Human Use and Ecological Impacts Associated with the Proposed Susquehanna to Roseland Transmission Line

July 27, 2012

prepared for:

National Park Service

Delaware Water Gap National Recreation Area

Middle Delaware Scenic and Recreational River

Appalachian National Scenic Trail

EXECUTIVE SUMMARY

The Susquehanna to Roseland 500-kilovolt (kV) Transmission Line Right-of-Way and Special Use Permit Final Environmental Impact Statement (FEIS) describes impacts within three units of the national park system (the parks) of constructing a double 500-kV transmission line (S-R Line). The National Park Service (NPS) has identified alternative 2 as the preferred alternative in the FEIS. This report describes analyses conducted to estimate human use and ecological losses in monetary terms resulting from alternative 2 using established approaches commonly applied in regulatory analysis and natural resource damage assessment.

To value human use losses, we conduct a benefit transfer analysis, relying on park visitation data, existing estimates of the value of recreational and cultural/historical activities, and information on the likely reduction in value associated with the proposed project. We calculate annual losses over time and express them in total present value terms using an appropriate discount rate. We estimate that total human use impacts will be $2.8 million per year and approximately $80.2 million over the life of the project. In addition to direct use losses, we consider the potential for losses to individuals who have not and may not visit the parks but nonetheless hold value for these natural, historic, and cultural resources. While there is evidence of such losses, insufficient information exists to develop quantitative estimates. Thus, the estimate of direct use losses should be viewed as a lower bound on total human use losses associated with the project.

To quantify ecological losses, we employ the Habitat Equivalency Analysis (HEA) methodology. Key inputs to HEA include estimates of the affected acreage by habitat type, as well as estimates of the duration and severity of impact attributable to the project. Estimated impacts are summed over space and time and expressed in "discounted service acre-years" (DSAYs) of impact. The required area and type of ecological mitigation projects sufficient to offset losses is then estimated. We estimate losses of 3,053 upland DSAYs, 159 wetland DSAYs, and 90 floodplain DSAYs. Based on our analysis, we estimate a restoration project-based compensation cost of approximately $8.5 million, which includes $3.5 million in compensation for wetland injuries as well as a $5 million land acquisition project to compensate for uplands, floodplains, and other qualitative damages.[1] Finally, the NPS has included modest funding for a small number of research and/or planning efforts as part of mitigation compensation that will help them better understand and manage potential impacts for which limited information is currently available. The total estimated cost of these efforts is $250,000.

Together, total quantified human use and ecological losses are estimated to be approximately $89 million.

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[1] We include compensation for wetlands impacts in our analysis for completeness, but note the potential for overlap with a ratio-based requirement for wetlands mitigation. For various reasons, ratio-based approaches often generate greater mitigation acreage requirements than HEA-based approaches. It is possible to remove the wetlands portion of our analysis if NPS proceeds with a ratio-based approach.

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CHAPTER 1

INTRODUCTION & PURPOSE

The Susquehanna to Roseland 500-kilovolt (kV) Transmission Line Right-of-Way and Special Use Permit Final Environmental Impact Statement (FEIS) describes the proposal of PPL Electric Utilities Corporation (PPL) and Public Service Electric and Gas Company (PSE&G) to construct a portion of the Susquehanna to Roseland 500-kV transmission line (S-R Line) and reconstruct an existing 230-kV line along their current right-of-way (ROW) through three units of the national park system. The FEIS identifies six alternatives for the construction of the transmission line, the resources that would be affected by the alternatives, and the environmental consequences of the alternatives. The National Park Service (NPS) has identified alternative 2 as the preferred alternative.

The analyses described in this document were conducted to assist the NPS in its efforts to understand potential mitigation needs associated with the preferred alternative. The objectives of this report were to:

1) Estimate the approximate monetized value of incremental adverse impacts to use of recreational and cultural/historical resources, as identified in the FEIS;
2) Consider the potential for losses associated with changes in “passive use” or “nonuse” values (i.e., members of the public who value these park units but do not directly use them);
3) Estimate the approximate scale and cost of restoration projects appropriate to offset incremental impacts to ecological resources, as identified in the FEIS; and
4) Provide a comparison of these methods, assumptions, and results with the project applicants' mitigation proposal.

OVERVIEW OF METHODS

To address the first objective we conduct a benefit transfer analysis, an approach commonly used to develop dollar-denominated estimates of losses in regulatory analysis and natural resource damage assessment (NRDA). Benefit transfer is the practice of using results from existing economic valuation studies and adjusting them to value changes in conditions in similar contexts. We first identify the number of trips, by activity type, taken annually in areas with viewsheds that will be affected by the project. Second, we provide a monetary value for each trip type based on a review of relevant economic literature. Third, we review available literature to estimate “per-trip” losses in value associated with visual disamenities such as transmission lines. Total loss estimates are calculated by summing annual loss estimates over the project lifespan and expressing these in present value terms through application of an appropriate discount rate.

With respect to the second objective, we recognize that the proposed project potentially could result in additional “passive” or “nonuse” losses, above and beyond those experienced by members of the public who recreate within project-affected viewsheds. We present summary information from public comments submitted on the Special Use Permit Draft Environmental Impact Statement (DEIS), which support the existence of such losses. We demonstrate that the original letter public comments come from a wide geographic area of 25 states and include expressions of support for the parks based on existence and bequest values.

With respect to the third objective identified above, we employ Habitat Equivalency Analysis (HEA) to estimate the potential need for habitat mitigation for alternative 2. HEA is a method developed and commonly used in NRDA to determine compensatory restoration needed to offset injuries to natural resources arising from oil spills or releases of hazardous substances. HEA also has been used in other contexts, including the evaluation of mitigation requirements arising from physical changes or disturbances to the environment associated with construction projects, such as the proposed S-R Line.

Key inputs to HEA include estimates of the affected acreage by habitat type, as well as estimates of the duration and severity of impact attributable to the project (i.e., above and beyond “baseline” habitat conditions that would exist if the project did not go forward). Estimated impacts are summed over space and time, and ultimately expressed in “acre-years” (or similar units) of impact. The required size of appropriate ecological mitigation projects (e.g., protection, improvement and/or creation of similar types of habitat) is then estimated, sufficient to offset the “acre-years” of impact. Key inputs for this portion of the HEA include estimates of the duration and magnitude of ecological mitigation project benefits. Discounting is applied in the analysis to adjust for any differences in timing between impacts and ecological mitigation project benefits. The output of this type of HEA is the estimated number of acres or costs of one or more project types needed to offset estimated impacts. Per-acre cost information was then applied to the number of acres of ecological mitigation project(s) required, thereby providing estimates of the total amount of funding needed for ecological mitigation.

The fourth and final objective is addressed in more detail later in this chapter. Our intent is to provide a “high-level” comparison of the applicants” mitigation approach with the methodologies used in our analysis, rather than perform a detailed evaluation.

KEY ASSUMPTIONS AND CAVEATS

Important assumptions and caveats that underlie our analysis are highlighted below.

- Our analysis monetizes incremental losses expected to arise from implementation of alternative 2, relative to conditions that would exist if the project were not implemented (i.e., “baseline” conditions). In the absence of the project, we assume that future conditions and management practices would be similar to currently observed conditions and practices.
- We estimate losses over a 60-year time horizon, consistent with the proposed project’s useful life. Although it is possible that the project could be extended,

and/or project impacts would last beyond 60 years, this is a reasonable period based on currently available information.

- We assume alternative 2 implementation and construction would begin in 2013. Thus, our 60-year period of analysis ends in 2072.
- Our analysis is based solely on pre-existing, readily available information; no primary research (e.g., collection of samples, new field surveys, etc.) was undertaken for this effort.
- Our analysis does not attempt to "net out" or otherwise account for actions that the applicants may be required to perform as a condition of project approval, if the project were approved. No such requirements were identified at the time the analyses described in this report were undertaken. To the extent such requirements are identified in the future, the NPS will need to consider if the analyses presented in this document "double-count" or otherwise create overlapping compensation claims for specific impacts.
- While we expect that this report will inform NPS decision-making with respect to potential compensation requirements if alternative 2 were approved, other factors may also need to be considered, possibly including but not necessarily limited to: the potential "precedential" impact of the decision on this project on the characteristics and likelihood of other projects in the future; the "cumulative" impact of this project in light of ongoing changes in the region to ecological and human use of natural resources; and underlying uncertainties in the estimates.
- The monetized loss estimates presented in this report are subject to change if/as additional information becomes available.

APPLICANT MITIGATION COMPENSATION PROPOSAL

Our understanding of the applicants' mitigation proposal is derived from a 13-page document titled "A Methodology for the Assessment and Analysis of the Resource Impacts Occurring within a 14-Mile Wide Viewshed of the National Park Service Units" (PSE&G and PPL, 2012). The introduction to that document states that "[t]his analysis provides the basis for compensation measures to offset unavoidable impacts to existing public attributes and natural resources within and related to NPS units affected by the proposed Project" and that "[t]he intent of the proposed methodology is to more than offset every potential unavoidable impact of the proposed Project, by creating and endowing a substantial fund to support acquisition and stewardship of lands and other resources in the DEWA region."

The applicants' methodology applies an "intensity level factor" to acreage within seven miles of the transmission corridor; the factor is decreased with increasing distance from the corridor. The "intensity level factor" is calculated as the number of categories of impact (eight) for which impacts "cannot be avoided or be readily minimized to insignificance by some form of a direct mitigation" divided by the total number of impact categories (18) identified in the DEIS (i.e., 44 percent). This 44 percent "intensity level factor" is applied to acreage within 0.5 miles of the corridor, and is reduced to 29.3, 14.7, 4.4 and 2.2 percent at 1 mile, 2 miles, 3.5 miles and 7 miles from the corridor, respectively. The applicants' mitigation compensation estimate ($36,494,241) is derived by multiplying acreage within seven miles of the corridor by the appropriate "intensity level factor," resulting in a total of approximately 38,221 acres, which is then multiplied by an estimated land acquisition cost of $9,500 per acre.[2] The applicant states that this per-acre cost estimate "is an adjusted average drawn from broad sample of transactions, and is biased upward to avoid under-estimation of possible costs. Many thousands of acres of high value land in the DEWA area could be placed in conservation status under agreements with considerably lower price terms."

Development of a detailed evaluation of the applicants' methodology is beyond the scope of this analysis. Rather, based on our current understanding of the applicants' methodology, we highlight important differences with our approach. Although the applicant believes its methodology is "conservative" (i.e., more likely to overstate than understate compensation), this view appears to be based primarily on the applicants' inclusion of all acreage within seven miles of the corridor in its analysis. However, very small "intensity level factors" (e.g., 2.2 and 4.4 percent) are applied to a substantial portion of this acreage. Furthermore, for reasons summarized below, we have concerns about the ability of the distance-adjusted "intensity level factor" to be an effective proxy for the impacts expected to arise from the project. We do not agree that resulting estimates of mitigation compensation needs are "conservative"; in our view their estimates bear an uncertain relationship to expected loss, as summarized below:

- As described in more detail in subsequent sections of this document, the park units impacted by the project are visited by millions of people each year. Some portion of these visits would be adversely impacted by the project. Our analysis accounts for the number of visitors expected to be affected and the monetized decrement in enjoyment resulting from project impacts. The applicants' methodology does not directly incorporate park visitation data, and the resulting compensation estimate appears to be insensitive to park visitation levels.
- In addition to direct human use of park resources, the project potentially could result in "passive-use" losses, above and beyond those experienced by members of the public who visit within project-affected viewsheds. Chapter 2 summarizes information submitted as part of the DEIS public comment process, supporting the notion that losses are not limited to direct users of park resources. While estimation of such losses can be difficult, this issue is not factored into the applicants' methodology.
- With respect to ecological loss, the FEIS provides estimates of habitat types and acreages that would be affected by the project. Our analysis directly incorporates this information, and associated compensation estimates vary accordingly. The applicants' methodology and resulting compensation estimates do not appear to rely on or vary with this type of information.

[2] The applicants' compensation estimate is $36,494,241, although 38,221 acres * $9,500 per acre = $36,299,500. The difference appears to be due to rounding.

- Across loss categories, our methodology discriminates between permanent and temporary impacts, and accounts for loss over an explicit time period (60 years). The applicants' methodology does not explicitly address the timing or permanence of impacts.

By seeking acquisition of acreage equal to its estimate of "affected" acreage (based on the viewshed acreage, "intensity level factors" and distance adjustments previously summarized), the applicant might contend that it is not necessary to address the issues identified above – impacted acreage is essentially replaced, and in that manner losses and gains are balanced. We do not agree, due in substantial part to concerns about the ability of the distance-adjusted "intensity level factor" to be an effective proxy for the impacts expected to arise from the project. Dividing the number of categories of impact (eight) for which impacts "cannot be avoided or be readily minimized to insignificance by some form of a direct mitigation" by the total number of impact categories (18) identified in the DEIS is a simple calculation that bears an uncertain relationship to harm because it does not take into account the spatial extent, severity, or temporal extent of impacts. It also is sensitive to the organization of impact categories, which from an editorial perspective could be collapsed into fewer categories or expanded into more categories, either of which would change the applicants' "intensity level factor" estimate.

In addition, to the best of our knowledge the applicant does not address the extent to which "replacement" acreage is likely to provide benefits similar in magnitude and type to those adversely affected by the project. For instance:

- Is targeted acreage located in the viewshed of park visitors?
- Is acreage intended to allow for trail network expansion?
- Absent acquisition, is development of targeted parcels likely?
- What ecological benefits would result from acquisition?

These types of questions need to be considered in any type of "acre for acre" framework.

REPORT ORGANIZATION

The remainder of this document is organized as follows:

- Chapter 2 presents our evaluation of human use losses associated with the project.
- Chapter 3 presents our evaluation of ecological losses.
- Chapter 4 presents our evaluation of ecological restoration.
- Appendix A provides additional information regarding recreational and cultural/historical trip values utilized in the human use loss calculation.
- Appendix B provides additional information about the HEA methodology.
- Appendices C through F provide additional information on the data used in the HEA analysis.

CHAPTER 2

HUMAN USE IMPACTS

In this section, we draw upon information from the FEIS, visitor use data, and economic literature to quantify and monetize visitor impacts. The proposed S-R Line crosses through three National Park units: Delaware Water Gap National Recreation Area (DEWA), the Appalachian National Scenic Trail (APPA), and the Middle Delaware Scenic and Recreational River (MDSR), which we collectively refer to as "the parks." As identified in the FEIS, the proposed project is expected to impact visitor experience through alteration of recreational, historical, ecological, and cultural resources. We consider both direct impacts to visitors as well as indirect impacts to individuals who have not or may not visit the parks.

METHODS

The economic value of recreational and cultural/historical opportunities is measured by what an individual is willing to pay for that experience above and beyond what they are required to spend to participate. This definition of value, referred to as consumer surplus, is fundamental to welfare economics and recognized as the appropriate measure to compare the costs and benefits of regulatory alternatives and measure damages resulting from injury to natural resources.[3] The relationship between expenditures and consumer surplus is illustrated in Exhibit 2-1.

[3] For example, see U.S. Environmental Protection Agency's Guidelines for Preparing Economic Analyses (2010) and U.S. Department of the Interior Natural Resource Damage Assessment Regulations (43 CFR Part 11).

EXHIBIT 2-1. DEMAND FOR RECREATIONAL TRIPS

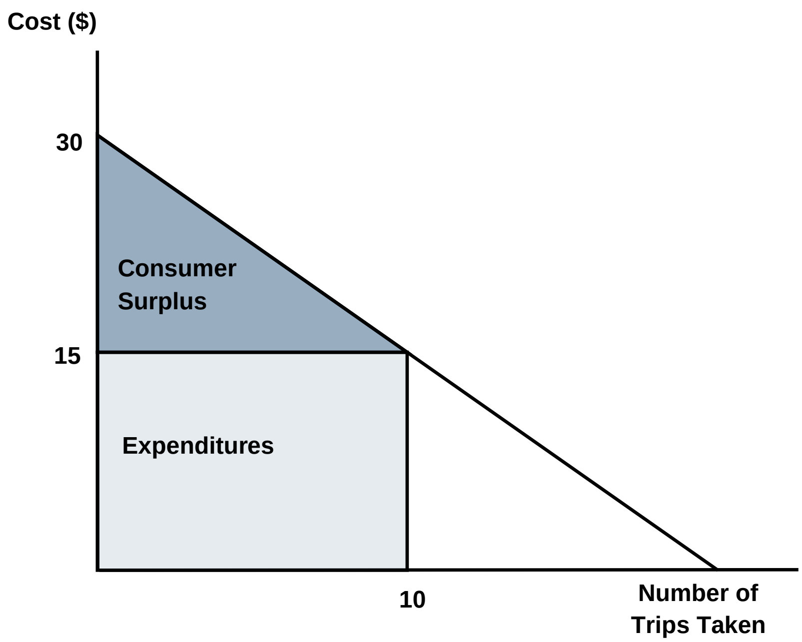

Exhibit 2-1 depicts an individual's demand curve for recreational trips. The demand curve indicates what the individual would be willing to pay for various numbers of trips taken over the course of a particular time period (e.g., a year or season). The downward slope reflects the conventional notion that the lower (higher) the cost per trip, the more (fewer) trips an individual will take.

For example, at a cost per trip of $15, the individual would take 10 trips. Additional trips at that price would exceed what the individual is willing to pay. The individual's total expenditures for these 10 trips is equal to the area of the rectangle labeled "Expenditures," or $150 ($15×10). Note that for each trip leading up to 10, the individual's willingness to pay exceeds the cost per trip. The area of this triangle, labeled "Consumer Surplus," represents surplus value that accrues to the consumer, in this case $75 [(10÷2)×(30-15)]. The total value (or social welfare value) of recreational trips is calculated by summing each individual's consumer surplus across all participants.

Economic values for recreational opportunities can be measured using "revealed preference" or "stated preference" valuation methods. Revealed preference methods rely upon observed behavior or choices to infer values for changes in natural resource services and environmental quality. Stated preference methods involve the creation of hypothetical markets through carefully designed surveys to elicit values directly. Because the conduct of primary valuation studies is time consuming and costly, "benefit transfer" is often used to develop economic benefit estimates. Benefit transfer refers to the use of valuation information from an existing study or studies to evaluate the benefits of an alternative policy or scenario. The method is formally recognized in the U.S. Environmental Protection Agency's (EPA's) *Guidelines for Preparing Economic Analyses* (2000, updated 2010) and the Office of Management and Budget's *Guidance on Development of Regulatory Analysis* (Circular A-4, 2003).

To estimate the total impact of the proposed S-R Line on visitor use and experience we conduct a benefit transfer analysis, relying on park visitation data, existing estimates of the value of various activities, and information on the likely reduction in trip value associated with visual disamenities.

ANALYSIS OF RECREATIONAL AND HISTORIC/CULTURAL IMPACTS

The parks offer a wide variety of recreational opportunities, including hiking, boating, swimming, picnicking, sightseeing, and nature study, all of which benefit from the natural and scenic beauty of the area. The parks also contain significant cultural and historical resources. Of principal concern with respect to the proposed project is Millbrook Village, an NPS owned and maintained mid-1800s village in the Old Mine Road Historic District that contains original and relocated historic buildings centered around an historic grain mill. These resources contribute to economic activity by attracting visitors who accrue surplus benefit (consumer surplus, as discussed above) from their experience.[4] Our analysis measures the impact of the project by estimating the number of visitors that will be affected, and the associated reduction in consumer surplus per-trip.

Quantifying and monetizing visitor impacts requires three steps:

1. **Estimate number of affected visitors.** We first estimate the number of visitors likely to experience a diminished experience due to the aesthetic impact of the proposed S-R Line.
2. **Estimate baseline value of affected trips.** Through literature and database searches we identify appropriate values for a variety of activities (i.e., hiking, boating, recreating, and visiting historical/cultural sites).
3. **Estimate per-trip loss.** We identify studies that provide evidence of the reduction in value of trips associated with the presence of visual disamenities.

Multiplying the total number of yearly affected visitors by the loss in value (expressed as a percentage of the baseline or unaffected trip value) yields an estimate of the total annual impacts associated with the S-R Line. Based on the FEIS, we assume that the proposed S-R Line will have a useful life of 60 years. We calculate annual losses over the 60-year period and express in total present

[4] It is our understanding that the primary contribution of these properties to economic activity is through visitor attraction, and that these properties do not contribute property tax, generate rental income, or otherwise substantively contribute to economic activity.

value terms using a discount rate of three percent. This is a generally accepted real social discount rate that is commonly employed in regulatory analysis and damage assessment (e.g., see Weitzman, 2001).

Visitor Use Estimates

The NPS Public Use Statistics Program (PUSP) gathers and compiles public use data for areas in the national park system. Monthly visitation estimates for DEWA are derived from data collected at traffic counters placed at seven locations around the park and from ranger counts for the APPA.[5,6] Correction factors specific to each counter were derived from a statistical analysis based on actual reported recreational visits and the results of the 1988 study *Summary of Traffic Characteristics – Delaware Water Gap National Recreation Area.* Multiplying the correction factors by traffic counts in a given month results in the estimate of total visitation to DEWA.[7]

In order to derive estimates of visitation specific to areas that may be visually impacted by the proposed S-R Line, we consulted two studies conducted as part of the University of Idaho Visitor Services Project (VSP). These studies, both based on surveys conducted within DEWA, are the most comprehensive and recent sources of information on the distribution of visitation within the park. The "Delaware Water Gap National Recreation Area Visitor Study" was conducted in 1989; 457 surveys were completed across 12 sites throughout the park. The survey asked respondents about their activities at the park and the sites they visited, as well as opinions on park amenities. The second VSP study, the "Delaware Water Gap National Recreation Area River Visitor Study," was conducted in 2010. The 2010 VSP study similarly queried park visitors about activities in the park and sites visited, but the survey sample was restricted to river users. Although the 2010 study is more recent, it focuses only on a sample of river users. The 1989 study surveyed all types of visitors, and therefore provides information that allows us to characterize visitation across the various sites and activities subject to impact by the project.

We consider four general types of visitors across five different areas (recognizing that visitors may participate in multiple activities and/or visit multiple sites during a trip) that are likely to experience a diminished experience due to the presence of the proposed S-R Line:

Exhibit 2-2 displays visitor areas within the parks where visitors will be affected.

- **Historic/Cultural Site Visitors**- Millbrook Village is one of the most popular and well-maintained historic sites throughout DEWA. Under

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[5] These estimates are publicly available on the NPS Public Use Statistics website: http://www.nature.nps.gov/stats/park.cfm?parkid=291.

[6] We assume that visitors to MDSR are also counted in the DEWA statistics.

[7] For more information on the DEWA visitation model, see the document "Delaware Water Gap National Recreation Area Public Use Counting and Reporting Instructions," available at the following URL: http://www.nature.nps.gov/stats/CountingInstructions/DEWACI1997.pdf.

alternative 2, the proposed S-R Line will be visible to visitors at parts of Millbrook Village. We estimate the number of annual historic/cultural site visitors affected based on the proportion of respondents to the 1989 VSP study who reported visiting Millbrook Village and participated in visiting historic sites during their visit to DEWA. We apply this proportion to the average annual estimate of total DEWA visitation over the last 12 years to derive an estimate of annual historic site visitors affected by the proposed S-R Line.

- **General Recreation Visitors-** Watergate Recreation Site and Van Campens Glen Picnic Site (Van Campens Glen) are recreation areas located in close proximity to the proposed S-R Line. We derive an estimate of annual recreation site visitors affected based on the results of the 1989 VSP study. For the Watergate Recreation Site, we calculate the proportion of visitors who reported participating in picnicking, sightseeing, nature study, or fishing. The 1989 VSP study did not ask respondents about Van Campens Glen, but did include the Depew Recreation Site, a site adjacent to Van Campens Glen that has since been closed. Due to their close proximity, we estimate affected visitors at Van Campens Glen by calculating the proportion of visitors who visited the Depew Recreation Site and reported participating in the activities popular at Van Campens Glen: picnicking, sightseeing, nature study, and sightseeing. We apply the proportions for the Watergate Recreation Site and Van Campens Glen to the average annual estimate of total DEWA visitation to derive a total estimate of annual recreation site visitors affected by the proposed S-R Line.
- **River Area Visitors-** Bushkill Access is a popular access and recreation point to the Delaware River located upstream from the crossing of the S-R Line under alternative 2. We derive an estimate of annual river area visitors affected based on the proportion of respondents to the 1989 VSP study who visited Bushkill Access and participated in boating, canoeing, tubing, fishing, hiking, nature study, or sightseeing. We apply this proportion to the average annual estimate of total DEWA to derive an estimate of annual river area visitors affected by the proposed S-R Line.[8]
- **APPA Visitors-** The APPA is one of the most well-known recreational resources managed by the NPS, and is highly valued for its natural beauty and seclusion from human development. A 27-mile segment of the APPA falls within DEWA boundaries. To derive an annual estimate of visitors to the APPA that will be affected by the proposed S-R Line, we rely upon use estimates specific to the portion of the trail within DEWA and

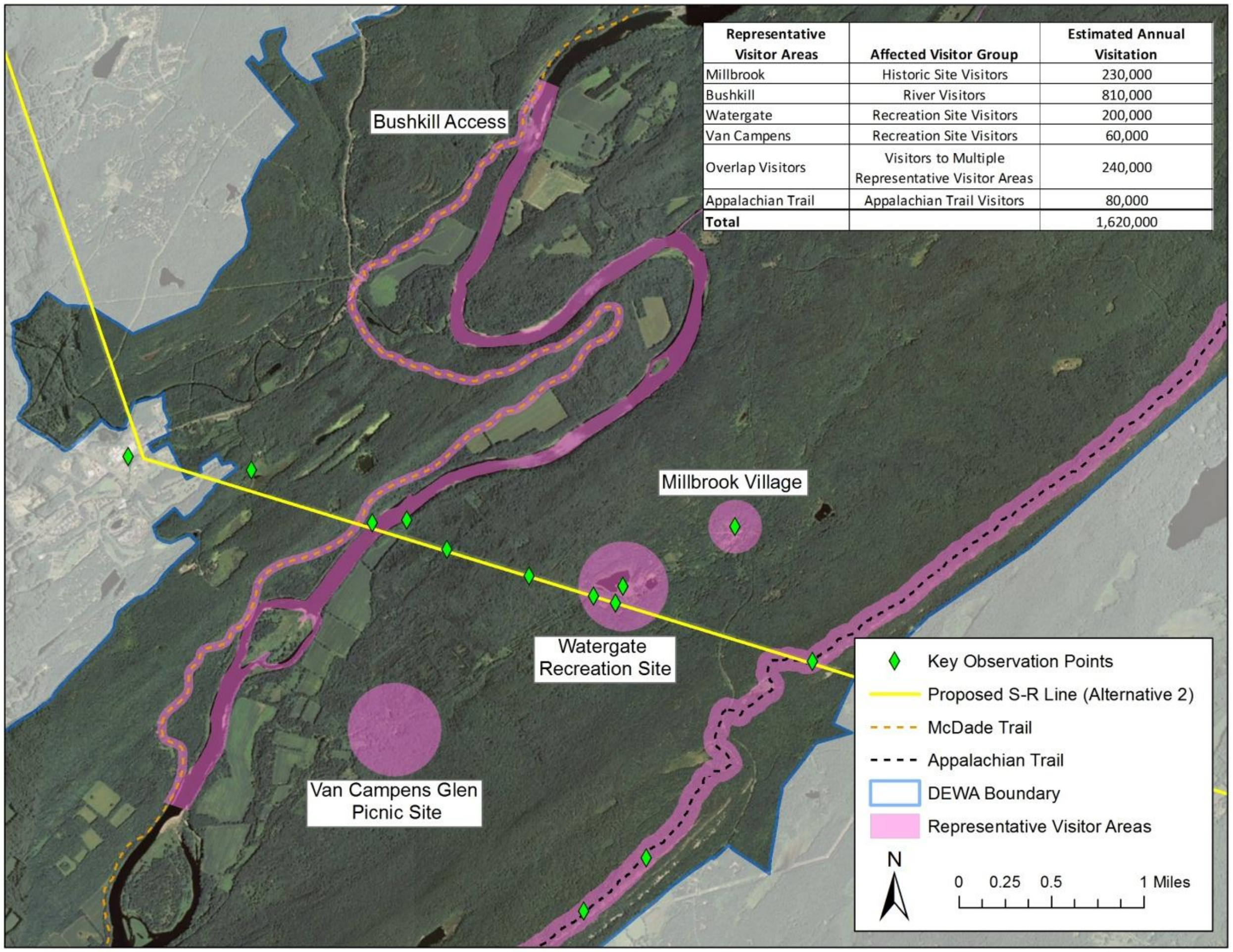
[8] Note that river users and other visitors may be affected by the closure and relocation of the Hamilton Campsites in that the replacement sites may be not be equally preferred. However, insufficient valuation information exists in the literature to monetize these potential impacts.

reported by the NPS PUSP. Field rangers generate the counts based on logbook entries, parking lot use, and field patrols along the trail.[9] We compare these figures to a 2011 U.S. Forest Service (USFS) pilot study examining visitor use on a 109-mile segment of the APPA, stretching from Harpers Ferry, WV to a point 10 trail miles north of Boiling Springs, PA. Per-mile estimates of trail use derived from the USFS study fall within the same range as those derived from the ranger-generated estimates that we incorporate in our analysis. Most of the popular day hikes along the APPA cross through the portion of the trail within sight of the proposed S-R Line. Overnight hikers are likely to be hiking longer portions of the trail and will also cross through points where the proposed S-R Line will be visible. We assume, therefore, that the proposed S-R Line will affect all visitors to the APPA within DEWA boundaries.

Estimates of visitation to DEWA remained relatively stable from 2000 through 2011. According to NPS estimates, average visitation to DEWA was approximately 5.4 million visitors per year over this time period. Because we do not find a consistent pattern of increasing or decreasing visitation over these 12 years or in recent years, we assume that baseline visitation to the parks will remain constant over the lifetime of the proposed S-R Line.

[9] For estimates of annual visitors to the APPA, we choose NPS-reported ranger estimates rather than data from the 1989 VSP visitor study. Ranger estimates provide more recent and comprehensive information on use specific to the APPA.

EXHIBIT 2-2. IMPACTED VISITOR AREAS*



Representative Visitor Areas	Affected Visitor Group	Estimated Annual Visitation
Millbrook	Historic Site Visitors	230,000
Bushkill	River Visitors	810,000
Watergate	Recreation Site Visitors	200,000
Van Campens	Recreation Site Visitors	60,000
Overlap Visitors	Visitors to Multiple Representative Visitor Areas	240,000
Appalachian Trail	Appalachian Trail Visitors	80,000
Total		1,620,000

*Visitation estimates from visitor areas are intended to capture affected visitors to the most frequented areas of the park within sight of the S-R Line. For example, Bushkill Access is a popular access point located upstream from the S-R Line; from there visitors participate in fishing, boating, canoeing, tubing, hiking, nature study, or sightseeing, in the vicinity of the S-R Line.

Estimating Baseline Recreational Use Values

To estimate baseline values for recreational activities, we relied upon the Recreational Use Values Database compiled by researchers at the Oregon State University College of Forestry (Rosenberger, 2006). This database contains a comprehensive collection of recreational and cultural/historical use values from published and gray literature between 1958 and 2006, and includes more than 350 studies that provide consumer surplus estimates for 21 types of recreational activities. Exhibit 2-3 shows the number of studies and associated value estimates for each of the activities associated with the affected visitor groups/areas.

EXHIBIT 2-3. LITERATURE SUMMARY FOR CATEGORIES OF RECREATIONAL ACTIVITIES

RECREATIONAL ACTIVITY	NUMBER OF STUDIES	NUMBER OF USE VALUE ESTIMATES	GEOGRAPHIC COVERAGE
Motorboating	18	75	AK, AL, AZ, CA, CA, CO, GA, IL, IN, IO, KS, KY, LA, MD, MI, MO, MT, NC, NM, NV, NY, OH, PA, SC, TN, TX, UT, VA, WA, WI, WV, WY, USA
Floating, rafting, and/or canoeing	23	85	AZ, CA, CO, DE, GA, ID, ME, MN, NC, OR, SC, UT, WY, Ontario, USA
Freshwater fishing	140	809	49 U.S. states (exception is HI), USA, 10 Canadian provinces, and one Canadian territory.
Visiting historic sites	1	1	NATIONAL
Sightseeing and wildlife viewing	37	346	50 U.S. states, USA, 10 Canadian provinces, and one Canadian territory
Picnicking	7	19	AR, AZ, CA, CO, FL, GA, ID, IN, MA, ME, MI, MS, MT, NC, NH, NM, OH, OR, SC, TN, UT, WA, WI, WV, WY, USA
Hiking	32	124	AK, AL, AR, AZ, CA, CO, FL, GA, ID, IN, ME, MI, MO, MS, MT, NC, NH, NM, NY, OH, OR, SC, TN, UT, VA, WA, WI, WV, WY, USA

To evaluate studies from the Recreational Use Values Database for quality and applicability to recreational activities at the parks, we considered the following:

1. **The time period in which the study was developed:** We focused on studies published in the last 30 years (1982-2011).
2. **The geographic area covered by the study:** We selected studies from areas east of the Mississippi River and north of the southern borders of Tennessee and North Carolina.
3. **The valuation methodology employed in the study:** As described earlier, values may be estimated using revealed-preference or stated-preference methods. We restricted our selection to studies that rely upon revealed-preference methods (e.g., travel cost and random utility models) because they are based on actual consumer choices/behavior. This is the preferred approach for valuing direct use activities.
4. **Study availability:** For studies that met the first three criteria outlined above, we attempted to locate a copy in order to further evaluate for quality and/or applicability. If we could not locate a study through on-line and database searches we did not incorporate associated value estimates.

Based on these criteria, we selected one or more relevant and applicable studies for each of the seven recreational activities of interest. To derive a single use value estimate for each recreational activity, we converted the value estimates to 2011 dollars using the Consumer Price Index and then calculated the average value across selected studies for each recreational activity.[10] The result of this calculation is an estimate of the baseline per-person, per-activity-day recreational use value. Exhibit 2-4 provides an overview of these baseline values and the supporting literature. Further details on selected literature sources are provided in Appendix A.

[10] Our per-day values and loss estimates are presented in $2011, the most recent full year of CPI data. This is conservative in that some additional inflation has occurred in the first half of 2012. However, these 2012 CPI estimates may still be subject to revision at this time.

EXHIBIT 2-4. BASELINE RECREATIONAL USE VALUES ($2011 PER PERSON PER ACTIVITY DAY)

PRIMARY ACTIVITY	ESTIMATED PER-DAY VALUE	NUMBER OF STUDIES	NUMBER OF USE VALUE ESTIMATES*	GEOGRAPHIC COVERAGE
Motorboating	$24.05	2	2	IL, IN, KY, MI, OH, PA, TN, WI, WV, USA
Floating, rafting, and/or canoeing	$36.44	1	2	NATIONAL
Freshwater fishing	$29.53	8	14	AL, GA, IN, MD, ME, MI, NC, NH, NY, OH, PA, SC, TN, VA, VT, WI, WV, USA
Visiting historic sites	$41.72	1	1	NATIONAL
Sightseeing and wildlife viewing	$25.32	7	8	IL, IN, KY, MI, NH, OH, PA, TN, WI, WV, USA
Picnicking	$17.33	2	2	IN, MI, NH, OH, WI, WV, USA
Hiking	$53.96	3	4	IN, MI, NC, NH, OH, WI, WV, USA

Per-Trip Loss in Recreational Use Value

We undertook a thorough literature search and review to identify studies that provide evidence of the impact of visual disamenities on recreational use and enjoyment. To our knowledge, no study has examined the impact of changes in the size and characteristics of transmission lines specifically. However, several studies in other contexts indicate that such impacts exist and are likely to range from low single-digit percentages up to 10 percent or greater. In this section we describe our approach to developing an estimate of the per-trip loss in recreational use value associated with the S-R Line. Specifically, we discuss:

1. The importance of visual quality to recreational experience;
2. Studies that indicate the effect of visual quality on recreational use values; and,
3. Studies in various contexts that examine transmission line impacts.

Importance of Visual and Scenic Resources to the Parks

The visual resources of the parks are recognized in their enabling legislation noting their aesthetic and scenic value. The DEWA enabling legislation states its purpose is for the "preservation of the scenic, scientific, and historic features contributing to the public enjoyment of such lands and waters" (PL-89-158, USC 460 as cited in FEIS, 7). The MDSR is protected under the Wild and Scenic Rivers Act which seeks "to protect the area's aesthetic, scenic, historic, archeological, and scientific feature" (FEIS, 9 - citation omitted in the original). The APPA's enabling legislation, the National Trails System, states its purpose is "to promote the preservation of, public access to, travel within, and enjoyment and appreciation of the open-air, outdoor areas, and historic resources of the Nation" (16 USC § 1241(a)), and the APPA received the designation of "National Scenic Trail" for its scenic qualities. The NPS founding legislation also notes the importance of visual resources in describing that its purpose: "... is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (National Park Service Organic Act 1916). Together these mission statements demonstrate the importance of visual resources to the parks.

Visitors to the parks likewise value the scenic and aesthetic resources, choosing activities that highlight these features. The comprehensive DEWA visitor survey in 1989 found that sightseeing was the most common recreational activity, with 56 percent of visitors participating (Madison and Machlis, 1990). The remainder of the top five activities (picnicking, swimming, hiking, canoeing/tubing) are influenced by the scenic quality of their surroundings. In addition, visitors mention the visual resources in describing their reasons to visit the parks. Visitor comments in the proposed S-R line EIS Scoping Report include:

- "The views seen from throughout the DEWA, along the river, and the Appalachian Trail are priceless."
- "Beautiful, scenic. I drive through here a few times a year and marvel."
- "It is a jewel in the crown of the Park Service because of its variety and beauty." (DEIS 313 -citations omitted)

It follows that impacts to visual resources will diminish visitor experience. With regard to the S-R Line specifically, a recent survey of river users suggests that the proposed project would negatively impact visitor experience. Blotkamp et al. (2011) report that in their 2010 survey 64 percent of river users indicated that the proposed S-R Line would detract from their park experience.

The Influence of Scenic and Site Quality on Recreational Values

The resource economics literature demonstrates that trip quality affects recreator behavior and the value they place on activities/experiences. For example, in a study of trail users in North Carolina, including the APPA, Sideralis et al. (2000) find that trail users would increase their number of trips if trails were to improve in quality (including scenery). On average, survey respondents would increase annual trips from 5.8 to 8.2, a 40-percent increase, if conditions were ideal and experience an increase in value per trip of approximately $19.50 ($2011).

Specific to visual resources, Kask et al. (2002) examine the impact of scenery on the number of visitor trips to the Blue Ridge Parkway. The Blue Ridge Parkway, like DEWA, is one of the top 10 most visited National Parks. Survey respondents indicate how hypothetical changes in scenic quality as depicted in photographs would influence their number of trips to the Parkway. The authors find that 26 to 41 percent of respondents would decrease their trips if scenic quality declined and 33 to 42 percent would increase their trips if scenic quality improved. Kask et al. also find that visitors value avoided reductions in scenic quality more highly than improvements (i.e., trip value decreases more for a reduction than it would increase for an equivalent improvement).

In other literature, researchers have estimated recreators' willingness to pay to preserve or improve the scenic quality of forests and vistas. For example, Walsh et al. (1990) ask respondents their willingness to pay to improve forest quality, as judged visually. They provide respondents with three color photographs showing a deteriorated forest, the current forest, and an improved forest, where changes are reflected in tree density. Respondents are told that a program would prevent the deterioration and improve forest quality as shown in the photographs and asked their maximum willingness to pay in taxes and increased prices of consumer goods. Of respondents who are recreators, estimated willingness to pay for the program is approximately $40.00 ($2011).

Krueger et al. (2011) examine visual impacts associated with wind turbines located in the ocean off the Delaware coast. The authors estimate what residents would be willing to pay to avoid wind turbines at various distances from shore. They estimate inland residents would be willing to pay $19, $9, $1, and $0 per year to avoid wind turbines at 0.9, 3.6, 6, and 9 miles from shore, respectively. Higher values were estimated for coastal residents.

Finally, Englin and Mendelsohn (1990) examine the influence of specific trip attributes such as views, clear cuts, views of rock and ice, and forest type on recreational values for hikers in Washington. They find that certain attributes such as forest type and the presence of a campground can change the value of a trip by -$10.25 to $12.18 ($2011). Of particular relevance to visual impacts, hikers on average would pay $1.00 to avoid a clear cut and $10.75 to encounter an "excellent view" ($2011).

Taken together, these studies demonstrate that recreators are willing to pay to improve or protect scenic resources and that specific trip characteristics, including visual amenities and disamenities, affect trip values.

Impacts of Transmission Lines

Several studies have estimated the impacts of transmission lines in various contexts; in particular, willingness to pay to reduce or remove the visual impact of the lines. For example, a recent study in England estimates willingness to pay to change the design of transmission lines for visual and aesthetic purposes (Atkinson et al., 2004). The authors survey residents living within 0.3 to 3.1 miles of existing transmission lines and ask their willingness to pay a one-time cost to redesign the towers. They estimate values up to $12.51 ($2011) depending on the new tower design.

Similarly, Navrud et al. (2008) estimate willingness to pay to bury transmission lines to avoid landscape degradation in Norway. The authors survey households living close to an existing transmission line. They estimate household willingness to pay to bury the line to be approximately $130 per year ($2011). Thirty three percent of households cite "power lines affect the landscape" as a reason for their willingness to pay. The transmission line crosses a public park, suggesting that part of residents' motivation may be attributable to recreational uses. Two other European studies explore the economic valuation of transmission line visibility, but they are not available in English (Gurholt 1998, Michaud 1995 as cited in Navrud et al. 2006).

A number of hedonic property value studies have investigated the impact of transmission lines. These studies utilize data on property transactions and characteristics (e.g., lot size, structural features, etc.) to estimate the implicit value of property attributes, including nearby amenities and disamenities. While these values are estimated in a different context (i.e., housing versus recreational choices) they nonetheless provide evidence of the negative impacts associated with transmission lines. Note that the effect of nearby lines on property values may also incorporate buyer perceptions regarding potential health risks, as well as visual or other impacts. As described below, some studies have attempted to isolate visual impacts specifically.

A review of this literature suggests a range of impacts associated with transmission lines. For example, a review by Chalmers and Voorvaart (2009) indicates:

> "Sixteen ... studies form the core of the professional literature and are widely quoted and cross-referenced one to the other (footnote with citations omitted). The results of these studies can be generally summarized as follows:
>
> - Over time, there is a consistent pattern with about half of the studies finding negative property value effects and half finding none
> - When effects are found, they tend to be small; almost always less than 10% and usually in the range of 3 to 6 %"

These findings are similar to previous reviews of the literature:

- "[M]ost studies conclude that proximity to a [high voltage transmission line] per se does not necessarily lead to a drop in the value of surrounding properties…. Wherever negative impacts are at stake, they vary, by and large, between 1% and 6% of the value at a 200 ft. distance" (Des Rosiers 2002, preceding citations omitted).
- "[I]mpacts, where they exist, are generally less than 5 percent of the property value" (Hamilton and Schwann 1995).

Of the sixteen studies cited by Chalmers and Voorvaart (2009), four focus on visibility impacts of transmission lines. Of these, Callanan and Hargreaves (1995) and Kinnaird Jr. et al. (1997) cannot be located. Des Rosiers (2002) examines the impact of a visible transmission pylon on home values in Montreal, Quebec. The author finds effects ranging from zero to 23 percent, with an average of 9.6 percent.

Hamilton and Schwan (1995) examine a neighborhood in Vancouver, British Columbia. They find the value of properties adjacent to a transmission line would increase by 5.7 percent if the unsightliness of the line were removed. If both the unsightliness of the towers is removed and the property is moved 100 yards from the line, then property values would increase by 6.3 percent. Because distance from the line and visibility are correlated, it is difficult to determine the share of the benefit attributable to the visual impacts, but their results suggest that the visibility effects dominate.

The proposed S-R line replaces an existing line and consequently its impact may be different than studies of the impact of the presence versus absence of a transmission line.

Ignelzi and Priestley (1991), one of the core 16 studies earlier identified, examine the impact of a transmission line upgraded from a 60 foot, 115-kV line to a 160 foot, 230-kV line through residential neighborhoods in Southern California (original not available; cited as Pacific Consulting Services in Kroll and Priestley 1991 – henceforth cited as Kroll and Priestley 1991). They find that the upgrade decreases property values by five percent or less (Kroll and Priestley 1991).

Note that with the exception of Ignelzi and Priestly (1991), the majority of these studies consider the presence versus absence of a transmission line. However, data from the 2010 visitor survey indicate that the current line is fairly unobtrusive - 56 percent of river users did not notice the existing line and 81 percent of those who did notice reported that it did not detract from their experience (Blotkamp et al., 2011).

As discussed, we are unaware of any existing studies that specifically estimate the reduction in recreational trip value associated with a change in transmission line size and characteristics. However, numerous studies have established the connection between trip value and scenic quality. In addition, studies in other contexts have demonstrated the impact of transmission lines associated with their aesthetic effects. This weight of evidence, combined with our research and professional experience analyzing recreational behavior, provides a basis for estimating the average percentage reduction in trip value likely to be experienced as a result of the S-R Line. We estimate this loss in value to be five percent.[11]

The five percent decrement results in absolute dollar losses of between $1.30 and $2.70 per trip. These figures are within the range of estimates of the value of recreational site attributes reported in the literature. For example, Englin and Mendelsohn (1991) find that "the average wilderness user places a marginal value of $4.48…for a trail with a mile of old growth, $12.18 for a campground, and $10.75 for a view per trip" ($2011). They are also comparable to Englin and Mendelsohn's decrement to hikers of a clear cut of $1.00 ($2011). As such, we feel that they are a reasonable and conservative estimate of the per-trip decrement in value associated with the project.

RESULTS

Recreational Use Impacts

Exhibit 2-5 reports estimated recreational and cultural/historical use impacts for the affected visitor groups over the 60-year useful life of the proposed S-R Line. Across the four representative visitor areas, we estimate that an average of 1.6 million visitors to DEWA will be affected each year. Per-trip losses range from $1.30 for recreation site visitors to $2.70 for APPA visitors. We estimate that total human use impacts will be $2.8 million per year and approximately $80 million over the life of the project.

[11] As referenced earlier, 64 percent of river users anticipate the proposed S-R line will negatively impact their experience (Blotkamp et al., 2011), suggesting that some portion of visitors may not actually be impacted. Note that the literature summarized in this section provides *average* values for the impact of visual amenities and disamenities across samples of recreators and homeowners, some of whom also may not necessarily experience impacts. If restricted to the portion that expect to experience impacts, our estimate of the loss in trip value would be greater than five percent.

EXHIBIT 2-5. ESTIMATED HUMAN USE IMPACTS BY AREA/VISITOR GROUP

AFFECTED VISITOR GROUP	ANNUAL VISITORS	PER TRIP VALUE ($2011)	PER-TRIP DECREMENT ($2011)	ANNUAL IMPACTS ($2011)	TOTAL PV IMPACTS* ($2011)
Historic Site Visitors -Millbrook	230,000	$42	$2.10	$480,000	$13,500,000
River Area Visitors - Bushkill	810,000	$34	$1.70	$1,400,000	$38,900,000
Recreation Site Visitors -Watergate	200,000	$27	$1.30	$260,000	$7,800,000
Recreation Site Visitors - Van Campens	60,000	$26	$1.30	$77,000	$2,200,000
Appalachian Trail Visitors	80,000	$54	$2.70	$220,000	$6,300,000
Overlap Visitors**	240,000	$34	$1.70	$410,000	$11,500,000
Total	**1,620,000**	**$35*** **	**$1.70*** **	**$2,800,000**	**$80,200,000**

*Assuming a 60-year useful life.
**This group represents visitors who belong to more than one of the four visitor groups.
***Figures presented are averages - not totals.

Potential Impacts due to Construction Activity

Current descriptions of anticipated construction activities and timing imply limited interference with recreational opportunities in the parks. To the extent that actual activities/schedule deviate from these plans, additional losses in the form of diminished or displaced visitation may occur.

According to the FEIS and the applicants' comments on the DEIS, construction will last eight months and will seek to place the most interfering activities during winter to avoid peak visitor use periods. Construction activities will consist of two phases: deconstruction (removing the existing structure) and construction (installation of the proposed S-R Line). For the deconstruction phase, the FEIS maintains that closures of trails, roads, and the Delaware River would be of relatively short duration, though the exact duration is not always specified. For roads and trails, deconstruction-related closures would last "for a day or more during the removal of the line" (FEIS, 578). For the Delaware River, deconstruction "closures to river traffic are anticipated for one day" (FEIS, 578). For the construction phase, which consists of installing the proposed S-R Line, the FEIS similarly estimates short-term closures for roads, trails, and the Delaware River. Specifically, "individual road closures would not likely last more than three days," "trail closures would not last more than three days," and "closures to river traffic are anticipated for one day" (FEIS, 578). While the FEIS provides estimates of duration for closures, it is vague about where closures would take place. It identifies several "facilities" that construction-related access roads would cross, including the Appalachian Trail, Millbrook Road / NPS

602, and U.S. Route 209, but it does not specify if the affected facilities would be closed or when such closures would occur. Further, though information for closures of roads, trails, and the Delaware River suggest limited negative impacts to visitor use, the FEIS states that overall construction-related impacts to “infrastructure, access, and circulation ... would last an estimated eight months,” and that cumulative impacts “would be adverse” (FEIS, 580). This acknowledges that impacts to visitor use could expand beyond direct losses due to closures, as visitors may avoid taking recreational trips during the period of construction activities to avoid adverse noise and visual impacts.

Due to the lack of specific information regarding the timing, location, and duration of any closures (i.e., which months, at which locations, and for how long), it is difficult to estimate the potential decrease in visitor use due to construction activities. However, for reference, we estimate how construction closures could impact daily visitor use in two scenarios: (1) visitor use during winter months (December – February), which represents the minimum use period; and, (2) visitor use during summer months (June – August), which represents the peak use period. If all expected trips are forgone due to construction-related closures, Exhibit 2-6 represents the maximum number of potential lost trips per day. Note that these figures represent daily trip averages by season; a greater proportion of visitation is likely to occur on weekend days when construction activities may not take place. In addition, winter figures are adjusted based on overall park visitation; data are not available to adjust for seasonal change in distribution by activity.

EXHIBIT 2-6. THE POTENTIAL MAXIMUM NUMBER OF LOST TRIPS PER DAY IN THE EVENT OF CONSTRUCTION-RELATED CLOSURES

	MILLBROOK VILLAGE*	WATERGATE RECREATION SITE*	APPALACHIAN TRAIL**	BUSHKILL ACCESS*
Winter (December - February)	700	500	100	1,000
Summer (June - August)	1,200	1,200	400	2,200
* Based on monthly visitation data for DEWA for 2002-2011.				
** Based on monthly visitation data for the Appalachian Trail for 2011.				

ADDITIONAL IMPACTS NOT QUANTIFIED

The total economic value of natural resource services comprises both *use* and *nonuse* value. Use value refers to value derived from direct use and interaction with those resources, as in the case of the values described in the preceding sections. Nonuse value refers to the value individuals may hold for resources independent of any current or anticipated future use. These values may be motivated by an interest in protecting natural resources for future generations (“bequest value”) or simply to maintain resources in their natural state (“existence value”) (Freeman, 2003). Nonuse values have been estimated in a variety of contexts, are recognized in EPA's *Guidelines for Preparing Economic Analyses* (2010), and are compensable values recognized in NRDA regulations.

Owing to their natural and historic significance, individuals may hold nonuse value for the parks. To estimate nonuse losses associated with landscape changes brought about by the S-R Line, two pieces of information are required: 1) an appropriate estimate of nonuse value from existing literature; and 2) an estimate of the relevant population who may hold those values. In both cases there is significant uncertainty that precludes us from developing an accurate and reliable estimate. Below we briefly review available literature that provides evidence of nonuse values for natural and historic resources, as well as public comments on the project that suggest that a broad population may hold such values. While not quantified, it is likely that the S-R Line project will result in nonuse losses. Thus, our estimate of direct use losses should be viewed as a lower bound on total human use losses associated with the project.

Literature on Nonuse Values

Literature searches did not reveal any studies that quantify nonuse impacts from infrastructure development in U.S. parks. However, several examples of nonuse values for ecological, recreational, and historic resources exist. For example, Stevens et al. (1991) estimate the existence value of four wildlife species in New England. Silberman et al. (1992) examine nonuse values for beach improvements in New Jersey. They find that nonusers show a positive willingness to pay for beach nourishment efforts at the examined beaches. Chambers et al. (1998) estimate the value of preserving a historical academy in Ste. Genevieve, Missouri. The authors conducted a mail survey of Missouri residents, asking respondents about their willingness to pay to prevent the conversion of the historic site to a privately-owned bed and breakfast. The authors find that nonusers exhibit a positive willingness to pay for preservation of the historic site, indicating that use value is an underestimate of the total value of historic site preservation.

Public Comments

The geographic scope and content of public comments submitted in response to the DEIS provide evidence that the public holds nonuse values for the parks. Nearly 27,000 pieces of correspondence were submitted in response to the project, originating from 50 states and 29 countries. While approximately 26,000 correspondences consisted of form letters associated with the National Parks Conservation Association (NPCA) and the Sierra Club, 908 pieces of correspondence consisted of unique comments. These 908 unique comments came from members of the public in 25 states and three countries. This broad geographic distribution of public comments, which includes unique comments from citizens as far away as Arizona and Washington, provides evidence that a broad population may hold nonuse values for the parks.

The content of many comments demonstrates evidence of the public holding existence and bequest values for park resources. Evidence of existence values for park resources is provided in comments that focus on preserving the natural resources of the parks (e.g., wildlife habitat) and in comments from members of the public that do not visit the parks, but still hold value for the existence and preservation of the parks. An example comment for this latter category is Comment ID 255908, from a Rhode Island resident:

> "With the park being in Delaware and myself in Rhode Island, I will likely never visit this place. However, that is what makes this comment important, I care about this park even though I never intend on attending..."

In addition to existence values, content of the public comments also shows that the public maintains bequest value for the parks' natural resources. Examples of such comments include Comment ID 256071, which advocates protecting natural park resources "for future generations to enjoy," Comment ID 257355, which states that "we have to preserve what we have for the people that come after us," and Comment ID 258079, which declares that "national parks are irreplaceable treasures that should be protected for generations to come."

LIMITATIONS AND UNCERTAINTIES

It is important to note several limitations and uncertainties associated with the preceding analyses.

- **Impacts Not Quantified.** As noted, it is likely that some share of the public holds nonuse values for the parks that will be negatively impacted by the proposed project. Insufficient information exists to quantify such impacts. Consequently, our estimates of direct recreational use losses should be viewed as a lower bound on total human use losses.
- **Construction Impacts.** Current descriptions of anticipated construction activities and timing imply little to no interference with recreational and cultural/historical opportunities in the parks. To the extent that actual activities/schedule deviate from these plans, additional losses in the form of diminished or displaced trips may occur.
- **Hamilton Campsite Impacts.** The Hamilton Campsites will be removed and replacement campsites will be located elsewhere. The replacement sites may not be as preferable to users. We lack sufficient data to quantify this potential loss.
- **Timeframe of Analysis.** Our analysis assumes a 60-year useful life of the project and calculates losses over this time period. In addition, based on relatively stable historical visitation we assume that the number of visitors to the parks will remain constant in the future. If visitation increases/decreases in the future, total losses will also increase/decrease.

CHAPTER 3

ECOLOGICAL IMPACTS

This chapter presents the inputs, calculations and results of our analysis of ecological loss attributable to alternative 2. As previously indicated in the introduction to this report, we utilize the Habitat Equivalency Analysis (HEA) methodology to quantify this loss.

Quantitative information describing habitat impacts (e.g., type of habitat affected, type of impact, acreage, and “one-time” or “recurring” impact) is provided in the FEIS, and is the primary source of information for our “loss” analysis. Consistent with standard HEA practice, habitat loss is quantified in units of “discounted service acre-years” (DSAYs) by habitat type. One service acre-year represents the suite of ecological services provided by one acre of the specified habitat for one year; discounting is applied to appropriately account for the stream of impacts over time.

HEA-based monetization of the estimated ecological loss is conducted by estimating the cost of restoration projects of a type and size needed to generate ecological benefits equal to quantified losses. Throughout this chapter we include compensation for wetlands impacts for completeness, but note the potential for overlap with a ratio-based requirement for wetlands mitigation. For various reasons, ratio-based approaches often generate greater mitigation acreage requirements than HEA-based approaches. It is possible to remove the wetlands portion of our analysis if NPS proceeds with a ratio-based approach.

As described in the FEIS and Draft Statement of Findings (SOF), implementation of alternative 2 is expected to adversely impact natural resources directly and indirectly as a result of construction, vegetation clearing, and ongoing vegetation maintenance, relative to the “baseline” condition of such resources in the absence of the project. A HEA is appropriate to value habitat impacts because quantitative information is available in the Draft SOF. A similar analysis is not possible for direct impacts to wildlife because potential impacts to biota are not quantified in the Draft SOF. We treat biota impacts qualitatively in this analysis, but give them consideration in our evaluation of the mix and scale of compensatory projects.

Activities under alternative 2 are expected to cause both short-term and long-term habitat impacts. The FEIS identifies short-term losses due to construction of the upgraded transmission line consisting of vegetation clearing for the expanded ROW as well as other areas for construction activities. Long-term habitat losses result from ongoing vegetation maintenance in selected areas as well as permanent access roads. These losses will occur in three types of habitat: wetlands, uplands, and floodplains. A basic map of the composition of the expanded ROW is included for reference in Appendix C.

Two wetland habitat types exist in the study area: Palustrine Forested (PFO) and Palustrine Emergent/Scrub Shrub (PEM/PSS). The major difference between these two classifications of wetlands is that PFO wetlands contain vegetation greater than 20 feet in height (FEIS, 120). Upland habitat can be classified into either mature forest or scrub shrub, which differ in large part due to past vegetation maintenance. Floodplains are defined as flat, flood-prone areas adjoining inland or coastal waters with at least a one percent chance of flooding annually (FEIS, 108).

HABITAT IMPACTS: TYPE AND QUANTITY

The acreage totals identified in the Draft SOF serve as the primary inputs for the quantitative analysis of ecological injury. As noted throughout this document, our focus is on incremental impacts associated with alternative 2; all vegetation losses and habitat effects are quantified relative to the "No-Action" alternative, which is defined to mean continuation of current conditions.

Three types of habitat impacts are quantified in our analysis: 1) vegetation clearing; 2) edge effects; and 3) habitat fragmentation. Exhibit 3-1 summarizes our estimates of the types of "net" acreage of vegetative impacts due to vegetation clearing under alternative 2 compared to the No-Action Alternative. We derive the estimates presented in Exhibit 3-1 from information in the Draft SOF (see Appendix D for underlying data).

EXHIBIT 3-1. NET VEGETATED ACREAGE IMPACTS UNDER ALTERNATIVE 2 COMPARED TO THE NO-ACTION ALTERNATIVE

HABITAT TYPE		NET ACRES PERMANENTLY LOST[1]	NET ACRES CLEARED & RECOVERING[2]	NET ACRES MAINTAINED[3]
Wetlands				
	Palustrine Forested	0	0	0.04
	Palustrine Forested (EV*)	0	0	1.05
	Palustrine Emergent/ Scrub Shrub	0.11	0	0.55
	Palustrine Emergent/ Scrub Shrub (EV*)	0.56	0	8.94
	Total	0.67	0	10.58
	Total (EV* only)	0.56	0	9.99
Uplands				
	Mature Forest	2.6	91.6	38
	Scrub Shrub	4.04	0	0
	Total	6.64	91.6	38
Floodplains				
	Total	0	0	6.93

*EV: Exceptional Value
1. "Net acres permanently lost" refers to the areas with access roads or towers that will not support habitat during and after construction.
2. "Net acres cleared and recovering" refers to areas cleared for construction that have the potential for recovery.
3. "Net acres maintained" refers to areas cleared for construction and maintained as scrub shrub, limiting their potential recovery.

Source: FEIS 2012; Draft SOF 2012

As shown in Exhibit 3-1, an estimated 0.67 acres of wetlands and 6.6 acres of uplands will be permanently lost due to the incremental effects of alternative 2. An estimated 91.6 acres of upland habitat will be cleared and allowed to recover naturally over time. Finally, approximately 10.6 acres of wetlands, 38 acres of uplands, and 6.9 acres of floodplains will be adversely impacted by incremental, recurring maintenance activities.

In addition to vegetation losses, two types of community habitat losses occur: edge effects and habitat fragmentation. Roads, ROWs, and other linear structures can create "edge effects" which can alter species composition and biological interactions such as predation, competition, and parasitism (Willyard et al. 2004). Since the ROW expansion does not change the length of the edge, we quantify no further edge effects due to the ROW expansion. It is possible that the wider ROW will amplify existing edge effects. For example, migration of certain species may be hindered by the wider ROW, and predation may increase in the recently cleared area without a tree cover. However, current literature is too sparse to quantify the effects of this dynamic on the ecology of the ROW habitat. Therefore, due to the incremental focus of our analysis, we only quantify long-term edge effects due to permanent access roads.

We adopt the method from Harper et al. (2005) to estimate affected acres by multiplying the length of the permanent access road by the width of the estimated edge effect. As shown in Exhibit 3-2, we include edge effects for 3.6 miles of access roads, and based on compiled data presented in Harper et al. (2005) assume the presence of significant edge effects within 60 feet of access roads through forested landscape and 30 feet of access roads through scrub shrub habitat. This results in adverse effects to an estimated 31.3 acres of habitat.

EXHIBIT 3-2. NET EDGE EFFECTS UNDER ALTERNATIVE 2 COMPARED TO THE NO-ACTION ALTERNATIVE

EDGE EFFECTS	MILES OF ACCESS ROAD	TOTAL WIDTH OF EDGE INFLUENCE (FT)*	TOTAL ACRES AFFECTED
Outside ROW (Forest)[1]	0.7	120	10.2
Inside ROW (Scrub Shrub)	2.9	60	21.1
Total	3.6	-	31.3

*We adopt the distance and magnitude of edge influence parameters given by Harper et al. (2005)

1. Example Calculation: 0.7 (mi) * 120(ft.) * (1 (mi.)/5280 (ft.)) * (640 (acres)/1 (sq. mi.))= 10.2 (acres)

Source: FEIS 2012

Finally, technical literature suggests that habitat fragmentation can reduce the quality of the affected habitat. For instance, clearing vegetation to create a permanent access road through a forest separates habitat patches and may result in reduced species migration, increased competition and predation within patches, altered foraging and brooding behavior and success, increased brood parasitism, spreading of invasive species, reduced plant and animal species densities, altered soil and groundwater systems, and other effects (Faaborg et al. 1993; Willyard et al. 2004; Geneletti 2002).

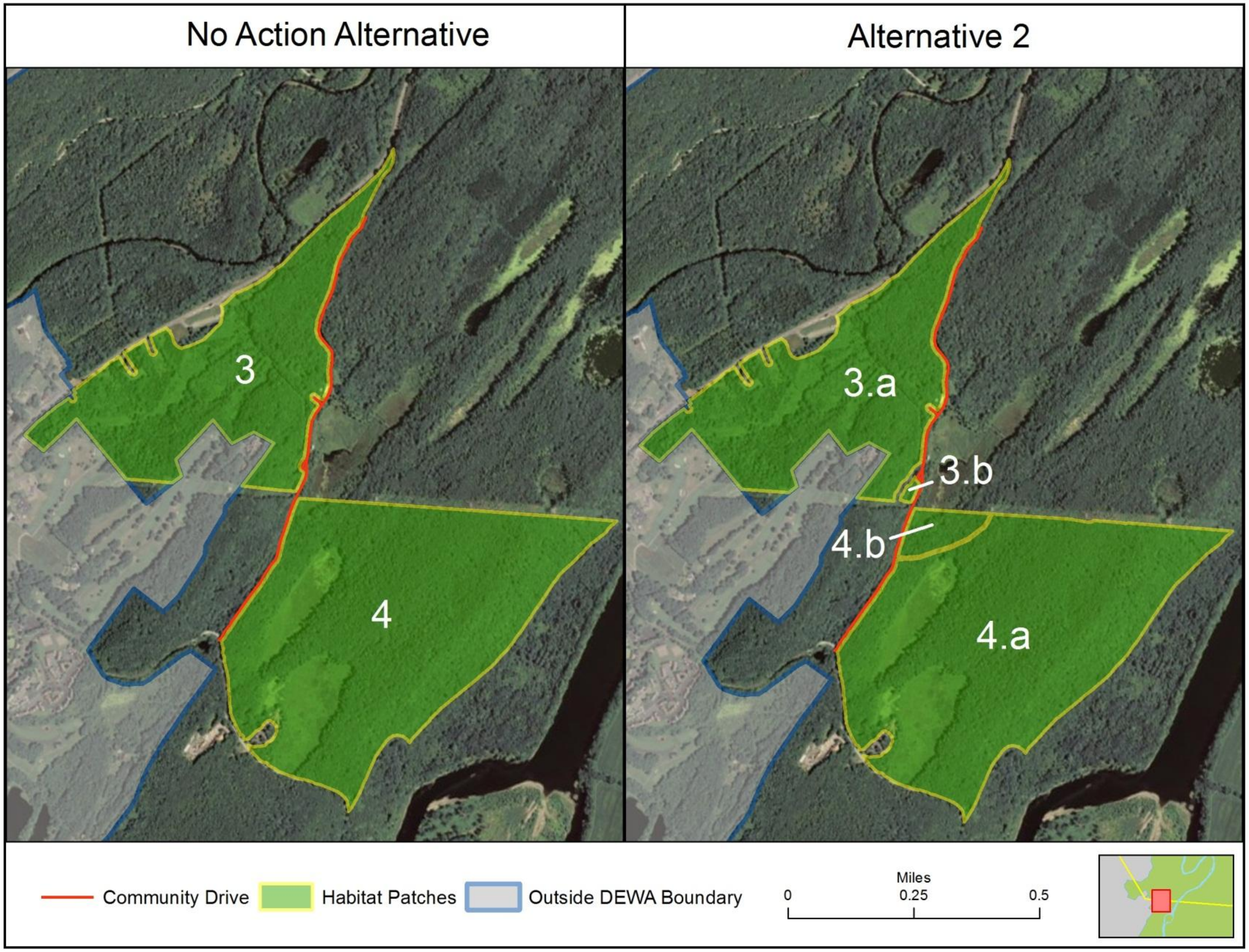
The magnitude of these phenomena, however, are difficult to quantify as they depend heavily on the affected ecosystem communities and require site-specific research and data to measure precisely. Because these types of data are not readily available, we apply conservative, generalized estimates of potential connectivity losses to the area of "new" habitat patches identified in the FEIS (shown in Exhibit 3-3, Exhibit 3-4, and Exhibit 3-5 below).

EXHIBIT 3-3. FRAGMENTED PATCHES OF HABITAT, ALTERNATIVE 2

LOCATION	ORIGINAL PATCH (ACRES)	NEW PATCHES A (ACRES)	NEW PATCHES B (ACRES)
1. Western boundary of DEWA west of ROW	26.3	18.6	2.5
2. Western boundary of DEWA east of ROW	13.6	9.3	0.2
3. East of 209, west of Community Drive, north of the ROW	88.3	84.3	0.3
4. East of Community Drive, south of the ROW	163.4	148.3	4.1
Source: FEIS 2012			

EXHIBIT 3-4. HABITAT FRAGMENTATION AT WESTERN BOUNDARY OF DEWA

EXHIBIT 3-5. HABITAT FRAGMENTATION NEAR INTERSECTION OF COMMUNITY DRIVE AND ROW



HEA INPUTS

In this section we identify input parameters used in HEA calculations, beginning with "general" inputs used for all impact types, followed by impact-specific inputs (i.e., vegetation loss, edge effects, and connectivity impacts).

GENERAL INPUTS

Project Start Date - We assume construction and associated impacts begin in 2013.[12]

Duration of Loss Calculation – We estimate losses over 60 years, which is equal to the expected 60 year useful life of the project (alternative 2).[13]

Annual Discount Rate - Consistent with standard HEA practice we apply an annual discount rate of three percent to estimated losses in each year. Losses are expressed as a present value in 2012, in DSAY units.

Our HEA quantification process employs the method of estimating the ecological service of different habitat types under specific circumstances. Ecological service of land is essentially a measure of value and habitat suitability to local animal and plant species. To quantify damages, we estimate the reduction in ecological service caused by vegetation clearing, edge effects, and fragmentation, which we refer to as "ecological service loss." In this manner we derive common figures incorporating various types of habitat injuries to aggregate the effects of alternative 2.

HEA calculations also require estimates of initial and terminal ecological service loss that occur as a result of initial and ongoing project activities, as well as the duration and change in loss between those points. Typically, service loss is expressed in percentage terms, with 100 percent service loss representing complete loss of the habitat (for example, if habitat were paved over) and zero percent service loss representing "baseline" condition in which the habitat would function if the project were not implemented. Service loss estimates between zero and 100 percent are used to capture gradations between complete and no impact.

Initial service loss reflects habitat condition immediately following initial project impact. Vegetation clearing and construction activities will result in significant injury to affected habitat. In addition to direct changes in habitat, the roughly eight-month period of construction is likely to cause soil compaction, species displacement, introduction of invasive species, and soil erosion. NPS requirements may mitigate some of the construction impacts through actions such as requiring low-impact vegetation clearing, project oversight by a professional forester, and experienced tree-clearing contractors.

Terminal service loss reflects the extent of recovery, if any, expected in affected habitat within the analysis period. Complete recovery would result in a terminal service loss of zero percent; partial recovery would result in a terminal service loss greater than zero

[12] The analysis can be adjusted to accommodate later start dates.

[13] Damages likely would extend beyond the 60 year project lifespan, as all maintained habitat will require additional recovery time for a return to full ecological service. However, because of uncertainties associated with estimating appropriate baseline conditions after the project period, and the limited effect of impacts several decades in the future due to the effects of discounting, we limit impact quantification to the 60 year project period.

percent, with the selected percentage reflecting the severity of lingering impact. In our HEA, terminal service loss often represents the estimate of the effect of ongoing vegetation maintenance performed by the applicants.

The choice of initial and terminal service loss and recovery trajectory depends on habitat and impact characteristics. Inputs used in the different components of our analysis are identified below.

INPUTS SPECIFIC TO VEGETATION LOSS

The following list outlines the different classifications of habitat included in the HEA and their associated estimated initial and terminal service losses. These figures are based on descriptions of vegetation clearing plans in the FEIS as well as the applicants' vegetation management plans. Note that the following assumptions apply to both upland and wetland habitats.

Permanently Lost Acreage (access roads and tower pads) – Initial service loss is 100 percent; terminal service loss is 100 percent.

"Cleared and Recovering" Forested Acreage **-** For pulling and splicing sites, initial service loss for cleared and recovering forested acreage is 100 percent, which reflects the severity of repeated, intense use of the sites. Outside of pulling and splicing areas, initial service loss for cleared and recovering forested acreage is 90 percent, which reflects an expectation of substantial habitat change due to extensive vegetation clearing for construction, but not the repeated use of the pulling and splicing sites. It is our understanding that these acreages will be left to recover naturally after construction is complete. However, due to the likely introduction of invasives after initial destruction of this habitat we assume that these acreages will not completely return to their original state. Based on discussions with NPS personnel and professional judgment we assume recovery to a 60 percent service level (i.e., terminal service loss of 40 percent). Pulling and splicing sites reach their terminal service loss over a period of 30 years and the remaining cleared forest over a period of 28 years, reflecting the difference in their initial service loss levels. This period reflects the substantial time likely required for mature forests to return to stable condition in the parks.

"Maintained" Forested Acreage – Initial service loss is 90 percent, similar to the "cleared and recovering" habitat. However, we estimate a terminal service loss of 80 percent, reflecting the low ecological service of maintained scrub shrub habitat relative to undisturbed mature forest. Inside the project proponent's easement, all trees under and adjacent to the ROW considered dangerous to the transmission line will be removed each year. For these acres we also assume a linear progression to full recovery in 50 years; however, due to ongoing maintenance this recovery is punctuated once the service loss level reaches 80 percent. In our calculations this terminal service loss level is achieved in 2019, or in six years, at which point it remains constant until the end of the project period.

"Maintained" Scrub Shrub Acreage – Initial service loss is 60 percent due to vegetation clearing and disturbances to animal species associated with construction activities. According to the applicants' vegetation management plans, yearly maintenance will result in the removal of "fast-growing vegetation" and will likely damage habitat and disturb local species. Based on this information, discussions with NPS personnel and professional judgment, we estimate a terminal service loss level of 40 percent. We use equivalent service level estimates for floodplains. For scrub shrub habitat we assume a linear recovery with duration of 50 years, but in our calculations recovery progresses until 2030 (for 17 years) at which point it reaches its terminal service loss level of 40 percent.

INPUTS SPECIFIC TO EDGE EFFECTS

Exhibit 3-2 presents acreage affected by permanent access roads. Following the construction period, this acreage remains constant over time as the roads will be maintained at a 15-foot width (FEIS, 38). Due to differences in ecology, the distance and magnitude of edge effects are likely to differ between forested and scrub shrub habitats.

Forested Landscape – As mentioned previously, Harper et al. (2005) present compiled data used to estimate the distance and magnitude of edge effects in Eastern North American forested landscapes. We adopt these parameters to quantify edge effects under alternative 2. The estimated distance of significant edge effects in forested landscape is approximately 60 feet. Based on the presented data and professional judgment, we apply an ecological service loss of 45 percent within this area. This effect is applied at a constant level throughout the project period.

Scrub Shrub Landscape – Harper et al. (2005) assert that the contrast in vegetation height is a significant determinant of edge effects. We therefore assume that edge effects within scrub shrub habitat are less extensive and span a shorter distance than in forested habitat. For simplicity purposes, we reduce the magnitude and distance of edge effects reported in forested landscape by a factor of two, resulting in an ecological service loss of 22.5 percent within a distance of 30 feet along permanent access roads. This effect is applied at a constant level throughout the project period.

Exhibit 3-6 summarizes these assumptions.

EXHIBIT 3-6. APPLIED DISTANCE AND MAGNITUDE OF EDGE EFFECTS

LANDSCAPE TYPE	DISTANCE OF EDGE EFFECTS	ESTIMATED SERVICE LOSS
Forest	60 feet	45%
Scrub Shrub	30 feet	22.5%

INPUTS SPECIFIC TO LANDSCAPE CONNECTIVITY

As previously discussed, habitat fragmentation due to the construction of access roads will result in adverse ecological impacts. To quantify these habitat fragmentation losses in terms of DSAYs, we assign an estimated ecological service loss to the entire acreage affected by each split. To avoid double-counting, areas used in these calculations do not include the road itself, or areas included in the edge effects analysis. Given the relatively small, new patches created by access roads, we assign modest service losses between zero and ten percent, depending on the size of the patches, as shown in Exhibit 3-7 below.

EXHIBIT 3-7. ESTIMATED SERVICE LOSSES OF FRAGMENTED PATCHES OF HABITAT UNDER ALTERNATIVE 2

LOCATION	ORIGINAL PATCH (ACRES)	NEW PATCHES A (ACRES)	NEW PATCHES B (ACRES)	SERVICE LOSS
1. Western boundary of DEWA west of ROW	26.3	18.6	2.5	10%
2. Western boundary of DEWA east of ROW	13.6	9.3	0.2	2.5%
3. East of 209, west of Community Drive, north of the ROW	88.3	84.3	0.3	0%
4. East of Community Drive, south of the ROW	163.4	148.3	4.1	2.5%
Source: FEIS 2012				

In Location 3 in Exhibit 3-7, services losses are assumed to be negligible due to the relatively small area (0.3 acres) disjoined from the larger fragmented patch (84.3 acres). Location 1 has a higher service loss (10 percent) due to the larger size of the isolated patch (2.5 acres) relative to the other patch (18.6 acres). Locations 2 and 4 fall in between the other two cases, although appear closer to the low end and so are assigned a 2.5 percent service loss.

HEA RESULTS

Using the HEA methodology, we estimate a total of 3,302 discounted service acre-years of ecological service loss as a result of construction and vegetation clearing across all habitat types and sources of service losses in the site assessment area for the period 2013 through 2073. These loss estimates provide the restoration "requirement" that needs to be offset by compensatory restoration projects, which is examined in Chapter 4.

Wetlands

For wetlands, we estimate a total of 159 DSAYs of impact, of which147 DSAYs occur in wetlands classified as Exceptional Value (25 DSAYs in PFO wetlands and 122 DSAYs in PEM/PSS wetlands). The majority of the total DSAYs (147) occur as a result of vegetation losses and an estimated 12 DSAYs occur as a result of edge effects.

Uplands

We estimate total uplands losses to be 3,053 DSAYs, of which 2,546 DSAYs are for vegetation loss in forested habitat, 70 DSAYs are for vegetation loss in scrub shrub habitat, 254 DSAYs are for edge effects, and 183 DSAYs are for landscape connectivity impacts.

Floodplains

We estimate a total of 90 DSAYs in damages to floodplain habitat in the study area. This total is attributed to expected vegetation losses in approximately seven acres of floodplain.

A comprehensive summary exhibit of quantified ecological damages is presented in Appendix E.

ADDITIONAL IMPACTS NOT QUANTIFIED

Additional ecological impacts are not captured in the HEA due to the lack of quantitative information. Such impacts include harm to special-status species, impacts from upgraded transmission infrastructure, as well as geologic, groundwater, and paleontological effects from drilling.

The FEIS indicates that many special-status species such as the bog turtle, timber rattlesnake, and Indiana bat likely will be affected by the transmission line upgrade and loss of habitat, especially during construction activities. However, due to variable population levels and migration patterns of these species within the construction area and ROW, it is difficult to quantify the magnitude of adverse effects.

The proposed S-R line under alternative 2 will be approximately twice as high as existing lines and will increase from six to twenty lines, potentially posing a greater barrier to foraging or migrating birds (FEIS, 443). Of particular concern is the proximity of the proposed line to a known bald eagle winter roost (FEIS, 175). To help minimize these impacts, PSE&G has developed an Avian Protection Plan in accordance with Avian Power Line Interaction Committee and United States Fish and Wildlife Service (2005). The change in type, number, and severity of impacts to birds due to alternative 2 cannot be quantified with existing information.

Noise produced by the construction, maintenance, and operation of the transmission lines may affect the physiology, behavior, and communication of proximal animal species. The FEIS also indicates that corona, insulator, and Aeolian noise from the transmission lines would sometimes be detectable by animals within the ROW and could affect their behavior (FEIS, 299).

Drilling activities will be needed for the construction of the new transmission line towers. These activities could damage geological resources, affect paleontological resources, and lead to groundwater contamination (FEIS, 362). These actions could have ecological implications, although such impacts are considered unlikely to occur and their potential extent cannot be quantified with existing information.

Although we are unable to incorporate qualitative impacts into our quantitative estimates of loss, it is important to recognize their existence and consider ways to incorporate them into mitigation compensation. This issue is discussed further in the following chapter.

CHAPTER 4

ECOLOGICAL COMPENSATION

HEA-based monetization of estimated ecological loss is conducted by estimating the cost of restoration projects of a type and size needed to generate ecological benefits equal to quantified losses. As described in the previous chapter, quantified losses total 3,053 upland DSAYs, 159 wetland DSAYs, and 90 floodplain DSAYs. This chapter presents the inputs, calculations and results of our analysis to estimate the type and cost of restoration projects appropriate to offset these losses attributable to alternative 2. Based on our analysis, we estimate a restoration project-based compensation cost of approximately $8.5 million, which includes $3.5 million in compensation for wetland injuries as well as a $5 million land acquisition project to compensate for uplands, floodplains, and other qualitative damages. Finally, the NPS includes funding for a small number of research and/or planning efforts that will help the NPS better understand and manage potential impacts for which limited information is currently available. The total estimated cost of these efforts is $250,000. The derivations of these figures are described in the following sections.

WETLANDS PROJECTS

Conceptually, a variety of types of wetlands projects could be undertaken to address wetland habitat impacts. For example, wetlands restoration projects often are undertaken by natural resource Trustees to offset impacts to wetlands. Such projects typically involve restoring wetlands-appropriate elevations in areas that were filled in previous decades and/or otherwise have accumulated sediments that prevent hydrologic interchange needed to maintain wetlands vegetation and characteristics. Management of invasive species is another type of project that can be undertaken, often involving regular application of pesticides targeting invasive species, and sometimes in conjunction with sediment removal or other site actions intended to make conditions less suitable for invasive species. Best management practices (BMPs), beyond those required by law, can be implemented in areas near wetland habitats to reduce the presence of nutrients and other substances in runoff transported to wetlands.

The NPS has not yet determined the specific types and locations of wetlands projects it would undertake (or require to be undertaken) to offset wetlands losses. Given this circumstance, we utilize wetland restoration as our project type for restoration calculations. We make this choice for multiple reasons: 1) this type of project is commonly undertaken to address natural resource impacts; 2) generalizable project cost and benefit information is readily available from other cases in the region; 3) resulting compensation estimates are likely to be "protective" – budgets needed to fund labor and equipment requirements associated with wetlands restoration would provide substantial funding for invasive species management, BMP implementation and/or similar projects if after further study and consideration the NPS determines that such projects need to be undertaken.

With respect to quantification of wetland restoration benefits, we assume a total gain of 16.7 DSAYs per acre of restored wetland. This estimate is consistent with a 50 percent wetland habitat service gain, effective immediately, continuing into perpetuity, and accounting for the standard annual discount rate of three percent used in HEA evaluations. This is a simplified, generic estimate, reflecting the fact that specific restoration projects have not been identified for this case. In practice, service gain trajectories are more complicated. For example, service gains can be higher than 50 percent, but do not arise immediately, often following a longer ramp-up period that is not linear. Ultimately, project-specific estimates of DSAY gains could be lower or higher than this generalized estimate, but in our experience 16.7 DSAYs per acre of wetland creation is a reasonable, fair approximation of project benefits and is comparable to figures used for similar types of projects in other natural resource damage cases in the Northeast Region (e.g., Athos and Chalk Point oil spills in the Delaware and Patuxent rivers, respectively).

Our calculations also require an estimate of per-acre wetlands restoration costs.

We estimate wetlands restoration cost of $362,825 per acre, based on NOAA's average cost of $342,134 per acre to restore wetlands in the Northeast U.S. plus land acquisition costs of $20,691 per acre from the New Jersey Department of Environmental Protection (NJDEP) Green Acres program. The derivations of these estimates are described below.

- NOAA provided a summary exhibit of the costs incurred to complete eight wetland restoration projects in Massachusetts, New York, and New Jersey. These projects involved the restoration of "filled" wetlands to their original, natural state. The costs include costs for project administration, planning and feasibility studies, design and permitting, construction, construction oversight and engineering, and monitoring.
- We do not include the costs for two projects in our calculation of per-acre averages because they involved more extensive, expensive processes and were not implemented as compensation for natural resource damages.
- We adjust the costs for the remaining six projects for inflation (to 2012 dollars) by applying the historical Construction Cost Indices from *Engineering-News Record*. On a per acre basis, the adjusted costs range from $152,358 to $506,648, with an overall average cost of $342,134.
- The restoration costs described above do not include costs for land acquisition. As a result, we estimate land acquisition costs using data provided by the NJDEP's Green Acres Program. Lands acquired under this program become part of New Jersey's statewide system of state parks, forests, natural areas, and wildlife management areas. The Green Acres program provided IEc with a dataset containing more than 6,500 land transaction records covering the period January 2000 through November 2011. We refine this data set by: 1) including only those transactions in the NJ Watershed Management Region located just southeast of

the parks (Raritan Region), 2) including only those transactions involving the acquisition of wetland or wetland-related areas, and 3) including only those transactions that have a non-zero value (i.e., we do not include transactions of donated lands).

- These steps reduced the number of individual records from approximately 6,500 to a consolidated data set of approximately 100 records. We then adjust each transaction value for inflation to fourth quarter 2011 dollars using the Federal Housing Finance Agency House Price Indices for the Edison-New Brunswick, New Jersey Metropolitan Statistical Area. Finally, we calculate an average per unit land acquisition cost of $20,691 per acre for the Raritan Watershed Management Region, by dividing the total adjusted cost of all transactions by the total area acquired.

Based on an estimated loss of 159 wetland DSAYs and a project benefit of 16.7 DSAYs per-acre, approximately 9.5 acres of wetlands restoration are required. At an estimated $362,825 cost per acre, this results in a wetland restoration funding requirement of approximately $3.5 million. A summary exhibit of damages to wetlands as well as required restoration and costs can be found in Appendix F. As noted previously, we include compensation for wetlands impacts in our analysis for completeness, but note the potential for overlap with a ratio-based requirement for wetlands mitigation. For various reasons, ratio-based approaches often generate greater mitigation acreage requirements than HEA-based approaches. It is possible to remove the wetlands portion of our analysis if NPS proceeds with a ratio-based approach.

OTHER HABITAT PROJECTS

As mentioned above, alternative 2 results in 3,053 DSAY losses in uplands habitat and 90 DSAY losses of floodplain habitat. Similar to wetlands, there are several types of projects that could be considered to offset these impacts. The NPS has not yet determined the specific types and locations of projects it would undertake (or require to be undertaken) to offset them. Given this circumstance, we utilize land acquisition as our project type for restoration calculations. We make this choice for multiple reasons: 1) land acquisition to prevent development and/or other habitat degradation can be an effective approach for offsetting habitat loss; 2) NPS staff have identified priority acquisition targets that can provide a basis for compensation calculations; and 3) some of the identified targets appear to reasonably match the habitat types and scale of restoration needed to address quantified losses.

The NPS Land Acquisition Ranking System (LARS) is a database containing properties neighboring NPS lands with natural resources that are either threatened or crucial to preserve. Land acquisition priorities for DEWA include several larger parcels focusing on resource protection also supported by several conservation groups dedicated to preserving natural resources. According to LARS, one or more high priority lands consist of forested landscapes and drain to watersheds that support wetlands and biodiverse ecosystems including rare plants.

Readily available, public information suggests that one or more of these high priority sites is reasonably likely to be subject to development in the near future (e.g., next 5 years). We employ publicly available information from planning documents to help estimate habitat service losses that would occur under development of one or more of these sites. Of the approximately 1,000 acres from priority sites evaluated, approximately 655 of the acres would remain open space, consistent with local zoning requirements. We assume a modest (five percent) service loss to “open space” acreage, arising from proximity to development and potential effects of fragmentation/loss of connectivity. Approximately 58 of the 1,000 acres would become roads. We assign complete (100 percent) service loss to “road” acreage. Finally, approximately 310 of the approximately 1,000 acres would be developed in some manner, primarily as residences and associated facilities. We assume a high degree of service loss (80 percent) to “developed” acreage, generally consistent with the substantial loss of ecological services in residentially developed areas. Overall these assumed service loss percentages are intended to capture a variety of impact mechanisms. We do not have sufficient data to specify portion of loss attributable to edge effects, fragmentation, or other specific mechanisms of harm.

These inputs result in a weighted average of service loss of approximately 67 percent. By preventing this type of future development, the set of acquisition projects is therefore assigned a 67 percent service gain.

HEA calculations for this restoration project also require an estimate of the timing of development. Given the current weak state of the economy and development, we assume development of the evaluated acreage would not begin until 2018 and take 15 years to be fully developed. Project “benefits” are estimated and accrued through 2073 and an annual discount rate of three percent is applied, consistent with HEA calculations throughout this document. Using these inputs, we estimate that an acquisition project of approximately 600 acres would generate approximately 3,650 DSAYs of benefit to upland and other habitats by preventing future habitat degradation arising from potential residential development. Although this estimate (3,650 DSAYs) slightly exceeds the estimated ecological loss the project is intended to address (3,053 upland DSAYs and 90 floodplain DSAYs), it is important to recognize that: 1) budgeting for a slightly higher acreage provides some buffer to reflect that available priority properties are unlikely to add up to the exact acreage required to meet estimated losses; 2) actual ecological loss is expected to exceed habitat losses quantified in our HEA analysis, due to the existence of impacts for which quantitative information is not available; and 3) it can be appropriate to build a margin of safety into compensation calculations to protect against the possibility that estimates of future impacts understate actual impacts and/or that actual ecological benefits realized from acquisition projects are less than forecast.

It is our understanding that the acquisition cost for 600 acres of priority properties would total approximately $5 million. Although we have focused this analysis on one or more high priority sites, similar costs and benefits likely would arise from other properties subject to similar development pressures.

OTHER ECOLOGICAL IMPACT COMPENSATION

In addition to the wetland and acquisition projects described above, it is appropriate to include funding for a small number of research and/or planning efforts to help the NPS better understand and manage potential impacts for which limited information is currently available. The NPS has allocated $250,000 for this purpose. Example projects include, but are not limited to:

- Research on Night Migrating Birds ($90,000) – This project would fund research intended to fill information gaps on the potential impacts of transmission lines and other infrastructure that may present obstacles to migration. Other projects related to migrating birds include installing cameras on tower structures near the bald eagle winter roost crossing and funding to local raptor rescue centers.
- Bog Turtle Research and Monitoring ($40,000) – This project would fund development and implementation of a long term research and monitoring plan for the bog turtle at DEWA, focused on surveying and monitoring population trends in the park.
- Hemlock Forest Restoration Plan ($70,000) – This project would fund development of restoration plans for declining Hemlock forests at DEWA.
- Van Campens Watershed Assessment ($50,000) - This project would fund the study, designation and management of the Van Campens watershed as a research area.

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GLOSSARY

Appalachian National Scenic Trail (APPA)
Delaware Water Gap National Recreation Area (DEWA)
Discounted Service Acre-Years (DSAYs)
Draft Environmental Impact Statement (DEIS)
Draft Statement of Findings (Draft SOF)
Environmental Protection Agency (EPA)
Exceptional Value Wetlands (EV)
Final Environmental Impact Statement (FEIS)
Habitat Equivalency Analysis (HEA)
High Voltage Transmission Line (HVTL)
Land Acquisition Ranking System (LARS)
Middle Delaware National Scenic River (MDSR)
National Park Service (NPS)
Natural Resource Damage Assessment (NRDA)
New Jersey Department of Environmental Protection (NJDEP)
NPS Public Use Statistics Program (PUSP)
Palustrine Emergent/Scrub Shrub Wetlands (PEM/PSS)
Palustrine Forested Wetlands (PFO)
PPL Electric Utilities Corporation (PPL)
Public Service Electric and Gas Company (PSE&G)
Right-Of-Way (ROW)
Susquehanna to Roseland 500-kV Transmission Line (S-R Line)
U.S. Forest Service (USFS)
Visitor Services Project (VSP)

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APPENDIX A

SELECTED SOURCES FROM THE RECREATIONAL USE VALUE LITERATURE

APPENDIX A-1. SELECTED SOURCES FROM THE RECREATIONAL USE VALUE LITERATURE

REC. ACTIVITY	AUTHOR(S)	DATE	TITLE	GEOGRAPHIC COVERAGE	DESCRIPTION	VALUE ESTIMATE
Motorboating	Bergstrom, J.C. and H.K. Cordell.	1991	An analysis of the demand for and value of outdoor recreation in the United States.	USA	Authors use a nationwide dataset on recreational activity and a travel cost model to estimate recreational use values for several activities, including "Motorized Boating."	$32.31
	Bhat, G., J. Bergstrom, R.J. Teasley, J.M. Bowker and H.K. Cordell.	1998	An ecoregional approach to the economic valuation of land- and water-based recreation in the United States.	WI, IL, IN, OH, MI, KY, TN, WV, PA	Authors use regional datasets for recreational activity and a travel cost method to estimate recreational use values estimate recreational use values for 10 "ecoregions" in the U.S. for different recreational activities, including "Motor Boating."	$15.79
					Average:	**$24.05**
Floating, Rafting, and/or Canoeing	Bergstrom, J.C. and H.K. Cordell.	1991	An analysis of the demand for and value of outdoor recreation in the United States.	USA	Authors use a nationwide dataset on recreational activity and a travel cost model to estimate recreational use values for several activities, including (1) "Canoeing/Kayaking" and (2) "Rafting/Tubing."	$25.09
						$47.80
					Average:	**$36.44**

APPENDIX A-1. SELECTED SOURCES FROM THE RECREATIONAL USE VALUE LITERATURE

REC. ACTIVITY	AUTHOR(S)	DATE	TITLE	GEOGRAPHIC COVERAGE	DESCRIPTION	VALUE ESTIMATE
Freshwater Fishing	Bergstrom, J.C. and H.K. Cordell.	1991	An analysis of the demand for and value of outdoor recreation in the United States.	USA	Authors use a nationwide dataset on recreational activity and a travel cost model to estimate recreational use values for several activities, including (1) "Coldwater Fishing" and (2) "Warmwater Fishing."	$35.28 $24.81
	Bhat, G., J. Bergstrom, R.J. Teasley, J.M. Bowker and H.K. Cordell.	1998	An ecoregional approach to the economic valuation of land- and water-based recreation in the United States.	MD, WV, VA, NC, SC, TN, GA, AL	Authors utilize an ecoregional approach to the travel cost model to estimate the economic value of outdoor recreational activities, including "cold-water fishing," in different ecoregions of the U.S.	$41.20
	Bowker, J.M., J.C. Bergstrom and J. Gill.	2004	The Waterway at New River State Park.	VA	Based on data from a recreational use study for the New River State Park in VA, the authors use the travel cost method to produce two estimates of consumer surplus for freshwater fishing. The two estimates are based on two versions of the travel cost model that differ in the underlying assumptions for the travel cost variable.	$14.34 $30.85

APPENDIX A-1. SELECTED SOURCES FROM THE RECREATIONAL USE VALUE LITERATURE

REC. ACTIVITY	AUTHOR(S)	DATE	TITLE	GEOGRAPHIC COVERAGE	DESCRIPTION	VALUE ESTIMATE
Freshwater Fishing	Englin, J., D. Lambert and W.D. Shaw.	1997	A structural equations approach to modeling consumptive recreation demand.	NY, NH, VT, ME	This study examines the economic value of recreational angling trips using a two equation model that accounts for catch rates and trip demand. The model is applied to angling trips to lakes in the northeast U.S.	$31.64
	Englin, J. and J.S. Shonkwiler.	1995	Modeling recreation demand in the presence of unobservable travel costs: Toward a travel price model.	NY, VT	The authors utilize data based on a survey of water-based recreation in the northeastern U.S. and the travel cost method to produce consumer surplus estimates for freshwater fishing. The three estimates are based on different applications of the travel cost model that differed in the specifications of the price variable.	$27.23
						$39.31
						$20.32
	McCollum, D.W., G.L. Peterson, J.R. Arnold, D.C. Markstrom and D.M. Hellerstein.	1990	The net economic value of recreation on the National Forests: Twelve types of primary activity trips across nine Forest Service Regions.	IN, MI, NH, OH, WI, WV	Authors use regional datasets for recreational activity and a travel cost method to estimate recreational use values in different regions of the U.S. for several activities, including (1) "Warm Water Fishing" and (2) "Cold Water Fishing."	$21.59
						$17.14

APPENDIX A-1. SELECTED SOURCES FROM THE RECREATIONAL USE VALUE LITERATURE

REC. ACTIVITY	AUTHOR(S)	DATE	TITLE	GEOGRAPHIC COVERAGE	DESCRIPTION	VALUE ESTIMATE
Freshwater Fishing	Miller, J.R. and M.J. Hay.	1984	Estimating substate values of fishing and hunting.	ME, TN	The authors utilize data from the 1980 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation and the travel cost method to estimate consumer surplus values for freshwater fishing. The two estimates are based on data sets for (1) ME and (2) TN.	$43.67 $35.49
	Shafer, E.L., R. Carline, R.W. Guldin and H.K. Cordell.	1993	Economic amenity values of wildlife: Six case studies in Pennsylvania.	PA	Authors use the travel cost method to evaluate the economic value of catch-and-release trout fishing on a creek in PA.	$30.61
					Average:	**$29.53**
Visiting Historic Sites	Bergstrom, J.C. and H.K. Cordell.	1991	An analysis of the demand for and value of outdoor recreation in the United States.	USA	Authors use a nationwide dataset on recreational activity and a travel cost model to estimate recreational use values for several activities, including "Visiting Historic Sites."	$41.72
					Average:	**$41.72**

APPENDIX A-1. SELECTED SOURCES FROM THE RECREATIONAL USE VALUE LITERATURE

REC. ACTIVITY	AUTHOR(S)	DATE	TITLE	GEOGRAPHIC COVERAGE	DESCRIPTION	VALUE ESTIMATE
Sightseeing And Wildlife Viewing	Bayless, D.S., J.C. Bergstrom, M.L. Messonnier and H.K. Cordell.	1994	Assessing the demand for designated wildlife viewing sites.	USA	Authors use data from the National Survey on Recreation and the Environment (NSRE) in conjunction with a variation of the travel cost method, a trip response model, to analyze willingness to pay to visit wildlife viewing sites.	$22.77
	Bergstrom, J.C. and H.K. Cordell.	1991	An analysis of the demand for and value of outdoor recreation in the United States.	USA	Authors use a nationwide dataset on recreational activity and a travel cost model to estimate recreational use values for several activities, including (1) "Sightseeing" and (2) "Wildlife Observation."	$28.18 $25.50
	Bhat, G., J. Bergstrom, R.J. Teasley, J.M. Bowker and H.K. Cordell.	1998	An ecoregional approach to the economic valuation of land- and water-based recreation in the United States.	WI, IL, IN, OH, MI, KY, TN, WV, PA	Authors use regional datasets for recreational activity and a travel cost method to estimate recreational use values estimate recreational use values for 10 "ecoregions" in the U.S. for different recreational activities, including "Sightseeing."	$22.28

APPENDIX A-1. SELECTED SOURCES FROM THE RECREATIONAL USE VALUE LITERATURE

REC. ACTIVITY	AUTHOR(S)	DATE	TITLE	GEOGRAPHIC COVERAGE	DESCRIPTION	VALUE ESTIMATE
Sightseeing And Wildlife Viewing	Mathews, L.G., S. Stewart and S. Kask.	2003	Blue Ridge Parkway Scenic Experience Project.	NC	Authors conduct a visitor survey for recreational visitors to Blue Ridge Parkway in NC. The authors then apply the travel cost method to the survey data to estimate consumer surplus values for "Sightseeing."	$20.69
	McCollum, D.W., G.L. Peterson, J.R. Arnold, D.C. Markstrom and D.M. Hellerstein.	1990	The net economic value of recreation on the National Forests: Twelve types of primary activity trips across nine Forest Service Regions.	IN, MI, NH, OH, WI, WV	Authors use regional datasets for recreational activity and a travel cost method to estimate recreational use values in different regions of the U.S. for several activities, including "Sightseeing."	$41.43
	Zawacki, W.T., A. Marsinko and J.M. Bowker.	2000	A travel cost analysis of nonconsumptive wildlife-associated recreation in the United States.	USA	Authors use data from the 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation and the travel cost method to estimate recreational use values for wildlife viewing. The values reported here represent consumer surplus estimates from the authors' truncated model, assuming 1/4 wage rate, for (1) hunters and (2) nonhunters that participatie in wildlife viewing.	$18.87 $22.86
					Average:	**$28.15**

APPENDIX A-1. SELECTED SOURCES FROM THE RECREATIONAL USE VALUE LITERATURE

REC. ACTIVITY	AUTHOR(S)	DATE	TITLE	GEOGRAPHIC COVERAGE	DESCRIPTION	VALUE ESTIMATE
Picnicking	Bergstrom, J.C. and H.K. Cordell.	1991	An analysis of the demand for and value of outdoor recreation in the United States.	USA	Authors use a nationwide dataset on recreational activity and a travel cost model to estimate recreational use values for several activities, including "Picnicking."	$23.46
	McCollum, D.W., G.L. Peterson, J.R. Arnold, D.C. Markstrom and D.M. Hellerstein.	1990	The net economic value of recreation on the National Forests: Twelve types of primary activity trips across nine Forest Service Regions.	IN, MI, NH, OH, WI, WV	Authors use regional datasets for recreational activity and a travel cost method to estimate recreational use values in different regions of the U.S. for several activities, including "Picnicking."	$11.21
					Average:	**$17.33**
Hiking & Backpacking	Bergstrom, J.C. and H.K. Cordell.	1991	An analysis of the demand for and value of outdoor recreation in the United States.	USA	Authors use a nationwide dataset on recreational activity and a travel cost model to estimate recreational use values for several activities, including (1) "Day Hiking" and (2) "Backpacking."	$24.37
						$51.24

APPENDIX A-1. SELECTED SOURCES FROM THE RECREATIONAL USE VALUE LITERATURE

REC. ACTIVITY	AUTHOR(S)	DATE	TITLE	GEOGRAPHIC COVERAGE	DESCRIPTION	VALUE ESTIMATE
Hiking & Backpacking	McCollum, D.W., G.L. Peterson, J.R. Arnold, D.C. Markstrom and D.M. Hellerstein.	1990	The net economic value of recreation on the National Forests: Twelve types of primary activity trips across nine Forest Service Regions.	IN, MI, NH, OH, WI, WV	Authors use regional datasets for recreational activity and a travel cost method to estimate recreational use values in different regions of the U.S. for several activities, including "Day Hiking."	$62.39
	Siderelis, C., R. Moore and J. Lee.	2000	Incorporating users' perceptions of site quality in a recreation travel cost model.	NC	Authors conducted statewide telephone survey to develop data for recreational activity, and then used the travel cost method to estimate a per-activity-day consumer surplus value for hiking trips on North Carolina trails.	$77.85
					Average:	**$53.96**

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Bayless, D.S., J.C. Bergstrom, M.L. Messonnier and H.K. Cordell. 1994. Assessing the demand for designated wildlife viewing sites. *Journal of Hospitality & Leisure Marketing*, 2(3):75-93.

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Englin, J. and J.S. Shonkwiler. 1995. Modeling recreation demand in the presence of unobservable travel costs: Toward a travel price model. *Journal of Environmental Economics and Management*, 29(3): 368-377.

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Miller, J.R. and M.J. Hay. 1984. Estimating substate values of fishing and hunting. *Transactions of the North American Wildlife and Natural Resources Conference,* 49: 345-355.

Shafer, E.L., R. Carline, R.W. Guldin and H.K. Cordell. 1993. Economic amenity values of wildlife: Six case studies in Pennsylvania. *Environmental Management,* 17(5):669-682.

Siderelis, C., R. Moore and J. Lee. 2000. Incorporating users' perceptions of site quality in a recreation travel cost model. *Journal of Leisure Research,* 32(4): 406-14.

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APPENDIX B

OVERVIEW OF HABITAT EQUIVALENCY ANALYSIS

OVERVIEW OF HABITAT EQUIVALENCY ANALYSIS

A commonly used methodology to determine appropriate compensation for the interim loss of natural resource services is habitat equivalency analysis (HEA). The basic premise of HEA is that the public can be compensated for past and expected future losses in ecological services through the provision of additional ecological services in the future. Compensable losses are "interim" losses – the loss in ecological services incurred from the time the resource is injured until the services provided by the injured resource return to their baseline level. Baseline is defined as the level of services that would have been provided in the absence of the contamination or event under evaluation. Recovery to baseline for each resource service may be achieved through remediation, restoration activities, and/or natural recovery. Compensatory restoration actions for these interim lost services are in addition to those actions (if any) required to restore injured resources to baseline conditions (i.e., primary restoration), and need to provide a level of services equivalent to what was lost in order to make the public whole.

HEA has been proven an acceptable and valid tool in both national and international arenas. Specifically:

- HEA has been accepted as a valid approach to natural resource damage assessment by several courts. For example, in the case of United States versus Great Lakes Dredge and Dock Company, HEA was used to scale damages to sea bottom habitat in the Florida Keys National Marine Sanctuary to restoration projects proposed as compensation. The United States Court of Appeals, 11^{th} Circuit, upheld the decision that reliance on HEA for scaling ecological losses to restoration was appropriate (259 F.3d 1300 No. 00-12002 (11^{th} Cir. 2001)). Similarly, the U.S. District Court (Eastern District of California) ruled that the U.S.'s claim for lost habitat and environmental services based on HEA are legally permissible and separately compensable from other requested damages (which include reforestation costs and timber damages, CIV S-06-1740 FCD/KJM).
- HEA has been used to estimate the appropriate scale of compensatory restoration in various damage assessment restoration plans published for public review and comment. For example, pipeline oil spills at both the Patuxent River, Chalk Point, Maryland, and Lake Barre, Louisiana injured natural resources in marsh habitats (e.g., benthic communities, fish, shellfish, birds, and mammals), and caused a loss of ecological services. In both cases, HEA was used to determine the amount of marsh restoration required to compensate for losses resulting from the spill, taking into account project-specific factors in scaling (e.g., time between injury and restoration to baseline conditions, relative quality of restored habitat, and project lifespan) (NOAA et al. 2002, LOSCO 1999, Penn and Tomasi 2002).
- Numerous papers have been published on the application of HEA and similar equivalency based approaches. For example, Strange et al. (2002) describe the application of HEA to scale salt marsh damages and restoration based on ecological service metrics. Milton and Dodge (2001) report the use of HEA to scale coral reef damages to restoration and/or replacement of ecological services. French McCay et al. (2004) estimate potential impacts and natural resource damages of oil, using HEA to scale habitat restoration. In addition, Dunford et al. (2003) build on the original equivalency work published by Unsworth and Bishop (1994), and describe HEA as an acceptable and appropriate scaling methodology in damage assessment that can be successfully applied in a wide range of situations.

- The European Union has recognized HEA as an essential and appropriate method by which to value natural resource damages and scale restoration. A report commissioned by the European Commission studying the valuation of restoration of damages to natural resources for the purpose of environmental liability states that the service-to-service approach is not only acceptable, but preferred (MacAlister Elliott and Partners Ltd. 2001). In addition, the common position of the European Parliament and the Council of the European Union, adopted in September, 2003, states that, "[w]hen determining the scale of complementary and compensatory remedial measures, the use of resource-to-resource or service-to-service equivalence approaches shall be considered first" (EC 2003).

Although HEA has numerous advantages, there are limitations associated with its use. As with any analytic method, the utility of HEA results will depend directly on the reliability of its inputs. Any uncertainties inherent in the underlying data (e.g., the determination of service losses, geographic or temporal scope, or other inputs) are carried through the analysis. Unless specifically constructed otherwise, HEA assumes that the lost and restored resources are the same type and quality. In situations where the proposed restoration may be for a type of resource or ecosystem other than the one(s) injured, additional evaluation and analysis may be needed to equate losses with restoration. Finally, HEA provides estimates of the cost of restoration, replacement, or acquisition of equivalent services (i.e., damages), not the value of the services.

Although not exhaustive, following is a list of documents that describe the methodology and application of HEA in a variety of contexts, including peer-reviewed literature, policy and gray literature, the United States court system, international forums, and specific damage assessment cases.

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Milton, J. Walter and Richard E. Dodge. 2001. Applying Habitat Equivalency Analysis for Coral Reef Damage Assessment and Restoration. *Bulletin of Marine Science*. 69(2):975-988.

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Penn, Tony and Theodore Tomasi. 2002. Environmental Assessment Calculating Resource Restoration for an Oil Discharge in Lake Barre, Louisiana, USA. *Environmental Management*. 29(5):691-702.

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Strange, Elizabeth, Hector Galbraith, Sarah Bickel, Dave Mills, Douglas Beltman, and Joshua Lipton. 2002. Determining Ecological Equivalence in Service-to-Service Scaling of Salt Marsh Restoration. *Environmental Management*. 29:290-300.

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Chapman, David, Nicholas Iadanza, and Tony Penn. *Calculating Resource Compensation: An Application of the Service-to-Service Approach to the Blackbird Mine Hazardous Waste Site*. National Oceanic and Atmospheric Administration, Damage Assessment and Restoration Program. October 1998.

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US v Great Lakes Dredge & Dock Co., 259 F.3d 1300 (11th Cir., 2001)

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U.S. v. Union Pacific Railroad Company. CIV S-06-1740 FCD/KJM (E.D. Cal, 2008).

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Commencement Bay. Hylebos Waterway, Commencement Bay, Washington.

Hylebos Waterway Natural Resource Damage Settlement Proposal Report. Prepared by the National Oceanic and Atmospheric Administration, the U.S. Department of the Interior, the Washington State Department of Ecology, the Puyallup Tribe of Indians, and the Muckleshoot Indian Tribe. March 14. Review Draft. Main Text + Appendices A-J. http://www.darp.noaa.gov/northwest/cbay/hyle-settlement.html

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http://www.darp.noaa.gov/library/pdf/westdarpfnl.pdf

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Service. 1999. Restoration Plan and Environmental Assessment for the January 19, 1996 Northe Cape Oil Spill. Revised Draft for Public Comment. March 31. http://www.state.ri.us/dem/pubs/damage/rptchooz.htm

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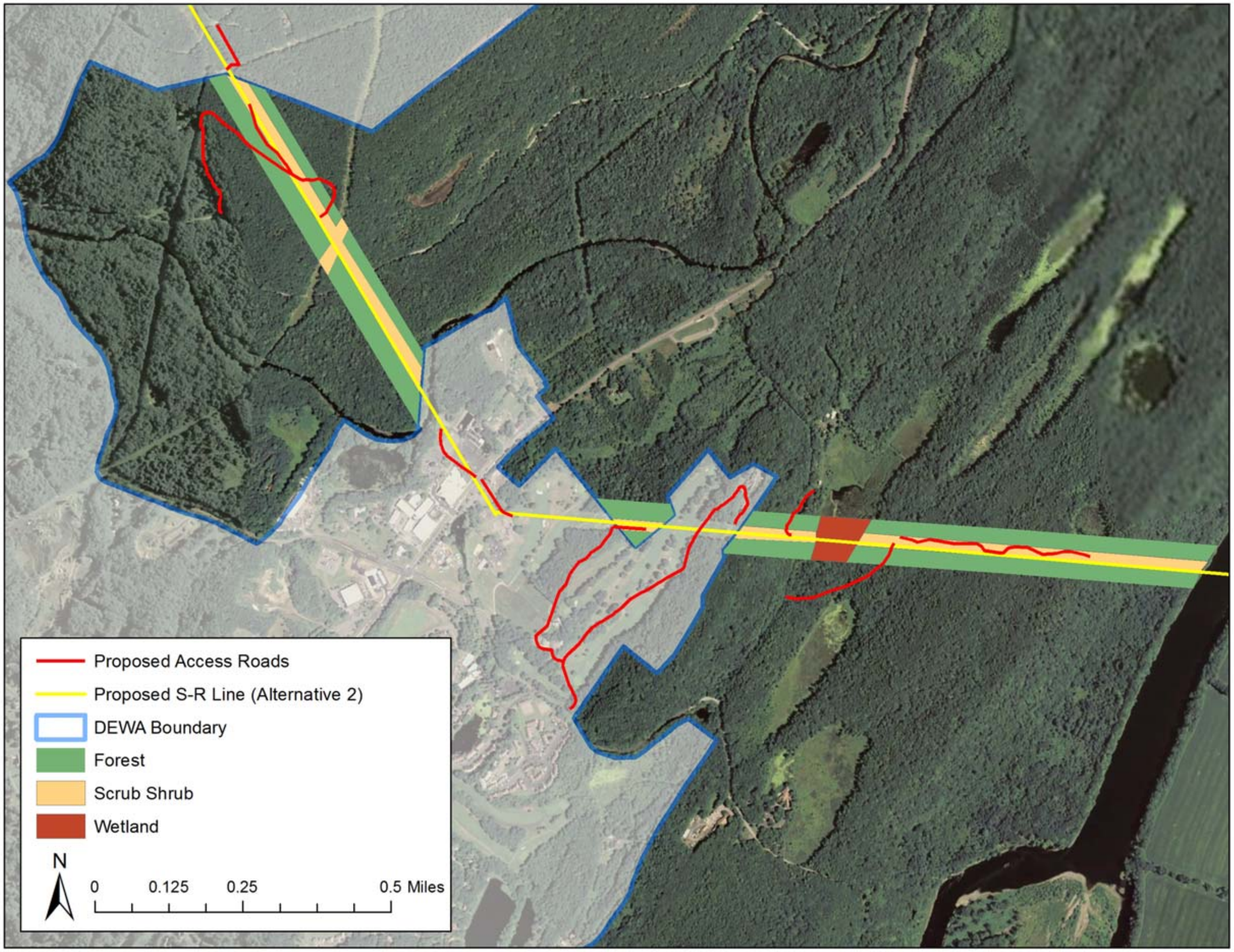
APPENDIX C

MAPS OF AFFECTED ACREAGE IN EXPANDED ROW UNDER ALTERNATIVE 2



Source: Project GIS data

Source: Project GIS data

APPENDIX D

CALCULATION OF NET VEGETATED ACREAGE IMPACTS

EXHIBIT D-1. NET VEGETATION LOSS IN ORDINARY VALUE WETLANDS UNDER ALTERNATIVE 2 COMPARED TO THE NO-ACTION ALTERNATIVE

Case	Wetland Type	Permanent Impacts	Cleared and Maintained Impacts			Total Permanent	Total Cleared and Maintained
		Access Road Impacts	Vegetation Removal	Crane Pad Impacts	Wetland Buffer Impacts		
No-Action	Palustrine Forested (PFO)	0	0	0	0	0	0
	Palustrine Emergent / Scrub Shrub (PEM/PSS)	0	2.05	0	0	0	2.05
Alternative 2	Palustrine Forested (PFO)	0	0.04	0	0	0	0.04
	Palustrine Emergent / Scrub Shrub (PEM/PSS)	0.11	2.37	0.12	0.11	0.11	2.6
Alternative 2 (Net)	**Palustrine Forested (PFO)**	**0**	**0.04**	**0**	**0**	**0**	**0.04**
	Palustrine Emergent / Scrub Shrub (PEM/PSS)	**0.11**	**0.32**	**0.12**	**0.11**	**0.11**	**0.55**
Note: No "cleared and recovering" impacts to wetlands.							

*Source: Draft SOF 2012

EXHIBIT D-2. NET VEGETATION LOSS IN EXCEPTIONAL VALUE WETLANDS UNDER ALTERNATIVE 2 COMPARED TO THE NO-ACTION ALTERNATIVE

Case	Wetland Type	Permanent Impacts	Cleared and Maintained Impacts			Total Cleared and Maintained	Total Permanent
		Access Road Impacts	Vegetation Removal	Crane Pad Impacts	Wetland Buffer Impacts		
No-Action	Palustrine Forested (PFO)	0	0	0	0	0	0
	Palustrine Emergent / Scrub Shrub (PEM/PSS)	0	5.46	0	0	5.46	0
Alternative 2	Palustrine Forested (PFO)	0	1.05	0	0	1.05	0
	Palustrine Emergent / Scrub Shrub (PEM/PSS)	0.56	14.17	0.23	0	14.4	0.56
Alternative 2 (Net)	**Palustrine Forested (PFO)**	**0**	**1.05**	**0**	**0**	**1.05**	**0**
	Palustrine Emergent / Scrub Shrub (PEM/PSS)	**0.56**	**8.71**	**0.23**	**0**	**8.94**	**0.56**
Note: No “cleared and recovering” impacts to wetlands.							

*Source: Draft SOF 2012

EXHIBIT D-3. NET VEGETATION LOSS IN UPLANDS UNDER ALTERNATIVE 2 COMPARED TO THE NO-ACTION ALTERNATIVE: PERMANENTLY LOST ACREAGE

Type	No-Action	Alternative 2	Alternative 2 (Net)
1. Permanent access roads and tower pads, scrub shrub (inside ROW)	0	3.94	3.94
2. Permanent access roads, scrub shrub (outside ROW)	0	0.1	0.1
3. Total permanent losses, scrub shrub [(1) + (2)]	**0**	**4.04**	**4.04**
4. Permanent access roads, forest (inside ROW)	0	1.4	1.4
5. Permanent access roads, forest (outside ROW)	0	1.2	1.2
6. Total permanent losses, forest [(4) + (5)]	**0**	**2.6**	**2.6**
7. Total permanent losses [(3) + (6)]	**0**	**6.64**	**6.64**

*Source: Draft SOF 2012

EXHIBIT D-4. NET VEGETATION LOSS IN UPLANDS UNDER ALTERNATIVE 2 COMPARED TO THE NO-ACTION ALTERNATIVE: CLEARED AND RECOVERING ACREAGE

Type	No-Action	Alternative 2	Alternative 2 (Net)
1. Mature forest cleared in expanded ROW, total	0	109	109
2. Permanent access roads, forest (inside ROW)	0	1.4	1.4
3. Forest inside ROW converted to scrub shrub (NPS lands only)	0	38	38
4. Total forest cleared inside ROW, not recovering [(2) + (3)]	0	39.4	39.4
5. Forested acres cleared and recovering inside ROW [(1) – (4)]	0	69.6	69.6
6. Impacts from construction outside ROW, recovering	0	22	22
7. Total forested acres cleared and recovering [(5) + (6)]	**0**	**91.6**	**91.6**

*Source: Draft SOF 2012

EXHIBIT D-5. NET VEGETATION LOSS IN UPLANDS UNDER ALTERNATIVE 2 COMPARED TO THE NO-ACTION ALTERNATIVE: ACREAGE CLEARED AND MAINTAINED AS SCRUB SHRUB

Type	No-Action	Alternative 2	Alternative 2 (Net)
Scrub shrub maintained in long term	63	101	**38**

*Source: Draft SOF 2012

EXHIBIT D-6. NET VEGETATION LOSS IN FLOODPLAINS UNDER ALTERNATIVE 2 COMPARED TO THE NO-ACTION ALTERNATIVE

Type	No-Action	Alternative 2	Alternative 2 (Net)
Total vegetation loss from expanding ROW for construction	0	6.93	**6.93**
Note: No "permanent" or "cleared and recovering" impacts to floodplains.			

*Source: Draft SOF 2012

APPENDIX E

NET ECOLOGICAL DAMAGES UNDER ALTERNATIVE 2

APPENDIX E. ALL NET ECOLOGICAL DAMAGES UNDER ALTERNATIVE 2 COMPARED TO THE NO-ACTION ALTERNATIVE

Land Type		DSAYS
1. Vegetation Loss		
1a. Wetlands		
	PFO	0.92
	PFO (EV)	24.28
	PEM/PSS	9.09
	PEM/PSS (EV)	112.77
Total (EV)		137.05
Total		147.06
1b. Floodplains		
All		89.59
Total		89.59
1c. Uplands		
	Mature Forest	2,546.12
	Scrub Shrub	70.20
Total		2,616.32
2. Edge Effects		
	Ordinary Wetlands	2.10
	EV Wetlands	10.26
	Uplands	253.52
Total		265.88
3. Landscape Connectivity		
	Uplands	183.47
Total		183.47
Total Uplands		3,053.32
Total Wetlands		159.43
Total Floodplains		89.59
Total DSAYs		**3,302.33**

APPENDIX F

WETLAND DAMAGES AND RESTORATION COSTS

APPENDIX F. NET DAMAGES AND RESTORATION COSTS FOR WETLANDS UNDER ALTERNATIVE 2

Wetland Type	DSAYs	Restoration Acres	Cost
Palustrine Forested	0.92	0.06	$20,092
Palustrine Forested (EV)	24.28	1.45	$527,426
Palustrine Emergent / Scrub Shrub	9.09	0.67	$243,125
Palustrine Emergent / Scrub Shrub (EV)	112.77	7.37	$2,673,045
Total	**147.06**	**9.55**	**$3,463,689**
Total (EV only)	**137.05**	**8.82**	**$3,200,471**
* EV : Exceptional Value			