DECOMMISSIONING STUDY FOR GEOTHERMAL FACILITIES

DRAFT Capital Cost Estimate

B&V PROJECT NO. 193130
B&V FILE NO. 40.0000

PREPARED FOR

Northern California Power Agency

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Executive Summary

Black & Veatch has evaluated the potential costs to decommission or demolish NCPA's geothermal facilities[1] and has defined other associated issues. This study includes the following activities associated with retiring the geothermal facilities:

- **Decommissioning –** Analyze the geothermal facility' systems to determine cost effective options for unit shutdown and demolition.
- **Environmental –** Identify potential environmental hazards associated with the geothermal facilities.
- **Capital Cost Estimate –** Develop cost estimates for demolition of plant equipment in today's dollars and, using Producer Price indexes, project future project capital costs.
- For the purpose of this study, retirement and decommissioning both refer to the formal process of removing an electric generating unit, and other associated equipment, from active service in a manner that it can no longer be used to generate electricity. Demolition is defined as the tearing down and removal of equipment, buildings, and structures (while potentially preserving valuable components and materials for reuse). Demolition does not refer to the process or actions taken to remove a piece of equipment for resale and reuse, which is more involved and typically requires skilled labor.

Black & Veatch has determined that the estimated capital cost to decommission and demolish the geothermal facilities is estimated at $59,300,000.

[1] This retirement, decommissioning, and demolition study is not intended to be, and should not be construed as, advice concerning legal obligations or a recommendation concerning the timing, scope or necessity to conduct any related activity. Black & Veatch has assumed that the limited information, both verbal and written, provided by others is complete and correct; however, Black & Veatch does not guarantee the accuracy of the information, data, or opinions contained herein.

1.0 Introduction

1.1 FACILITY DESCRIPTION

The geothermal facilities consist of two similar power plants, a steam field, and a gathering and distribution system spread across a large area. The steam field consists of a total of 12 well pads and 81 wells between both plants. The steam field is divided in two section areas, one for each plant with a crosstie between them. Support for these plants includes a steam field control room, a pipe yard, and an effluent water pumping system. There is an effluent pumping system (Southeast Geysers Effluent Pipeline) encompasses 6 miles of 21kV lines and poles, a fiber optic system, a 6 mile underground 12 inch pipeline, and four pump stations.

Plant 1 consists of two steam turbines, a condenser, a cooling tower, and all associated equipment. The Plant 2 Unit 4 steam turbine has the same equipment as note for Plant 1 and is fully operational. The Plant 2 Unit 3 steam turbine does not generate. The cooling tower has been demolished, but the Cooling Tower basin still remains. There are also two 1 MW photovoltaic solar plants that provide electricity for the effluent pumps, one at the Clear Lake pumping station and the other at the Middletown Treatment Facility.

2.0 Geothermal Facilities Demolition Project Approach

Black & Veatch's project approach was split into several tasks. These include:

- Review of data provided by NCPA.
- Desktop review for the demolition of the geothermal facilities.
- Consider environmental hazards associated with the geothermal facilities' demolition process.

Black & Veatch's approach to estimate these costs was based on the use of a proprietary estimating spreadsheet developed for previous generating station decommissioning and demolition studies. Where possible, configuration data from the geothermal facilities' drawings, and other technical resources provided by the NCPA was used to populate the spreadsheet. When site specific data was not available, typical data was supplemented from Black & Veatch in-house databases and information from previous projects. A general set of decommissioning assumptions was developed to guide the analysis based on the project kick-off conference call held on July 28, 2016. These discussions focused on safety and security requirements, potential hazardous materials that would be encountered during demolition, any equipment to remain in service (if applicable), and final site condition requirements.

The retiring and disposing of a power plant can require close coordination with the regulatory agencies. There are several groups which administer regulations associated with air quality, surface water quality, ground water quality, solid waste management, hazardous waste, and petroleum storage tanks. There are no regulations which relate specifically to the dismantling of electric generating plants. The existing permits may contain limited closure guidelines or specific conditions. However, as more power generating facilities are retired these requirements could evolve in future years. Black & Veatch did not consult with or seek clarification from government agencies to confirm current or future anticipated decommissioning permitting requirements and processes. Therefore, during the next phase of the study, it is recommended that NCPA work closely with the various agencies during the planning stage to identify and negotiate specific closure requirements.

A decommissioning and demolition (D&D) plan, including a constructability analysis, was not completed as part of this estimate. It is recommended for the next phase of this project that a D&D plan is developed as it is a valuable roadmap to the deconstruction, final functionality (as applicable), and appearance of the facility and is recommended as part of any future project. This document can further define the project and enhance the accuracy of the cost estimate.

Based on discussions with NCPA, the Geothermal facility equipment was broken down into ten groups which are reasonable depictions of facility systems for the purposes of this estimate. The systems for each group include the following and are illustrated in Appendix A:

- Group 1 includes Plant 1, steam field office, admin building, welding shack, seven (7) transmission towers and pump station at holding pond 1.
- Group 2 includes Plant 2, two (2) transmission towers and pump station at holding pond 2.
- Group 3 includes well pads, steam lines, guard shack, yellow road gate along bear creek road, sedimentation basin, and drilling shed at well site "B".
- Group 4 includes water effluent line from the Middletown Treatment Facility.

- Group 5 includes main transmission lines and main transmission tower.
- Group 6 includes Middle town solar ray (near Southwest Treatment Plant).
- Group 7 includes Clear Lake solar ray (near Bear Canyon Pump Station).
- Group 8 includes 23kV transmission line to pump stations.
- Group 9 includes pump stations 1 through 3.
- Group 10 includes pump station 0 (zero).

The following sections describe the assumptions and observations based on review of the available information and the site visit conducted on August 24-25, 2016 to support this cost estimate.

2.1 SCENARIO SPECIFIC ASSUMPTIONS

For purposes of the cost estimate, Black & Veatch's general assumptions include the following:

- The cost estimate has an accuracy level equivalent to AACE Class 4.
- The availability of supporting information for the decommissioning study was limited. This includes quantities and weights of equipment and materials, Engineering Data Manuals, and construction contractor "close-out" manuals or reports. Wherever specific quantities were not readily available, Black & Veatch used estimates and typical quantities based on our experience and previous projects to populate the cost development spreadsheets.
- The geothermal facilities equipment to be decommissioned and demolished will be modified and put into in a safe and secure condition by NCPA with no effort to preserve the equipment for later return to service or sale of equipment on the grey market.
- All equipment and materials are considered for scrap value only; no equipment salvage values were utilized. No resale or reuse of the plant components was included as part of the costs.
- Nonessential equipment and systems will be prepared by NCPA for permanent shutdown and removal.
- The transmission system connecting the geothermal facilities to the main grid will be removed as part of this analysis.
- For the purpose of this study, all piping and equipment, except known to be hazardous materials such as the cooling tower pressure treated wood portion, will be assumed as non-hazardous material. In discussions with NCPA it is understood that there is the potential for scaling of arsenic (and potentially other contaminants) in the steam piping, fire water piping, cooling water piping, steam turbine, steam ejectors, condensate ball cleaning systems, vacuum pumps, condensers, condensate pumps, circulating water pumps, auxiliary cooling water pumps, fire pumps, and other equipment that delivers steam or plan water, and the Stretford H_2S Abatement System, but no testing and analysis information is available. Therefore, no assumptions have been included for hazardous material abatement or on-site cleaning, or hazardous material disposal of the equipment.
- Where possible, nonhazardous (non-salvageable) materials from the decommissioning and demolition activities will be disposed off-site in a nearby landfill. Costs have been included to haul materials up to a distance of 50 miles.
- The estimate assumes that all concrete and rebar will be processed on-site by the demolition contractor.

- Concrete and asphalt materials will be used as on-site backfill material.
- As part of the demolition activities, existing asphalt roadbeds and parking areas around the Admin building, power block, and parking areas will be removed.
- All materials and equipment used to operate the geothermal plants, well pads, and pump stations' equipment (as applicable) will be removed by NCPA and associated costs or revenue are not included in the estimate. These include:
    - Plant operating fuels (i.e., fuel oil, gasoline, etc.).
    - Chemicals.
    - Fluids in tanks, pipes, barrels, storage areas, and other container and media.
    - Spare parts, tools, etc.
    - Any equipment that is not tied down by anchor to the foundation.
    - Any radioactive equipment, as applicable.
    - All mobile equipment and vehicles.
    - Disposal of office furniture, office equipment, and spare parts inventory were not considered.
- The estimate assumes that all the identified plant systems for decommissioned equipment will be de-energized, drained and tagged-out of service by NCPA.
- Construction power and potable and non-potable water is assumed to be available at the station for decommissioning activities.
- The facility's current security fence will be used during construction to control access to the decommissioned area during demolition activities and will be removed for final site grading. Due to the limited access to the well pads and steam gathering piping, no construction or security fence has been assumed.
- Plant insurance, legal fees, permits, and property tax adjustments, other administrative fees, and other potential community engagement costs are not included.
- The duration of this decommissioning scenario is 24 months.

2.1.1 Civil/Structural Observations

2.1.1.1 Scenario Specific Assumptions

- Remove foundations to a depth of 2'.
- Foundations that consists of an open basin below grade such as the cooling tower and sedimentation basin will be removed to a depth of 2'. The existing bottom slab shall be broken up to allow for water drainage then the structure will be backfilled with concrete chippings or clean soil to a depth equal to natural grade.
- All existing roads will remain in place. NCPA noted that the Federal Land Managers would likely require the access roads to remain intact.
- Existing asphalt helipad to the west of Plant 1 will remain.
- Existing drainage culverts next to the roads and drainage ditches that go to ponds 1 and 2 will remain.
- Existing terraces around plants 1 & 2 and around the well pads will remain.

- All gravel and asphalt located within the areas around Plant 1, Plant 2, all well sites, misc. tanks, and pump houses will be used as backfill or removed and replaced native soil. Approximately 3 inches of new top soil will be added in order to bring the site back to natural grade and will be graded to allow for natural drainage. It is assumed that this natural material will be readily available on NCPA property nearby and will not be purchased and transported to the geothermal facility.
- Drilled shaft foundations that support steam lines, conduit, and condensate lines will be removed to 2' below grade and the chippings from the removal of the foundation will be used as backfill for the holes.
- The nine NCPA owned transmission towers will be removed and their foundations will be removed to 2' below grade.
- Existing NCPA guard shack located at the North side of the NCPA lease and associated road barriers will be removed.
- Bear canyon pump station 0 (zero), 1, 2, & 3 will be removed.
- Middletown and Clearlake solar stations will be removed and returned to natural grade with native grass/vegetation.
- Underground pipe less than or equal to 18 inch diameter (such as the effluent line) will be capped and abandoned in place.
- Underground pipe greater than 18 inch diameter will be backfilled with concrete slurry or similar material and abandoned in place.
- Ponds 1 & 2 will be left in place, the pumps and concrete pump structure will remain in place. Existing retaining walls next to the pumps will remain in place. The overflow culver at pond 1 and overflow spillway at pond 2 will remain in place.

2.1.2 Civil Structural Observations

The demolition of the geothermal facility will consist of a complete removal of all above grade buildings/structures, foundations to a depth of 2 feet below grade, and permanent capping of all wells. The existing land around the well sites, pump stations, solar arrays, and Plants 1 & 2 will have all asphalt and gravel removed and new native soil will be placed to match existing plant grade.

The geothermal facility should have enough open land at Plant 1 or plant 2 in order to support staging for laydown and waste materials. All demolition activities for the geothermal facility should be able to be contained within the NCPA lease.

2.1.3 Mechanical Observations

Mechanically, the Geothermal Plant 1 and Plant 2 don't share any system with each directly with the other and can be demolished with minimum provisions. As stated in Section 2.1, all piping and equipment except the cooling tower pressure treated wood portion will be assumed non-hazardous.

It was noted that Plant 2, Unit 3 is decommissioned and portion of the cooling tower was demolished. All three Unit 3 circulating water pump's motors and one pump were previously removed. The displayed old steam turbine rotors (one in each plant) will not be included in the demolition cost. Per NCPA's direction all steam blowdown tanks at the well pads will not be included in the demolition cost.

The following Geothermal major equipment will be removed during the demolition process:

- Steam Turbines
- Steam Condensers
- Condenser Tube Cleaning Systems
- Steam Ejector Systems
- Bridge Cranes
- Cooling Tower including Circulating Water Pumps
- Stretford H_2S Abatement System including tanks and pumps
- Condensate Pumps
- Clean Oil Storage Tanks and Dirty Oil Storage Tanks
- Fire Protection Pumps
- Compressed Air System including compressors, dryers and receivers
- Potable Water Storage Tanks and Pumps
- All Steam Piping
- Drip pots
- Condensate Tanks and Pumps at well pads
- Effluent Water Piping
- Water Pumps at Water Pump Stations
- Surge Tanks at Water Pump Stations

2.1.4 Electrical Observations

Electrical and Control scope at Geothermal facility includes removal of all the electrical generation and unit distribution systems at the site. This includes the two plants, the well heads, the three pump stations, two solar arrays and the transmission lines. The removal includes all the associated cable, raceway, and miscellaneous components connected to these equipment. The plant lighting and grounding system has also been identified for removal.

Please note the following:

- There are a total of 81 wells to be decommissioned. Each well has power and controls for manual isolation valves and motor operated vale.
- There are a total of 9 lattice transmission towers that needs to be decommissioned.
- Total of 15 Remote Transmission Units (RTU) at each well head. Each RTU has 480V power, controls, and telephone cables run to it.
- Out of the total 5 pump stations, only stations 1, 2 and 3 will be included in the decommissioning estimate as these are owned by NCPA.

2.1.4.1 Removal of Geothermal Plant 1 and 2

The following is a list of major electrical equipment that has been identified for removal at each plant:

- (4) LV Switchgear
- (2) 13.8 Switchgear
- (2) 2.4kV Switchgear
- (2) 230KV - 13.8KV Main Transformer 61MVA
- (2) 13.8kv - 2.4kv 2000KVA Station Service Transformer
- (4) 13.8-480V 2000KVA Load Center Transformers
- (8) 480V LV Transformers
- UPS Transformer 480-120 15KVA
- (8) 480V MCC, 600A, 6 Vertical Sections
- (2) Power Distribution Panels
- (2) Fire Protection Panels
- (15) Metering and Relaying Panels
- (2) Aux Relay Panels
- (10) I/O cabinets
- 125 V DC Switchboard
- (8) 480V Panelboards
- (3) 480/227 Panelboards
- (17) 120/208V Panel Boards

2.1.4.2 Removal of Associated Geothermal Areas

The following is a list of major electrical equipment that has been identified for removal:

- (15) 480V Power Panels
- (15) Mini Power Centers (120V Panelboard)
- (15) Dry Type Transformers
- (15) Control Cabinets

2.1.4.3 Pump Stations 0 (zero) and 1-3

- (4) 21KV- 480V Transformers 2000KVA
- (4) 480V Switchgear 2500A (8 vertical sections)
- (20) Control Cabinets
- (4) 480V Panelboards
- (4) 120V Panel boards
- (4) 480-120V Dry type Transformers

2.1.4.4 Solar Plants 1 and 2

- (5,640) Kyocera 210W PV Modules
- (376) Strings of 15 Modules each
- (4) 480V Inverters - XANTREX GT-250
- (4) Single Axis Tracking Arrays
- (4) Distribution panels for inverters
- The main Plant 1 building has a Unit 1 switchgear room and a Unit 2 Switchgear room where all the switchgears and motor control centers are located. Plant 1 also has a main control room and a DCS and Metering/relaying room.
- Plant 1 and 2 both have the Stretford preparation building that has a 480V MCC, a PLC control panel and a 120V distribution panel, the chemical storage lab that has a 480V MCC and the warehouse that has a 480/277V panelboard and two 120V distribution panels.
- The main Plant 2 building has a common switchgear room for Units 3 and 4 where all the switchgears and motor control centers are located. Plant 2 also has a main control room and a DCS and Metering/relaying room.
- The cooling tower loads are all powered and controlled from the main plant buildings for both plants.
- Each plant has a diesel generator for emergency power.
- The Steam Field Office is used as a controls junction house between Plant 1 and Plant 2. The control room at Plant 1 has the capability of controlling Plant 2 remotely. The Plant 2 control room gets status signals from Plant 1. All the control cabling between the two plants are routed through this building. The steam field building also has lighting and power distribution panels as well for the building and the offices. Additionally, the Steam Field Office has a diesel generator for emergency power.
- The administrative building is located at Plant 1 and has lighting and power supplies for the building and offices.
- There are nine (9) transmission towers that connect Plant 1 and Plant 2 to the Pacific Gas & Electric (PG&E) transmission grid. Tower 8 has disconnects for each plant.
- There are a totally of 15 well heads, and each well head has a Remote Transmission Unit (RTU). Each RTU has 480V Power Panel, 120V distribution panel and a controls cabinet. These provide power and controls to each of the well heads. Power and control cables are routed from the main plant buildings to the well heads via conduits run along the main steam pipe lines
- There are the three (3) Bear Canyon pump stations owned and operated by NCPA for the effluent line. These pump stations can be fed from Calpine Unit 16's 21kV line or from Plant 1's 21kV line. Each pump station has 21kV run to them, which is then stepped down to 480V to feed the pumps in the building. The pump stations also have lighting, power and controls for all the equipment in the building.
- NCPA also own and operates the Southeast treatment plant (1MW) and the Bear Canyon 0 (zero) (1MW) solar plants. Each solar plant has four (4) grid tie inverters that consolidate power to a distribution panel by the arrays.

- Since specific quantities of materials were not available, all cable and raceway quantities have been estimated based on the arrangement drawings and location of the electrical equipment.

2.2 COST ESTIMATE

2.2.1 Estimate Description

The decommissioning and demolition costs provided in Table 2-1 were prepared based on the assumptions and observations defined in this report. The estimate is expressed as overnight costs and excludes any forward escalation. The estimates are considered to have an AACE Class 4 accuracy level.

2.2.2 General Cost Estimate Assumptions/Clarifications

- The cost estimate is primarily based on a dismantling method that utilizes torches, shears, and other heavy equipment rather than generally utilizing explosives.
- The plant has sufficient lay down areas for staging demolition equipment, contractors' trailers, and temporary storage and breakdown of demolished materials.
- Credits for the resale of scrap metals is included for structural steel, tank metals, compressors, pumps, piping & valves, cable and conduit and electrical equipment.
- For the disposal of the pressure treated wood on the cooling towers, considered hazardous material, an allocation of $1,000,000 was included in the estimate. No vendor bids were requested.
- The estimate assumes that all scrap metal, such as: structural steel, miscellaneous steel, conduit, cable, piping, valves and equipment, will be cut to size on site for transporting in roll-off containers and 40' trailers for transporting to the nearest landfill and/or recycling centers (assumed within 50 miles of the plant). Costs for transportation are included in the scrap unit pricing in 2016 dollars.
- Scrap prices for materials can be estimated when detailed material quantities are available from historical data from previous demolition study estimates, vendor estimates, or industry internet sites like Iron Mike's Scrap Metal Services. Due to the limited detail material quantity information scrap value pricing was based on a combination of current internet pricing and 5 percent to 25 percent of the demolition costs were assumed for various equipment and materials. It should be noted that scrap values are subject to change based on daily market conditions.
- All costs are expressed in current day December 2016 U.S. dollars. Escalation is not included in this cost but is addressed in the next section.
- Wage rates are based on the state of California's Department of Industrial Relations labor rates.[2] A labor study was not performed.
- Direct costs include the costs associated with equipment rental, demolition and all contractor services.
- Demolition costs for the estimate include all contractor overhead, staff, indirect costs, and profit.

[2] http://www.dir.ca.gov/OPRL/2016-2/PWD/index.htm

- The decommissioning cost estimates are based on an EPC contracting approach.
- Contingency of 15 percent is included as an allowance for site unknowns. Time constraints and limited plant-specific information are the primary drivers of this level of contingency. This added contingency value is independent of the project costs estimate, confidence level for estimate accuracy, and goes beyond the noted project assumptions. This value has been included to capture those unforeseen project costs not identified within the scope of the project.
- Based on the ownership structure between NCPA and Calpine Corporation, the costs for Group 9 (i.e., Bear Canyon Pump Stations 1, 2, and 3 and the 21kV line) have been reduced by 50 percent to reflect NCPA's ownership.

The estimates are based on limited information provided and supplemented with Black & Veatch estimate data for similar type and size units. Salvage value estimates are based on typical salable materials and estimate quantities. Decommissioning costs and salvage values are presented in 2016 dollars. Table 2-1 summarizes the estimated decommissioning and demolition costs for the Phases.

2.2.3 Special Considerations

Several special considerations could alter these estimated decommissioning costs, including on-site investigation, identification of actual equipment and material weights, changes in environmental legislation, changes in economic considerations such as labor rates, demolition costs, or scrap values, changes disposal regulations/methods, costs for hazardous materials abatement (if found to be applicable), changes in contracting methodology, allocations for engineering and construction management, project contingency costs, changes to the location demolition materials are disposed, or a change in the future use of the site.

Table 2-1 Decommissioning and Demolition Capital Cost Estimate Summary

	LABOR COST	SUBCONTRACTOR COST	SALVAGE COST	TOTAL
Group 1	$8,294,000	$1,990,000	-$3,138,000	$7,146,000
Group 2	$6,837,000	$1,517,000	-$2,080,000	$6,274,000
Group 3	$11,823,000	$7,803,000	-$4,795,000	$14,831,000
Group 4	$389,000	$8,000	-$90,000	$307,000
Group 5	$992,000	$0	-$2,363,000	-$1,371,000
Group 6	$800,000	$5,000	-$173,000	$632,000
Group 7	$796,000	$0	-$173,000	$623,000
Group 8	$512,000	$0	-$1,000	$511,000
Group 9	$266,000	$15,000	-$68,000	$213,000
Group 10	$76,000	$31,000	-$13,000	$94,000
Demo Subtotal	**$30,785,000**	**$11,369,000**	**-$12,894,000**	**$29,260,000**
Construction Indirects	--	--	--	$14,588,000
Construction Equipment	--	--	--	$6,157,000
Engineering & Construction Management (5%)	--	--	--	$1,539,000
Contingency (15%)	--	--	--	$7,732,000
Demo Total	**$30,785,000**	**$11,369,000**	**-$12,894,000**	**$59,276,000**

3.0 Cost Model Updating

3.1 INTRODUCTION

Black & Veatch understands that NCPA would like to utilize Black & Veatch's Cost Model at a future point in time without the need to fully re-perform the cost estimation exercise. Black & Veatch believes that the estimated amounts as shown in the Cost Model should remain materially accurate for a period of five to seven years, subject to adjustment for inflation. In order to allow the Cost Model to refresh the cost estimates as needed in the future, Black & Veatch has developed an escalation tool to estimate the future value of the cost estimates.

3.2 METHODOLOGY

Black & Veatch has built an escalation mechanism to adjust the 2016 Cost Model estimates to a desired future year using the U.S. Bureau of Labor Statistics (BLS) Producer Price Index (PPI). PPI measures the average change over time in the selling prices received by domestic producers for their output, and is reported on a monthly basis by the BLS for hundreds of categories of domestic producers. In order to allow for the update of the Cost Model, Black & Veatch has selected the four indices shown below in Table 3-1.

Table 3-1 Summary of PPI Assumptions

COST MODEL ITEM	PPI	SERIES ID
Indirect Costs	Engineering Services	PCU54133-5413
Direct Costs	Municipal utility and power generation and distribution engineering projects	PCU541330541330202
Construction Equipment	Construction equipment rental and leasing	PCU5324125324121
Scrap Value	Carbon Steel Scrap	PCU42993042993011

Black & Veatch has built two optional methods for updating the Cost Model using the above PPI, as summarized below:

- **Extrapolation:** The historical average annual percent change for an index (adjusted to exclude outlier years) is assumed to reasonably represent escalation for that cost category over the near term future, and the cost category is escalated at a fixed annual growth rate from the base year to the escalation year. The annual average was adjusted to omit any outlier years, defined as years in which the year-over-year growth fell outside of two standard deviations from the mean (excluding the 5 percent most extreme data).
- **Actual Value:** Because PPI is reported as an absolute index value and not a relative percentage growth rate, if a PPA values is known for both the base year and the escalation year, a cost category may be escalated proportional to the ratio of the escalation year's PPI value to the base year's PPI value. Black & Veatch has documented the latest September 2016 PPI value for each cost category, than may be compared to the actual future PPI value when the Cost Model is refreshed to reflect actual escalation.

The rationale for choosing each PPI, as well as the resulting fixed annual growth rate, is discussed in the following subsections.

3.2.1 Direct Costs

Black & Veatch has chosen the PPI "Municipal utility and power generation and distribution engineering projects" to represent escalation for estimated Direct Costs. Per the Cost Model methodology, Direct Costs are calculated as the value of contract or subcontracted labor and consumables to be utilized on the Project site. The chosen PPI reports the blended value of both services and goods typically required to construct utility or municipality scale power projects, which should utilize materially similar resources to the studied decommission scope.

The Municipal utility and power generation and distribution engineering projects index is a relatively new PPI, which has only been reported by the BLS since 2009. However, it has historically shown relatively consistent annual growth. A summary of this PPI, including actual annual percentage growth, average annual percentage growth, and adjusted annual average percentage growth is shown in Figure 3-1 below.

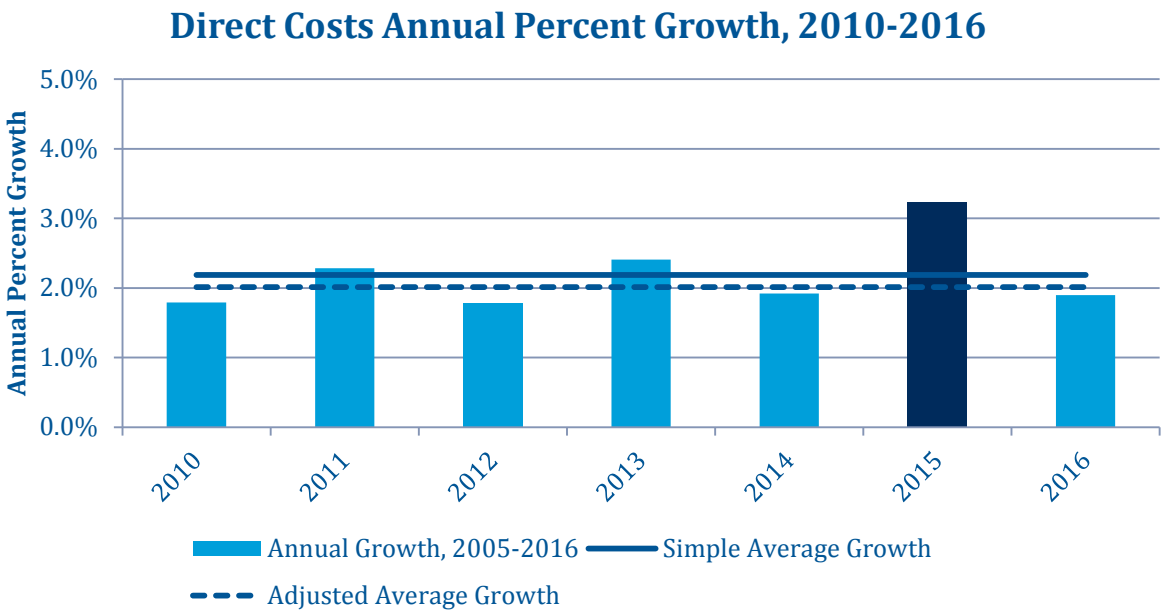


Figure 3-1 Direct Costs Annual Percent Growth, 2010-2016

As shown in Figure 3-1, Black & Veatch has calculated a simple historical average annual growth rate of 2.2 percent and an adjusted average annual growth rate of 2.0 percent when 2010 is omitted.

3.2.2 Indirect Costs

Black & Veatch has chosen the PPI "Engineering Services" to represent escalation for estimated Indirect Costs. Per the Cost Model methodology, Indirect Costs are calculated as the value of offsite labor, predominately engineering and project management. The chosen PPI reports the value of diversified engineering services.

The Engineering Services index has been reported by the BLS since 2004. A summary of this PPI, including actual annual percentage growth, average annual percentage growth, and adjusted annual average percentage growth is shown in Figure 3-2 below.

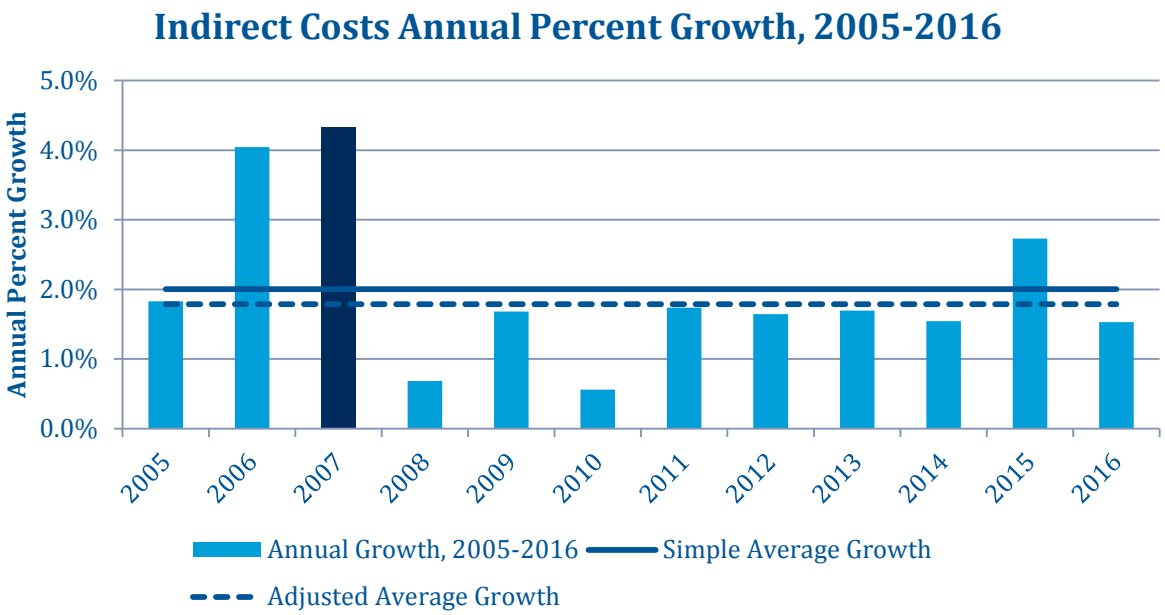


Figure 3-2 Indirect Costs Annual Percent Growth, 2005-2016

As shown in Figure 3-2, Black & Veatch has calculated a simple historical average annual growth rate of 2.0 percent and an adjusted average annual growth rate of 1.8 percent when 2007 is omitted.

3.2.3 Construction Equipment

Black & Veatch has chosen the PPI "Construction equipment rental and leasing" to represent escalation for estimated Construction Equipment Costs. Per the Cost Model methodology, Construction Equipment Costs are calculated as the value of the non-consumables equipment that is required to execute the demolition scope. The chosen PPI reports the value of construction equipment rental. Black & Veatch notes that the contractor performing the decommissioning work may choose to utilize owned equipment instead of rental; however, while the absolute value of renting versus owning equipment will vary, the overall market value trends should be linked, and for relative annual growth assumptions, the chosen PPI should be applicable to both scenarios.

The Construction equipment rental and leasing index has been reported by the BLS since 2004. A summary of this PPI, including actual annual percentage growth, average annual percentage growth, and adjusted annual average percentage growth is shown in Figure 3-3 below.

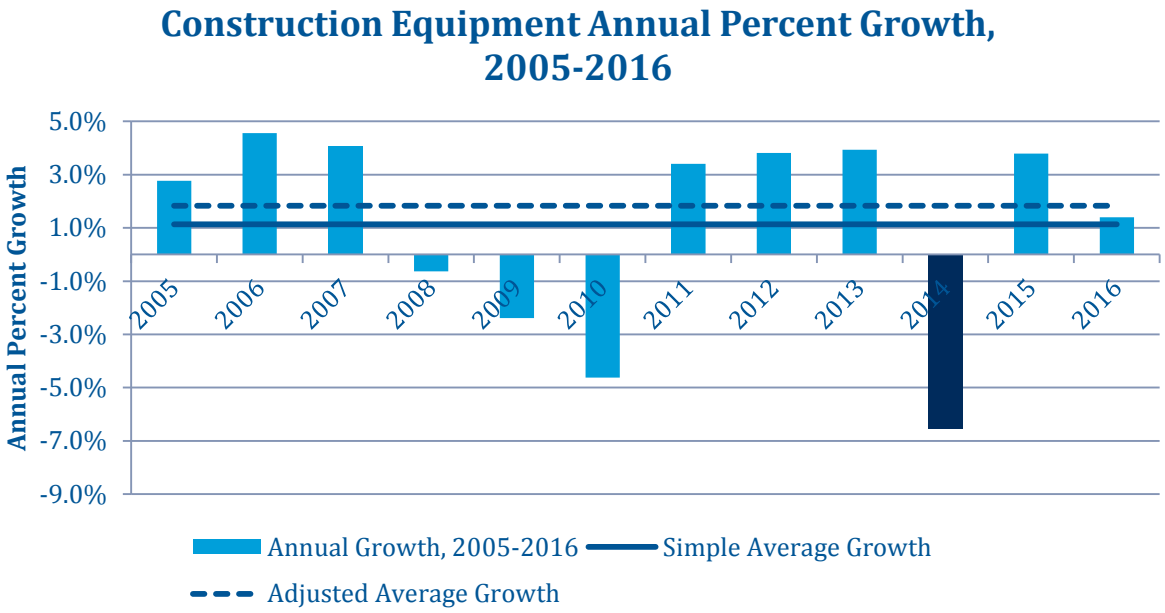


Figure 3-3 Construction Equipment Annual Percent Growth, 2005-2016

As shown in Figure 3-3, Black & Veatch has calculated a simple historical average annual growth rate of 1.1 percent and an adjusted average annual growth rate of 1.8 percent when 2014 is omitted.

3.2.4 Scrap Value

Black & Veatch has chosen the PPI "Carbon Steel Scrap" to represent escalation for estimated salvage value of materials recovered from the Project site. The chosen PPI reflects the value of high quality steel like that which is typically utilized in construction for the utility industry. Black & Veatch notes that other materials such as copper and precious metals will contribute to the actual salvage value of the Project; however, steel should represent the largest portion of salvageable material by value, and has accordingly been chosen as the representative index.

The Carbon Scrap Steel index has been reported by the BLS since 1987. A summary of this PPI, including actual annual percentage growth, average annual percentage growth, and adjusted annual average percentage growth is shown in Figure 3-4 below.

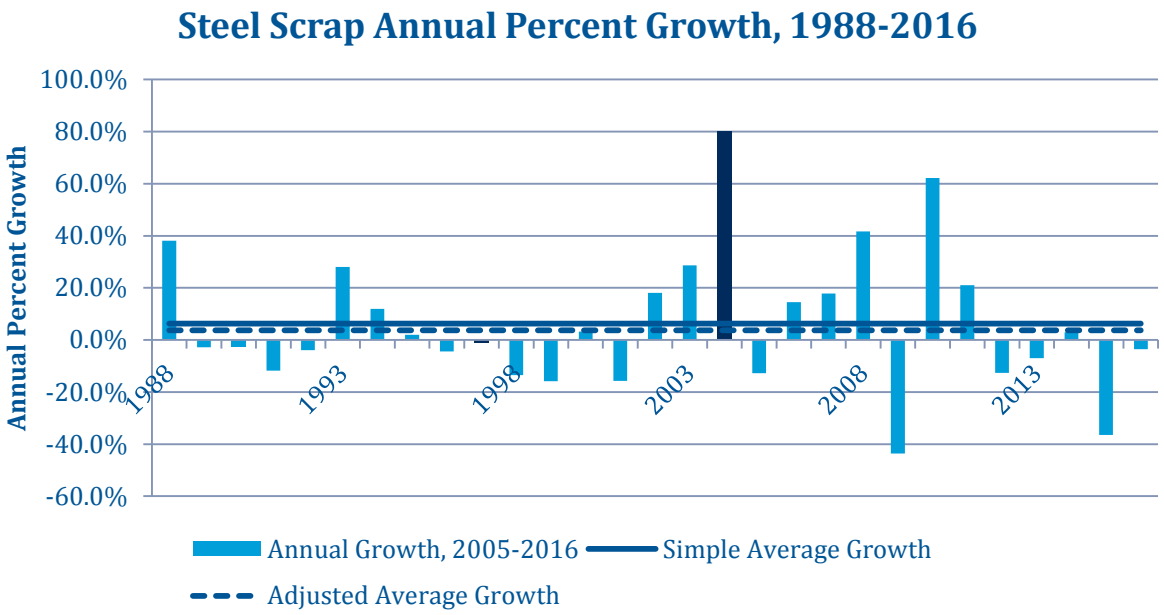


Figure 3-4 Steel Scrap Annual Percent Growth, 1988-2016

As shown in Figure 3-4, Black & Veatch has calculated a simple historical average annual growth rate of 6.3 percent and an adjusted average annual growth rate of 3.7 percent when 2004 is omitted.

Table 3-2 summarizes the estimated decommissioning and demolition costs for the project considering the future. For this example, the information in this table is based on 2016 as the Base Year, 2020 as the Escalation Year utilization of the Extrapolation Escalation Methodology.

Table 3-2 Decommissioning and Demolition Indexed Capital Cost Estimate Summary

COST ESTIMATE	2016 INDEX	2020 INDEX	2016 VALUE	2020 VALUE
Direct Costs	116.4	130.0	$42,154,000	$45,654,000
Direct Labor	116.4	130.0	$30,785,000	$33,341,000
Subcontract	116.4	130.0	$11,369,000	$12,313,000
Less Salvage Value	297.5	300.0	-$12,894,000	-$14,903,000
Indirect Costs	128.7	130.0	$14,587,800	$15,660,000
Construction Equipment	115.4	130.0	$6,157,000	$6,620,000
Engineering & Construction Management	5% of Direct Labor		$1,539,000	$3,334,000
Contingency	15% of Subtotal		$7,732,000	$8,455,000
Total Cost	**--**		**$59,276,000**	**$64,820,000**

The information in this table is based on 2016 as the Base Year, 2020 as the Escalation Year using Extrapolation Escalation Methodology.

Appendix A. System Grouping

The following list highlights the structures at the Geothermal facility shown on the following illustration:

Plant 1 Area (Group 1)

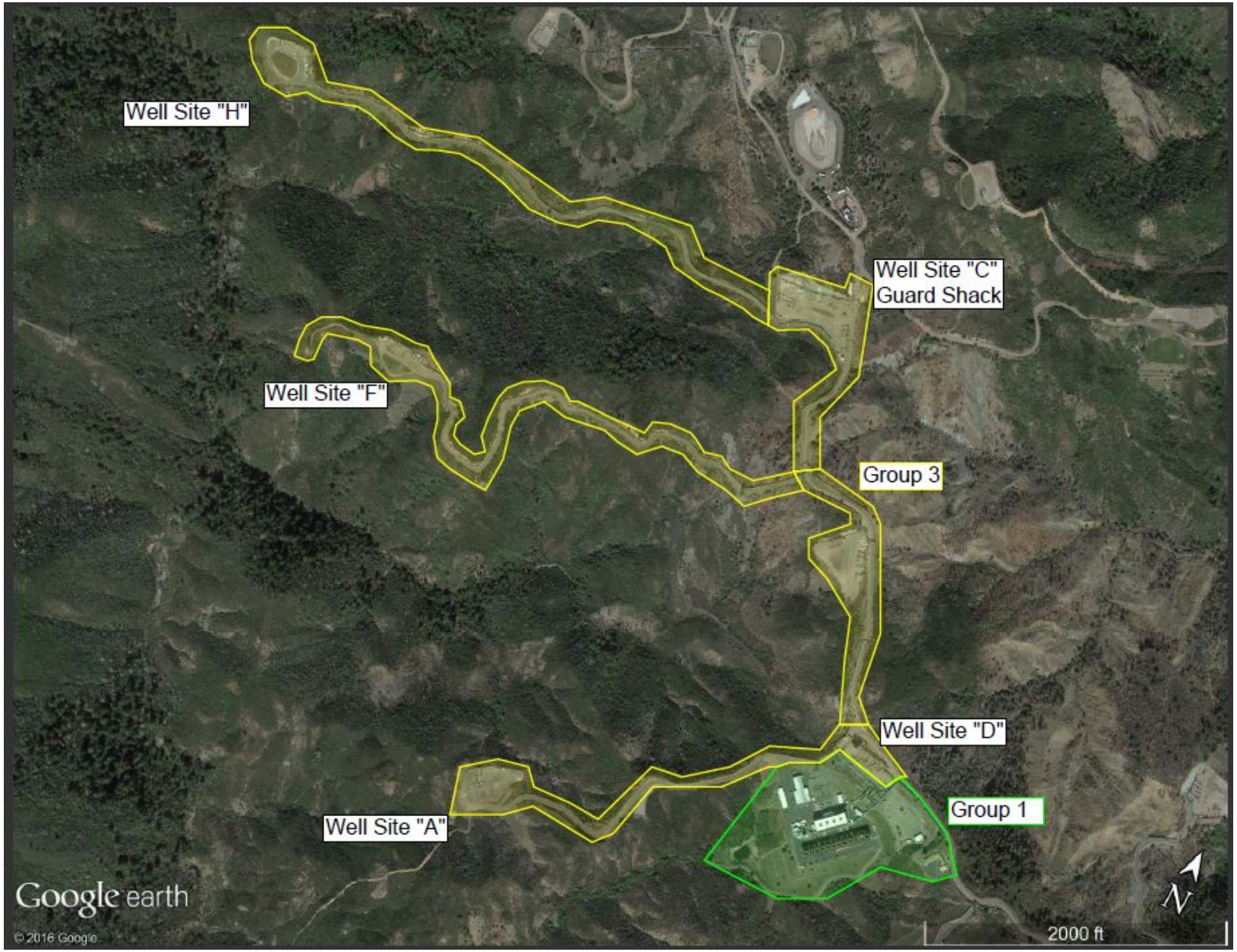
1. Turbine Building.
2. H_2S Abatement Area.
3. Maintenance shop and warehouse.
4. Admin building.
5. Switchyard.
6. Auto shop Building.
7. Sandblast Building.
8. Rock muffler.
9. Cooling Towers.
10. Transmission towers.
11. Welding Shack Building.
12. Steamfield office.
13. Pump Station for Holding Pond 1.

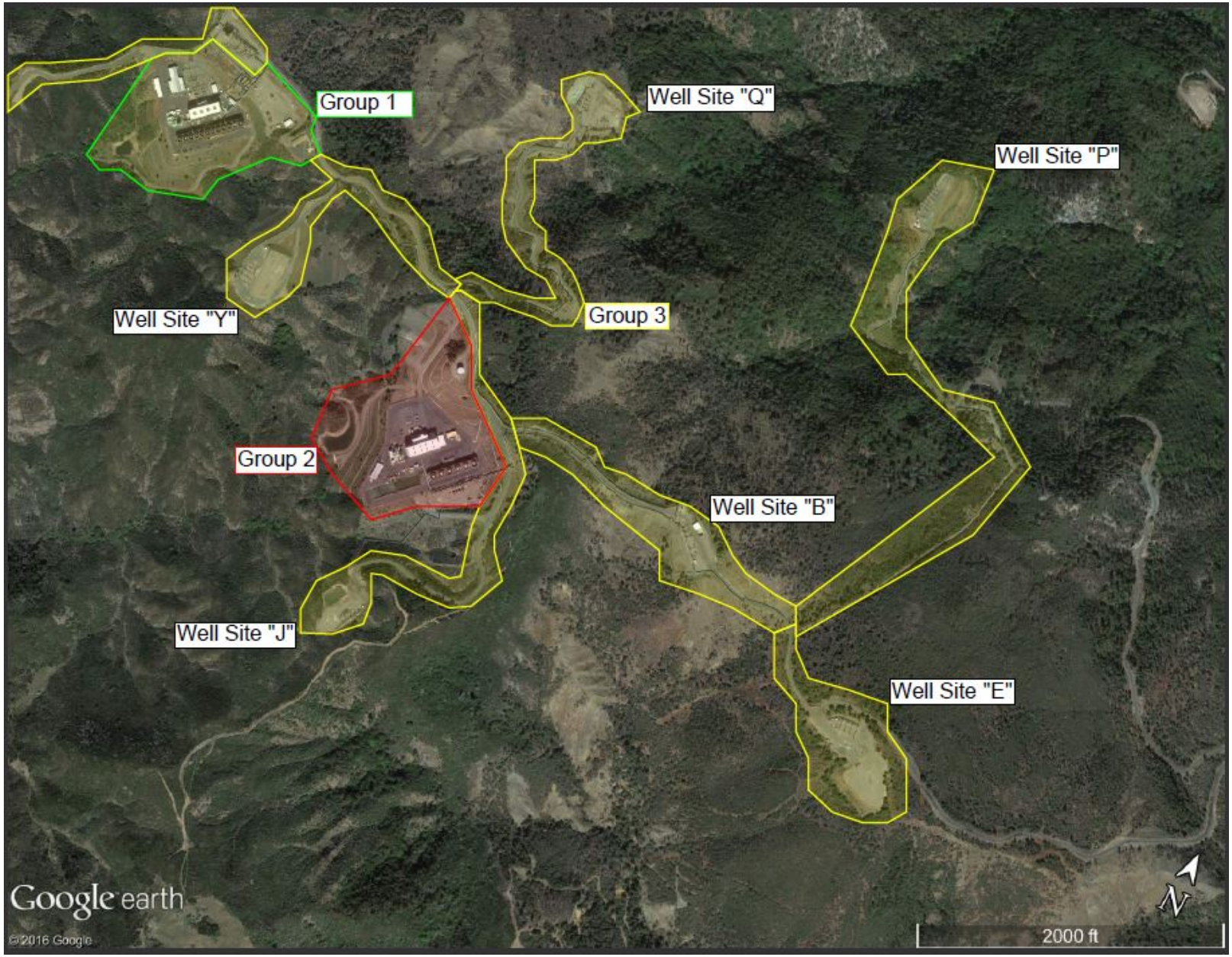
Plant 2 Area (Group 2)

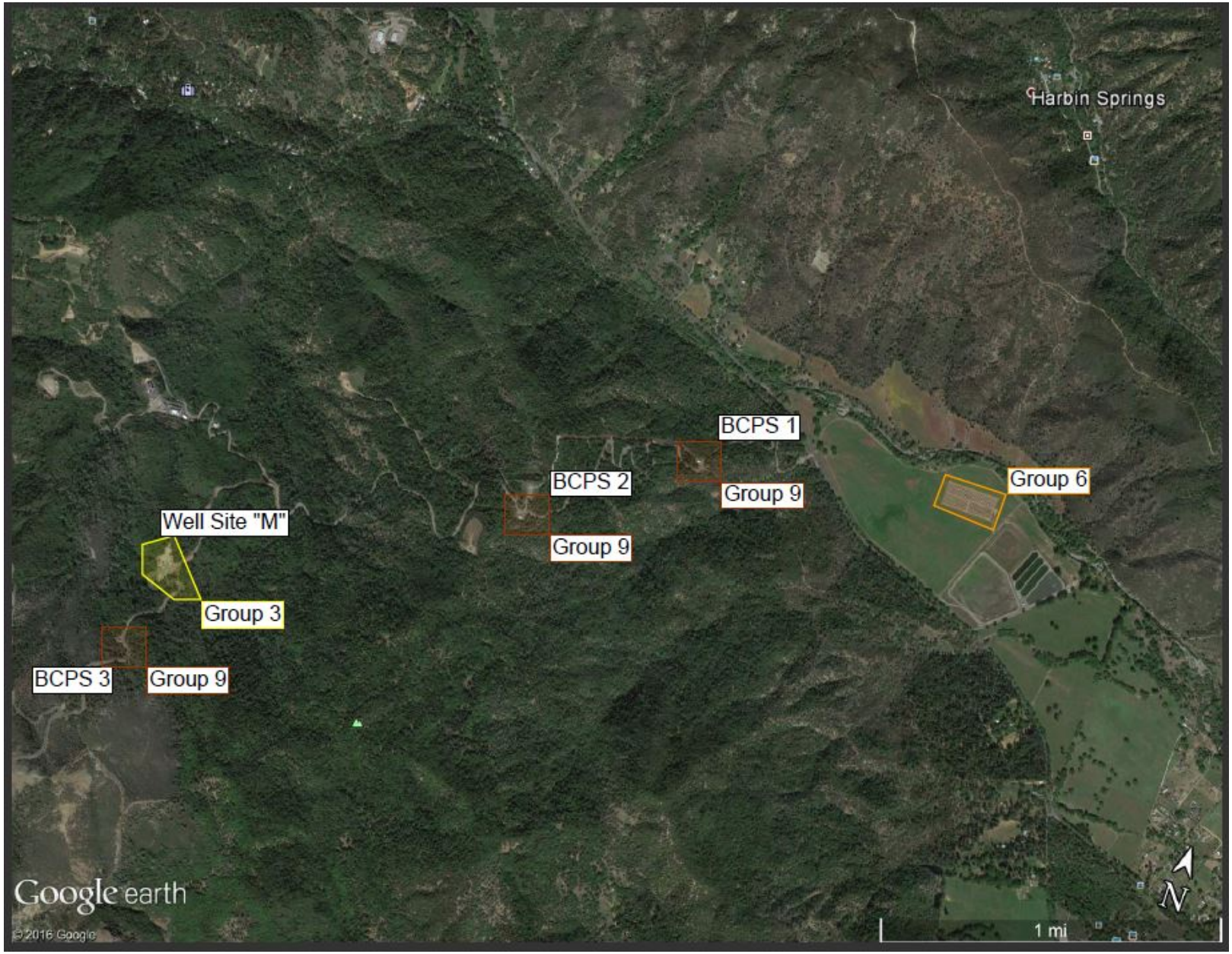
14. Turbine Building.
15. H_2S Abatement Area.
16. Storage Building.
17. Cooling Tower Basin 3.
18. Cooling Tower 4.
19. Fire Pump Building.
20. Switchyard Tower.
21. Rock Mufflers.
22. Pump Station for Holding Pond 2.
23. Service Water Tank.


Plant 1
29
10
8
3
5
11
4
1
12
2
9
13
Google earth
500 ft
N


Plant 2
23
24
20
19
14
15
18
16
17
21
22
Google earth
©2016 Google
500 ft
N


Well Site "H"
Well Site "C"
Guard Shack
Well Site "F"
Group 3
Well Site "D"
Group 1
Well Site "A"
Google earth
© 2016 Google
2000 ft
N


Group 1
Well Site "Q"
Well Site "P"
Well Site "Y"
Group 3
Group 2
Well Site "B"
Well Site "J"
Well Site "E"
Google earth
©2016 Google
N
2000 ft


Harbin Springs
BCPS 1
Group 9
BCPS 2
Group 9
Group 6
Well Site "M"
Group 3
BCPS 3
Group 9
Google earth
© 2016 Google
1 mi
N


Clear Lake Solar Array
Group 6
Google earth
© 2016 Google
2000 ft
N