Exhibit A

ECOLOGY'S RESPONSE TO SIERRA CLUB'S COMMENTS ON PROPOSED PSE FREDONIA EXPANSION PROJECT PERMIT NO. PSD-11-05

October 21, 2013

Sierra Club submitted comments on the proposed Puget Sound Energy (PSE) Fredonia Generating Station Expansion Project Prevention of Significant Deterioration (PSD) permit and Technical Support Document (TSD) Permit Number PSD-11-05.

Sierra Club's comments, dated April 17, 2013, were submitted in a letter with two introductory paragraphs followed by seven numbered comments. To see the full comment, please refer to the appendices in the TSD.

The second introductory paragraph of Sierra Club's letter made two statements the Department of Ecology (Ecology) considers comments even though they were not numbered as such. The **first comment** is that the permit application and TSD lack documentation for several critical assertions needed to establish appropriate permit terms and conditions. Specifically, the paragraph notes: "For example, Ecology copies PSE's Table 5-5 into the TSD as Table 14 and includes calculations that are neither sourced nor critically reviewed by Ecology. Ecology should provide all worksheets in Excel or other accessible formatting to the public."

Response: The information submitted in the application was critically reviewed by Ecology. From the information submitted, Ecology determined that PSD permitting was triggered for this project, and went on from there to write the PSD permit. Ecology based the PSD permit, which was public noticed and presented at a public hearing on April 17, 2013, on the materials submitted by PSE. The assumptions made in PSE's Table 5-5 (shown as Table 14 in the TSD and reproduced on the next page of this document for reference), are given in the table notes. This comment does not result in a change in the proposed permit.

The **second comment** in the second introductory paragraph was, "Similarly, PSE's load forecasts and dispatch (electrical distribution) modeling must be provided to verify several critical operating assumptions for the proposed addition to Fredonia."

Response: The Fredonia expansion project is being developed by PSE as an option to provide additional future generating capacity for PSE. According to PSE's 2013 Integrated Resource Plan (IRP), the company will require additional capacity of just over 200 MW starting in 2017. Analysis in the IRP also found that simple cycle combustion turbines are more cost-effective than combined cycle plants for this type of peaker plant resource need.

Dispatch modeling does not accurately predict the use of the turbines, and therefore is not useful here. PSE's proposals to expand the Fredonia Generating Station was not based simply on the results of a quantitative dispatch model, because quantitative dispatch models consider only the economic dispatch of a unit and, in PSE's experience, are prone to significant uncertainties over the life of a project. Those models also fail to consider non-economic factors that significantly influence how often a particular generating unit is dispatched. Those factors include transmission outages, generation outages, fluctuations in output available from intermittent resources such as wind and solar, changes in power demand, the need for system stability support, and the provision of ancillary services. Ecology agrees with PSE's assessment that these factors often cannot be anticipated. PSE needs a power generation project that has the ability to respond, as needed at a reasonable cost, to changing circumstances and future events that cannot be anticipated. This comment does not result in a change in the proposed permit.

Table 14, from the PSE Fredonia TSD, is included below with the assumptions in the table notes. The source of the information is PSE's internal evaluation submitted as part of their application.

Table 14. Incremental Emission Reduction Cost Analysis for Five Turbine Options

	LMS100	LM-6000	7FA.05	5000F4	7FA.04
Emissions Calculations					
Plant Capacity, net (MW)	199.7	165.1	209.4	207.1	182.3
Generation (MW-hr), 200 MW at 7.5% CF[1]	131,400	131,400	131,400	131,400	131,400
Heat rate @ full load (Btu/kWh, HHV)	9,007	9,871	10,145	10,152	10,193
Fuel CO_2 Rate (lb/MMBtu, HHV)[2]	115.9	115.9	115.9	115.9	115.9
Fuel CO_2e Rate (lb/MMBtu, HHV)[3]	116.8	116.8	116.8	116.8	116.8
Plant CO_2e Emissions Rate (lb/MW-hr)	1,052	1,153	1,185	1,186	1,191
Annual CO_2e Emissions (tpy)	69,118	75,748	77,850	77,904	78,219
Emissions Rank (1 = lowest emitting)	1	2	3	4	5
CO_2e Reduction from Base Unit (tpy)	9,101	2,471	368	315	0
Cost Calculations					
Plant Book Life (yrs)	35	35	35	35	35
PSE Discount Rate	8.10%	8.10%	8.10%	8.10%	8.10%
Annual O&M					
Fixed O&M (FOM) ($/kW-yr)	15.71	19.06	11.48	11.76	12.32
First-Year FOM ($/yr)	3,136,522	3,146,952	2,403,015	2,436,339	2,246,140
FOM Escalation Rate[(1)](%/yr)	3.00%	3.00%	3.00%	3.00%	3.00%
FOM Levelized Cost ($/yr)	4,063,695	4,998,100	3,113,360	3,156,534	2,910,111
Variable O&M (VOM) ($/MW-hr)	3.58	4.34	11.88	10.28	10.68
First Year VOM ($/yr)	470,713	570,584	1,560,650	1,350,846	1,402,785
VOM Escalation Rate[(1)](%/yr)	3.00%	3.00%	3.00%	3.00%	3.00%
VOM Levelized Cost ($/yr)	609,858	906,221	2,021,987	1,750,164	1,817,457
Fuel ($/MMBtu, HHV)	8.08	8.08	8.08	8.08	8.08
First Year Fuel ($/yr)	9,562,840	10,480,159	10,771,068	10,778,500	10,822,030
Fuel Escalation Rate(%/yr)[4]	3.00%	3.00%	3.00%	3.00%	3.00%
Fuel Levelized Cost ($/yr)	12,389,669	16,644,959	13,955,056	13,964,685	14,021,083
All-In CapEx ($)	279,000,000	274,000,000	198,000,000	191,000,000	185,000,00 0
Capital Recover Factor	8.67%	8.67%	8.67%	8.67%	8.67%
Annual CapEx ($/yr)	24,182,437	23,749,060	17,161,729	16,555,002	16,034,949
Total Levelized Annual Cost ($/yr)	41,245,660	46,298,340	36,252,133	35,426,384	34,783,600

Table 14. Incremental Emission Reduction Cost Analysis for Five Turbine Options					
	LMS100	LM-6000	7FA.05	5000F4	7FA.04
Levelized Cost (Savings) Over Base ($/yr)	6,462,059	11,514,739	1,468,532	642,784	$0
Incremental Cost-Effectiveness ($/ton CO_2e)	$710	$4,660	$3,987	$2,043	$0

[1] Assuming the project would generate 131,400 MW-hrs of electricity per year for all options.
[2] Assuming natural gas would be used as the fuel.
[3] Based on source testing at PSE's Sumas and Mint Farm Generating Stations in 2009, CO_2 emissions account for approximately 99.27% of total CO_2e emissions.
[4] Assuming an escalation rate of 3% as an average inflationary number. This number falls within the range of historical inflation.

PSE used their internal load forecasts to develop the kind of project the company felt was needed. This information was reviewed by Ecology, and used to develop the PSD permit for the Fredonia expansion project.

This comment did not result in a change in the proposed permit.

Sierra Club's Numbered Comments

1. **GHG BACT requires a GHG emissions rate limit achievable by the most efficient turbine model.**

Response: BACT does not require permit limits based on the most efficient equipment model available within a technology category. Rather, limits are developed on a case-by-case basis, taking into account energy, environmental, and economic impacts, and other costs of the project proposed by the applicant (as noted in Definitions, 40 CFR 52.21 (b) (12)). Efficiency is an important consideration. However, another consideration applicable to the peaking and load matching generation required by PSE for this project is the ability of the project to quickly adjust its generating capacity rapidly enough to accommodate unpredictable changes in market demand and the availability of power from other sources.

Ecology determined that any of the four turbine options could be permitted and that all four meet all applicable air quality requirements. The BACT discussion is found in Section 3 of the TSD. BACT for GHG emissions is discussed in Section 3.5. Tables 13 and 14 compare the turbine models, and do not translate directly into permit limitations because permit limitations include the effects of other operational parameters and considerations. Other considerations for this proposal include operating hours, loads, and the number and duration of start-ups and shutdowns. The GHG BACT Summary for the combustion turbines is listed in Table 15. Ecology used performance data from the turbine vendors and proposed operation (such as start-ups and shutdowns) to estimate emissions. Emissions estimates for both CH_4 and N_2O used the results of source testing at PSE's Sumas and Mint Farm Generating Stations in 2009.
The proposed BACT limits for each of the four options evaluated for this project are lower than the York Plant Holding Project proposed BACT limits listed in Table 13 of the TSD. The York

Plant Holding Project proposed to restrict their simple cycle combustion turbine to emit less than 1,450 pounds CO_2 per MW-hr, which is higher than any of the four options for PSE's project.

As discussed below, Ecology concludes that any of the four turbine options constitute BACT for this project. All four turbine options are very efficient. It is important to recognize that PSE must consider factors in addition to efficiency when deciding which turbine option will best meet the purpose of this project. Those factors include:

- Reliability: Turbine models exhibit different operating histories and reliability performance both between models and over time as a given technology matures. PSE must feel confident that a chosen turbine model will operate reliably after installation.
- Flexibility: A turbine's ability to start and stop rapidly, as well as to ramp up and down quickly, adds value to PSE. Two smaller turbines may be able to fulfill power demands more economically than a single large turbine. Typically this comes at a cost premium that must be considered at the time of final selection.
- Power Quality: Different turbine generators will exhibit different impacts on the power quality of a given transmission system. During the interconnection process, PSE's transmission contracts group will run computer simulations of the transmission system to determine potential impacts of a proposed addition of generating capacity. Based on system information that will be available at that time, these simulations will estimate potential overloads, system voltage concerns, and system stability. The simulations then develop hypothetical potential transmission upgrades to mitigate any impacts if necessary. It is important for PSE to be able to choose among different turbine options because some turbines may require more extensive system upgrades than others.
- Availability: Demand for new turbines has a great impact on availability, cost, and lead time for delivery. If a given turbine is in heavy demand, it may not be available in time to meet project requirements.

For the Fredonia project, PSE narrowed down their project to four turbine options from a larger set of initial options. PSE's final decision will not only be based on a turbine with superior efficiency, but will also balance the issues discussed above with capital and operating costs. PSE directed their consultant to develop a complex permit application that included four options that operate at similar levels of efficiency. At some point, PSE will make a decision and one of the four options will beat out the others in meeting PSE's performance and economic needs. All four options are very efficient turbines, and Ecology concluded that any of the four options meets the regulatory requirements of the PSD permit program.

This comment does not result in a change to the proposed permit.

a. The permit may not set a weaker GHG limit based on alternate operating scenarios.

Response: Historically, PSD permits have authorized the permit holder to install different equipment options (and either established different criteria pollutant emission limits for each option, or set permit limits based on the higher emitting option). The same approach is appropriate for GHG emissions. Consistent with that approach, EPA Region 6 has recently proposed to issue a PSD permit for the La Paloma Energy Center that would give the permit holder the option of using any of three turbine models (GE 7FA, Siemens SGTF-5000(4), and SGTG-5000F(5)), and would establish different emissions limitations for each turbine option (Draft Statement of Basis Draft PSD Permit for La Paloma Energy Center, LLC, March 2013, <http://www.epa.gov/earth1r6/6pd/air/pd-r/ghg/la-paloma-draft-sob.pdf>). In addition, several other recent PSD permit applications propose to allow the applicant to choose the actual equipment to be installed at the time of construction. For example, the NRG Texas Power–Cedar Bayou Station Application, dated November 2012, proposes four turbine options for a simple cycle facility: the GE Model 7FA.03, 7FA.04, 7FA.05, or Siemens Westinghouse 5000F (5). The PSE Fredonia expansion project uses a similar approach. Because Ecology has determined that each of the four turbine options proposed by PSE satisfies the BACT requirement, Ecology considers the efficiency differences between the four possible turbines small enough to allow PSE to make a final turbine selection based on business considerations at the time that the project is given final authorization to construct.

As is the case with any new utility project that considers multiple equipment options, PSE's turbine equipment alternatives have differing characteristics which can result in differing annual operating hours. The operating parameters do not constitute alternative operating scenarios as thought of in Title V air operating permits. Ecology is including the operating parameters along with the efficiency of turbines to provide for a clear definition of what equipment and operating parameters are required in the proposed PSD permit. Four options were included in the PSD permit. These four options provide four equipment alternatives along with their respective operating parameters that generate about the same amount of power. Ecology determined all four options meet PSD permitting requirements. In considering how a two turbine option may be used versus a one turbine option, the equipment has slight differences that result in a possible variability in operation. This means that if PSE goes with the two turbine option, there may be times when only one of the two turbines may be run, and very likely will result in more start-ups. Any of the four turbine options proposed satisfy the BACT requirement. The selection of a turbine will not result in a "weaker" limit, but will result in the appropriate limit for the specific turbine that is eventually selected. After PSE chooses the final option to install, Ecology will remove the options not chosen from the permit.

This PSD permit is not intended to be based on "average" or "typical" operating scenarios. PSE determined a reasonable maximum annual operating condition for each turbine model that would avoid adverse air quality impacts, and satisfy PSE's future system needs. PSE estimated maximum annual capacity factors of 26% for the large frame turbines (50000F(4), 7FA.05 and 7FA.04) and 33% for the LMS-100 model turbine, which results in a valid comparison while providing the flexibility required for a peaking scenario.

Ecology requested that PSE analyze the relative cost of GHG emission reduction associated with different combustion turbine models. To better evaluate the relative costs of different turbines, PSE assumed that all turbines would operate at the same capacity factor. To accurately assess the relative costs that would actually be incurred during operation, PSE based its calculations on a capacity factor that reflects the typical long term operations of a peaking facility in the Pacific Northwest, which finds peaking generation units typically operate 5%-10% of the time. PSE concluded that a 7.5% capacity factor was a reasonable assumption to use from the range of 5%-10% in this analysis.

This comment does not result in a change to the proposed permit.

b. BACT requires an emission limitation based on the maximum degree of reduction available.

Response: A determination that requires an emission limitation based only on the maximum degree of reduction available is called a Lowest Achievable Emissions Rate (LAER)[1] determination. LAER is required for projects located in areas that do not meet the National Ambient Air Quality Standard (NAAQS) for a pollutant. As there are no NAAQS for GHGs, LAER for GHGs is not defined.

The PSE Fredonia project is located in an area that is in attainment for all NAAQS. These areas require a control technology determination based on BACT. Chapter B of EPA's New Source Review Workshop Manual (draft October 1990) states on pp. B.1-B.2 that the BACT requirement is defined as:

> an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. ...
>
> During each BACT analysis, which is done on a case-by-case basis, the reviewing authority evaluates the energy, environmental, economic and other costs associated with each alternative technology, and the benefit of reduced emissions that the technology would bring. The reviewing authority then specifies an emissions limitation for the source that reflects the maximum degree of reduction achievable for each pollutant regulated under the Act. In no event can a technology be recommended which would not meet any applicable standard of performance under 40 CFR Parts 60 (New Source Performance Standards) and 61 (National Emission Standards for Hazardous Air Pollutants).

This quotation from the NSR Workshop Manual demonstrates that a BACT evaluation includes consideration of several more criteria than just the maximum degree of reduction. Federal guidance requires each PSD permit applicant to implement a "top-down" BACT analysis process for each new or physically or operationally changed emission unit. Ecology has adopted the top-down BACT process for our BACT determinations. This top-down BACT analysis process consists of the five basic steps described below:

[1] As defined in the federal regulation 40 CFR 51.100(o).

- Step 1: Identify all available control technologies with practical potential for application to the specific emission unit for the regulated pollutant under evaluation.
- Step 2: Eliminate all technically infeasible control technologies.
- Step 3: Rank remaining control technologies by control effectiveness and tabulate a control hierarchy.
- Step 4: Evaluate most effective controls and document results.
- Step 5: Select BACT, which will be the most effective practical option not rejected, based on economic, environmental, and/or energy impacts.

If the applicant proposes to implement the most effective, or "top" available control strategy identified in step 3, it is not necessary to evaluate the most effective controls and document results. See EPA's *Draft New Source Review Workshop Manual*, 1990 (NSR Manual) and PSD and Title V Permitting Guidance for Greenhouse Gases <http://www.epa.gov/nsr/ghgdocs/ghgpermittingguidance.pdf>.

The manual never discusses how to perform the analysis when the emission differences are the result of design differences between different makes and models of the emission unit itself. Throughout the NSR Manual, the BACT analysis is described as an analysis that focuses on categories of control technologies, rather than the comparison of different makes or models of equipment within a particular category (NSR Manual, p. B.23). Significantly, the NSR Manual presents a detailed example of how the BACT analysis should be performed for simple cycle gas turbines firing natural gas. The control technologies evaluated are SCR, water injection, steam injection, low NO_X burners, and SNCR. The manual does not suggest that different models of combustion turbines should be evaluated (NSR Manual, pp. B.58–B.73) Indeed, the manual emphasizes that the BACT analysis should not be used as a basis to "redefine the design of the source" (NSR Manual, p. B.13).

To be considered BACT, a control technology must have been demonstrated or achieved in practice. Cost and feasibility are two additional factors included in a BACT analysis. Ecology uses a top-down process, but one does not just start at the BACT top and stay there. The NSR Manual describes the top-down BACT analysis as one that requires consideration of "air pollution control technologies or techniques" including "inherently lower-polluting processes" (NSR Manual, p. B.5).

Ecology acknowledges that turbine efficiency is a critical piece of determining BACT for combustion turbines. Ecology appropriately considered efficiency, along with the other elements required by the top-down BACT process when setting BACT for the PSE Fredonia project. EPA's guidance on GHG permitting focuses on the evaluation of different categories of technology (EPA, <u>PSD and Title V Permitting Guidance for Greenhouse Gases</u>, March 2011). In this GHG guidance, EPA encourages consideration of "technologies or processes that maximize the energy efficiency of the individual emissions unit" (EPA, <u>PSD and Title V Permitting Guidance for Greenhouse Gases</u>, March 2011). Two examples were given to illustrate this point. For a proposal to construct a pulverized coal or circulating fluidized bed boiler, the guidance states that the BACT analysis should consider whether more efficient types of boilers that use supercritical and ultra-critical steam pressure designs would be appropriate alternatives. For a proposal to construct a simple cycle gas turbine facility, the guidance states that the BACT analysis should consider whether a combined cycle combustion turbine technology would be an appropriate alternative.

Ecology followed EPA guidance in that it considered different types of technology that could be used in peaking applications, such as simple cycle combustion turbines, reciprocating internal combustion engines, and combined cycle combustion turbines. Reciprocating engine technology was rejected because available engines in this size range have greater emissions, and modeling indicated that they would result in unacceptable ambient air quality impacts. Combined cycle technology was ruled out for this peaking project on technical and commercial risk grounds as stated in the permit application and Ecology's TSD (also see response to Comment 3). These grounds were sufficient for Ecology's BACT analysis findings.

This comment does not result in a change to the proposed permit.

c. The TSD's analysis of incremental emission reduction costs does not comply with BACT requirements.

Response: The Sierra Club is correct that PSD BACT guidance does utilize the total cost comparison as the basis to evaluate cost-effectiveness between control options or differing control efficiencies between control options. However, PSD BACT guidance also looks at incremental emission reduction costs (NSR Manual, pp. B.41–B.44). The NSR Manual states, "The incremental cost effectiveness should be examined in combination with the total cost effectiveness in order to justify elimination of a control option." In this case, Ecology determined that the incremental cost analysis, which is identified by EPA as a way to distinguish between otherwise similar control alternatives in deciding BACT, was a permissible way to evaluate the options. Ecology used the incremental cost analysis to determine whether the 7FA.04 turbine should be considered BACT.

This comment does not result in a change to the proposed permit.

d. (found as "a" on page 6 of the comments—appears to be a numbering error)

The TSD's analysis of incremental emission reduction costs is unsupported and incorrect.

Response: As discussed on p. 35 of the TSD, the least efficient make or model is not necessarily the highest annual emitting option. For example, for a peaking facility in which a turbine does not operate all the time, a more efficient make or model may still have higher annual GHG emissions if running more, compared with a less efficient make or model with fewer operating hours (i.e., because of less fuel used). Ecology required PSE to estimate the operating time because this project will not be run on a regular basis. As a result, Ecology considered engine efficiency together with hours of operation during the BACT analysis. For example, given PSE's turbine options, the least efficient engine (7FA.04) generates the fewest annual GHG emissions while the most efficient engine (GE LMS100) generates the largest annual GHG emissions mainly because of more operation hours (i.e., increased fuel use). As noted above in Response 1., 1.a., 1.b., and 1.c.), BACT is a procedure that was carefully followed. As discussed in the response above in 1.c., incremental cost analysis is the proper way to proceed for this project. The support and assumptions for the Incremental Emission Reduction Cost Analysis are provided in the TSD in the notes of Table 14. The all-in capital expenses are listed in Table 14 on p. 35 of the TSD. The costs were provided to PSE, who in turn included these costs in their application. PSE and Ecology based their analyses on these figures, which are the best numbers available. When PSE makes their decision on which turbine to purchase, PSE will be using final prices (among other considerations) to complete their purchase. Ecology does not expect any significant changes based on future updated vendor information.

This comment does not result in a change to the proposed permit.

2. Hours of operation allowed for peaking unit(s) are too high.

a. Peaking units operate less than 2000 hours annually.

Response: In developing the permit, Ecology searched for a definition of peaking units, discussed peaking units with PSE, and concluded that there was not a specific definition for PSD permitting purposes. In addition, Ecology found that it was difficult to compare peaking units in operation because there were differences in the electrical systems where the peaking units were being used. Sierra Club's comment asked why Ecology considered the proposed project a peaking unit when allowing 2,280 to 2,880 hours of operation per year. Although some electrical generating units used less than 2,000 hours per year, this does not constitute a definition of peaker operation. Peakers must respond to demand, which can be much greater during some years. PSE anticipates that the new unit(s) will operate less than 2,000 hours during typical years. PSE's peaking turbine capacity factors vary between 5% and 10% during typical years. Thus, a 7.5% capacity factor was used for PSE's economic analysis in the permit application. This is roughly equivalent to less than 700 hours at full load, or 1400 hours at 50% load. Ecology found on-line a company flyer by Cummins that noted two peaking power plants. One was a diesel peaking unit for low-hour use, and the other a natural gas peaking unit for use ranging from 1,000 to 4,000 hours per year. Thus, peaking units have a range of hours for use, and the PSE proposed natural gas project falls within this range. The bottom line is that the proposed PSE units are not base load units, and will be used to meet peaking demand. The project is described in detail on p. 4 of the TSD.

Within this comment, Sierra Club noted that setting maximum operating hours based on total fuel usage increases the total hours of operation because the calculations assume a compliance margin of hours of operation, but in practice the units will operate much more efficiently allowing even higher annual operating hours than the 2,880 and 2,280 hours proposed. As described on p. 12 of the TSD, allowable emission calculations for each turbine option are based on the anticipated maximum annual hours of operation, which includes peaking mode operations and the anticipated number of unit start-ups and shutdowns each year. The LMS100 option has two turbines so that there may be times that only one turbine might be operating. This could result in this option having more start-ups and shutdowns. Ecology chose to account for the variable operation anticipated for these peaking units by limiting the fuel usage and number of start-ups and shutdowns instead of the hours of operation because emissions are more closely related to fuel use than operating hours. Ecology must include emissions during unit start-ups and shutdowns because emissions may be higher than normal operating conditions. Since the turbine will not run on a predictable schedule like a base load electrical generating unit, an estimate of peaking mode operations, including the number of start-ups and shutdowns, must be made. This means that a turbine that can quickly be brought into service may have more starts and annual operating hours than another unit that takes longer to begin generating electricity. Annual fuel uses were estimated and summarized in Table 4 on p. 12 of the TSD. This is a better approach to analyze a peaking turbine's emissions, as well as giving PSE maximum operating flexibility.

This comment does not result in a change to the proposed permit.

3. Exclusion of combined cycle combustion turbine (CCCTs) is inappropriate.

Response: PSE has consistently stated that the purpose of the Fredonia Generation Station expansion project is to provide approximately 180–210 MW of additional peaking generation capacity for its system. To operate effectively to provide peaking generation capacity, the Fredonia turbine must be able to respond rapidly to changing and often short-term peak power demand on PSE's system. Although the facility will not operate most of the time, fast start and frequent starts and stops are essential for PSE to adapt to changing loads and unanticipated events, including supporting wind generation, peak demand periods, transmission and generation outages, and ancillary service needs through the life of the proposed combustion turbines.

Simple cycle combustion turbines are best suited and more cost-effective for peaking applications. A simple cycle combustion turbine does not have a steam cycle like a combined cycle turbine. So the simple cycle combustion turbine does not have cool or cold water, and boiler tubing to heat as part of the start-up sequence. Unlike a combined cycle system, start-up duration and quantity of emissions during start-up of a simple cycle turbine are unrelated to when the last shutdown occurred. The duration of start-up/shutdown for a simple cycle combustion turbine is relatively short because it is mainly related to bringing the turbine rotors up to speed, lighting the turbine burners, bringing the SCR and oxidation catalysts up to their minimum operating temperatures, and synchronizing the electric generator to the grid.

While the industry is working to develop combined cycle plants that could offer some of these fast-starting peaking abilities; they currently are not cost-effective for this type of peaking application. In connection with its IRP, PSE performed detailed modeling and concluded that CCCT would be significantly more expensive. For further information, see 2013 IRP, p. 5-58, available at: http://pse.com/aboutpse/EngergySupply/Documents/IRP_2013_Chap5.pdf. Although Sierra Club identified instances in which developers are considering installing "fast-start" combined cycle facilities in California, Sierra Club does not provide any information about the expected operations of these facilities, or about whether conditions in California are relevant to PSE's system conditions. Nor has Sierra Club demonstrated that these new technology turbines are reliable when started and stopped frequently. Combined cycle systems experience more wear and tear from thermal cycling than simple cycle turbines as the number of annual starts and stops increases. A fast-start combined cycle design might make sense for a facility operating at much higher capacity factors, but Ecology and PSE are not aware of any utility or developer planning to build a combined cycle facility in order to provide 180 to 210 MW of peak generating capacity that is expected to typically operate at a 7.5% capacity factor. Ecology finds that it is appropriate to not use a CCCT for the Fredonia project.

In addition, EPA's Environmental Appeals Board (EAB) recently considered a case regarding the Pio Pico Energy Center. In this case (In re: Pio Pico Energy Center, PSD Permit No. SD 11-01, PSD Appeal Numbers 12-04 through 12-06, August 2, 2013), the applicant proposed to build a simple cycle generating facility to provide peaking and load-shaping generation. The facility would also support intermittent renewable generation, and would need to have the capability for frequent and fast turbine start-ups. EPA Region 9 considered combined cycle combustion turbine technology in its BACT analysis, but ultimately concluded it was technically infeasible and inapplicable to the proposed source. EPA explained that when assessing the technical feasibility of a control technology, it is appropriate to consider whether the technology may reasonably be deployed on, or is applicable to, the source under consideration. Longer start-up times are not compatible with the operational characteristics of the proposed facility and that these technical difficulties would preclude successful deployment of a combined cycle operation. The EAB upheld this analysis on appeal. This analysis is equally applicable to PSE's proposed Fredonia expansion.

This comment does not result in a change to the proposed permit.

4. **The TSD does not provide sufficient support for the elimination of carbon capture and sequestration (CCS).**

Response: The TSD did provide sufficient support for the elimination of CCS. In Section 3.5.1 on p. 29 of the TSD, Ecology found that voluntary BACT analyses of CCS were performed for two projects permitted in late 2010: the Calpine Russell City Energy Center Project, which includes a combined cycle combustion turbine project, and Portland General Electric's Port Westward II Project, which includes a simple cycle GE LMS100 gas turbine. In both BACT analyses, CCS was found to be unavailable or infeasible in practice. In addition, PSE indentified a PSD permit (SE-09-01) issued to Palmdale Hybrid Power Project in southern California by EPA Region 9 on October 18, 2011, involving GHG BACT analyses. This proposed project includes thermal solar technology and two combined cycle GE Frame 7FA CCCTs. The project application and permitting documents considered two GHG control technologies. One was the use of new thermally efficient CCTs, and, second, the use of CCS. CCS was eliminated as technically infeasible for the project and was not considered beyond BACT step 2.

In Ecology's independent BACT review, the following three additional combine cycle generating facilities were identified and evaluated.

1. Pacificorp Lake Side Power Plant (PLSPP), UT (DAQE-AN0130310010-11)
2. Lower Colorado River Authority (LCRA) Thomas C Ferguson plant (PSD-TX-1244-GHG)
3. Pioneer Valley Energy Center (PVEC) Westfield, MA (EPA draft PSD 052-042-MA15)

The PLSPP permit was issued by Utah Department of Environmental Quality (DEQ) on May 4, 2011. The Utah DEQ concluded that high efficiency combustion turbine and HRSG design are the BACT for GHG. The LCRA permit was issued by EPA Region 6 on November 10, 2011. Region 6 concluded that there is no commercially available CCS system to proper scale to LCRA in the near term. In addition, even if technically feasible, the option has been eliminated based on a cost-effectiveness basis. The PVEC draft permit prepared by EPA Region 1 was available for public comment from December 5, 2011, to January 24, 2012. EPA Region 1 eliminated CCS technology for PVEC's proposed project as GHG BACT due to the energy, environmental, and economic impacts.

Ecology also identified four other combustion turbine permits involving GHG emissions, which are under review by state and local permitting authorities at the time of preparing this document and have received EPA written comments. These projects are the Effingham County Power Project (GA, DNR), Cricket Valley Energy Project (NY, DEC), York Plant Holding Project (PA, DEP), and Wolverine Power-Sumpter Project (MI, DEQ). The use of CCS has been eliminated in these draft permits as BACT for GHG.

Within the PSE's permit application BACT analysis, the applicant proposed to eliminate CCS because CO_2 capture is not technically feasible for combustion turbines. In their application, PSE examined a list of 14 active and potential CCS projects (predominantly by the pre-combustion capture technology and only one by the post-combustion capture technology) published by the Global CCS Institute to see if any are similar to the proposed simple cycle gas turbine options. PSE also reviewed seven other post-combustion CO_2 capture and storage demonstration projects that were built and operated over the years, but are no longer in operation or on hold due to economic reasons, including a demonstration scale capture technology at a Florida Power and Light (FP&L) natural gas combine cycle turbine power plant in Bellingham, Massachusetts. The increased natural gas prices in 2004 to 2005 forced the FP&L power plant to operate in a peak load shaving mode, which rendered the CO_2 capture plant uneconomical after 14 years of operation (1991–2005). During this time, only a fraction of CO_2 from gas-turbine exhaust was captured and provided for off-site sale. Sequestration was not attempted at the Bellingham, Massachusetts plant.

The applicant also identified four potential sequestration options: enhanced oil recovery (EOR), geologic sequestration, silicate mineral reactions, and industrial reuse. In the Pacific Northwest, EOR opportunities do not exist due to the lack of oil and gas production areas. Pipelines do not exist for the transportation of CO_2 to distant oil and gas production areas to provide for EOR. Geologic sequestration, including deep saline formation, deep basalt formations, and the tectonic subduction zone, was also explored for this project and none of them is a viable option and/or within a reasonable distance of the project site (200 miles or more) in addition to the fact that two of the three approaches (deep basalt formations and injection in tectonic subduction zones) have not been demonstrated in practice. Silicate mineral reactions are also infeasible because the mineral deposit is undeveloped and there is no existing rail transport infrastructure to transport the minerals to and from the power plant site or developed disposal sites to receive the reacted minerals.

PSE performed a qualitative cost analysis for carbon capture and sequestration. PSE considered cost per ton of CO_2 avoided prepared by others, and then compared these projects' specifications with the proposed PSE Fredonia Project specifications. PSE concluded that the fewer operating hours, additional steam requirement for the CO_2 capture system, heat rejection system with a bigger cooling duty, no available saline formation within a 50-mile radius of the facility, and a smaller size of a CCS system required for the PSE Fredonia Project will cause the cost per ton of CO_2 avoided to be much higher than currently acceptable economic thresholds. Carbon capture alone is demonstrated not to be economically viable for the PSE Fredonia Project. Adding the cost of any sequestration would add significantly to the Fredonia Generating Station Expansion Project's overall cost. Ecology thoroughly considered CCS systems, and concludes that CCS systems would not be cost-effective for the proposed project at this time.

This comment does not result in a change in the proposed permit.

a. Availability of saline formations

Response: BACT requires control technology that is available. In order for CCS to be required as BACT, sequestration storage areas, including saline formations, have to be currently viable. Although the WESTCARB atlas indicates certain geologic structures have a potential for carbon storage, much more technical investigation and development must be done before a CCS commercial operation can be considered viable and available for this project. A review of the 2012 edition of the Department of Energy's Carbon Utilization and Storage Atlas, Fourth Edition (December 2012)[2] confirms that no commercial CCS projects using geologic saline sequestration are operational. The Big Sky Carbon Sequestration Partnership is in the process of investigating the potential of basalt strata to store CO_2 in eastern Washington, but that study will only indicate the site's potential for carbon storage. No commercial CCS operation is currently planned for eastern Washington, or any other site in Washington. Saline sequestration is not listed as a control option in the EPA RACT/BACT/LAER Clearinghouse, has not been demonstrated in practice, and is not available as a commercially proven process. Therefore, saline sequestration was not considered as available for GHG BACT for Fredonia.

This comment did not result in a change in the proposed permit.

[2] The United States 2012 Carbon Utilization and Storage Atlas, Fourth Edition, December 2012, available at <http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlasIV/Atlas-IV-2012.pdf>.

b. Cost of CCS

Response: Ecology's use of the applicant's cost estimates was an attempt to develop a cost estimate for a project that is effectively impossible to cost using normal procedures. The normal BACT cost determination process is built around the concept of comparing a project's site-specific pollutant control costs to the cost borne by other sources of the same type in applying that control alternative. Ecology tried, but could not find any CCS projects of the same type for comparison.

When calculating the cost-effectiveness of CCS at Fredonia, two cost figures must be determined: (1) The annualized cost of the CCS system to be installed and operated at Fredonia divided by the number of tons of pollutant removed, and (2) the annual $/ton cost-effectiveness threshold that determines whether the CCS installation is cost-effective or not. Data provided in IPCC's *Carbon Dioxide Capture* report [3] indicate that the capital cost of the Fredonia expansion project would be nearly doubled by the addition of CO_2 capture technology. The capital cost increase, costs to operate capture equipment, and costs to transport and store the CO_2 would make the project economically infeasible. Ecology found no CCS process in commercial operation on gas-fired turbines that could be compared to the Fredonia project.

The wide range of estimates for the social cost of carbon (from $28 up to $893) shows the difficulty in attempting to cost out an unproven technology. It is difficult to find costs because of lack of CCS applications for gas turbine power plants and the amount of uncertainty in attempting to apply this lack of information to the Fredonia project. Therefore, Ecology's use of costs found from the U.S. Department of Energy is appropriate.

This comment did not result in a change in the proposed permit.[3]

5. PM limits are too high.

Response: The emissions of PM from the Fredonia project are largely determined by the amount of fuel burned and the concentration of sulfur in the fuel. Long-term monitoring records of the total sulfur content of the natural gas imported from Canada into western Washington shows this gas generally has higher sulfur content than natural gas from the rest of the United States. PSE analyzed seven years of daily total sulfur measurements (June 1, 2002 through March 8, 2010) for the Northwest Pipeline compressor station at Sumas, WA. The maximum 365-day rolling average was 1.10 grains of sulfur per 100 standard cubic feet of natural gas, and the highest 99th percentile daily sulfur concentration measured at Sumas during the seven year period was 3.23 grains per 100 standard cubic feet. In comparison, in California, the pipeline natural gas typically contains much less than one grain of sulfur per 100 standard cubic feet. Further details are presented in the TSD on p. 20. It is not necessary to review stack tests of similar uncontrolled natural gas-fired units that use Canadian natural gas because of the fuel differences. Given the sulfur content of the fuel for this facility, Ecology has concluded the PM limits are appropriate.

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[3] IPCC, 2005, *Carbon Dioxide Capture and Sequestration*, edited by Bert Metz, Ogunlande Davidson, Heleen de Coninck, Manuela Loos and Leo Meyer, Cambridge University Press, Chapter 8–Cost and Economic Potential, <http://www.ipcc.ch/pdf/special-reports/srccs/srccs_chapter8.pdf>.

This comment did not result in a change in the proposed permit.

6. The air quality analysis is insufficient.

Response: The Sierra Club correctly notes that the air quality analysis should have included a comparison of the SILs to background and emissions from nearby and area sources in the area. The background concentrations affecting the Fredonia Power Generating Station are:

Species	Background	SIL	NAAQS
$PM_{2.5}$ 24 hr $\mu g/m^3$	13	1.2	35
$PM_{2.5}$ annual $\mu g/m^3$	6	0.3	12
PM_{10} 24-hr $\mu g/m^3$	43	1.04	150
CO 1 hr ppm	1.323	1.11	35.0
CO 8 hr ppm	0.922	0.278	9.0
NO_2 1 hr ppb	33		100
NO_2 annual ppb	8	0.53	53

The above table shows that background is very low compared to the NAAQS, and that adding the SILs to background does not come close to the NAAQS. In addition, on p. 46 of the TSD, Ecology demonstrates that the maximum impacts occur at locations well within the receptor grids and not on the borders, which would necessitate further grid analyses. As a result, no additional modeling was performed on the finer grid spacing. Ecology appropriately concluded that a full NAAQS analysis and an increment analysis were not required for any pollutant. Ecology found that the SIL and background levels are not close to violating one of the NAAQS. In addition, the facility where the turbine is proposed to be located is in a rural area that has few industrial neighbors.

This comment did not result in a change in the proposed permit. However, the TSD will be amended to add the above discussion concerning the background concentrations of NAAQS and SILs.

7. No consideration of secondary $PM_{2.5}$ formation.

Response: EPA guidance (40 CFR App. W) encourages agencies to consider secondary $PM_{2.5}$ in areas where $PM_{2.5}$ is a problem, such as nonattainment areas and areas close to or upwind of nonattainment areas. 40 C.F.R. pt. 51 app. W § 5.2.2.1.a "Control agencies with jurisdiction over areas with secondary $PM_{2.5}$ problems are encouraged to use models which integrate chemical and physical processes important in the formation, decay and transport of these species (e.g., Models-3/CMAQ or REMSAD)." The area where the Fredonia plant is located is in attainment of all the NAAQS.

Unlike in the eastern United States and areas of California, secondary PM in the Puget Sound area is a minor contributor to $PM_{2.5}$ concentrations during the winter when high $PM_{2.5}$ concentrations are observed. Marysville is the closest monitoring site with data. On 17 days since 2009 when $PM_{2.5}$ levels exceeded 15 $\mu g/m^3$ in Marysville, aerosol nitrate (which is the most abundant secondary inorganic aerosol species measured) made up an average of 5% of the total $PM_{2.5}$, and never exceeded 15 percent.

All of the secondary $PM_{2.5}$ formed from emissions from the Fredonia project is formed from the NO_X emitted by the project. Therefore, the amount of NO_X emitted by the project provides the upper limit for the amount of secondary $PM_{2.5}$ that can form from the project's emissions. Because the PM and NO_X mass emissions from the proposed facility are roughly the same, the maximum expected secondary $PM_{2.5}$ cannot exceed the amount of primary $PM_{2.5}$ produced. So, the total primary $PM_{2.5}$ + NO_X caused $PM_{2.5}$ cannot exceed a total of 2.3 $\mu g/m^3$. However, in reality the $PM_{2.5}$ emissions and impacts will likely be less, and result in $PM_{2.5}$ (both primary and secondary) that will remain below the currently accepted de minimis level. Therefore, Ecology included only the impacts from primary PM_{10} and $PM_{2.5}$ in the analysis.

This comment did not result in a change in the proposed permit.

Exhibit B

Intensive Cultural Resources Survey of the Proposed 78-Acre La Paloma Energy Center Tract, Harlingen, Cameron County, Texas

By:

Jeffrey D. Owens

HJN 080122 AR 31

Prepared for:

Zephyr Environmental Corporation
Austin, Texas

Prepared by:

Horizon Environmental Services, Inc.
Austin, Texas

December 2012

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By:

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Russell K. Brownlow, Principal Investigator

HJN 080122 AR 31

December 2012

MANAGEMENT SUMMARY

Horizon Environmental Services, Inc. (Horizon), was selected by Zephyr Environmental Corporation (Zephyr), on behalf of La Paloma Energy Center, LLC (La Paloma), to conduct an intensive cultural resources inventory and assessment of the proposed location of the La Paloma Energy Center (LPEC) located at 24684 Farm-to-Market Road (FM) 1595, Harlingen, Cameron County, Texas. La Paloma is proposing to construct a new natural gas fired, combined cycle electric generating plant. The LPEC would consist of 2 natural gas fired combustion turbines, each exhausting to a fired heat-recovery steam generator (HRSG) to produce steam to drive a shared steam turbine. Construction of the LPEC, associated infrastructure, and auxiliary equipment would take place within a proposed 32-hectare (ha) (78-acre [ac]) project site. Currently, the site is an agricultural field utilized for growing cotton. Due to the nature of the soils on-site, the proposed facility would be installed on spread-footing foundations that would be formed and poured in excavations throughout the site. The topsoil on the site would be removed and replaced with structural fill material in the area of the power-generating equipment. The primary foundations for the gas turbines, boilers, and steam turbine pedestal would be excavated 1.8 to 2.4 meters (m) (6.0 to 8.0 feet [ft]) below surface and would be backfilled with imported sediments when completed. The Area of Potential Effect (APE) of the proposed undertaking consists of the entire proposed 32-ha (78-ac) LPEC site.

As construction of the proposed facility would require a Prevention of Significant Deterioration (PSD) permit for Greenhouse Gasses (GHG) issued by the US Environmental Protection Agency (EPA), the undertaking falls under the regulations of Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, which is invoked when federal funds are utilized or when federal permitting is required for a proposed project. The NHPA states that the Advisory Council for Historic Preservation (ACHP) and the Texas Historical Commission (THC), which serves as the State Historic Preservation Office (SHPO) for the state of Texas, must be afforded the opportunity to comment when any cultural resources potentially eligible for inclusion in the National Register of Historic Places (NRHP) are present in a project area affected by federal agency actions or covered under federal permits or funding.

On December 5, 2012, Horizon archeologists Michael Mudd and Jared Wiersema, under the overall direction of Russell K. Brownlow, Principal Investigator, performed an intensive cultural resources survey of the APE to locate any cultural resource properties that potentially would be impacted by the proposed undertaking. Horizon's archeologists traversed the 32-ha (78-ac) APE and thoroughly inspected the modern ground surface for aboriginal and historic-age cultural resources. The APE consisted of an active agricultural field that had been recently plowed, though no crops had been planted at the time of the survey. No vegetation was present in the agricultural field, and visibility was excellent (100%) across the entire project area. Horizon excavated a total of 41 shovel tests in the 32-ha (78-ac) APE, thereby exceeding the Texas State Minimum Archeological Survey Standards requirements for a project area of this size.

No cultural resources, historic or prehistoric, were identified within the APE as a result of the survey. Based on the results of the survey-level investigations documented in this report, no potentially significant cultural resources would be affected by the proposed undertaking. In accordance with 36 CFR 800.4, Horizon has made a reasonable and good faith effort to identify archeological historic properties within the APE. No archeological resources were identified that meet the criteria for inclusion in the National Register of Historic Places (NRHP) according to 36 CFR 60.4, and no further archeological work is recommended in connection with the proposed undertaking. However, in the unlikely event that any human remains or burial accoutrements are inadvertently discovered at any point during construction, use, or ongoing maintenance in the project area, even in previously surveyed areas, all work should cease immediately and the THC should be notified of the discovery.

TABLE OF CONTENTS

LIST OF FIGURES

Page

1.0 INTRODUCTION

Horizon Environmental Services, Inc. (Horizon), was selected by Zephyr Environmental Corporation (Zephyr), on behalf of La Paloma Energy Center, LLC (La Paloma), to conduct an intensive cultural resources inventory and assessment of the proposed location of the La Paloma Energy Center (LPEC) located at 24684 Farm-to-Market Road (FM) 1595, Harlingen, Cameron County, Texas. La Paloma is proposing to construct a new natural gas fired, combined cycle electric generating plant. The LPEC would consist of 2 natural gas fired combustion turbines, each exhausting to a fired heat-recovery steam generator (HRSG) to produce steam to drive a shared steam turbine. Construction of the LPEC, associated infrastructure, and auxiliary equipment would take place within a proposed 32-hectare (ha) (78-acre [ac]) project site (Figures 1 and 2). Currently, the site is an agricultural field utilized for growing cotton. Due to the nature of the soils on-site, the proposed facility would be installed on spread-footing foundations that would be formed and poured in excavations throughout the site. The topsoil on the site would be removed and replaced with structural fill material in the area of the power-generating equipment. The primary foundations for the gas turbines, boilers, and steam turbine pedestal would be excavated 1.8 to 2.4 meters (m) (6.0 to 8.0 feet [ft]) below surface and would be backfilled with imported sediments when completed. The Area of Potential Effect (APE) of the proposed undertaking consists of the entire proposed 32-ha (78-ac) LPEC site.

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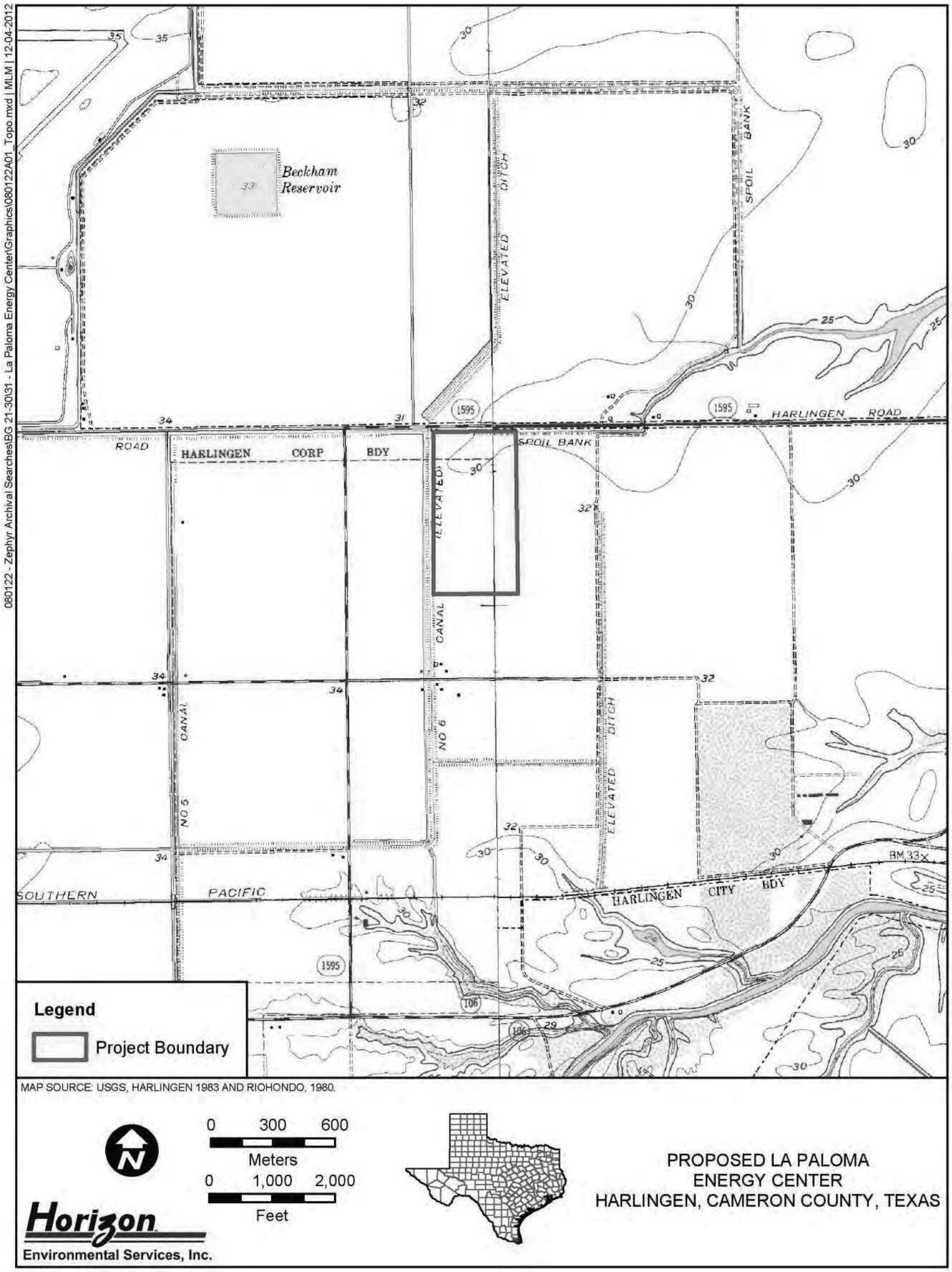

Figure 1. Location of Project Area on USGS Topographic Quadrangle

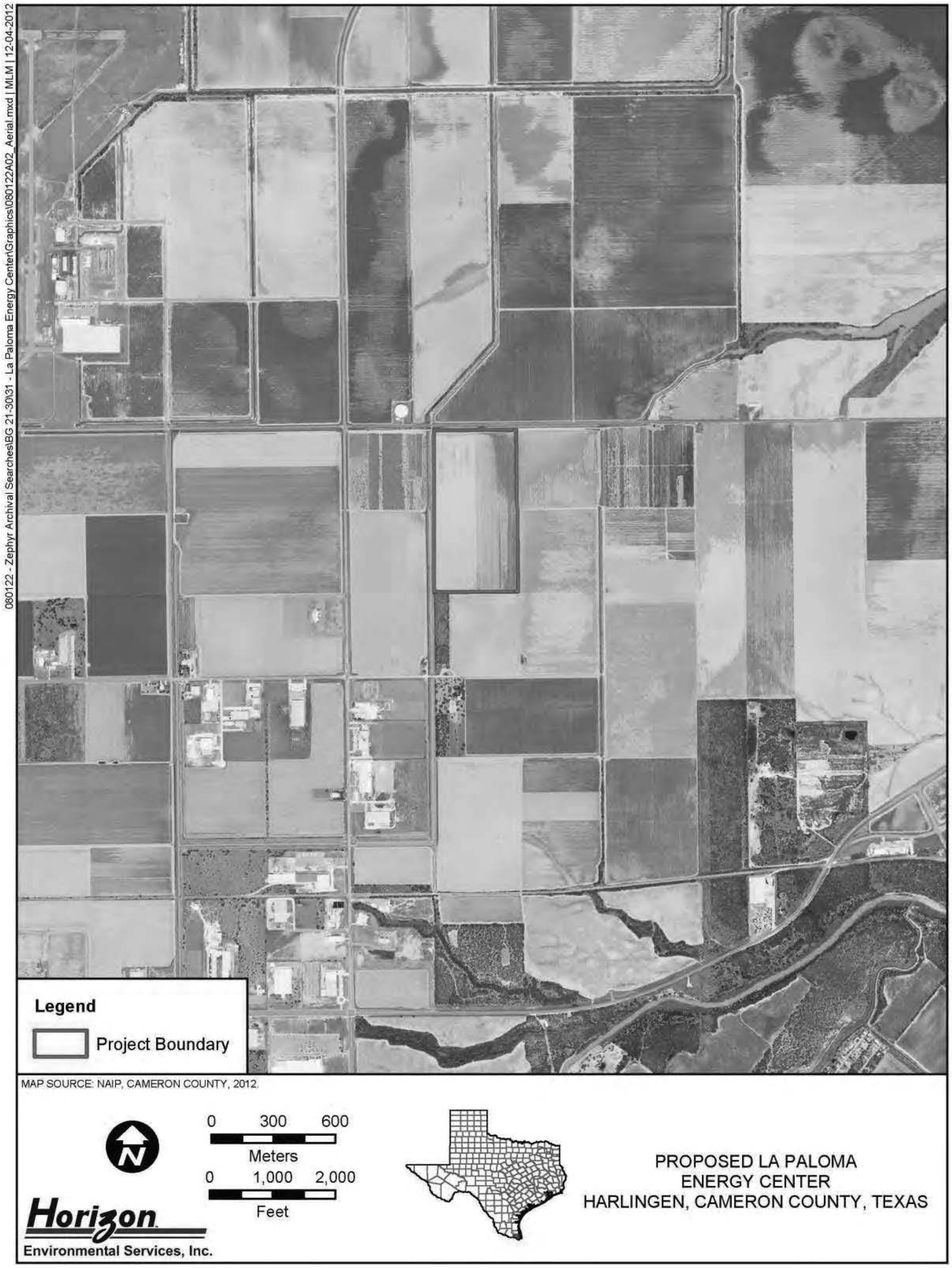

Figure 2. Location of Project Area on Aerial Photograph

of an archival review, an intensive pedestrian survey of the APE, and the production of a report suitable for review by the State Historic Preservation Office (SHPO) in accordance with the Texas Historical Commission's (THC) Rules of Practice and Procedure, Chapter 26, Section 27, and the Council of Texas Archeologists' (CTA) Guidelines for Cultural Resources Management Reports.

This report presents the results of this cultural resource survey. Following this introductory chapter, Chapters 2.0 and 3.0 present the environmental and cultural background, respectively, of the project area. Chapter 4.0 describes the research objectives, results of archival research, and cultural resource survey methods implemented during the survey. Chapter 5.0 presents the results of the cultural resource survey, and Chapter 6.0 presents cultural resource management recommendations for the project. Chapter 7.0 lists the references cited in the report. Appendix A summarizes shovel test data, and Appendix B contains the curriculum vitae of the Principal Investigator.

2.0 ENVIRONMENTAL SETTING

2.1 PHYSIOGRAPHY AND HYDROLOGY

The proposed LPEC site is located east of Harlingen in central Cameron County in South Texas. The proposed project site is located on a broad alluvial flat located immediately adjacent to the No. 6 Canal, an artificial, elevated irrigation canal connected to the Arroyo Colorado. The project site is situated in an active crop agricultural field. Elevations within the project area are extremely flat, averaging approximately 30 feet above mean sea level. Hydrologically, the proposed project site is situated within the Arroyo Colorado basin, which drains directly into Laguna Madre, a barrier island lagoon of the Gulf of Mexico, approximately 34 kilometers (km) (21 miles [mi]) northeast of the project site. The project site is drained to the northeast toward an unnamed tributary of the Arroyo Colorado.

2.2 GEOLOGY AND GEOMORPHOLOGY

The project area is underlain by floodplain alluvial deposits (Qam), which along the lower course of the Rio Grande consist predominantly of mud with varying fractions of silt, sand, clay, and gravel (Fisher 1976). Specifically, the project area is underlain by the Mercedes clay, 0 to 1% slopes soil unit (MEA) (Figure 3) (NRCS 2012), which consists of calcareous clayey alluvium found on delta plains. A typical profile of this soil type consists of deep, undifferentiated deposits of clay extending to depths of more than 188 centimeters (cm) (74 inches [in]) below surface. This soil is moderately well drained and tends to have a relatively flat surface.

2.3 CLIMATE

The climate in Cameron County is generally mild in the winter, with an average temperature of 55.5 degrees. In the summer months, the average temperature is 84.7 degrees, with an average daily maximum temperature of 97.2 degrees. The average annual total precipitation is about 23.42 inches. Of this, about 21.08 inches, or 90%, usually falls in February through November. Thunderstorms occur on about 37 days each year, with most occurring in May.

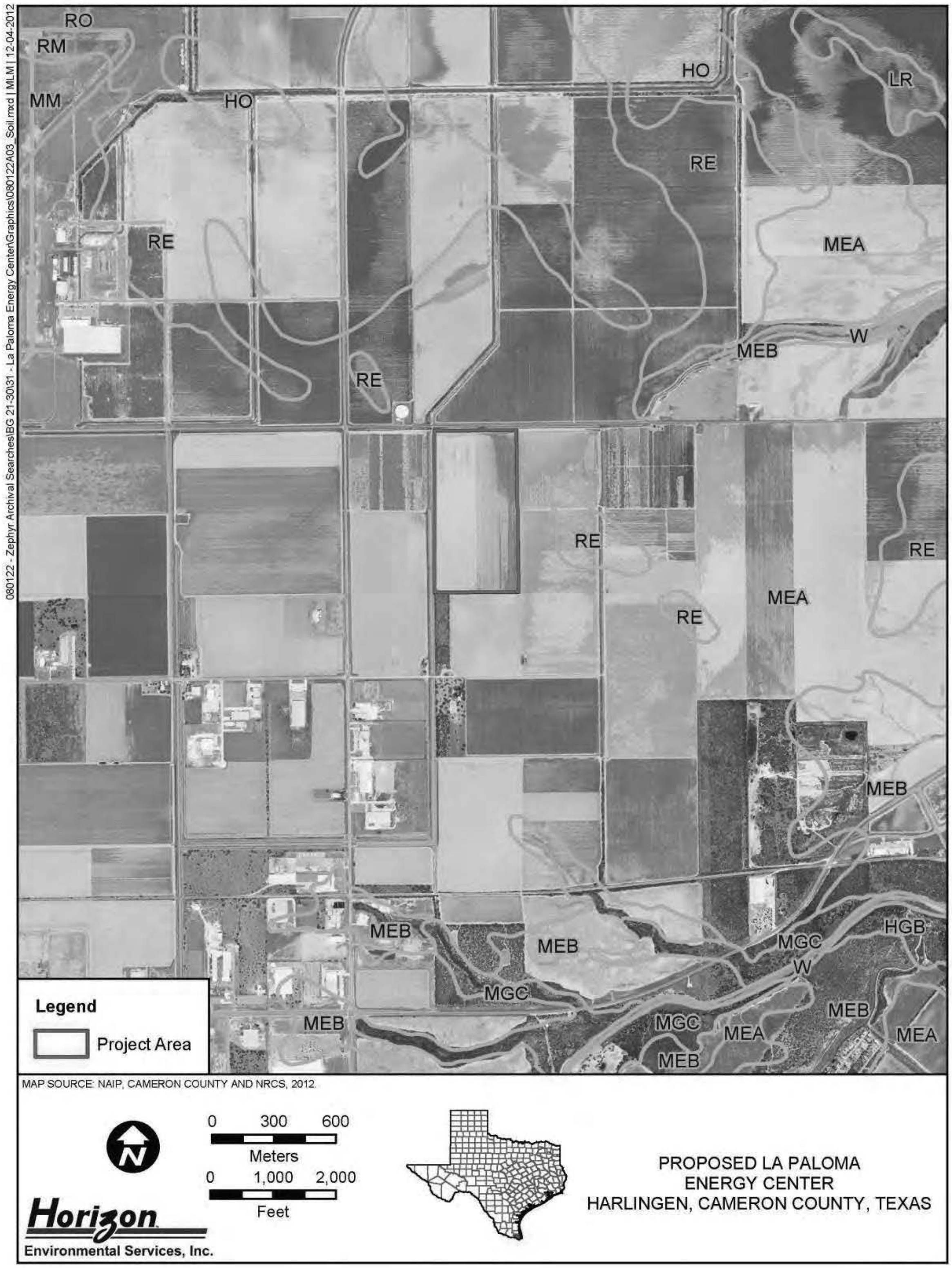

Figure 3. Distribution of Mapped Soils in Project Area

2.4 FLORA AND FAUNA

The project site is located in the Tamaulipan Biotic Province (Blair 1950) and the South Texas Plains vegetational region (Gould 1975). The upland areas support a rich tapestry of south Texas chaparral. The vegetation of the undeveloped and uncleared areas can be characterized as brush country, with variably dense scrub ranging in height from 4.0 to 10.0 feet. Mesquite and associated thorny shrubs, such as catclaw acacia, huisache, blackbrush, granjeno, whitebrush, prickly pear, and Spanish dagger are common locally. Understory vegetation is characteristically sparse. Along major drainages, live oak, Texas ebony, Texas sugarberry, cedar elm, and retama occur. Little bluestem, bristlegrass, paspalums, windmill grass, and buffelgrass are dominant grasses.

The Tamaulipan/Mezquital ecoregion of southern Texas and northeastern Mexico has unique plant and animal communities containing tree- and brush-covered dunes, wind tidal flats, and dense native brushland. Although there are large acreages of cultivated land on the South Texas Plains, most of the area is still rangeland. Land holdings predominantly are large cattle ranches. Deer and other wildlife species are common. This area originally supported a grassland- or savannah-type climax vegetation. Long continued grazing and other factors have altered the plant communities to such a degree that ranchmen of the region now face a severe brush problem (Gould 1975).

3.0 CULTURAL BACKGROUND

The prehistory of South Texas can essentially be divided into 3 major periods: (1) Paleoindian (9200–6000 BC); (2) Archaic, which has been subdivided into the Early Archaic (ca. 6000–2500 BC), Middle Archaic (ca. 2500–400 BC), and Late Archaic (ca. 400 BC–AD 800); and (3) Late Prehistoric (AD 800–1600). These prehistoric periods are principally defined by the presence of particular diagnostic projectile points, but they are intended to designate general cultural patterns based on ecology, technology, and subsistence strategies (Black 1989:48-57; Suhm et al. 1954).

3.1 PALEOINDIAN PERIOD (CA. 9200–6000 BC)

Evidence of Paleoindian occupations in South Texas (9200–6000 BC) usually consists of surface finds found most frequently in the Nueces-Guadalupe and Rio Grande plains. Only 2 stratified Paleoindian sites have been excavated in the region: Buckner Ranch (Sellards 1940) and Berger Bluff (Brown 1987). Both sites were deeply buried in alluvial terraces. Diagnostic projectile point styles of the Paleoindian period include Clovis (Meltzer 1986), Folsom (Largent et al. 1991), Golondrina, Scottsbluff, and Angostura (Black 1989:48-49). Finely flaked end scrapers fashioned on blades and bifacially worked Clear Fork tools are also diagnostic of the Paleoindian period. Paleoindian peoples have traditionally been characterized as terminal Pleistocene big-game hunters, but these highly mobile hunter-gatherers probably exploited a rich diversity of wild plant and animal foods. Investigations at Baker Cave, for instance, indicate that a diverse array of fish, snakes, and rodents was exploited by the Paleoindian occupants (Hester 1983). Paleoindian populations were probably organized into small groups that ranged over great distances across periglacial plains and marginally forested areas to acquire different food sources throughout the year (Black 1989:48).

3.2 ARCHAIC PERIOD (CA. 6000 BC–AD 800)

The major distinction of the Early Archaic period (6000–2500 BC) is the replacement of earlier lanceolate-shaped projectile points by stemmed and corner-notched types. These styles include Bell, Andice, Early Triangular, and Early Expanding Stemmed points such as Bandy, Martindale, Uvalde, and related forms (Turner and Hester 1999). Other diagnostic artifacts include Clear Fork tools and large, thin, triangular bifaces with concave bases. The beginning of the Early Archaic period marks the onset of the modern Holocene era, during which the periglacial climate of the late Pleistocene began to grow warmer. Available evidence from the

Gulf Coastal Plain suggests that population densities remained low through the beginning of the Archaic period in South Texas, reflecting a continuation of the highly mobile adaptations of the Paleoindian period.

The Middle Archaic period (2500–400 BC) in South Texas is defined by the presence of Pedernales, Langtry, Kinney, Bulverde, and Tortugas projectile point styles (Bell 1958; Turner and Hester 1999). Distally beveled tools are also common during this period, and ground stone tools, such as tubular grinding stones and manos, appear for the first time (Black 1989:49). Site densities in South Texas increase markedly during the Middle Archaic, possibly reflecting a decrease in group mobility and/or an increase in territoriality among groups (Black 1989:51). A heavier reliance on vegetal foods may be indicated by the introduction of ground stone technology and the appearance of large burned rock middens throughout Central Texas.

Late Archaic (400 BC–AD 800) occupations in South Texas are defined by small corner- and side-notched dart points, including Ensor, Frio, Marcos, Fairland, and Ellis types (Bell 1958, 1960; Turner and Hester 1999). Site densities continue to increase throughout the Late Archaic period, possibly indicating that population densities continued to rise. Cultural deposits on Late Archaic sites also tend to be deeper than during preceding periods, suggesting that occupations were either more extended in duration or that reoccupation of the same locations was more frequent (Black 1989:51). Cemeteries appear during this period, possibly indicating higher levels of social organization and increasing territoriality (Black 1989:51). During the Late Archaic, the exploitation of different ecological niches continued to intensify, becoming increasingly oriented toward the exploitation of seasonal food sources. This kind of adaptation is best illustrated by the frequent occurrence of shell middens along the coast and burned rock middens farther inland. Data collected from inland sites indicate that the economy was based primarily on vegetal resources supplemented with the hunting of small game such as rodents and rabbits (Black 1989:51).

3.3 LATE PREHISTORIC PERIOD (CA. AD 800–1600)

The onset of the Late Prehistoric period is defined by the appearance of pottery and the bow and arrow. The small dart points of the Late Archaic period were largely replaced by arrow points (Black 1989:52). The Late Prehistoric period in South Texas has been divided into 2 distinct time horizons, the Austin (AD 800–1350) and Toyah (AD 1350–1600) phases (Black 1986). The Austin phase is characterized by the presence of Scallorn arrow points, while the Toyah phase is defined by the presence of Perdiz arrow points. Faunal resources became increasingly important during this period, especially large mammals such as bison and deer. Lithic tool kits seem to have been manufactured for the processing of large mammals (Black 1989:51-57). Late Prehistoric sites are relatively common throughout South Texas, which might be interpreted as the result of population increases. The movement of bison from Central to South Texas may coincide with a movement of peoples and/or technology from both the Austin and Toyah phases of Central Texas (Black 1989:51-57).

3.4 HISTORIC PERIOD (CA. AD 1520 TO PRESENT)

The historic era of South Texas began with the arrival of Europeans in the region and can be subsumed within the overall history of Texas. In South Texas, the historic era has been divided into 3 time periods: (1) Spanish Exploration and Colonial (ca. AD 1520–1821); (2) Mexican (1821–1836); and (3) Texas-American (ca. 1836 to present). The Protohistoric era in this region can generally be incorporated within the early part of the Spanish Exploration and Colonial period.

Protohistoric

Records from the initial Spanish expeditions provide the earliest ethnohistoric accounts of the Coahuiltecan-affiliated groups indigenous to the Rio Grande Plain (Hester 1989a:1-4; 1989b:77-82). Based on fragmentary ethnohistorical records, it appears that these people—part of an extinct cultural group that occupied lands stretching from South Texas deep into Mexico—were highly nomadic hunter-gatherers who moved in a seasonal pattern within distinctive territories (Hester 1989a). Available evidence suggests that Coahuiltecans living in the Rio Grande Plain (as well as in other parts of South Texas and northern Mexico) subsisted on a number of seasonal food sources, ranging from prickly pear in the fall to bison or deer in the late fall or winter, as well as small mammals and roots during off-seasons or in times of hardship (Hester 1989b:77-81).

Two causes can be cited for the early destruction of the Coahuiltecan groups on the Rio Grande plain. The primary reason stems from the great period of unrest among Native American groups generated by the introduction of the horse by the Spanish. Groups who adopted the horse (especially the Apache and the Comanche) eagerly took to raiding neighboring groups. Nomadic peoples such as the Coahuiltecans were especially vulnerable to such pressure, as they could neither consolidate for protection nor occupy defensible positions without risking starvation. Therefore, finally, the Coahuiltecans asked for missions to be established in their territories in order to protect them from the Apache and Comanche raiders. After the establishment of the Spanish missions in South Texas during the first half of the 18th century, the remnants of the indigenous Native American groups were rapidly integrated into the mission system or were subjected to outright extinction by depredation or disease (John 1975:171-174).

Spanish Colonial

The first European incursion into Texas was by Alvarez de Pineda in 1513 during the course of a Spanish mapping expedition. In 1528, Cabeza de Vaca crossed South Texas after being shipwrecked along the Texas Coast near Galveston Bay (Folan et al. 1989:85). Between 1688 and 1717, Spanish explorers such as Mazanet and Espinosa passed through the Rio Grande Plain from Mexico on their way to the Caddoan settlements in northeast Texas (Hester 1989b:80-81). These early Spanish explorers recorded observations about the aboriginal groups in the region, but they were primarily engaged in consolidating territory for the Spanish Crown.

Following the founding of San Antonio in 1718, the town of Laredo was established along the Rio Grande in 1755 when rancher Tomas Sanchez de la Berrera y Gallardo was granted permission by the great Spanish colonizer, Jose de Escandon, to form a new settlement. Located in the province of Nuevo Santander, which included most of northeastern Mexico and parts of present-day Texas, Laredo was one of a series of settlements that Escandon established or authorized as part of Spain’s effort to colonize the area south of the Nueces River (Clark and Juarez 1986:85; Folan et al. 1986:6).

Mexican and Texas-American

Prior to the Treaty of Guadalupe Hidalgo, a Spanish garrison was established in Laredo to minimize the effects of depredations by Lipan Apache and Comanche raiders. In 1790, a daring attack on the city overran the garrison and exploded the powder magazine, deepening fears “that the Comanches’ efforts to sweep through south Texas were succeeding” (Briggs 1982:7). Once the Texas-Mexico border was established along the Rio Grande in 1848, the role of protection in the Laredo area passed to the United States. In 1849, a company of mounted infantry under 2nd Lieutenant E.L. Viele arrived to establish an army post on “some high flats west of the city, opposite a ford and just north of a bend in the Rio Grande” (Briggs 1982:7) on the Texas side of the river about 3/4 of a mile west of the old Spanish town of Laredo. Originally named Camp Crawford (or Camp Laredo), the name of the post was changed in 1850 to Fort McIntosh in honor of Lieutenant Colonel James S. McIntosh, who died in September 1847 from wounds received at the Battle of Molino del Rey during the Mexican-American War (Frazer 1972). When construction began in 1850, the general military objective of the fort was to provide “escort service to caravans of travelers and [to reduce] Indian depredations and general outlawry” (Briggs 1982:8).

4.0 RESEARCH OBJECTIVES AND METHODOLOGY

The archeological survey described in this report was undertaken with 3 primary research goals in mind:

1. To locate and record cultural resources occurring within the designated project area
2. To provide a preliminary assessment of the significance of these resources regarding their potential for inclusion in the National Register of Historic Places (NRHP)
3. To make recommendations for the treatment of these resources based on their NRHP assessments

The first of these goals was accomplished by means of a review of documentation on file at the Texas Historical Commission's (THC) online *Texas Archeological Sites Atlas* (Atlas), the National Park Service's (NPS) online *National Register Information System* (NRIS), the Texas State Historical Association's (TSHA) *Handbook of Texas Online*, as well as a program of intensive pedestrian survey. No cultural resources were documented within the project area as a result of the survey; as a result, the second and third goals were not brought into play. The rest of this chapter presents the results of archival research, the methodological background for the current investigations, and the specific survey methods used in the field.

4.1 ARCHIVAL RESEARCH

Prior to initiating fieldwork, Horizon personnel reviewed existing information on the THC's online Atlas (THC 2012) and the NPS's NRIS database (NPS 2012) for information on previously recorded archeological sites, cemeteries, and historic properties as well as previous cultural resources investigations conducted within a 1.6-km (1.0-mi) radius of the project area. This archival research indicated the presence of 1 previously recorded archeological site (41CF196) within a 1.0-mile radius of the project site (Table 1) (THC 2012), while a review of the National Park Service's (NPS) NRHP Google Earth map layer indicated the presence of no historic properties listed on the NRHP within the review area (NPS 2012).

Recorded in 2005 during a cultural resources survey for a proposed pipeline, site 41CF196 was described as a surficial aboriginal lithic artifact scatter in a plowed agricultural field (Brownlow 2005). The site was recommended as ineligible for inclusion in the NRHP based on its disturbed context in a plowed agricultural field and its lack of subsurface cultural

Table 1. Summary of documented cultural resources within 1.0 miles of Project Area

Site No.	Site Type	NRHP Eligibility	Distance/Direction from Project Area	Potential to be Impacted by Project?
41CF196	Aboriginal lithic scatter (undated prehistoric)	Recommended ineligible	0.7 miles northeast	No

NRHP National Register of Historic Places

deposits. The proposed pipeline right-of-way (ROW) associated with this prior survey was subsequently rerouted in such a way that site 41CF196 would be avoided; as a result, the site was not included in the final report for the project and the THC did not review the NRHP eligibility recommendation associated with this site.

No previously recorded archeological sites, cemeteries, or historic properties, including any listed on the NRHP, are located within or immediately adjacent to the boundaries of the APE. Based on the Atlas data, no previous cultural resources surveys have been undertaken within the boundaries of the project site.

Prehistoric archeological sites are commonly found in upland areas and on alluvial terraces near stream and river channels. The proposed LPEC project site is located in an active agricultural field situated on calcareous, clayey alluvial deposits. Based on the location of the project site within an agricultural field set away from extant water sources and the low density of recorded cultural sites in the surrounding area, it is Horizon's opinion that there exists a low potential for intact, undocumented aboriginal cultural resources within the boundaries of the proposed project site.

In regard to historic-era resources, the lack of visible structures in proximity to the project site on topographic and aerial maps of the project area suggests a low potential for historic-era architectural or archeological resources within the limits of the proposed project site.

4.2 SURVEY METHODS

On December 5, 2012, Horizon archeologists Michael Mudd and Jared Wiersema, under the overall direction of Russell K. Brownlow, Principal Investigator, performed an intensive cultural resources survey of the APE to locate any cultural resource properties that potentially would be impacted by the proposed undertaking. The APE of the proposed undertaking consists of the proposed 32-ha (78-ac) LPEC site.

Horizon's archeologists traversed the 32-ha (78-ac) APE on foot in parallel transects spaced no more than 30 m (100 ft) apart and thoroughly inspected the modern ground surface for aboriginal and historic-age cultural resources. The APE consisted of an active agricultural field that had been recently plowed, though no crops had been planted at the time of the survey (Figures 4 to 6). No vegetation was present in the agricultural field, and visibility was excellent (100%) across the entire project area.

Figure 4. Overview of Project Area from Northwest Corner (Facing South)

Figure 5. Overview of Project Area from Northwest Corner (Facing Southeast)

Figure 6. Overview of Project Area from Southern Boundary (Facing North)

In addition to pedestrian walkover, the Texas State Minimum Archeological Survey Standards (TSMASS) for cultural resource surveys state that, for block-area projects, a minimum of 1 subsurface probe (i.e., shovel tests, auger tests, backhoe trenches) is required per 2 acres for projects the size of the current project's APE unless field conditions warrant excavation of more probes (e.g., due to the presence of culturally sensitive areas) or less probes (e.g., due to extensive prior disturbances or cultural low-probability areas). In the event that a probe yields evidence of subsurface cultural deposits, additional probes may be necessary to determine the horizontal and vertical extent of the subsurface deposits associated with the cultural resource. Thus, a minimum of 39 subsurface probes would be required within the proposed project's 32-ha (78-ac) APE. Horizon excavated a total of 41 shovel tests in the APE, thereby exceeding the TSMASS requirements for a project area of this size (Figure 7). In general, shovel tests measured approximately 30 cm (12 in) in diameter and were excavated to a target depth of 1.0 m (3.3 ft) below ground surface, to the top of pre-Holocene deposits, or to the maximum depth practicable, and all sediments were screened through 6.35-millimeter (mm) (0.25-in) hardware cloth. In practice, shovel tests were terminated at depths of 10 to 40 centimeters (cm) below surface (cmbs) less than 1.0 m (3.3 ft) below surface due to the presence of pre-Holocene sediments composed of dense, calcareous clay underlying a shallow, 30- to 40-cm-deep disturbed plowzone. The Universal Transverse Mercator (UTM) coordinates of all shovel tests were determined using hand-held Garmin ForeTrex Global Positioning System (GPS) devices based on the North American Datum of 1983 (NAD 83). Specific shovel test data are summarized in Appendix A.

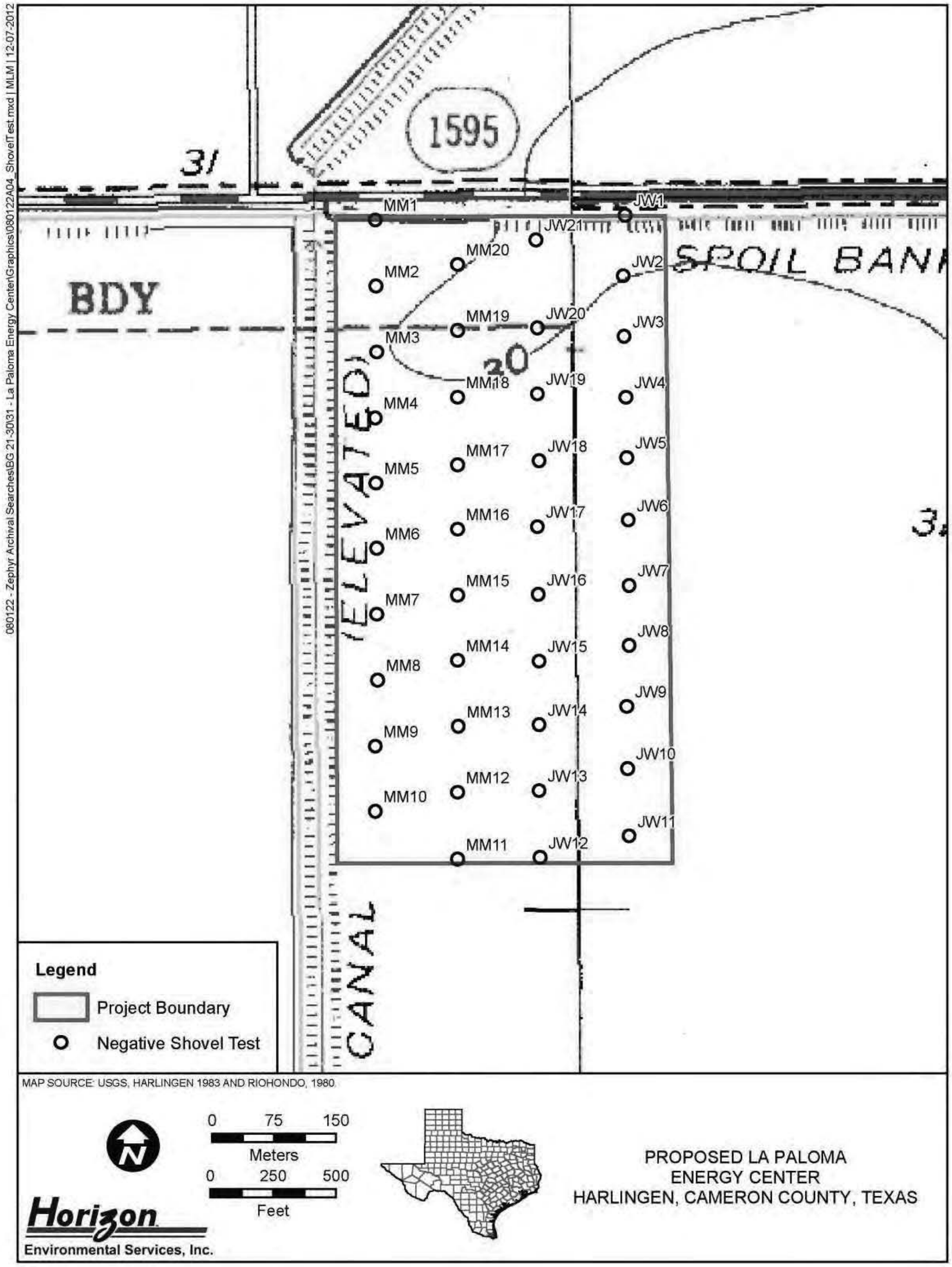

Figure 7. Locations of Shovel Tests Excavated in Project Area

The TSMASS also require backhoe trenching in stream terraces and other areas with the potential to contain buried cultural materials at depths below those that shovel tests are capable of reaching. Shovel testing revealed that sediments in the project area consisted of a shallow, 30- to 40-cm-deep, disturbed plowzone underlain by dense, calcareous, pre-Holocene clay sediments. Based on the physiographic setting of the project area in an active agricultural field set away from extant water sources and the soil characteristics observed in shovel tests, surface inspection with shovel testing constituted an adequate survey technique for identifying cultural resources within the APE, and no backhoe trenching was warranted.

The survey methods employed during the survey represented a “reasonable and good-faith effort” to locate significant archeological sites within the project area as defined in 36 Code of Federal Regulations (CFR) 800.3.

5.0 RESULTS OF INVESTIGATIONS

Horizon was selected by Zephyr, on behalf of La Paloma, to conduct an intensive cultural resources inventory and assessment of the proposed location of the LPEC located at 24684 FM 1595, Harlingen, Cameron County, Texas. La Paloma is proposing to construct a new natural gas fired, combined cycle electric generating plant. The LPEC would consist of 2 natural gas fired combustion turbines, each exhausting to a fired HRSG to produce steam to drive a shared steam turbine. Construction of the LPEC, associated infrastructure, and auxiliary equipment would take place within a proposed 32-ha (78-ac) project site. Currently, the site is an agricultural field utilized for growing cotton. Due to the nature of the soils on-site, the proposed facility would be installed on spread-footing foundations that would be formed and poured in excavations throughout the site. The topsoil on the site would be removed and replaced with structural fill material in the area of the power-generating equipment. The primary foundations for the gas turbines, boilers, and steam turbine pedestal would be excavated 1.8 to 2.4 m (6.0 to 8.0 ft) below surface and would be backfilled with imported sediments when completed. The APE of the proposed undertaking consists of the entire proposed 32-ha (78-ac) LPEC site.

As construction of the proposed facility would require a PSD permit for Greenhouse Gasses (GHG) issued by the US EPA, the undertaking falls under the regulations of Section 106 of the NHPA of 1966, as amended, which is invoked when federal funds are utilized or when federal permitting is required for a proposed project. The NHPA states that the ACHP and the THC, which serves as the SHPO for the state of Texas, must be afforded the opportunity to comment when any cultural resources potentially eligible for inclusion in the NRHP are present in a project area affected by federal agency actions or covered under federal permits or funding.

On December 5, 2012, Horizon archeologists Michael Mudd and Jared Wiersema, under the overall direction of Russell K. Brownlow, Principal Investigator, performed an intensive cultural resources survey of the APE to locate any cultural resource properties that potentially would be impacted by the proposed undertaking. Horizon's archeologist traversed the 32-ha (78-ac) APE and thoroughly inspected the modern ground surface for aboriginal and historic-age cultural resources. Horizon's archeologists traversed the 32-ha (78-ac) APE and thoroughly inspected the modern ground surface for aboriginal and historic-age cultural resources. The APE consisted of an active agricultural field that had been recently plowed, though no crops had been planted at the time of the survey. No vegetation was present in the agricultural field, and visibility was excellent (100%) across the entire project area. Horizon excavated a total of 41 shovel tests in the 32-ha (78-ac) APE, thereby exceeding the TSMASS requirements for a project area of this size.

No cultural resources, historic or prehistoric, were identified within the APE as a result of the survey.

6.0 SUMMARY AND RECOMMENDATIONS

6.1 CONCEPTUAL FRAMEWORK

The archeological investigations documented in this report were undertaken with 3 primary management goals in mind:

- Locate all historic and prehistoric archeological resources that occur within the designated survey area.
- Evaluate the significance of these resources regarding their potential for inclusion in the NRHP and for designation as State Archeological Landmarks (SALs).
- Formulate recommendations for the treatment of these resources based on their NRHP and SAL evaluations.

At the survey level of investigation, the principal research objective is to inventory the cultural resources within the APE and to make preliminary determinations of whether or not the resources meet one or more of the pre-defined eligibility criteria set forth in the state and/or federal codes, as appropriate. Usually, management decisions regarding archeological properties are a function of the potential importance of the sites in addressing defined research needs, though historic-age sites may also be evaluated in terms of their association with important historic events and/or personages. Under the NHPA and the Antiquities Code of Texas, archeological resources are evaluated according to criteria established to determine the significance of archeological resources for inclusion in the NRHP and for designation as SALs, respectively.

Analyses of the limited data obtained at the survey level are rarely sufficient to contribute in a meaningful manner to defined research issues. The objective is rather to determine which archeological sites could be most profitably investigated further in pursuance of regional, methodological, or theoretical research questions. Therefore, adequate information on site function, context, and chronological placement from archeological and, if appropriate, historical perspectives is essential for archeological evaluations. Because research questions vary as a function of geography and temporal period, determination of the site context and chronological placement of cultural properties is a particularly important objective during the inventory process.

6.2 Eligibility Criteria for Inclusion in the National Register of Historic Places

Determinations of eligibility for inclusion in the NRHP are based on the criteria presented in the Code of Federal Regulations (CFR) in 36 CFR §60.4(a-d). The 4 criteria of eligibility are applied following the identification of relevant historical themes and related research questions:

> The quality of significance in American history, architecture, archeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:
>
> a. [T]hat are associated with events that have made a significant contribution to the broad patterns of our history; or,
>
> b. [T]hat are associated with the lives of persons significant in our past; or,
>
> c. [T]hat embody the distinctive characteristics of a type, period, or method of construction, or that represent a significant and distinguishable entity whose components may lack individual distinction; or,
>
> d. [T]hat have yielded, or may be likely to yield, information important in prehistory or history.

The first step in the evaluation process is to define the significance of the property by identifying the particular aspect of history or prehistory to be addressed and the reasons why information on that topic is important. The second step is to define the kinds of evidence or the data requirements that the property must exhibit to provide significant information. These data requirements in turn indicate the kind of integrity that the site must possess to be significant. This concept of integrity relates both to the contextual integrity of such entities as structures, districts, or archeological deposits and to the applicability of the potential database to pertinent research questions. Without such integrity, the significance of a resource is very limited.

For an archeological resource to be eligible for inclusion in the NRHP, it must meet legal standards of eligibility that are determined by 3 requirements: (1) properties must possess significance, (2) the significance must satisfy at least 1 of the 4 criteria for eligibility listed above, and (3) significance should be derived from an understanding of historic context. As discussed here, historic context refers to the organization of information concerning prehistory and history according to various periods of development in various times and at various places. Thus, the significance of a property can best be understood through knowledge of historic development and the relationship of the resource to other, similar properties within a particular period of development. Most prehistoric sites are usually only eligible for inclusion in the NRHP under Criterion D, which considers their potential to contribute data important to an understanding of prehistory. All 4 criteria employed for determining NRHP eligibility potentially can be brought to bear for historic sites.

6.3 Summary of Inventory Results

Horizon archeologists performed an intensive cultural resources survey of the APE to locate any cultural resource properties that potentially would be impacted by the proposed undertaking. The APE was traversed by Horizon's archeologists, the modern ground surface was thoroughly inspected for cultural resources, and a total of 41 shovel tests were excavated within the APE. The TSMASS requirements were exceeded for a project area of this size. No cultural resources, historic or prehistoric, were identified within the APE as a result of the survey.

6.4 Management Recommendations

Based on the results of the survey-level investigations documented in this report, no potentially significant cultural resources would be affected by the proposed undertaking. In accordance with 36 CFR 800.4, Horizon has made a reasonable and good faith effort to identify archeological historic properties within the APE. No archeological resources were identified that meet the criteria for inclusion in the NRHP according to 36 CFR 60.4, and no further archeological work is recommended in connection with the proposed undertaking. However, in the unlikely event that any human remains or burial accoutrements are inadvertently discovered at any point during construction, use, or ongoing maintenance in the project area, even in previously surveyed areas, all work should cease immediately and the THC should be notified of the discovery.

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