review of Federal Register notice:	2 hours
d. Review of response to comments on DARP/EA	8 hours
e. Review of FONSI and Record of Decision	4 hours
f. Notice of DARP to responsible party with demand for performance:	3 hours
g. Correspondence with/referral to OSLTF:	8 hours
Total:	87 hours

Salary - Gerald Thornton: 87 hours @ $79.85/h	$6,946.95
Other Direct Costs – Travel	175.20
Total DOI Solicitor's Office	**$7,122.15**

U.S. Geological Survey

Federal Fiscal Year 2004

October 2003 - DARP review and Trustee meeting – 8 hr
November 2003 - Letter report to NPS – 3 hr
March 2004 - Data review / evaluation – 2 hr
August 2004 - Trustee meeting, site visit, and sample collection – 18 hr
September 2004 - Research and proposal development – 6 hr

FY 2004 Cost Summary

Salary and benefits - 37 hr @ $49.45/hr	$ 1,829.65
Travel and per diem	320.34

GOV mileage	110.50
Analytical Costs	276.00
Subtotal – direct costs	$ 2,536.49
Indirect costs – 58%	$ 1,471.16
Total FY 2004 Costs	$ 4,007.65

Federal Fiscal Year 2005

Cost to Date (October 2004)
October 2004 - Revise proposal/conceptual model – 4 hr
DARP review and Trustee meeting – 10 hr

Salary and benefits – 14 hr @ $49.45/hr	$ 692.30
Travel and per diem	136.50
GOV mileage	51.00
Subtotal – direct costs	$ 879.80
Indirect costs – 58%	$ 510.28
Total Costs in October	$ 1,390.08

Projected Costs for technical support through calendar year 2005

Costs based on 6 Trustee meetings (10hrs/meeting plus travel), one technical meeting with EPA(hydrologist and microbiologist 8 hours each plus travel) and review of about 12 reports/documents (4 hrs per document). Total estimated time is 116 hours for a senior ground-water hydrologist and 8 hours for the microbiologist.

2005 Estimated costs for continued technical support

Salary and benefits	
GW hydrologist 116 hrs at $51.43	$ 5,965.88
Salary and benefits	
Microbiologist, 8 hours at $47.27	378.16
Travel and per diem	728.00
GOV mileage	357.00
Subtotal – direct costs	$ 7,429.04
Indirect costs	$ 4,308.84
Total Costs	$ 11,737.88

Total USGS Costs **$17,135.61**

DOI Overhead Rate on DOI Salaries ($123,467.58 * 16.84%) = $20,791.94

Tennessee Department of Environment and Conservation

Marsha White

Report review	14.0 hours	
Meetings & travel time.	75.0 hours	
Calls, emails, correspondence	8.0 hours	
Subtotal	97.0 hours @ $27.53 per hour =	$2,670.41
Travel Expense		
Mileage	2070 miles @ .35 per mile=	$724.50
Lodging and Meals	$594.00 (6 nights @ 68.00/$31.00 per day)	

Patrick Parker

Report review	14.0 hours	
Meetings & travel time	75.0 hours	
Calls, emails, correspondence	8.0 hours	
Subtotal	97.0 hours @ $37.60=	$3647.20
Travel Expense		
Mileage	2070 miles @ .35 per mile=	$724.50
Lodging and Meals	$594.00 (6 nights @ 68.00/$31.00 per day)	

Ron Zurawaski

Report review	14.0 hours	
Meetings (by phone)	30.0 hours	
Subtotal	44.0 hours @ $45.38=	$1996.72

Jonathon Burr & staff

Report review	14.0 hours	
Meetings & travel time	39.0 hours	
Field/technical activities	107.0 hours	
Subtotal	160.0 hours @ $30.26=	$4841.60
Travel Expense		
Mileage	1380 miles @ .35 per mile=	$483.00

Summary

Labor	$13,155.93
Mileage	1,932.00
Lodging and Meals	1,188.00
Subtotal	$16,275.93
Overhead @ 22%	2,898.66
Total State of Tennessee Costs	**$19,856.63**

APPENDIX H

TECHNICAL SUPPORT TO THE TRUSTEE COUNCIL

Study Description

The Trustee Council will be responsible for data analysis, review of individual study reports, and preparation of the draft and final Damage Assessment and Restoration Plan (DARP) relating to the Pryor oil well fire and spill at Obed Wild and Scenic River near Wartburg, Tennessee. A variety of studies have been identified to quantify the injury. The Trustees will use the results of the individual studies to quantify the injury to natural resources under the Oil Pollution Act (33 U.S.C. 2701, *et seq.*), and to determine appropriate restoration measures. The Trustee Council will require the services of a Contractor to coordinate their efforts during injury assessment, evaluation and selection of restoration options, and preparation of the draft and final DARP. Individual tasks to be conducted include:

Phase 1

Task 1: Conduct a site visit at Obed Wild and Scenic River; attend Trustee Council Meetings, as necessary (up to 4 meetings).

Task 2: Review existing information relating to spill, injury, and data (including Preassessment Phase Report); refine the categories of potential injury identified in the Preassessment Report and Notice of Intent, if necessary.

Task 3: Determine what studies are necessary to quantify injury.

Task4: Prepare Damage Assessment Study Plan with cost estimates and time line.

Task 5: Assist the Project Manager in identifying appropriate Principal Investigators to implement the studies.

Task 6: Support the Project Manager in preparing a Claim to be filed with the NPFC.

Phase II

Task 7: Review draft and final injury quantification study reports for each impacted resource.

Task 8: Assist the Trustees in selection and scaling of options to restore injured resources.

Task 9: Prepare a draft DARP that quantifies the categories of injury, discusses the proposed restoration, and documents the quality assurance and control procedures to be followed. The Trustees will submit the draft DARP for public comment.

Task 10: Attend a public meeting, compile all public comments, and coordinate response to public comments.

Task 11: Incorporate comments received from Trustees (including those based on the public comments) into a final DARP.

Task 12: Prepare environmental compliance documents as required for Restoration Plan implementation.

The Trustees have already contracted with Research Planning, Inc. through a competitive bidding process using the GSA Schedule to conduct Tasks 1-6.

Study Costs

Phase I
Salaries

Senior Scientist – 108 hours @ $154.09/hour	$ 16,641.72
Ecologist – 128 hours @ $49.44/hour	6,328.32

Other Direct Costs

Per diem	420.00
Hotel	756.00
Ground Transportation	840.00
Communication/Shipping	300.00
Sub-contract	713.60
Total Phase I	**$ 25,999.64**

Phase II
Salaries

Senior Scientist – 680 hours @ $160.25/hour	$108,970.00
Ecologist – 696 hours @ $65.11/hour	45,316.56

Other Direct Costs

Per diem/Hotel	3080.00
Air/Ground Transportation	6,600.00
Communication/Shipping	500.00
Draft and Final Report Production (WP/Graphics)	6,508.56
Printing	500.00
Total Phase II	**$ 171,475.12**

APPENDIX I

DATA MANAGEMENT SUPPORT TO THE TRUSTEE COUNCIL

Study Description

The U.S. Fish and Wildlife Service (Service) will provide Geographic Information System (GIS) data management support to the Trustee Council during the Injury and Restoration Assessment Phases of the Natural Resources Damage Assessment (NRDA)project. The proposed work will consist of gathering spatial data on all sampling and observation stations within the Clear Creek watershed. Existing and future analytical data will also be simultaneously entered into a relational database (i.e., Microsoft Access). This attribute data will then be linked with the spatial database created in ArcGis 9. All spatial data will be projected in the Tennessee State Plane and the NAD83 datum coordinate systems. The GIS database will be used by various researchers who will need to access data on water and sediment quality, as well as biological data collected within impacted and reference sites. Results of various studies on affected resources and habitats entered into this GIS database will be easily accessible for researchers to conduct NRDA-related assessments. The Service previously created GIS coverages and associated attribute data for ephemeral data collection efforts during the actual spill event and the NRDA Preassessment Phase. This proposed work will update previously generated data, reflect additional data collection efforts, and manage all data over the life of the NRDA project. All work is expected to be completed in 2005.

Costs

Salaries	
GIS Technician (GS-11) - 200 hours @ $37.16	$ 7,432.00
Technical Review and Supervision (GS-12) - 18 hours @ $43.46	782.28
Indirect Costs	1,807.14
Other Direct Costs	N/A
Total Costs	**$ 10,021.42**