United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations for individual properties and districts. See instructions in National Register Bulletin, *How to Complete the National Register of Historic Places Registration Form.* If any item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials, and areas of significance, enter only categories and subcategories from the instructions.

DRAFT

1. Name of Property

Historic name: Big Creek Hydroelectric System Historic District
Other names/site number: ______
Name of related multiple property listing: N/A
(Enter "N/A" if property is not part of a multiple property listing

2. Location

Street & number: Various, See Section 10 for detailed Location and Boundary Description
City or town: Multiple (see Section 10) State: California County: Fresno, Kern, Los Angeles, Madera, Tulare
Not For Publication: N/A Vicinity: X

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended,

I hereby certify that this ___ nomination ___ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60.

In my opinion, the property ___ meets ___ does not meet the National Register Criteria. I recommend that this property be considered significant at the following level(s) of significance:

___national ___statewide ___local

Applicable National Register Criteria:

___A ___B ___C ___D

______

Signature of certifying official/Title: Date

______

State or Federal agency/bureau or Tribal Government

In my opinion, the property ___ meets ___ does not meet the National Register criteria.

______

Signature of commenting official: Date

______

Title : State or Federal agency/bureau or Tribal Government

4. National Park Service Certification

I hereby certify that this property is:

___ entered in the National Register

___ determined eligible for the National Register

___ determined not eligible for the National Register

___ removed from the National Register

___ other (explain:) ______________________

Signature of the Keeper Date of Action

5. Classification

Ownership of Property

(Check as many boxes as apply.)

Private:	X
Public – Local	
Public – State	
Public – Federal	X

Category of Property

(Check only **one** box.)

Building(s)	
District	X
Site	
Structure	
Object	

Number of Resources within Property
(Do not include previously listed resources in the count)

Contributing	Noncontributing	
11	1	buildings
	2	sites
37	28	structures
		objects
48	31	Total

Number of contributing resources previously listed in the National Register 0

6. Function or Use
Historic Functions
(Enter categories from instructions.)
INDUSTRY/energy facility
TRANSPORTATION/rail-related
TRANSPORTATION/road-related
DOMESTIC/institutional housing

Current Functions
(Enter categories from instructions.)
INDUSTRY/energy facility
TRANSPORTATION/road-related
DOMESTIC/institutional housing

7. Description

Architectural Classification
(Enter categories from instructions.)
OTHER-Industrial
LATE NINETEENTH AND EARLY TWENTIETH CENTURY REVIVAL-Classical
MODERN MOVEMENT-Art Deco
OTHER-Water Conveyance Infrastructure
OTHER-Electrical Transmission Infrastructure
OTHER-Railroad Grade
OTHER-Vehicular Grade

Materials: (enter categories from instructions.)
Principal exterior materials of the property:
Foundation:-concrete, granitic bedrock
Walls:-reinforced concrete, steel, wood
Roof:-metal, built-up tar and gravel, concrete
Other:-*railroad/vehicular grade:* gravel, asphalt, dry laid rock, concrete; *transmission lines:* steel, aluminum, concrete; *water conveyance tunnel*: rock, steel; *dams*: concrete, steel; granite bedrock.

Narrative Description
(Describe the historic and current physical appearance and condition of the property. Describe contributing and noncontributing resources if applicable. Begin with **a summary paragraph** that briefly describes the general characteristics of the property, such as its location, type, style, method of construction, setting, size, and significant features. Indicate whether the property has historic integrity.)

Summary Paragraph

The Big Creek Hydroelectric System Historic District (BCHSHD) is a sprawling early twentieth century hydroelectric generation and transmission system that begins on the western slope of the Sierra Nevada in Fresno and Madera Counties and extends to urban spheres in Tulare, Kern, and Los Angeles Counties. The system is comprised of a range of inter-related facilities, including large dams, small diversions, flowlines, powerhouses, transmission lines, and substations that together serve to generate and transmit electricity from the Upper San Joaquin River Watershed to population centers located in the San Joaquin Valley and Southern California. In addition to the resources directly associated with the generation and transmission of hydroelectric energy, the BCHSHD includes a number of resources developed to support construction and ongoing operation of the system, including several vehicular access roads, construction-related railroad inclines, and the remnants of a railroad alignment that was central to construction and early development of the system. While geographically expansive, with components of the system separated by tens and hundreds of miles of diverse terrain, as an operational system the resources of the BCHSHD reflect a united method and type of construction, innovative historical development context, and integrated functional cohesion. The historic integrity of the district is very high, with all contributing resources readily conveying significance through integrity of materials, workmanship, design, setting, feeling, association, and location. In addition, the system conveys its significance through integrity of operation, with the historic period components of the system remaining vital to the development and transmission of energy in California and remaining much as they were developed in the early twentieth century. As an intact and continuously operating assemblage, the district is an evocative portrait of California's development, with the BCHSHD intimately linked to the state's early twentieth century population growth, industrial and commercial expansion, and national standing.

Narrative Description

The BCHSHD is operationally and spatially complex. This Narrative Description includes an introductory overview section to generally acquaint the reader with the current form of the district, its construction history, and its role within the larger Southern California Edison (SCE) system. This overview section is intended to provide a foundational understanding of the BCHSHD for context. The overview is followed by a table beginning on page 12 that includes all contributing and noncontributing resources with their construction date, mapping reference number, narrative page reference, and Photo/Figure number(s). The table is followed in turn by a detailed resource description and development narrative.

Overview

The BCHSHD is a component of a larger operating hydroelectric system referred to as the Big Creek Hydroelectric System (BCHS) that consists of seven distinct, interrelated projects. The BCHS generating facilities are located in the San Joaquin River Watershed, primarily on the San Joaquin River, and two major tributaries, the South Fork of the San Joaquin River and Big Creek. Elevations in the Watershed range from about 9,000 feet above mean sea level (msl) to about 1,000 feet above msl.

The original components of the BCHS were developed during the early twentieth century, and the system has been modified and expanded over time to improve efficiency and to accommodate constantly growing energy demand in California. In its current configuration the BCHS includes six major reservoirs, 27 dams, nine powerhouses, and a vast infrastructure of tunnels, penstocks, and generating units. These facilities are located in Fresno and Madera Counties, primarily on public land managed by the Sierra National Forest (SNF) or private land held by SCE.[1]

[1] Southern California Edison, *Initial Information Package for the Big Creek Hydroelectric System Alternative Licensing Process*, (2000), 3-1.

The BCHSHD includes three of the seven hydroelectric projects that make up the BCHS. These three projects are identified by SCE and the Federal Energy Regulatory Commission (FERC) as follows:

- Big Creek Nos. 1 and 2 Project (FERC Project No. 2175);
- Big Creek Nos. 2A, 8 and Eastwood Project (FERC Project No. 67); and
- Big Creek No. 3 Project (FERC Project No. 120).

The other four BCHS Projects, FERC Project Nos. 2017, 2174, 2085, and 2086 do not illustrate the significant themes of development for the BCHSHD. These later projects are spatially discrete, do not share the significant development themes of the BCHSHD, and were constructed after the period of significance for the district.[2]

Development of the BCHS in its entirety has occurred over several distinct construction phases. The initial development phase from 1909 to 1929 provides the basis for the BCHSHD and created the innovative foundational structure of the operating system, establishing Big Creek as one of the premier hydroelectric systems in the state and nation. This development phase set records for energy capacity, transmission distance, and engineering innovation and provided a superlative baseline upon which virtually all subsequent California hydroelectric development was measured.

The 1909 to 1929 development phase was initiated with the construction of Powerhouse Nos. 1 and 2, the impoundment of Huntington Lake, and the development of hundreds of miles of transmission lines to Southern California. Following a brief hiatus wrought by the economic and social disruptions of World War I, the BCHS was expanded in the 1920s during an intensive period of construction that included the development of Florence Lake, Shaver Lake, Mono-Bear Diversions and Siphon, Powerhouse Nos. 2A, 8, and 3, as well as an impressive 36 miles of granite tunnels and associated water conveyance pipes that linked the water storage and generating facilities into a complex productive network. Upon completion of this development phase, the BCHS was the largest hydroelectric system in California, and indeed the nation, with a generating capacity of 345 MW and a transmission span that was unrivalled at the time. In addition, development of the system had transformed a near wilderness into a sophisticated industrial system, with the hydroelectric facilities supported by a broad network of roads, rails, and support infrastructure. The innovative and groundbreaking developments that occurred during this phase form the BCHSHD.[3]

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[2] Resources related to FERC Project Nos. 2017, 2174, 2085, and 2086 were not inventoried and evaluated as part of this NRHP Nomination except in cases where the individual components directly intersect or effect district contributors. In these cases, the resources were analyzed and evaluated in relation to the significant themes of the NRHP district.

[3] Southern California Edison, *Initial Information Package for the Big Creek Hydroelectric System Alternative Licensing Process,* 3-9-3-15; Laurence Shoup, *The Hardest Working Water in the World: A History and*

Following this concentrated and unprecedented period of industrial growth, further development of the system languished for nearly twenty years, as the travails of the Depression and a marked uptick in the viability and primacy of steam-based electrical generation undercut the basis for continued hydroelectric development. Following World War II, increased energy demands precipitated a surge of development and the BCHS was expanded in a second phase of growth to allow for increased storage and generation capacity. Between 1948 and 1960, the BCHS was enlarged to include Redinger Lake, Thomas A. Edison Lake, Mammoth Pool Reservoir, Powerhouse No. 4, Mammoth Pool Powerhouse, Portal Powerhouse, and several small diversions that in combination added approximately 300 MW of power to the system. This development phase served to create additional storage and generation capacity within the established operational and technological framework of the pioneering early twentieth century system, a recurring theme in the development of the Big Creek Hydroelectric System.[4]

The last period of growth, from 1984 to 1987, included construction of Balsam Meadows Forebay and Eastwood Power Station that utilized an existing early twentieth century water conveyance tunnel flowing from Huntington to Shaver Lake (Flowline No. 7) to generate an additional 200 MW of energy and provide pump storage capacity. The construction of these facilities was the last major physical addition to the system, with subsequent activities limited primarily to ongoing management, operation, and maintenance of the established hydroelectric system. In 2015, the seven combined projects that make up the BCHS had an installed generating capacity of approximately 1,000 MW.[5]

Within the larger BCHS context described, the BCHSHD includes the hydroelectric facilities and support infrastructure associated with the system’s initial 1909-1929 development phase. This pioneering period of development established the physical and operational framework for the BCHS as a whole, provided an unrivalled engineering model for hydroelectric development across the state and nation, and employed a host of construction and engineering innovations that remain a testament to both the skill of the system’s engineers and the immense labor force associated with its development. In addition, this period of development represents the zenith of hydroelectric development in California, with the relative importance and electrical output of hydroelectric facilities largely eclipsed by steam-based generation by the 1930s.

BCHSHD Resource Types

While the resources of the BCHSHD are enveloped within the larger operating framework of the modern BCHS, the early twentieth century district assemblage is bound by an innovative and

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Significance Evaluation of the Big Creek Hydroelectric System, (submitted to Southern California Edison, October 1988).

[4] Southern California Edison, *Initial Information Package for the Big Creek Hydroelectric System Alternative Licensing Process*, (2000), 3-6-3-8; William A. Myers, *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company* (Glendale, CA: Trans-Anglo Books, 1983), 207.

[5] Southern California Edison, *Initial Information Package for the Big Creek Hydroelectric System Alternative Licensing Process*, (2000), 3-8; Myers, *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company,* 237.

technologically significant development history and a distinct construction program, built form, and spatial layout, allowing the district to convey significance as a premiere early hydroelectric development within the evolving context of a modern operating system.

The district generally includes three distinct resource types: (1) hydroelectric generation resources; (2) electrical transmission resources; and (3) an array of support resources that relate to both the construction and ongoing operation of the system. A summary of the general development context of each resource type is presented here, with detailed resource descriptions of all contributing and noncontributing resources following later in the narrative.

Hydroelectric Generation Resources
Resources within this framework include those components of the district that are associated with the generation of hydroelectric energy. In general, these resources form the core of the district and include: large dams and associated reservoirs; moderate and small-sized diversion dams and associated impoundments; water conveyance features, including intakes, flowlines, tunnels, siphons, surge tanks, and outlets; powerhouses, including penstocks, valve houses, vents, and ancillary infrastructure; and, individual stream gauges that record flows throughout the watershed and within the hydroelectric system. Virtually all of these resources have remained in continuous operation since construction.

Electrical Transmission Resources
Resources within this framework include those components of the district that transmit electricity from the hydroelectric generating facilities to energy consumers. In general these resources are linear in form, with three major high voltage transmission lines extending from the San Joaquin River Watershed hundreds of miles down the east side of the San Joaquin Valley to the environs of Los Angeles. In addition to the transmission lines themselves, this classification of resources includes several substations located along the transmission corridor and at its terminus. Transmission-related resources include smaller, low-voltage distribution lines that supply power to the BCHS facilities and immediate surrounding areas. Like the generation resources, these transmission features have been under continuous operation to the present.

Construction and Operations Support Resources
In addition to the two major classifications of resources described, the district includes a number of support resources related to the initial early twentieth century development and construction of the BCHS. In general, this classification of resources includes transportation and circulation systems, construction camps, and administrative services and housing, briefly described here, and in detail later in this section.

Transportation and Circulation Systems: Prior to initial construction of the BCHS in 1909, the Big Creek area was mostly inaccessible, with no notable transportation corridors apart from the most rudimentary of wagon roads crossing terrain that was characterized by steep canyons, rugged mountains, and boulder strewn granite bedrock. The initial construction campaign included the development of a number of vital transportation systems, each of which was used to access different portions of the project and enable expansion of system. This type of resource includes remnants of the San Joaquin and Eastern (SJ&E) Railroad that accessed the project from the San Joaquin Valley, remnants of rail inclines that served specific construction efforts, and roads that were specifically built to support the project by providing access to development areas. While only remnants of the railroad and inclines remain, the roads have been improved over time and continue to serve as vital operational support resources for the BCHS System.

Construction Camps: Numerous temporary work camps were established to support construction of the BCHS during the 1909-1929 period. The camps were located throughout the project area and moved as construction needs dictated. In general, the camps were characterized by rudimentary facilities, with canvas tents and portable frame bunkhouses erected and moved as evolving construction needs warranted. In some cases, camps included more permanent support structures, including field hospitals, recreation halls, and mess halls. During the initial development period, more than 50 documented camps were erected throughout the project area and at the height of construction, 32 camps were under simultaneous operation, with thousands of workers dispersed throughout the system. All of the work camps have since been dismantled, with most removed soon after completion of associated construction activities. At present, virtually all associated resources are gone, with the camp sites generally characterized by a light scattering of remnant foundations, primarily for air compressor and other construction equipment, and miscellaneous and undifferentiated historic period debris including scrap metal, nails, and other small-scale items from the development period. In many cases, modern development and recreational use has occurred in and around former camp sites, introducing an ongoing assortment of materials, artifacts, and modern development in and around the sites. In addition to documented camps, scattered occupational remnants from the development period, including cans, light debris scatters, and small-scale utility foundations are found throughout the project area.

Administrative Services and Housing: While the majority of construction workers lived in isolated and temporary camps, a smaller number of permanent facilities were established to house company employees and to support domestic life. The majority of these facilities were located in the town of Big Creek that became the center of operations for Pacific Light and Power and subsequently SCE. Since its inception, the town of Big Creek included company housing and operational support structures, including SCE's Big Creek Headquarters. Despite this continuity of use, the company town has been substantially altered since development, with the removal of almost all original buildings and structures and widespread modern construction throughout. In addition to the town of Big Creek, a small number of residential and support facilities were developed elsewhere in the project area, generally adjacent to powerhouses and related facilities that required manual operation and/or regular oversight. While some of these resources remain, most have been removed over time as mechanization and improved transportation negated the need for substantive satellite communities and support buildings in the immediate vicinity of the powerhouses and related features.

Within the three major resource types, there are two general categories of properties within the district boundary that are noncontributing to the district. The first type of noncontributing property consists of physically integrated resources that post-date the period of significance and thereby cannot convey the significant development associations of the BCHSHD. The second type of noncontributing property are those resources that date to the period of significance, and lack the necessary integrity of material, workmanship, design, setting, feeling, association, and location to convey significance within the context of the district. Both contributing and noncontributing resources within the district boundary are described in detail in the following resource descriptions and development narrative and are documented on maps in the Additional Documentation Section of this document.

Resource Descriptions and Development Narrative

Due to its geographic breadth, scale, and diversity of resources, the BCHSHD is a complex district that does not readily lend itself to traditional resource description, for example street-by-street overviews or clearly delineated property-type classifications. The district resources exist across a wide and varied terrain with functionally overlapping layers that blend distinctions between resources and property types.

Accordingly, these resource descriptions employ a narrative structure that addresses the contributing and noncontributing resources of the district by following the contextual chronology of the district's development. The district resources were constructed between 1909 and 1929, with facilities added on an on-going basis through this period, thereby enlarging the hydroelectric network. By tracing this historical development chronology through the physical descriptions, readers are provided with an integrated understanding of how and why the district developed over time and how the various resource contributors operationally relate to each other. In addition, intermittent historical overviews are provided throughout the narrative for context.

The narrative is informed by intensive surveys of the district resources that were conducted in 2013 and 2014 in support of this nomination effort, with all contributing and noncontributing resources field documented and evaluated in relation to the significant themes of the district.[6] In addition, the narrative employs a number of previous first-person accounts and academic studies that address the development of the BCHS. The hydroelectric system has been extensively documented over time, with numerous first-person accounts, archival and photographic records, and scholarly research. This narrative cites many of these previous documents and provides relevant excerpts, as the previous works contain a wealth of research and information that underscores the significance of the district's development.

[6] The 2013-2014 field survey undertaken in support of this nomination included the development of California Department of Parks and Recreation Documentation Forms (DPR 523) for all of the hydroelectric and transmission resources of the district. These forms contain detailed physical documentation of all of the district resources, including both contributing and noncontributing resources. The forms are on file at SCE Northern Hydro Headquarters in Big Creek and at the California Office of Historic Preservation.

Within this chronological narrative, the resource descriptions are grouped according to the general resource types: *hydroelectric generation resources*; *electrical transmission resources*; and *construction and operations support resources*. Within this organizational structure, there is some overlap of discussion between resource types, as the various functional classifications share an integrated development history that often requires reference between resource types.

The physical descriptions of BCHSHD contributors and noncontributors include discussion of character defining features for individual contributors. Following the descriptions of contributors, this description includes analysis of the BCHSHD as a whole, with analysis of the district's character defining features and physical integrity.

Contributing Resource Name	Construction Date	Contributing or Noncontributing	Resource Type	Mapping Reference Number	Narrative Page Reference	Photo/Figure Number
Huntington Lake Dam No. 1	1913	Contributing	Structure	1	19	Photo 1 Figures 1-3
Huntington Lake Dam No. 2	1913	Contributing	Structure	2	20	Photo 2 Figures 4-5
Huntington Lake Dam No. 3	1913	Contributing	Structure	3	21	Photo 3 Figures 6-7
Huntington Lake	1913	Contributing	Structure	4	22	Photo 4 Figure 8
Tunnel No. 1 Flowline	1913	Contributing	Structure	5	23	Photo 5 Figures 9-11
Powerhouse No. 1 and Penstocks	1913	Contributing	Building	6	24	Photos 6-9 Figures 12-16
Scot Lake Domestic Diversion	1913	Noncontributing	Structure	7	28	N/A
Dam No. 4	1913	Contributing	Structure	8	29	Photo 10 Figures 17-18
Tunnel No. 2 Flowline	1913	Contributing	Structure	9	30	Photos 11-12 Figures 19-21
Adit 8 Creek Diversion Dam	Circa 1913-1921	Contributing	Structure	10	31	Photo 13 Figure 22
Ely Creek Diversion Dam	1921	Noncontributing	Structure	11	32	N/A
Balsam Creek Diversion Dam	1925	Noncontributing	Structure	12	32	N/A
Powerhouse No. 2 and Penstocks	1913	Contributing	Building	13	32	Photos 14-18 Figures 23-26
Huntington Lake Dam No. 3A	1917	Noncontributing	Structure	14	37	N/A

Contributing Resource Name	Construction Date	Contributing or Noncontributing	Resource Type	Mapping Reference Number	Narrative Page Reference	Photo/Figure Number
Tunnel No. 5 Flowline/Shaver Tunnel	1920-21; 1926-1928	Contributing	Structure	15	38	Photos 19-20 Figures 27-30
Tunnel No. 8 Flowline	1920-1921	Contributing	Structure	16	40	Photos 21-23 Figures 31-33
Dam No. 5	1920-1921	Contributing	Structure	17	42	Photo 24 Figures 34-36
Powerhouse No. 8 and Penstocks	1920-1921	Contributing	Building	18	43	Photos 25-29 Figures 37-41
Tunnel No. 3 Flowline	1921-1923	Contributing	Structure	19	47	Photos 30-34 Figures 42-45
Dam No. 6	1922-1923	Contributing	Structure	20	50	Photo 35 Figures 46-48
Powerhouse No. 3 and Penstocks	1922-1923	Contributing	Building	21	51	Photos 36-40 Figures 49-55
SCE Stream Gauges	1920s-1980s	Noncontributing	Structure	22	54	N/A
Ward/Florence Lake Tunnel	1920-1925	Contributing	Structure	23	56	Photos 41-44 Figures 56-61
Bolsillo Creek Diversion	1945	Noncontributing	Structure	24	58	N/A
Chinquapin Creek Diversion	1948; 2001	Noncontributing	Structure	25	58	N/A
Camp 61 Creek Diversion East	Circa 1940s	Noncontributing	Structure	26	58	N/A
Camp 61 Creek Diversion West	Circa 1940s	Noncontributing	Structure	27	58	N/A
Camp 62 Creek Diversion	1948; 2001	Noncontributing	Structure	28	58	N/A
Portal Powerhouse and Forebay	1955-1956	Noncontributing	Building	29	58	Photo 44

Contributing Resource Name	Construction Date	Contributing or Noncontributing	Resource Type	Mapping Reference Number	Narrative Page Reference	Photo/Figure Number
Florence Lake Dam	1925-1926	Contributing	Structure	30	59	Photos 45-50 Figures 62-68
Florence Lake	1926	Contributing	Structure	31	62	Photo 51 Figure 69
Hooper Creek Diversion	1945-1946	Noncontributing	Structure	32	63	N/A
North Slide Creek Diversion	1945	Noncontributing	Structure	33	63	N/A
South Slide Creek Diversion	1945	Noncontributing	Structure	34	63	N/A
Tombstone Creek Diversion	1945-1946	Noncontributing	Structure	35	63	N/A
Crater Creek Diversion	1944-1946	Noncontributing	Structure	36	63	N/A
Bear Creek Diversion Dam	1926-1927	Contributing	Structure	37	64	Photo 52 Figures 70-72
Mono Creek Diversion Dam	1926-1927	Contributing	Structure	38	66	Photo 53 Figures 73-74
Mono-Bear Flowline	1926-1927	Contributing	Structure	39	68	Photos 54-56 Figures 75-78
Shaver Lake Dam	1926-1927	Contributing	Structure	40	70	Photos 57-58 Figures 79-81
Shaver Lake	1926-1927	Contributing	Structure	41	71	Photo 59 Figure 82
Eastwood Tunnel Tailrace	1984-1987	Noncontributing	Structure	42	72	N/A
Tunnel No. 7 Flowline	1925-1928	Contributing	Structure	43	72	Photos 60-63 Figures 83-84
Balsam Diversion Tunnel	1984-1987	Noncontributing	Structure	44	74	N/A

Contributing Resource Name	Construction Date	Contributing or Noncontributing	Resource Type	Mapping Reference Number	Narrative Page Reference	Photo/Figure Number
Pitman Creek Diversion Dam	1925-1928; 2001	Noncontributing	Structure	45	74	N/A
Powerhouse No. 2A	1926-1928	Contributing	Building	46	75	Photos 14, 64-66 Figures 85-88
Big Creek East and West Transmission Lines	1912-1913	Contributing	Structure	47	79	Photos 67-68, 81 Figures 89-91
Big Creek No. 8-Big Creek No. 2 Transmission Line	1921	Contributing	Structure	48	81	Photo 70
Big Creek No. 3-Big Creek No. 8 Transmission Line	1923	Contributing	Structure	49	82	Photos 69-70
Vincent Transmission Line	1925	Contributing	Structure	50	83	Photos 71-72 Figures 92-94
Minor Electrical Distribution Infrastructure	Ongoing	Noncontributing	Structure	51	85	N/A
Eagle Rock Substation	1913	Contributing	Structure	52	86	Photos 74-75 Figures 95-97
Magunden Substation	1913	Contributing	Structure	53	87	Photos 76-77 Figures 98-100
Vestal Substation	1920	Contributing	Structure	54	89	Photos 78-79 Figures 101-103
Rector Substation	1928	Contributing	Structure	55	91	Photos 80-81 Figures 104-106
Gould Substation	1926	Noncontributing	Structure	56	93	N/A
Huntington Lake Road-Shaver Lake to Big Creek	1909	Noncontributing	Structure	57	94	N/A

Contributing Resource Name	Construction Date	Contributing or Noncontributing	Resource Type	Mapping Reference Number	Narrative Page Reference	Photo/Figure Number
Huntington Lake Road/Huntington Lodge Road between Big Creek and Huntington Lake Dam No. 1	Circa 1910	Contributing	Structure	58	95	Photos 82-83 Figure 107
San Joaquin and Eastern Railroad Alignment and Infrastructural Landscape Features: Auberry Mission Road to Powerhouse No. 1	1912	Contributing	Structure	59	96	Photos 84-91 Figures 108-116
Incline No. 1/Big Creek Incline/Basin Railroad	1912	Noncontributing	Structure	60	102	Figures 117-119
Powerhouse No. 1 Penstock Incline	1912	Contributing	Structure	61	103	Photos 92-93 Figure 120
Incline No. 2	1912; 1926	Noncontributing	Structure	62	104	Figure 121
Canyon Road	Circa 1913; 1920	Contributing	Structure	63	105	Photos 94-95 Figure 122
Incline No. 8	1920-1921	Noncontributing	Structure	64	106	Figure 123
Million Dollar Mile Road	1921-1922	Contributing	Structure	65	107	Photos 96-100, 121 Figures 124-126
Incline No. 3	1921	Noncontributing	Structure	66	108	Figure 127
Kaiser Pass Road	1920-1922	Contributing	Structure	67	109	Photos 101-103 Figures 128-131

Contributing Resource Name	Construction Date	Contributing or Noncontributing	Resource Type	Mapping Reference Number	Narrative Page Reference	Photo/Figure Number
Mono-Bear Road/Lake Edison Road	Circa 1925	Contributing	Structure	68	111	Photos 104-106 Figures 132-133
Dawn Railroad	1925	Noncontributing	Structure	69	113	Figure 134
Construction Camps	1911-1929	Noncontributing	Site	70	114	Photos 108-111 Figures 135-150
Big Creek Townsite	1911-2015	Noncontributing	Site	71	122	Photos 112-114 Figures 151-152
Building 109	Circa 1912	Contributing	Building	72	124	Photo 115 Figure 153
Building 176	1924	Contributing	Building	73	125	Photo 116 Figure 154
Building 177	1924	Contributing	Building	74	126	Photo 117
Huntington Lake Dam Tender’s Cabin	Circa 1913	Contributing	Building	75	127	Photo 118
Powerhouse No. 3 Hospital	1922	Contributing	Building	76	128	Photo 119 Figures 142, 155
Florence Lake Dam Tender’s Cabin	1925	Contributing	Building	77	129	Photo 120
Pitman Creek Domestic Diversion	Circa 1920	Noncontributing	Structure	78	129	N/A
Snowslide Creek Domestic Diversion	1929	Noncontributing	Structure	79	130	N/A

Hydroelectric Generation Resources

Construction of the BCHS began in 1909 and was spearheaded by the Pacific Light and Power Company, subsequently Pacific Light and Power Corporation (PLPC). In 1917, Pacific Light and Power conveyed all Big Creek rights and property to Southern California Edison (SCE), who completed construction and continues to operate the project.[7]

Initial construction of the system included the creation of Huntington Lake, with the waters of Big Creek impounded by three dams erected on the west end of the Big Creek Basin. All work done during this period was led by Stone and Webster Construction Company, a firm with an extensive portfolio of hydroelectric construction across the country. As described in a 1912 Stone and Webster report to Pacific Light and Power Corporation:

> Three solid concrete gravity-type dams are being built at the west end of the Basin. For the initial development, these dams will have an aggregate length of about 2,700 feet and will contain about 120,000 yards of concrete. The storage reservoir formed will impound 38,000 acre feet of water, which for the ultimate development will be increased to 100,000 acre feet by raising the dams 50 feet.[8]

Clearing and excavation of the dam sites was begun in the summer of 1912 and continued through the winter. As reported in a first-person account by Big Creek engineer David H. Redinger:

> Compared to present day equipment, the guy derricks and skips used in excavation for the dams was slow but sure. The pouring of concrete for Dams 1 and 2 continued through the winter, even though low temperatures prevailed. Steam pipes under canvas were the protective measures used to prevent freezing. Dams 1 and 2 were completed shortly after the first of the year 1913, leaving Dam 3, the smallest one, trailing behind because much trouble was experienced in excavation. Bed rock was deep, and much more difficult to reach than the foundation for either of the other two dams. The three sluice gates in the bottom of Dam No. 1 were closed for the first time on April 8, 1913, causing Big Creek to halt abruptly, accustomed as it had been to cascading down the canyon since time immemorial. Such was the beginning of the reservoir to be known later as Huntington Lake.[9]

By December 31, 1913, Huntington Lake held 35,303 acre feet of water. By the end of 1914, as the reservoir was able to capture a full year's worth of snowmelt and rainfall, the total inflow had risen to 169,437 acre feet. As the system's first water storage reservoir, the development of

[7] Southern California Edison, *Initial Information Package for the Big Creek Hydroelectric System Alternative Licensing Process*, (2000), 3-1.
[8] Stone and Webster Construction Company, Progress of the Big Creek Initial Development, Report to Pacific Light and Power Corporation, (San Francisco: Louis Sloss and Company, 1913).
[9] David H. Redinger, *The Story of Big Creek*, (Los Angeles, CA: Angelus Press, 1949), 29-30.

Huntington Lake served as the linchpin for the initial Big Creek Project, providing the foundation for the control and conveyance mechanisms that would allow for downstream hydroelectric power generation. [10] Facilities and features associated with this development are described in detail:

Huntington Lake Dam No.1 (Contributing Structure)
Huntington Lake Dam No.1 was constructed in 1912-1913, one of three curved concrete gravity dams erected to impound the waters of Huntington Lake (**Figures 1, 2**). When originally constructed, the dam was 132 feet in height and approximately 1,000 feet in length. In 1917, the dam was raised 38 feet in order to provide more water for the project, and currently stands 170 feet in height with a crest elevation of 6,953 feet. As noted in the 1912 Stone and Webster Report, the raising of the Huntington Lake Dam No. 1 was part of the original conceptual design. Raising the dam was anticipated at the time of initial construction, with the increased dam capacity planned for further project expansion as part of initial project conceptualization.

Original design features of the dam include a nine-foot diameter steel intake pipe controlled by a slide gate that leads to Tunnel No. 1, and subsequently downstream Powerhouse Nos. 1 and 2. The dam also features a 72-inch outlet pipe, with slide gate, passing through the right abutment of the dam to the downstream face for local outflow. In addition, concurrent with the 1917 raising of the dam, three 42-inch outlet pipes were developed through the center of the dam at its base, with slide gates located on the upstream face and a valve works with an access platform at the toe of the dam. Other original design features include a small recorder house sited at the center of the dam. The building is square in plan with a pyramidal roof and a poured concrete slab foundation. The frame of the building is wood, with a smooth concrete plaster finish. The northern half of the recorder house extends over the reservoir, supported by steel beams affixed to the dam. Portions of the building have been altered, including the placement of standing seam metal sheathing over the original roof material and the insertion of new fenestration, including a new panel access door.

While the main concrete body of Dam No. 1 and its orientation to Tunnel No.1 is reflective of the original design, the dam has been subject to a number of ongoing alterations, most notably through the addition of two spillways. The dam was raised 38 feet in 1917, during which time a siphon spillway was added near the west dam abutment. The spillway includes seven concrete bays, each of which is ten feet in width. A wood-planked bridge crosses the top of the spillway. The spillway was disabled in the 1940s, and currently the structure serves as an as-needed overflow spillway.

An additional spillway was added in 1938, located west of the siphon spillway. This auxiliary spillway is approximately 310 feet in length, with two fixed concrete ogee weir sections at either end and a gated center section with 15 vertical lift slide gates. A pedestrian walkway and access stairs traverse the crest of the spillway.

[10] Pacific Light and Power Corporation, *Big Creek Annual Report, 1913*, (On file at SCE Archives, Big Creek, CA).

In addition to the placement of spillways, the dam has also been somewhat modified by the placement of compacted earth fill across the downstream face of the dam to strengthen and support the original concrete body. Additionally, portions of the upstream face have been covered in steel sheathing to prevent spalling and leakage. Other ongoing changes include the development of a modern telecommunications station between the two spillways, and ongoing replacement of minor features including new pavement and wood planking for access routes across the dam, replacement of utility features including railings and access stairs, and other miscellaneous alterations to allow for continued operability and safety.

Despite these ongoing alterations, the dam remains an integral component of the BCHSHD and is a contributing resource that is reflective of the district's significant development context (**Figure 3**). Further, all alterations are in keeping with the utilitarian operational design of the concrete gravity structure, allowing the dam to retain overall integrity of materials, workmanship, design, setting, feeling, and association within the context of the district.

Character defining features of the dam include its placement and orientation on Huntington Lake; its physical and functional relationship to the intake for Tunnel No. 1 including the steel intake pipe and slide gate; and its overall mass and concrete body—although this is currently obscured by earth fill on the downstream side. While the small recorder's house centered on the dam dates to the period of significance and is generally indicative of and compatible to the original design of the dam, it has compromised integrity and is of secondary operational importance, and therefore is not a character defining feature.

Huntington Lake Dam No. 2 (Contributing Structure)
Huntington Lake Dam No. 2 was constructed simultaneously with Dam No. 1, approximately one-half mile southwest along the west edge of the Big Creek Basin. The dam is of the same basic concrete curved gravity design. Originally the dam did not serve any outlet purposes and was designed for impoundment only. The dam's crest is 1,862 feet in length, with a width of approximately 35 feet. A 2.5-foot boulder parapet wall runs along the downstream side of the crest of the dam that has been coated in gunite in the modern period. Like Dam No. 1. Dam No. 2 was raised 38 feet in 1917 to allow for more storage in Huntington Lake, and currently stands at a height of 120 feet (**Figure 4**).

In addition to the 1917 raising of the dam, Dam No. 2 has been subject to a number of alterations, both within the period of significance and beyond. In 1926, the dam was augmented to accommodate development of the Huntington-Pitman-Shaver Conduit (alternately Tunnel No. 7 Flowline) that was constructed to convey water from Huntington Lake and nearby Pitman Creek into Shaver Lake. To provide flow for the conduit, the dam was penetrated to allow for a ten-foot diameter steel intake pipe with slide gate that connects to the flowline.

Additional alterations include the ongoing placement of earth fill against both the upstream and downstream faces of the dam in order to provide stability and protect against freezing. In 1937 the dam was equipped with a metal seepage pipe that discharges seepage water into a rock-lined channel and small weir downstream. Sheet steel was added to portions of the upstream face in the 1950s to protect the dam face from spalling. Other ongoing alterations include the paving of the vehicular access road running across the crest of the dam and the placement of gunite on the parapet wall, isolated areas of gunite repairs along the face of the dam, and replacement of minor features including water level recorders and other infrastructure.

Despite these ongoing alterations, Dam No. 2 remains an integral component of the BCHSHD and is a contributing resource that is reflective of the district's significant development context (**Figure 5**). Further, all alterations are in keeping with the utilitarian design of the concrete gravity structure, allowing the dam to retain overall integrity of materials, workmanship, design, setting, feeling, and association within the context of the district.

Character defining features of the dam include its placement and orientation on Huntington Lake; its physical and functional relationship to the intake for the Tunnel No. 7 Flowline including the steel intake pipe and slide gate; and its overall mass and concrete body—although this is currently obscured by earth fill on the downstream side.

Huntington Lake Dam No. 3 (Contributing Structure)

Huntington Lake Dam No. 3 is the smallest of the three original Huntington Lake dams, with a crest length of 640 feet and height of 165 feet (**Figure 6**). The dam is located one-half mile west of Dam No. 2, on the far west side of the lake. The dam is of a curved concrete gravity design that was raised 38 feet in 1917 as part of the enlargement of the reservoir capacity. The dam does not include any spillways or outlets, as reservoir overflow is discharged through the Dam No. 1 spillways. Minor drainage features include two metal leakage piezometers that are located on the downstream face of the dam and are used to monitor water levels at the dam. The piezometers were installed in 1917 and 1937.

While the main body of the dam is unaltered from construction, there have been a number of modifications to the dam. Most notably, earth fill was placed on both the upstream and downstream faces of the dam to provide stability and freeze protection. In addition, a thick layer of rock rip-rap lines the downstream face, with a layer of gunite along the upstream face. The top of the dam has been covered in asphalt and currently serves as a pedestrian walkway for recreation visitors. A gunite coated parapet wall lines the downstream side of the crest, and a concrete eave extends from the upstream side of the crest, acting to deflect snowmelt from the dam face. A utilitarian pipe railing extends along the upstream side of the crest.

Despite these alterations, the dam remains an integral component of the Huntington Lake system and is a contributing resource that is reflective of the district's significant development context (**Figure 7**). Further, all alterations are in keeping with the utilitarian design of the concrete gravity structure, allowing the dam to retain overall integrity of materials, workmanship, design, setting, feeling, and association within the context of the district.

Character defining features of the dam include its placement and orientation on Huntington Lake; its utilitarian impoundment role; and its overall mass and concrete body—although this is currently obscured by earth fill on the downstream side.

Huntington Lake (Contributing Structure)
Huntington Lake is a storage reservoir that has a surface area of 1,435 acres and a storage capacity of 89,166 acre feet. Water impounded in the reservoir is sent to Powerhouse No. 1 via an intake at Dam No. 1 leading to the Tunnel No. 1 Flowline, or to Shaver Lake through an intake at Dam No. 2 to the Huntington-Pitman-Shaver Conduit, also called Flowline No. 7. The reservoir is fed by Big Creek and a number of smaller tributaries, as well as water from Ward Tunnel that was completed in 1925 and conveys water from Florence Lake located in the uppermost portions of the Watershed.

As a hydroelectric resource, there have been several notable changes to Huntington Lake since its 1913 inundation. Most importantly, the 1917 raising of the three dams provided for a much larger reservoir, increasing capacity from 38,000 acre feet to its present nearly 90,000 acre feet. Accompanying this increase in capacity, and in large part owing to it, there have been several notable alterations to the water inflow and outflow capacity of the reservoir. In 1925 SCE constructed Ward Tunnel that substantially added to inflow by carrying water from Florence Lake and the upper portions of the Watershed to Huntington Lake. The corresponding 1926 addition of the Huntington-Pitman-Shaver Conduit added additional outflow capacity, conveying water to Shaver Lake and ultimately the downstream powerhouses beyond. Over time Huntington Lake became increasingly integrated into a more complex water conveyance and management system. Throughout these evolutions, the reservoir has served the same basic function, to both store and supply water for the powerhouses located downstream in the project. Huntington Lake retains integrity of materials, workmanship, design, setting, feeling, and association within the context of the district and is a contributing resource of the BCHSHD (**Figure 8**).

While Huntington Lake has served the same basic storage and delivery function for the BCHSHD, the area surrounding the lake has evolved over the century from a largely undeveloped wilderness to a recreational enclave. Like most hydroelectric and water projects, recreational, tourist, and community amenities have been developed around the BCHSHD reservoirs, as the reservoirs have become integrated components of the landscapes of which they are part. The United States Forest Service (USFS) lands surrounding Huntington Lake have been developed with residential cabin tracts and summer camps, particularly on the north and west sides of the lake. A number of modest, removable boat ramp facilities are associated with this type of development, appearing intermittently around the lake. This type of ancillary recreational development is common along reservoirs of this type, and is not within the boundary of the BCHSHD as the recreational development generally does not convey significant engineering, design, or industrial themes related to hydroelectric development and operation of the BCHS. Rather, the ongoing adjacent development is indicative of an evolving twentieth century recreational, social, and tourism-related context that is overlapping with, and not within, the scope of the BCHSHD.

Character defining features of Huntington Lake include its storage capacity; its functional and physical relationship to connecting infrastructure including inflow from Ward Tunnel and outflow to the Tunnel No. 1 Flowline and the Huntington-Pitman-Shaver Conduit (Tunnel No. 7 Flowline); its impounding structures including Dam Nos. 1, 2, and 3; and its wooded and generally remote contextual setting.

Tunnel No. 1 Flowline (Contributing Structure)
Concurrent with the 1912-1913 development of Huntington Lake, PLPC constructed a tunnel and flowline system leading to Powerhouse No. 1 that was simultaneously under construction. As designed, the water conveyance system includes three basic linear components: a 3,870 foot (0.73 mile) subsurface tunnel bored through granitic bedrock, and two parallel 1.2 mile riveted steel pipelines that feed into the penstocks that plunge to meet Powerhouse No. 1 in the Big Creek Canyon. In general, these linear features have changed little since construction, with all basic components intact and serving the same water conveyance functions.

The intake for Tunnel No. 1 is located adjacent to Huntington Lake Dam No. 1. The intake is located below an octagonal concrete gatehouse that stands atop a 95-foot tower that extends to the bottom of the lakebed at the base of Dam No. 1. The intake is controlled by a nine-foot diameter steel slide gate protected by a steel trash rack. The gate is operated by an electric motor-powered hoist and three manually operated wheels in the gatehouse.

The tunnel itself flows west under the bedrock, extending in a southwesterly direction from Huntington Lake down the Big Creek Canyon. Construction of the tunnel proved particularly grueling, with round-the-clock blasting, harsh subterranean labor conditions, and challenging engineering constraints. As reported by David Redinger, who oversaw tunnel engineering in this period:

> Along the “tunnel battlefront” the thunderous report from each dynamite blast was terrific, and the echoes would reverberate through Big Creek Canyon, up and down, across and back, as though infuriated by the interference of the canyon walls. Zeus himself could not have done a better job.
>
> The pistol drill was used, as compared to the present much-improved hammer type drill. A blacksmith shop stood at the mouth of each adit for the sharpening of the drill steel, which was done by hand. Instead of having storage battery or trolley locomotives for hauling out blasted rock or muck, we used mules. It was amazing to observe the intelligence of these animals.[11]

[11] Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System*, 60.

Most of the subsurface tunnel is unlined, with solid granite bedrock walls. A single adit accesses the tunnel approximately 1,400 feet southwest of Dam No. 1 at Huntington Lake. The construction adit was developed to provide additional blast facings, with such openings developed along the length of tunnels to speed construction and provide a number of points, or "headings," from which to work (**Figure 9**). At present, the adit is abandoned and partially collapsed, with the remains of a corrugated metal shed standing at its entrance.

Near its termination, the flowline's granite tunnel is lined in concrete, with the very last portion of the tunnel lined in concrete reinforced with steel riveted pipe that bifurcates into two parallel pipelines that travel approximately 1.2 miles to the Powerhouse No. 1 Penstocks. These pipes are both of a riveted steel design; however, they differ slightly in their dimensions, with one measuring 84 inches in diameter and the other 60. Both are controlled by upper and lower valve houses that control water flow into and out of the lines. The valve houses are original to construction and of a utilitarian design, with board formed concrete walls and flat roof lines (**Figure 10**). The 84-inch flowline is primarily a subsurface feature, located approximately one foot below grade. In areas, the line is covered by stacked granite slabs and/or concrete buttresses. The 60-inch line runs both below and at grade, with major portions of the line visible. While much of this line rests at grade, partially embedded in soil, areas of the line are raised slightly and supported by concrete anchors.

The Tunnel No. 1 Flowline has served the same function since construction, to convey water from Huntington Lake to the Powerhouse No. 1 penstocks, and ultimately the turbines of Powerhouse No. 1. The linear feature has had no notable alterations to its design or overall operation since construction, with the sole known major alteration being the replacement of the intake gatehouse at Huntington Lake in the 1920s, during the period of significance for the district. The resource is a contributing resource of the BCHSHD and retains high integrity of materials, workmanship, design, setting, feeling, and association within the context of the district (**Figure 11**).

Character defining features of the Tunnel No. 1 Flowline include its operational alignment that extends from Huntington Lake Dam No. 1 to the Powerhouse No. 1 penstocks; its unlined granite tunnel; its intake infrastructure including the octagonal concrete gatehouse and associated slide gate; the two utilitarian concrete valve houses along the alignment; and the above grade and under-grade riveted steel pipelines, including the associated stabilization infrastructure composed of stacked granite and concrete anchor blocks. The alignment's single collapsed construction adit is not a character defining feature because it lacks sufficient physical integrity to convey significance as an engineering or construction feature.

Powerhouse No. 1 and Powerhouse No. 1 Penstocks (John E. Bryson Powerhouse) (Contributing Building)

The concrete foundation for the Big Creek System's first powerhouse, Big Creek Powerhouse No. 1, was poured in March 1913, with the completed plant coming on line only seven months later on November 10, 1913 (**Figure 12**). The site for the powerhouse is situated approximately

2,100 vertical feet below Huntington Lake, beneath the towering granite of Kerckhoff Dome on the bank of Big Creek (**Figure 13**). The location for the site was chosen for its vertical distance from Huntington Lake, with the elevation drop from the reservoir to the powerhouse representing ideal conditions for high head power generation. Simultaneously, the 1913 construction campaign included Powerhouse No. 2, located approximately four miles and 2,000 feet below Powerhouse No. 1 on the south bank of Big Creek. As designed, Powerhouse No. 1 and No. 2 operate in tandem, with the waters of Huntington Lake feeding Powerhouse No. 1, and in turn Powerhouse No. 2 as part of an integrated flow system.[12]

Powerhouse No. 1 is a five story reinforced concrete and structural steel building that stands 104 feet in height. At the time of initial construction, the building measured 171 feet by 85 feet. In 1925 the building was expanded to 227 feet by 85 feet in order to accommodate an additional generating unit. The building is sited along the north bank of Big Creek at the eastern edge of the town of Big Creek, providing a dramatic focal point that defines the entry into the town of Big Creek along Huntington Lake Road.[13]

The design of Powerhouse No. 1 exemplifies a restrained neoclassical aesthetic adapted to the mandates of industrial hydroelectric operations. The building is of a smooth concrete finish that is punctuated by generous bands of wood frame industrial sash windows separated by unadorned concrete pilasters. The pilasters correspond to the structural framing of the building and provide a rhythmic vertical articulation that defines the massing of the structure.

The south side of the powerhouse, fronting Big Creek, is the primary aesthetic façade. The base of the building is defined by eight tailrace openings, from which water is released into the powerhouse afterbay after traveling through the turbines. Rising from this functional and aesthetically spare foundation, vertical bands of industrial sash windows separated by pilasters line the façade, breaking up the otherwise monolithic concrete form of the building. Between each floor, simple concrete spandrels provide subtle visual cues to the internal arrangement of the powerhouse. A modest stringcourse with pendant dentils separates the fourth and fifth floor, with a smooth concrete cornice line articulating the top of the building. Block lettering reading "Southern California Edison" is centered between the fourth and fifth floors, with the more recently added "John E. Bryson Powerhouse" running atop the building on the otherwise spare and unadorned cornice. The building was renamed in 2009 in commemoration of the former president of SCE and United States Secretary of Commerce John E. Bryson.

The north side of the building is framed by the steep slope rising from the banks of Big Creek. The basic fenestration pattern and vertical articulation generally mirrors that of the south side of

[12] Philip Olson, *The Big Creek Project: A Hydroelectric Development on the San Joaquin River 1912-1930* (Unpublished Masters Thesis Submitted to California State University Fresno, August 1973, on file at Southern California Edison Archives), 27; David H. Redinger, *The Story of Big Creek,* 31.
[13] Powerhouse No. 1 has been recorded under the Historic American Engineering Record (HAER) program. This documentation provides the basis for the physical description herein and includes a wealth of detailed documentation regarding the development and operational components of Powerhouse No. 1. Daniel Shoup, *Historic American Engineering Record: Big Creek Powerhouse No. 1*, *HAER No. CA-167-E* (2012).

the powerhouse, with some deviations including a prominent concrete canopy extending from the crown of the building, originally designed to protect transmission features, and concrete spandrels replacing windows on the middle floors of the building. Operationally, the north side of the building provides the entry point for the four penstocks that feed high pressure water flows to the four turbines within the building. The penstocks are below grade and buried by concrete casing and earth fill as they enter the building at the basement level.

The west side of the powerhouse fronts a vehicular access drive. Remnant rails of an original railroad spur accessing the building are embedded in the pavement. While this elevation features a similar arrangement of vertically oriented industrial windows, a number of the units have been filled with metal vents. Additionally, a lattice steel hoist and catwalk structure extends from the building, added at an unknown date after construction. The switchrack for the plant extends at a northwesterly angle from the steel lattice structure, with the switchyard located approximately 0.15 miles to the west. Both the switchrack and switchyard have been continuously altered and upgraded to the present. Originally, electrical bussing and switching rooms were located internally in the upper three floors of the building, with these functions moved to the exterior of the building after the period of significance for the district in the 1930s.

The east side of the powerhouse is only three stories in height, as this portion of the building was added in 1925 when Powerhouse No. 1 was extended to accommodate a fourth generating unit. The addition is in keeping with the original design and configuration, with vertically oriented windows coupled with smooth concrete massing.

While Powerhouse No. 1 has continued to generate hydroelectricity since it was brought online in 1913, the interior has been subject to ongoing infrastructural alteration and upgrade as mechanical and technological innovations have led to replacement and adaptation of original features and operational wear has required maintenance and replacement of original components. As originally designed, the powerhouse had two turbines rated at 40,000 horsepower. By the mid-1920s, two additional units had been added for a total of 97,500 horsepower. At present, with the operational upgrade of all turbines in the plant, Powerhouse No. 1 is rated at 128,210 horsepower with four generating units.

Key original interior operational features that remain in generally the same configuration include the turbines, governors, and generators in the first floor generating room, which largely remain in their original casings despite the replacement of component parts including turbine buckets; re-winding of the generators; and enclosure of governors in cabinets (**Figure 14**). Turbines 1, 2, 3, and 4 are of the Pelton type and are horizontal shaft, single jet, double overhung, hydraulic impulse turbines. Units 1, 2, and 3 were manufactured by Allis-Chalmers, who supplied most of the original hydraulic equipment. Turbine 4, added in 1925, was supplied by the Pelton Company. The generators for the first three units were manufactured by General Electric, with the fourth by Westinghouse. Other notable original support features include an 85-ton capacity traveling crane manufactured by the Cleveland Electric Company that is suspended over the generating room floor.

Other interior areas of Powerhouse No. 1 have been continuously augmented to the present, including the control room in the second floor that has been modernized with computers and other office equipment, and the former switching area that originally occupied the third to the fifth floors, and now serves storage and other miscellaneous utilitarian purposes.

The Powerhouse No. 1 penstocks extend from the north side of Powerhouse No. 1, entering at the basement level to flow through the four turbines. The four welded steel penstocks are approximately 4,300 feet (0.81 mile) in length, plunging nearly vertically from the Tunnel No. 1 Flowline above (**Figure 15**). The penstocks for generating Units 1 and 2 were part of the 1913 construction, and were fabricated using a lap welding process by the Mannesman Rohrenwerke Company of Dusseldorf, Germany. These penstocks begin at a 44-inch diameter, tapering to a 36-inch diameter before reaching the powerhouse and splitting into two nozzles, one for each turbine wheel. The second two penstocks were added with the placement of the third and fourth generating units in 1917 and 1925. These penstocks are virtually identical to those of the original development, differing only slightly in dimensions.

The flow of the penstocks is controlled by a valve house at the top of the penstocks at the terminus of Flowline No. 1. The gate valves are currently electrically operated from Powerhouse No. 1 or remotely from a control center at Powerhouse No. 3. The valve house itself is a small, utilitarian building of board formed concrete construction that dates to the initial construction period. Slightly downslope of the valve house, four steel vent stacks associated with each penstock rise from concrete anchor blocks. Other associated infrastructure includes both concrete and laid rock anchor blocks and piers that support and stabilize the penstocks as they extend downslope. This type of infrastructure generally appears to date to the initial construction period and was developed to provide increased stability against the extreme force of the water as it flows through the penstocks.

As a system, Powerhouse No. 1 and its associated penstocks embody the mechanical translation of water to energy, as described succinctly by David Redinger:

> The high pressure pipelines, or penstocks, are connected to the lower end of the flowlines, and extend down the steep mountainside to Powerhouse No. 1. They terminate at the powerhouse in eight nozzles, one for each wheel, two wheels per turbine, from which the water discharges at a velocity of about 350 feet per second. These jets, almost like bars of steel, discharge across an open space of a few inches to strike the buckets of the water wheels. A tremendous impact might be expected, but the shock is relieved since the part of the bucket, when first touched, is nearly parallel to the jet. The water's course over the surface of the bucket is momentary, and without much pressure and velocity it falls into the tailrace… The control of pressure and the economical use of water at varying loads is provided for, each turbine having a governor, so that maximum efficiency can be obtained from a unit by using one or both wheels according to load

> demand… After reaching the tailrace, the water, instead of continuing unchecked down the natural canyon, must repeat its first performance, because its job is only half done—and is again impounded, this time by Dam No. 4 across Big Creek just below Powerhouse No. 1. The water passes through a four mile tunnel and into the high pressure lines, through which it is carried to work on the wheels in Powerhouse No. 2.[14]

This functional role has changed little over time despite ongoing maintenance and mechanical alterations to constituent components of the turbines, generators, and bussing and switching equipment. In addition, the overall physical form of both the powerhouse and penstocks has changed little since the initial construction period, and the resource in its entirety retains a high degree of operational and physical integrity within the context of the district and is a contributing resource of the BCHSHD (**Figure 16**).

Exterior character defining features of Powerhouse No. 1 include the powerhouse's location on and orientation toward Big Creek; its functional and physical connection to the powerhouse penstocks and the Tunnel No. 1 Flowline; its overall stepped form and mass as well as its concrete finish; its industrial fenestration that includes vertical bands of wood-frame industrial windows coupled with smooth concrete pilasters and minimal industrial entries; its tailrace openings flowing to Big Creek; and the remnant rail features that run adjacent to the exterior of the building. The outdoor switchyard located immediately to the west of Powerhouse No. 1 does not contribute to the significance of the Powerhouse, as it is comprised of utilitarian features that have been upgraded to the present, do not date to the period of significance, and do not reflect the significant development themes of the district.

Interior character defining features consist of the generally open industrial-scale volume of the large generating room floor; its intact operating components including the original generator, governor, and turbine casings for the generating units; the original Cleveland Crane stationed above the generating room floor; and the below grade penstock entries at the basement level. Other areas including the control room and the upper level switching and bussing equipment have been altered, augmented, and removed to the present and do not retain sufficient physical integrity to be considered character defining.

Character defining features of Powerhouse No. 1's penstocks include the general alignment that plunges from Tunnel No. 1 Flowline; the welded steel penstocks that travel above grade and their associated concrete and rock stabilization walls, anchor blocks, and piers; and the utilitarian board formed concrete valve house and associated vent stacks that mark the transition between Tunnel No. 1 Flowline and the penstocks.

Scot Lake Domestic Diversion (Noncontributing Structure)
Scot Lake Domestic Diversion was built in 1913 in conjunction with Powerhouse No. 1. The small diversion dam is located approximately one-third of a mile upstream from Powerhouse No.

[14] David H. Redinger, *The Story of Big Creek,* 33.

1 on Big Creek and was constructed to provide day-to-day water supplies for operators of Powerhouse No. 1 as well as a local water supply for the town of Big Creek. While the diversion still supplies water for day-to-day operation of the powerhouse, it no longer serves as a primary water supply for the town of Big Creek.

The small utilitarian dam is constructed of concrete and is approximately 77 feet in length, with a 61-foot linear main body and a 16-foot curved spillway. The dam ranges in height from five feet to one foot as the crest meets the spillway. The intake structure is approximately seven feet by 7.5 feet in size and is of board formed concrete, with an 8-inch pipe extending from the headworks downslope to Powerhouse No. 1. The dam is serviced by a modern metal walkway that traverses the steep slope adjacent to the diversion. A modern trash rack and monitoring equipment is affixed to the concrete intake structure.

The Scot Lake Diversion was developed as a minor utilitarian accompaniment to the construction of Powerhouse No. 1 and was designed to serve localized plant needs. The dam has been altered since the construction period by the addition of modern infrastructural elements and no longer serves as an important support feature for the town of Big Creek's water supply. Because it served as a minor support element and lacks physical integrity, the diversion does not contribute to the significance of the district and is a noncontributing resource.

Dam No. 4 (Contributing Structure)

Dam No. 4 was developed to impound water flowing from the tailraces of Powerhouse No. 1, with the small reservoir serving as a forebay for Powerhouse No. 2 four miles downstream. The dam is a 75-foot high constant-radius concrete arch dam with a crest length of 287 feet (**Figure 17**). The spillway of the dam consists of 27 ungated bays with removable flashboards. The bays are separated by concrete piers, with the spillway running for a total length of 187 feet. The net storage capacity of the dam is 60 acre feet. The dam's primary outlet works are located a short distance upstream from the left abutment of the dam, forming the entrance to Tunnel No. 2 that flows through granite bedrock to Powerhouse No. 2. An additional 72-inch sluice pipe penetrates the bottom of the dam at its center, discharging into the Big Creek streambed. The pipe is controlled by a mechanically operated sluice gate located on the crest of the dam.

While the mass and primary outlet feature of the dam remain largely as they appeared when they were constructed in 1913, some minor features of the dam have been modified or upgraded as part of ongoing maintenance. These features include development of steel access stairs and security gates, placement of reservoir gauging and monitoring equipment, the addition of a steel frame overhead trolley to the crest of the dam to access flashboards, the conversion of the hand-operated sluice gate to mechanical operation, and other miscellaneous utilitarian upgrades. These functional alterations are minor and compatible in form and have served to preserve the ongoing function and operations of the dam. None undermine Dam No. 4's ability to convey significance as a contributing resource within the context of the district, with the dam retaining a high level of physical integrity (**Figure 18**).

Character defining features of the dam include its placement and orientation in relation to Powerhouse No. 1 and the Powerhouse No. 2 forebay; its curved concrete body; its ungated spillway separated by concrete piers; its sluice pipe and gate; and its physical and functional relationship to the intake for Tunnel No. 2 including the steel intake pipe and slide gate.

Tunnel No. 2 Flowline (Contributing Structure)
Tunnel No. 2 is a subsurface linear feature that flows approximately four miles through granite bedrock from the Dam No. 4 impoundment to the penstocks above Powerhouse No. 2. The tunnel originates slightly upstream of Dam No. 4, with a twelve-foot intake pipe housed below a small utilitarian concrete intake structure located in the Dam No. 4 impoundment. The pipe passes through the lower portion of the dam and is equipped with a slide gate at the upstream end. From the portal, the tunnel travels approximately four miles in a generally southwesterly direction, terminating at a surge tank located on a bluff approximately 4,000 feet above Powerhouse No. 2. Through the majority of its length, the tunnel is twelve feet in diameter and composed of unlined granite bedrock (**Figure 19**).

Drilling Tunnel No. 2 was one of the most arduous components of the initial construction of the BCHS. Nine adits were constructed along the 21,759-foot tunnel for access, so that crews could drive at twenty headings, or rock faces, thereby speeding construction. At each adit, crews of sixteen men worked virtually round-the-clock, blasting with dynamite and piston drills to move the tunnel forward. As relayed by Redinger, “Since there were so many headings, and as the work was on a 24-hour basis, our party at times would be ‘run ragged’ because blasting could occur at any hour. It was our job to go in after each round was fired, to give direction and grade, or elevation for drilling the next.”

While critical to construction, the adits are now largely abandoned, with half of the openings either collapsed or obscured by mature overgrowth and vegetation. Several remain generally intact, including Adits 5, 6, and 7 that feature unlined rock tunnels terminating at poured concrete bulkheads; and Adits 7.5 and 8 that feature small board formed concrete entry structures embedded in the hillside, leading to unlined adit tunnels within. Additionally, Adit 7.5 features a leakage weir equipped with modern sensors and electrical equipment that conveys leakage water from the adit tunnel. Adits 1 through 4 have collapsed and are inaccessible.

Tunnel No. 2 terminates at a concrete-lined surge chamber that measures 106 feet in height and 30 feet in diameter. The surge chamber is largely buried, with only a small portion extending above ground. Flow from the surge chamber is controlled by a nine-foot slide gate controlled by levers in a gate house that rises above the surge chamber. The gate house is octagonal in plan and of board formed concrete construction. While the building is largely utilitarian in design, subtle decorative details including a round finial crowning the roofline and rhythmic bands of industrial windows at the bottom and top of the structure combine to impart a heightened yet spare treatment that is reminiscent of a turret rising from the wooded hillside (**Figure 20**).

Water from Tunnel No. 2 exits the surge tank via a buried nine-foot diameter steel pipe. The buried pipe travels for approximately 250 feet before terminating at Powerhouse No. 2's four penstocks that plunge to Powerhouse No. 2 along the bank of Big Creek below.

The Tunnel No. 2 Flowline has served the same function since construction, to convey water from Powerhouse No. 1 to the Powerhouse No. 2 penstocks, and ultimately the turbines of Powerhouse No. 2. The linear feature has had no notable alterations to its overall design or operation since construction. The resource retains high integrity of materials, workmanship, design, setting, feeling, and association within the context of the district and is a contributing resource of the BCHSHD (**Figure 21**).

Character defining features of the Tunnel No. 2 Flowline include its operational alignment that extends from Powerhouse No. 1 to the penstocks of Powerhouse No. 2; its unlined granite tunnel; its intake infrastructure including the 12-foot intake pipe and associated slide gate; and its concrete-lined surge chamber, including the associated slide gate and octagonal concrete gatehouse rising above. The alignment's intact construction adits are character defining features in that the shafts of the adits are indicative of the method and type of construction of the flowline. Adits 1 through 4 are not intact and are therefore not considered character defining features.

Adit 8 Creek Diversion Dam (Contributing Structure)
Adit 8 Creek Diversion Dam is a small reinforced concrete diversion dam that was developed following the completion of Tunnel No. 2 to provide additional flows into the tunnel through a bore hole at Tunnel No. 2's Adit No. 8. The diversion spans Adit 8 Creek approximately three and one-half miles southwest of Big Creek, diverting the flows of the creek to the tunnel. The dam is no longer in use.

The concrete dam is 30 feet high, with a crest length of 44 feet and a width of four feet. The dam has an 11-foot spillway, currently blocked by milled lumber flashboards. A five-foot by five-foot sluice gate is located on the bottom west side of the dam that originally directed flow to Tunnel No. 2. While the original features are intact, the gate is closed and no longer in use. In addition to the main body of the dam, the resource includes two large wing walls downstream of the dam that were developed to direct flow from the stream bed into a box culvert that crosses under the former San Joaquin and Eastern Railroad Grade.

While the diversion dam is no longer operating, it retains physical integrity to the historic period through integrity of materials, workmanship, design, setting, feeling, and association and continues to contribute to the significance of the district as a contributing resource.

Character defining features of the dam include its placement and orientation in relation to Tunnel No. 2; its location in a steep, incised canyon and physical connection to the adjacent bedrock; its overall mass and concrete body, including the 11-foot spillway; and the sluice gate that directed flows to Adit 8, although this feature is currently non-operating (**Figure 22**).

Ely Creek Diversion Dam (Noncontributing Structure)

Ely Creek Diversion is a small concrete diversion dam that was developed following completion of Tunnel No. 2 to provide additional flows into the tunnel. The diversion spans Ely Creek approximately three miles southwest of Big Creek. The small concrete dam is five feet high with a crest length of 44 feet. Diverted water is conveyed through approximately 300 feet of 12-inch diameter steel tube to Tunnel No. 2, where it enters through Adit No. 6. Flow through this conduit is controlled by a gate valve located upstream of the diversion structure.

The small diversion has been altered since the construction period by the addition of new piping, valves, and a gauging station in 1952, compromising the resource's physical integrity to the historic period. Because it served as a minor support element and lacks physical integrity, the diversion does not contribute to the significance of the district and is a noncontributing resource.[15]

Balsam Creek Diversion Dam (Noncontributing Structure)

Balsam Creek Diversion Dam is a small concrete diversion dam that was developed following completion of Tunnel No. 2 to provide additional flows into the tunnel. The diversion spans Balsam Creek approximately four miles southwest of Big Creek. The concrete dam is eight feet high with a crest length of 100 feet. Diverted water is conveyed through approximately 340 feet of 12-inch diameter steel tube to Tunnel No. 2. Flow through this conduit is controlled by a gate valve located upstream of the diversion structure.

The small diversion has been altered since the construction period by the addition of new piping, valves, and a gauging station in 1952, compromising the resource's integrity to the historic period. Because it served as a minor support element and lacks physical integrity, the diversion does not contribute to the significance of the district and is a noncontributing resource.[16]

Powerhouse No. 2 and Powerhouse No. 2 Penstocks (Contributing Building)

The Powerhouse No. 2 foundation was laid in April of 1913, concurrent with the construction of Powerhouse No. 1 and the massive tunneling efforts that were reshaping the Big Creek Watershed above. Initial construction efforts were stymied by one of the project's first major disasters, with a fire breaking out at the partially completed powerhouse in October of 1913. Spreading from an adjacent carpentry shop, the blaze caused the newly laid roof to collapse and partially destroyed much of the upper floors. Despite the setback, the pace of construction

[15] See California Office of Historic Preservation (OHP) Consultation FERC120306B: Determination of Eligibility for the Ely, Balsam, and Bolsillo Creek Diversion Facilities, FERC Project 2175, Fresno County, CA, April 13, 2012. In this consultation all resources were determined noncontributors.

[16] See California Office of Historic Preservation (OHP) Consultation FERC120306B: Determination of Eligibility for the Ely, Balsam, and Bolsillo Creek Diversion Facilities, FERC Project 2175, Fresno County, CA, April 13, 2012. In this consultation all resources were determined noncontributors.

remained virtually undiminished, with the completed plant brought on line by December of 1913 (**Figure 23**).[17]

Upon completion, Powerhouse Nos. 1 and 2 were virtual operational and aesthetic mirrors. Like its upstream neighbor, Powerhouse No. 2 is built of reinforced concrete and structural steel. The building is five stories in height, and as initially designed measured 171 feet by 85 feet, with a height of 104 feet. Like Powerhouse No. 1, Powerhouse No. 2 was expanded to house additional generating units in 1921, with the expanded size mirroring that of Powerhouse No. 1 at 227 feet by 85 feet in size. In addition to the overall functional equivalence, Powerhouse No. 2 is reflective of the same restrained formalism, with a neoclassical façade defined by a rhythmic vertical arrangement of industrial windows and smooth concrete structural members (**Figure 24**).

While the initial design and early development history of Powerhouse No. 2 generally aligns with Powerhouse No. 1, of notable difference was the 1927 addition of Powerhouse No. 2A to the east side of Powerhouse No. 2, that brought the number of generating units at the site to six. Although the two buildings share a common wall, they are fed by different water sources and exemplify different construction and operational contexts. The two powerhouses are treated as distinct resources, with Powerhouse No. 2A fully described later in this narrative.

The north side of Powerhouse No. 2 fronts Big Creek. Tailrace openings at the base of the structure flow into Big Creek, with an orderly vertical grid of windows and concrete pilasters rising above. The generally flat roof is defined by a simple concrete cornice, with slight sloping to front and rear for drainage. The switchyard for the powerhouse stands to the north of the building, across Big Creek.

Four penstocks enter the base of the south side of Powerhouse No. 2 after crossing under the powerhouse access road. The penstocks are exposed as they enter the building, with each bifurcating before entering the powerhouse. Like the primary façade, the south elevation is largely defined by the vertical arrangement of pilasters and windows, with the primary difference being a large concrete canopy that spans the cornice line, which initially served to protect transmission features that spanned from the building prior to the development of exterior transmission equipment. Additionally, a modern transformer bank runs along this side of the building.

The west portion of the powerhouse was added in 1921 and consists of three stories that aesthetically mirror the original design. A modern storage area extends from this side of the building. The storage area was constructed circa 2010 and is constructed of concrete with fenestration that mirrors the remainder of the building.

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[17] David H. Redinger, *The Story of Big Creek,* 32; Powerhouse No. 2 has been recorded under the Historic American Engineering Record (HAER) program. This documentation provides the basis for the physical description herein and includes a wealth of detailed documentation regarding the development and operational components of Powerhouse No. 2. Daniel Shoup, *Historic American Engineering Record: Big Creek Powerhouse No. 2 and 2A*, *HAER No. CA-167-F* (2012).

The east side of the building adjoins Powerhouse No. 2A, with the juncture between the two buildings marked by a steel truss bridge that crosses Big Creek. A 20-foot wide industrial corridor connects the two powerhouses and acts as a service alley between the two.

The interior of Powerhouse No. 2 is governed by the same operational layout as Powerhouse No. 1. Key operational features at the basement levels include the pits for the turbines and generators; the penstock entries; and the tailrace openings discharging to Big Creek to the north. The first floor is dominated by the generator room that runs the full length of the building on its north side with a soaring height of 45 feet (**Figure 25**). The second floor houses the control room; the third through the fifth floors originally housed transformers and switching and bussing equipment. Because of the removal of these features from the interior of the plant these areas are now devoted to miscellaneous storage and utilitarian functions.

While Powerhouse No. 2 has continued to generate electricity since it was brought on line in 1913, the interior has been subject to ongoing infrastructural alteration and upgrade as mechanical and technological innovations have led to replacement and adaptation of original features and operational wear has required maintenance and replacement of original components. Key original interior operational features that remain in generally the same configuration include the turbines and generators and governors in the first floor generating room, which remain in their original casings despite the replacement of component parts including turbine wheels and/or buckets and the re-winding of the generators. The first three turbines installed in the Powerhouse No. 2 are of the horizontal shaft Pelton type and were manufactured by Allis-Chalmers, who supplied most of the original hydraulic equipment for the powerhouse. The last turbine, No. 6, was added in 1925, and was supplied by the Pelton Company. The generators were fabricated by Westinghouse. Other notable original features inside the powerhouse include an 85-ton capacity traveling crane manufactured by the Cleveland Electric Company that is suspended over the generating room floor.

Other areas of Powerhouse No. 2 have been continuously augmented to the present, including the control room in the second floor that has been modernized with computers and other office equipment and the former switching area that originally occupied the third to the fifth floors, which now serves storage and other miscellaneous utilitarian purposes, as switching equipment was moved to the outside of the facility in the 1930s. Like Powerhouse No.1, the turbines and generators have been operationally upgraded to produce more power, with Powerhouse Nos. 1 and 2 now producing a combined 150 MW of power.

The Powerhouse No. 2 penstocks extend from the south side of Powerhouse No. 2, entering at the basement level to flow through the four turbines. The four welded steel penstocks range between approximately 4,300 and 4,600 feet in length (0.81-0.87 mile), plunging from the Tunnel No. 2 surge tank above.

The penstocks for the two original generating units, Units 3 and 4, were part of the 1913 construction, and were fabricated using a lap welding process by the Mannesman Rohrenwerke Company of Dusseldorf, Germany. These penstocks begin at a 44-inch diameter, tapering to a 36-inch diameter before reaching the powerhouse and splitting into two nozzles, one for each turbine wheel. The second two penstocks are of the same dimension and were added with the placement of the third and fourth generating units in 1921 and 1925. These penstocks are largely identical to those of the original development.

Flow to the penstocks is controlled by a valve house that is located at the top of the penstocks at the terminus of Flowline No. 2. The gate valves are operated on site or remotely from a Control Center at Powerhouse No. 3. The valve house itself is a small, utilitarian building of board formed concrete construction that dates to the initial construction period. Slightly downslope of the valve house, four steel vent stacks associated with each penstock rise from concrete anchor blocks. Other associated infrastructure includes both concrete and laid rock anchor blocks and piers that support and stabilize the penstocks as they extend downslope as well as a single access hatch. This type of infrastructure generally dates to the initial construction period and was developed to provide increased stability against the extreme force of the water as it flows through the penstocks and to allow for maintenance.

The functional role of Powerhouse No. 2 has changed little over time despite ongoing maintenance and mechanical alterations. In addition, the overall physical form of both the powerhouse and penstocks has changed little since the initial construction period, and the resource retains a high degree of operational and physical integrity within the context of the district and is a contributing resource of the BCHSHD (**Figure 26**).

Exterior character defining features of Powerhouse No. 2 include the powerhouse’s location on and orientation toward Big Creek; its functional and physical connection to the powerhouse penstocks and Tunnel No. 2 Flowline; its overall stepped form and mass and physical and functional linkage to Powerhouse No. 2A; its concrete finish and industrial fenestration with neoclassical allusions, including the vertical bands of wood-frame industrial windows coupled with smooth concrete pilasters; and its tailrace openings flowing to Big Creek. The outdoor switchyard located immediately to the north of Powerhouse No. 2 across Big Creek does not contribute to the significance of the powerhouse, as it is comprised of utilitarian features that have been upgraded to the present, do not date to the period of significance, and do not reflect the significant development themes of the district.

Interior character defining features consist of the generally open industrial-scale volume of the large generating room floor; the original generator, governor, and turbine casings for the generating units; the original Cleveland Crane stationed above the generating room floor; and the penstock entries at the basement level. Other areas including the control room and the upper level switching and bussing equipment have been altered, augmented, and removed to the present and do not retain sufficient physical integrity to be considered character defining.

Character defining features of Powerhouse No. 2's penstocks include the general alignment that plunges from Tunnel No. 2 Flowline; the welded steel penstocks that travel above grade and their associated concrete and rock stabilization walls, anchor blocks, and piers; and the utilitarian board formed concrete valve house and associated vent stacks that mark the transition between Tunnel No. 2 Flowline and the penstocks.

Contextual Overview: World War I and Temporary Cessation of Big Creek Construction
Powerhouse No. 2 was brought on line on December 18, 1913, with Powerhouse No. 1 relaying power approximately one month earlier. The combined output of the two powerhouses was 60,000 kilowatts (kW), transmitted to Southern California by a pair of 241 mile transmission lines that operated at 150,000 volts and extended to the Eagle Rock Substation on the periphery of Los Angeles.[18] At the time of the 1913 completion, the initial developments at Big Creek had the highest head, or vertical distance between reservoir and turbine, both in the state and the nation. In addition, the turbines and generators of the two powerhouses were the largest of their type ever built, with the size and scale of the electrical generation unprecedented in American hydroelectric development. In keeping with the record breaking generation capacity, the project's transmission lines were the longest ever built, serving a vast urban market hundreds of miles away, a feat that would have been considered inconceivable even a decade prior.[19]

The completion of this first phase of development coincided with the eruption of World War I, which served to undermine capital, electrical demand, and labor supplies during the 1914-1918 period. During these years, the frantic pace of development that characterized the project's inception dramatically slowed, with facility development largely limited to operations and maintenance. As recounted by Redinger:

> As soon as the first development was completed, the Stone & Webster forces moved out. In one respect, any construction job is like a large circus—even including the clowns. As soon as the "show" is over the outfit moves elsewhere… After the exodus there was a lull in the area with respect to major construction, but not with the two large powerhouses just completed, as they settled down to grinding out kilowatts for rapidly growing Southern California, the job for which they were built.[20]

One exception to this general cessation was the raising of Huntington Lake for additional storage capacity that occurred in 1917 and included the raising of Dams 1, 2, and 3, as well as the construction of a small additional dam, Huntington Lake Dam No. 3A. The expansion project doubled the storage capacity of the lake, which in turn allowed for the placement of an additional

[18] While two lines were part of the initial 1913 development, the eastern line, "Big Creek East" was not completed until 1917 because of financial considerations and project delays. David H. Redinger, *The Story of Big Creek,* 67.
[19] Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System,* 74-80.
[20] David H. Redinger, *The Story of Big Creek,* 32.

generating unit in Powerhouse No. 1 in 1917, and an additional unit at Powerhouse No. 2 in 1921.[21]

Huntington Lake Dam No. 3A (Noncontributing Structure)
Huntington Lake Dam No. 3A was constructed in 1917 as a concrete gravity dam structure when Dams Nos. 1, 2, and 3 were raised to double the storage capacity of the lake. The dam is located between Dam No. 2 and Dam No. 3, and served as a saddle dam to impound the heightened reservoir levels. As originally constructed, the dam was 22.5 feet in height and 263 feet in length, and composed of concrete, with no spillways or outlet works. In 1936-1937, the dam was extensively modified by placing earth fill and rock rip-rap against both faces of the dam. Additional backfill was placed over the upstream face of the dam in 1966 to protect the concrete from frost damage, completely covering the upstream face and obscuring the original dimensions. The dam appears now as a low, broad-based earthen dike, with the concrete core completely obscured.

Huntington Lake Dam No. 3A was developed as a minor support structure to accommodate the raising of Huntington Lake, with the small dam working in concert with adjacent Dams 1, 2, and 3 to impound the waters of Huntington Lake. The concrete dam has been altered and is largely unrecognizable as a concrete gravity structure, with fill and rip-rap entirely obscuring the original profile and crest. Huntington Lake Dam No. 3A is relatively minor support structure and has been altered extensively since its original construction. Dam No. 3A does not contribute to the significance of the district and is a noncontributing resource to the BCHSHD.

Contextual Overview: Post-World War I Energy Demands Catalyze System Expansion
While both capital and demand languished during the World War I period, the years following the 1918 armistice were defined by escalating energy consumption, with industrial, agricultural, and consumer interests demanding power on an unprecedented scale. While the demand stemmed in part from pent up development pressures, it also reflected a host of new innovations in industrial, agricultural, and personal life, as electricity became central to day-to-day existence on a dizzying array of levels. In SCE's Annual Report of 1919, the problem of unmet demand was characterized as a fundamental growth opportunity for the company, with the market dynamic characterized succinctly below:

> All classes of business, particularly industrial, oil development, and agricultural, were given a tremendous impetus upon the signing of the armistice. This placed before us unusual demands for electrical power, which are increasing. These will be met by development of additional power. We are fortunate in having 900,000 hydroelectric horsepower capable of being developed on a commercial basis in

[21] Southern California Edison, *Initial Information Package for the Big Creek Hydroelectric System Alternative Licensing Process,* C-2-3.

> the watersheds in which the company's principal power plants are located… a potential which will be realized.[22]

Big Creek's tremendous 1920s expansion was constructed on the heels of this demand, with massive outputs of capital, manpower, and engineering innovation used to undergird an unprecedented expansion of an already groundbreaking system. As described by historian Laurence Shoup in his authoritative account of the development of the Big Creek System, *The Hardest Working Water in the World,* the 1920s in Big Creek were a time of "superlatives," with the rapidly developing hydroelectric system seeming to break one record after the next in rapid succession:

> During this decade, the bulk of construction was completed on one of the world's greatest engineering projects of the first third of the twentieth century. This enterprise included building three new powerhouses and expanding two others; construction of two major dams and several smaller ones; drilling of several major tunnels; and installation of penstocks and hydraulic and electrical generating and transmitting equipment needed to create a system capable of generating over one-half million horsepower and almost 400,000 kilowatts. Several world records (in tunnel size and length, dam length, transmission voltage, and size of hydraulic equipment) were set during the course of this expansion project… During the 1920s, as many as 5000 men at a time were employed in building the Big Creek System. Some of them braved the High Sierran winter year after year in order to complete Florence Lake Tunnel, which was the centerpiece of the entire project.[23]

The following sections describe all of the contributing and noncontributing hydroelectric generation resources from this 1920s development period, with the construction history and current conditions of each summarized and placed within the overall development context of the district. The narrative traces the physical development of the hydroelectric system as it developed through the 1920s, presenting the resources in chronological order.

Tunnel No. 5 Flowline/Shaver Tunnel (Contributing Structure)

While the BCHS was by far the most expansive water diversion project to shape the region in the early twentieth century, the project was not the first to alter the San Joaquin River Watershed. In 1893, lumberman C.B. Shaver oversaw the inundation of Stevenson Basin, located approximately six miles southwest of the site of Huntington Lake. As initially developed, Shaver Lake was impounded by a 40-foot high rock-fill dam and had a storage capacity of 5,200 acre-feet, with the water serving to support lumber operations for C.B. Shaver's Fresno Flume and Lumber Company.

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[22] *Southern California Edison Annual Report of 1919: Report of the President* (on file at Southern California Edison Company Archives).

[23] Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System,* 86.

In July of 1919, with the Big Creek Hydroelectric Project poised to expand, SCE purchased this small reservoir and thousands of acres of surrounding lands, quickly integrating the diminutive Shaver Lake into project development. Upon purchase, the company immediately connected Shaver Lake to Powerhouse No. 2 via a new flowline, Tunnel No. 5. Several years later, in 1927, SCE dramatically expanded the storage capacity of the lake with the development of a new dam.[24]

Constructed in 1920 and 1921, the 14,300-foot Shaver Tunnel, or Tunnel No. 5 Flowline, was the first infrastructural nexus between Shaver Lake and the Big Creek System. As designed, the tunnel carried water from Shaver Lake to Powerhouse No. 2, located approximately four and one-half miles and 2,400 vertical feet below. Construction of the tunnel provided additional flows that supported the 1921 expansion of Powerhouse No. 2 (**Figures 27, 28**). As reported by Redinger:

> The word had been given to get the tunnel started, and when such instructions are turned loose in construction, "the dirt must fly" right now—and what's more, it usually does. The Shaver Tunnel, 14,300 feet long, eight by eleven feet in cross section, actually got under way with respect to driving, on February 5, 1920, and was completed May 6, 1921. An average crew of 90 men for each of the four headings worked continuously throughout the job. At that time we considered the progress to be excellent. In one heading, an advance of 522 feet was made in a thirty-day period. Equipment included air-operated "Shuveloaders," or mucking machines, "Leyner" drills, pneumatic drill sharpeners, storage battery locomotives, and huge blowers for supplying fresh air. The experience with this equipment served as a valuable guide for driving other large tunnels during the next ten years.[25]

When Tunnel No. 5 was completed, water flows were directed through a temporary joining pipe known as a "shoo-fly" pipeline that connected to Tunnel No. 2 at the Adit 8 Creek Diversion Dam. In 1928, when SCE completed Powerhouse No. 2A adjacent to Powerhouse No. 2, Tunnel No. 5's flows were redirected to Powerhouse No. 2A's penstocks, a configuration that remains in place today. While the shoo-fly is no longer in use, remnants of the structure remain, including remnants of pipe, concrete retaining walls, and notched granite foundations.

At present, Tunnel No. 5 is characterized by four primary components: an intake and intake gate house; the tunnel and two associated construction adits; a surge chamber; and an outlet portal.

The intake structure for the flowline is located in Shaver Lake, with control regulated by a gate valve and flow screened by a trash rack. The gate valve is situated below an intake gate house, located near the north abutment of Shaver Lake Dam. The intake gate house was constructed in

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[24] Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System,* 90; David H. Redinger, *The Story of Big Creek,* 78.
[25] David H. Redinger, *The Story of Big Creek,* 80.

1927, when the expanded Shaver Lake Dam was completed, and is of a utilitarian board formed concrete design, with a flat roof and regularly placed industrial sash windows with lug sills. The building measures approximately 30 feet by 22 feet. A pair of modern metal utility doors line the north side of the building. The gate valve is six feet by nine feet wide and is operated by controls in the gatehouse. The trash rack is generally submerged, and is of a slatted steel design and rectangular in shape.

Tunnel No. 5 runs through granite bedrock from Shaver Lake. The tunnel is unlined for 13,900 feet (2.6 miles) and is approximately eight-by-eleven feet in cross section for its entire length. Construction of the tunnel was supported by the development of two adits, both of which have collapsed and are overgrown. The tunnel flows into a surge chamber located at the top of Powerhouse No. 2A penstock. The surge chamber is buried approximately 200 feet underground and is 15 feet wide, 15 feet high, and 150 feet in length. A vertical overflow/ventilation shaft rises from the underground chamber to the ground surface. The shaft is six feet in diameter and 145 feet long, with the sides partially lined in concrete and partially unlined granite. A low concrete wall with chain link fence surrounds the opening of the shaft. From the surge chamber, flow from the tunnel runs for 460 feet to the Powerhouse No. 2A penstock, with flow to the penstock controlled by a gate valve. This section of the tunnel is lined in riveted steel pipe.

Tunnel No. 5 has served the same function since construction, to convey water from Shaver Lake to downstream SCE powerhouses (**Figures 29, 30**). While the tunnel initially served Powerhouse No. 2, as the system expanded in the late 1920s the tunnel was augmented to service adjacent Powerhouse No. 2A. There have been no notable alterations to the overall operation of the resource, and Tunnel No. 5 is a contributing resource to the BCHSHD that retains high integrity of materials, workmanship, design, setting, feeling, and association within the context of the district.

Character defining features of the Tunnel No. 5 Flowline include its operational alignment that extends from Shaver Lake to the penstock of Powerhouse No. 2A; its unlined granite tunnel; its intake infrastructure including the gate house and associated slide gate and trash rack; its underground surge chamber, including the ventilation shaft; and its steel pipe and gate valve at the termination of the flowline. While the construction adits were critical to construction and of character defining importance, both have collapsed and no longer retain sufficient integrity to be considered character defining features.

Tunnel No. 8 Flowline (Contributing Structure)
At the same time SCE was integrating flows from Shaver Lake into the Big Creek System though Tunnel No. 5, the company was expanding the hydroelectric system further down the San Joaquin River through a series of tunnels and additional powerhouses. Tunnel No. 8 was the first of these, with construction beginning in February of 1920 and completed in June of 1921. The 5,933-foot (1.1 mile) unlined granite tunnel extends from Powerhouse No. 2 to Powerhouse No. 8, which stands at the confluence of Big Creek and the San Joaquin River and was added to the

system in 1921. As designed, the tunnel extends from a forebay below Powerhouse No. 2 to a ridge above Powerhouse No. 8, where the flow reaches Powerhouse No. 8's twin penstocks.

In many senses, the construction of Tunnel No. 8 and associated Powerhouse No. 8 was a stopgap measure intended to relieve critical shortages in SCE's electrical production. By 1920, urban electrical demand was regularly outstripping Big Creek's production. Prior to this point, SCE was focused on the development of Powerhouse No. 3, a high head powerhouse that would be located a considerable distance down the San Joaquin River. Development of Powerhouse No. 3 required an exceedingly arduous construction campaign, however, including a nearly 30,000-foot tunnel and a massive road-building effort. Because of the pressing electrical shortfall and the difficulty of Powerhouse No. 3 planning, in early 1920 SCE temporarily abandoned the Powerhouse No. 3 efforts. Instead, planners focused on the much shorter Tunnel No. 8 and Powerhouse No. 8 that could be brought on line with far more efficiency because of its comparative proximity to the established infrastructure of the BCHS (**Figure 31**).[26]

Tunnel No. 8 follows the same basic principle of Tunnel No. 2, in which water flowing from one powerhouse is impounded for flow into another downstream powerhouse. The tunnel consists of three primary features: an intake and intake structure; the tunnel itself, as well as one construction adit; and a surge tank and outlet portal.

The Tunnel No. 8 intake is located in the Dam No. 5 forebay, adjacent to Powerhouse Nos. 2 and 2A. The visible portions of the intake structure are highly utilitarian, with a concrete platform that measures approximately 27 feet by 18 feet that is partially covered by a corrugated metal roof and encircled by a metal pipe railing. The concrete structure extends approximately 40 vertical feet into the forebay, leading to the mouth of the tunnel. The tunnel mouth is protected by a metal trash rack that is original to construction as well as a motor-operated trash rake, that was added in the 1940s and serves to remove accumulated debris from the rack. The 1940s trash rake system includes a metal trash burner located on the platform that is accessed by a metal bucket running on rails. The Tunnel No. 8 intake is accessed by a walkway that leads from Dam No. 5. The walkway is utilitarian in design, with portions composed of poured concrete, dirt, and elevated steel walkways.

The underground granite tunnel runs 5,933 feet with an approximately 20 foot diameter from the intake to a surge tank that connects to the Powerhouse No. 8 penstocks (**Figure 32**). A single construction adit accesses the tunnel, located approximately half way between the intake and the outlet, along SCE's Lower Canyon Road. The adit is 50 feet in length and approximately 20 feet in diameter, with blasted granite walls. A poured concrete bulkhead with a steel manhole lines the back wall of the adit, accessing the main body of Tunnel No. 8.

The outlet of Tunnel No. 8 is located on a hillside above the surge chamber and penstocks that lead to Powerhouse No. 8. The outlet mouth is concrete, poured in an arch that extends from the surrounding granite rock. The mouth is utilitarian in form, with the sole decorative

[26] David H. Redinger, *The Story of Big Creek,* 82.

embellishment consisting of a keystone detail at the apex of the arch. An 18-foot diameter riveted steel pipe runs from the tunnel outlet to the Powerhouse No. 8 surge tank, composed of steel and stands above ground (**Figure 33**).

The Tunnel No. 8 Flowline has served the same function since construction, to convey water from Powerhouse No. 2 to the Powerhouse No. 8 penstocks, and ultimately the turbines of Powerhouse No. 8. The linear feature has had no notable alterations to its overall design or overall operation since construction. The flowline is a contributing resource that retains high integrity of materials, workmanship, design, setting, feeling, and association within the context of the district.

Character defining features of the Tunnel No. 8 Flowline include its operational alignment that extends from Powerhouse No. 2 to the penstocks of Powerhouse No. 8; its unlined granite tunnel; its intake infrastructure including the utilitarian concrete intake structure and trash rack; and its concrete outlet mouth and above ground steel surge tank. The flowline's single construction adit is intact and a character defining feature, as it is indicative of the type, period, and method of construction of the resource.

Dam No. 5 (Contributing Structure)
In coordination with the driving of Tunnel No. 8, SCE constructed Dam No. 5 to impound water below Powerhouse No. 2, and to provide a regulating forebay for flow into Tunnel No. 8. Construction of Dam No. 5 began in November of 1920 and was completed in April of 1921 (**Figure 34**). As recounted by David Redinger:

> The first step in this operation was to divert the flow of Big Creek into a flume, which enabled excavation work at the dam site to begin in mid-November 1920. Air for operating jackhammers was supplied by an air compressor located in Powerhouse No. 2; all blasting was done with 40 percent gelatin dynamite; and mucking, due to the limited amount and to the close quarters, was carried on by hand… materials and equipment to build this dam were carried from the San Joaquin and Eastern Railroad on Incline No. 2, which ran about 6,000 (1900 vertical) feet from the railroad to Powerhouse No. 2… A concrete mixing plant consisting of a cement platform, gravel bin, concrete mixer, and tower was placed at the upstream face of the dam, and chutes were used to deliver concrete to various parts of the dam.[27]

Dam No. 5 is a 60-foot high constant radius concrete arch dam (**Figure 35**). The crest of the dam is 224 feet long at an elevation of 2,950 feet. The top of the dam is seven feet, six inches wide. A concrete walkway spans the length of the dam, with metal pipe railing lining both sides. The spillway of the dam is 133 feet long and consists of 19 ungated bays separated by concrete piers that vary in size from seven feet in width to nine feet in width to accommodate the curve of the

[27] Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System,* 96.

dam. Within each bay are flashboards that can be raised or lowered using a trolley hoist to control the release of the water through the bays and to provide additional storage capacity. The hoist consists of a horizontal steel rail mounted on vertical steel supports that houses a chain and pulley system that operates each gate. The trolley hoist was originally hand operated. It was modernized at an unknown date and movement of the flashboards is now controlled by a power operated trolley hoist. In addition to the spillway, the dam features two, 72-inch diameter steel drain pipes located near the bottom center of the dam. Flow through the drain pipes is locally controlled by electric slide gates on the upstream face of the dam. The slide gates were originally controlled manually with hand wheels, and modernized at an unknown date to provide for electrical operation. An additional pipe extends through the dam above the two 72-inch pipes. This metal pipe was added in the latter part of the twentieth century and is used to release minimum in-stream flow into Big Creek in compliance with present-day regulatory requirements. Flow through this pipe is controlled by two hand-operated wheels.

The Dam No. 5 reservoir has a gross-storage capacity of 42 acre feet. The reservoir is supplied by water exiting the Powerhouse Nos. 2 and 2A tailrace as well as supplementary flows from Big Creek that runs into the upper end of the impoundment.

While the mass and primary outlet features of the dam remain largely as constructed in 1921, some minor features of the dam have been modified or upgraded as part of ongoing maintenance. These features include development of steel access stairs at the north and south ends of the dam, the conversion of the hand-operated sluice gates and flashboard trolley to mechanical operation, the addition of a minimum in-stream flow pipe, and other miscellaneous functional upgrades including the placement of new reservoir measuring equipment. These utilitarian alterations are minor and compatible in form and have served to preserve the ongoing function and operations of the dam. None undermine the resource’s ability to convey significance within the context of the district and the dam is a contributing resource to the BCHSHD (**Figure 36**).

Character defining features of the dam include its placement and orientation in relation to Powerhouse No. 2 and the Powerhouse No. 8 forebay; its curved concrete body; its ungated spillway separated by concrete piers; its physical and functional relationship to the intake for Tunnel No. 8; the trolley hoist; and its two gated drain pipes that penetrate the base of the dam to the Big Creek streambed.

Powerhouse No. 8 and Powerhouse No. 8 Penstocks (Contributing Building)
Concurrent with the development of Tunnel No. 8 and Dam No. 5, SCE began construction of a powerhouse at the confluence of Big Creek and the San Joaquin River, which would be fed by flows from the Tunnel No. 8 system (**Figures 37, 38**). Excavation for Powerhouse No. 8 was begun in January of 1921 and completed in April of that year. The foundations for the structure were poured in May, with the plant in operation by August 11 of 1921. The dizzying speed of construction earned the plant the contemporaneous moniker, “The Ninety Day Wonder,” with both the pace and innovations involved in construction setting a number of engineering records. As documented in a Historic American Engineering Record (HAER) addressing the building:

> Big Creek No. 8 represented a number of firsts. It was among the first plants to use the improved Francis-type vertical turbine, which allowed higher efficiencies at relatively low heads. It set records for the speed of its construction, just [90] days from groundbreaking to operation. Powerhouse No. 8 was the first plant in the world designed for transmission at 220kV, and in 1923 was the first in the world to transmit commercial power at that voltage. It also reflects the architectural trend toward separating generation and transmission equipment at power plants, with these functions segregated in separate buildings.[28]

The powerhouse is located on Big Creek, at its confluence with the San Joaquin River. The surrounding landscape is characterized by sheer cliffs and undeveloped hills of chaparral, oak, and pine. The powerhouse is located on the south bank of Big Creek and consists of two attached concrete and steel structures. The lower, streamside structure houses the generating equipment. The upper structure, offset slightly and built into the adjacent hillside, contains transmission equipment.

Like Powerhouse Nos. 1 and 2, the industrial form of Powerhouse No. 8 is characterized by neoclassical façade details, with a smooth concrete mass punctuated by vertically oriented bands of steel sash industrial windows and concrete pilasters (**Figure 39**). Simple concrete cornices frame the rooflines of both portions of the building, with that of the generating room slightly peaked and that of the transmission area flat. A vehicular road accesses the east side of the building, with an industrial roll-up door punctuating the southeast side of this elevation. In addition, a steel footbridge crosses Big Creek from the powerhouse access road, accessing the north side of the building. In general, the integrity of the exterior of the building is excellent, with few notable changes to the façade or surroundings.

As originally constructed, the generating portion of the powerhouse measured 90 feet by 56 feet and contained one generating unit. The building was expanded to house a second generating unit in 1929 and currently measures 128 feet by 56 feet. The interior of the generating building consists of a basement and main floor, with the turbines located in the basement and generators located on the first floor. The first floor also contains a machine shop and pump room. The tailraces are located on the northeast side of the building and discharge water to Big Creek where it enters the impoundment formed behind Dam No. 6. While the bulk of the building is comprised of the large generating floor, the west side of the building features four floors of office and utility rooms, including a control room on the second floor.

The upper transmission structure extends from the south side of the generating structure. The structure is three stories in height and rises above the generating facility, extending into the

[28] Powerhouse No. 8 has been recorded under the Historic American Engineering Record (HAER) program. This documentation provides the basis for the physical description herein and includes a wealth of detailed documentation regarding the development and operational components of Powerhouse No. 8. Daniel Shoup, *Historic American Engineering Record: Big Creek Powerhouse No. 8, HAER No. CA-167-G* (2012).

steeply rising hillside to the south. This portion of the building holds four transformers, low tension and high tension buses, switchboard, and offices.

The generating units in Powerhouse No. 8 differ from those of Powerhouse Nos. 1 and 2 in that the turbines are vertical-shaft, single runner Francis-type reaction turbines (**Figure 40**). This type of turbine internally increases water pressure through a spirally curved body, allowing for more pressure at a lower head and enabling power generation without the exceedingly steep drops characterized by earlier development, including those at Powerhouse Nos. 1 and 2. Powerhouse No. 8's Turbine No. 1 was developed by Allis-Chalmers and is rated at 36,500 horsepower, with Turbine No. 2 developed by Pelton Water Wheel Company, installed in 1929, and rated at 52,500 horsepower. The generators and associated equipment were primarily developed by General Electric, with the total powerhouse installed capacity 75,000 kW.[29]

Construction of the first generating unit exemplifies the immense challenges associated with the scale of construction efforts in such a remote and rugged locale. Such challenges, and correspondingly innovative construction management solutions, came to define the Big Creek Project during the period of significance for the district. As reported by David Redinger:

> The large generator was shipped for assembly in the field, including "stacking the iron." Load limitation on the [2 mile] incline was the main reason for such field work. Not to lose any time on the installation of the turbine and generator, an unusual procedure was followed for assembly of the latter. A tower of heavy timbers was built to support a large platform twenty feet above the turbine. While the 30,000 H.P. vertical Francis-Pelton turbine was being installed, the 22,500-kilowatt General Electric generator was being assembled on the platform, both being fenced in gradually by the powerhouse. As the building grew in height, so did the foundation beneath the generator, which did not have to be disturbed except to be lowered slightly to its permanent position after assembly.[30]

While Powerhouse No. 8 has continued to generate hydroelectricity since it was brought on line in 1921, the interior has been subject to ongoing infrastructural alteration and upgrades as mechanical and technological innovations have led to replacement and adaptation of original features and operational wear has required maintenance and replacement of original components. Key original interior operational features that remain in generally the same configuration include the turbines and generators that largely remain in their original casings despite the replacement of component parts including turbine wheels and/or buckets and the re-winding of the generators. Other notable original support features include a 150-ton capacity traveling crane manufactured by Western Manning, Maxwell and Moore, Inc. that is suspended over the generating room floor. Other areas of Powerhouse No. 8 have been continuously augmented to the present, including the control room that has been modernized with computers and other office equipment. In addition, the 220kV transformers and oil circuit breakers were replaced in 1960 because of wear.

[29] Daniel Shoup, *Historic American Engineering Record: Big Creek Powerhouse No. 8, HAER No. CA-167-G*.
[30] David H. Redinger, *The Story of Big Creek,* 85.

Two penstocks enter the basement of Powerhouse No. 8 from the south side, traveling approximately 2,670 feet (0.5 mile) down the steep hillside from the surge tank at the termination of the Tunnel No. 8 Flowline. Both penstocks are constructed of riveted and lap welded steel. The penstock for Unit No. 1 was installed in 1921 and is 96 inches in diameter, tapering to 72 inches before meeting the turbine. The penstock for Unit No. 2 was constructed in 1929 and is 120 inches in diameter, tapering to 84 inches before connecting to the turbine. The penstocks run above ground and are supported by a series of concrete and steel piers and five concrete anchor blocks. In addition, steel reinforcing bands appear intermittently along the length of the penstocks in order to provide additional reinforcement and prevent penstock failure.

The associated surge tank that marks the transition from Tunnel No. 8 to the penstocks is 90 feet in height and 35 feet in diameter, with a concrete foundation. Flow from the surge tank is controlled by two slide gates on the inside wall of the tank. A surge tank control house stands adjacent to the structure. The small concrete building is utilitarian in nature, with a square plan and flat roof. Both the surge tank and control building date to 1921. In addition, two small modern corrugated metal valve houses stand adjacent to the surge tank, and serve to regulate flows into and out of the tank.

In addition to the support infrastructure related to Powerhouse No. 8, a small diversion dam is located on Big Creek approximately 350 feet upstream of Powerhouse No. 8. The dam diverts water into a tunnel on the north side of Big Creek, around Powerhouse No. 8 to protect the powerhouse and access road from flooding. The dam is poured concrete and 110 feet in length, adjoining granite bedrock on either side of Big Creek. The small structure diverts water into an unlined tunnel located on the north side of the creek. The dam and tunnel are original to construction and are considered infrastructural support elements to the powerhouse.

A small number of modern utilitarian support features have been added to the vicinity of the powerhouse, including a storage shed and domestic water treatment plant, both of which were added in the twenty-first century and do not contribute to the significance of the powerhouse.

The overall functional role of Powerhouse No. 8 has changed little over time despite ongoing maintenance and mechanical alterations as well as the development of modern utilitarian support features. In addition, the overall physical form of both the powerhouse and penstocks has changed little since the initial construction period, and the contributing resource retains a high degree of operational and physical integrity within the context of the district (**Figure 41**).

Character defining features of Powerhouse No. 8 include the powerhouse's location at the confluence of Big Creek and the San Joaquin River; its functional and physical connection to the powerhouse penstocks and subsequently Tunnel No. 8 Flowline; its overall stepped form and mass, with distinct masses for transmission and generation; its concrete finish and industrial fenestration with neoclassical allusions, including the vertical bands of wood-frame industrial windows coupled with smooth concrete pilasters; and its tailrace openings flowing to the San Joaquin River.

Interior character defining features consist of the generally open industrial-scale volume of the large generating room floor and transformer room; the original generator, governor, and turbine casings for the generating units and station service generator; the original traveling crane stationed above the generating room floor; and the penstock entries at the base of the building. Other areas including the control room and the transmission equipment have been replaced, augmented, and removed to the present. While these features remain operationally integrated and cohesive, they are reflective of a number of different development periods.

Character defining features of Powerhouse No. 8's penstocks include the general alignment that plunges from the Tunnel No. 8 Flowline; the welded steel penstocks that travel above grade and their associated concrete and rock stabilization walls, anchor blocks, and piers as well as the steel stabilization bands; and the surge tank and associated control building that marks the transition from the Tunnel No. 8 Flowline to the penstocks. The adjacent valve houses are modern additions and are therefore not considered character defining features.

Tunnel No. 3 Flowline (Contributing Structure)
The construction of Powerhouse No. 8 was in many senses a stopgap measure designed to sate immediate energy demands in the early 1920s. While SCE hurried to get Powerhouse No. 8 on line, the company continued to pursue the development of the much more ambitious, costly, and time-consuming Powerhouse No. 3 that required a water conveyance tunnel over five miles in length. The down-river powerhouse and associated hard rock flowline remained a central component of Big Creek's development during this period, requiring an immense amount of expense and labor in the early 1920s.

The driving of Tunnel No. 3 occurred intermittently over the span of nearly a decade, with the first dynamite blasts in 1914, and the tunnel "holed through' after several years of concerted effort on August 1, 1923 (**Figure 42**). The tunnel, and associated Powerhouse No. 3, was anticipated in original plans for the project. Construction was forestalled by, first, the disruption of World War I and, second, the hasty decision to frontload the comparably easier to develop Powerhouse No. 8. Because of the prior addition of Powerhouse No. 8 to the system, SCE engineers slightly rerouted the original intended alignment of Tunnel No. 3, with the new design extending from Powerhouse No. 8 to the site of Powerhouse No. 3, five miles southwest on the San Joaquin River.[31]

The full length of Tunnel No. 3, 28,508 feet, or just over five miles, was the longest undertaken to date in the system and the steep river canyon of the San Joaquin provided exceptionally difficult construction conditions both because of its isolation and rugged topography. As documented by Laurence Shoup in the *Hardest Working Water in the World*:

[31] David H. Redinger, *The Story of Big Creek,* 89-97.

> As was usually the case for the Big Creek Project as a whole, the tunnel drilling needed to bring water to Powerhouse No. 3 took longer than development of any other feature. Even so, this time was shortened considerably by driving three short adits—a procedure allowing Tunnel No. 3 to be drilled and blasted from eight headings… A new Ingersoll-Rand Drill, the Model X-70, was used extensively to drill holes for blasting. Gelatine dynamite was used to blast the hard gray rock. Very little of this rock had to be timbered. The muck from blasting was loaded by marion steam shovels, operated by compressed air. Each tunnel camp had a large compressor plant to provide air for this machinery.[32]

As recorded by Redinger, company officials gathered in mid-August 1923 to commemorate Tunnel No. 3's first "washing." SCE President John B. Miller, vice-president of construction George C. Ward, and an array of guests and employees gathered at Tunnel No. 3's, Adit No. 2 to observe the first flows through the tunnel; a ceremonial marker was reserved for the most trying of construction completion:

> On August 1, 1923, the last section of tunnel was "holed through," after which the effort was concentrated towards making ready for a huge flushing of the upper half. The side walls and roof were given a good washing with the fire hose before turning the river through for the final washing. All such bathing was to remove finely crushed rock, sand, rock dust etc., as such material causes damage if allowed to go through the powerhouse turbines. August 14 arrived—the day for the river to be turned in at the intake. A heavy bulkhead had been built across the main tunnel just below Adit No. 2, to divert the water and debris into Stevenson Creek and thence to the San Joaquin River… The roar of the water could be heard long before its arrival. All spectators were tense, time passed slowly. Finally, through the adit rushed the dirtiest river, carrying pieces of broken ties, odds and ends of lumber, wire, rocks, sand—everything left in the tunnel—in spite of a previous general clean-up. Mr. Miller, deeply impressed, remarked that he had never in all his life witnessed such a spectacle.[33]

As designed, the Tunnel No. 3 Flowline consists of an intake and an intake gate house; the tunnel itself and three construction adits; a surge chamber and associated infrastructure; and an outlet portal.

The intake structure is located in the Dam No. 6 Reservoir below Powerhouse No. 8. The utilitarian concrete structure extends 100 feet from the lowest point of the foundation under the reservoir to a small cylindrical concrete gate house that rises above the reservoir. Flow into the intake is controlled by a nine-foot diameter, 50-ton gate that is controlled by an electric motor-powered hoist and three manually operated gate wheels inside of the gatehouse. A number of

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[32] Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System,* 106-107.
[33] David H. Redinger, *The Story of Big Creek,* 92-93.

utilitarian support features are located on the gatehouse platform, including a trash rake and a small sheet metal sheathed recorder house. While the majority of the intake structure is now covered by the waters of the reservoir, the scale of the intake in its entirety was well-captured by David Redinger upon construction, when he observed that, "standing inside this structure at its base one is reminded—or at least I was—of one of the larger movie theaters in Hollywood."[34] The majority of the five mile tunnel is unlined, with only the last several hundred feet lined in concrete prior to meeting the surge chamber. The boring of Tunnel No. 3 included the development of three construction adits, numbered 34, 35, and 36. All of the adits are located along the Million Dollar Mile Road, developed along the San Joaquin River Canyon to support construction and operation of Powerhouse No. 3. The adits are all intact, consisting of blasted granite walls with concrete bulkheads and access hatches along the rear walls.

The surge chamber is underground and is hollowed out of solid rock in the shape of a massive hourglass over 200 feet high and from 26 to 78 feet in diameter. The top of the chamber extends to the ground surface, with the opening in the bedrock surrounded by a seven-foot high concrete wall and chain link fence (**Figure 43**). Flow from the unlined tunnel runs through a trash rack at the base of the surge chamber, before entering a riveted steel pipe that extends from the surge chamber to the outlet portal and Powerhouse No. 3 penstocks. The surge chamber controls are located in a control building that is adjacent to Powerhouse No. 3. The control building dates to the original construction of the flowline and is of an understated neoclassical design, with smooth concrete walls, symmetrically placed industrial steel sash windows, and an articulated frieze band.[35]

The Tunnel No. 3 outlet portal is located approximately one-quarter of a mile above Powerhouse No. 3. The tunnel opening is embedded in a steep hillside, with a poured concrete retaining wall surrounding the mouth of the opening. The wall features subtle neoclassical stylistic allusions, with a keystone arch framing the riveted steel portal pipe. Upon exiting the tunnel, water flows through a riveted steel manifold and splits into five distinct lines before entering the adjacent Powerhouse No. 3 valve house and penstocks (**Figure 44**).

Tunnel No. 3 has served the same operational function since construction, to convey water from Powerhouse No. 8 to Powerhouse No. 3. While minor operational features have been upgraded or augmented to the present, including gate controls, surge chamber flushing equipment, and access and safety features, there have been no notable alterations to the overall operation of the resource, and Tunnel No. 3 is a contributing resource to the BCHSHD that retains high integrity of materials, workmanship, design, setting, feeling, and association within the context of the district (**Figure 45**).

Character defining features of the Tunnel No. 3 Flowline include its operational alignment that extends from Powerhouse No. 8 to the penstocks of Powerhouse No. 3; its unlined granite tunnel; its intake infrastructure including the utilitarian concrete intake structure and 50 ton gate;

[34] David H. Redinger, *The Story of Big Creek,* 96.
[35] David H. Redinger, *The Story of Big Creek,* 94.

the form and underground placement of its hourglass-shaped surge chamber and associated concrete control building; and its articulated concrete outlet portal and adjoining steel manifold. The flowline's three construction adits are intact and character defining features, as they are indicative of the type, period, and method of construction of the resource.

Dam No. 6 (Contributing Structure)
Dam No. 6 is a concrete constant-radius arch dam that stands directly below Powerhouse No. 8 on the San Joaquin River. The dam serves as a regulating forebay for Tunnel No. 3 and subsequently Powerhouse No. 3, forming a small reservoir directly below Powerhouse No. 8. The dam was constructed between November 1922 and March of 1923, with the gates of the dam closed days before the first spring flood of 1923 thundered down the San Joaquin River. According to Redinger, construction of the dam was one of the most difficult dam construction projects encountered in the development of the Big Creek System (**Figures 46, 47**):

> While the dam was being built, the flow of the river had to be carried around the site through a flume hanging on the slick canyon side. A wooden flume was constructed, having a capacity of 5,000 feet per second. The size was adopted after careful study of the hydrographic record showed this to be the maximum flow to be expected during the period when diversion would be necessary. Two coffer-dams were required—one at the intake of the flume and one at the outlet—to keep the excavation at the riverbed clear. 56,000 sacks of earth were required for these two coffer-dams, and once during the critical part of excavation, the flume was taxed to the limit. It would have been disastrous had it overflowed and flooded the three shovels working below the river bed.[36]

Dam No. 6 is 155 feet high, with a 495-foot long crest. The base of the dam is 39 feet in width, tapering to a width of eight feet at the crest. The spillway is an overpour type consisting of six ungated spans separated by piers, with a total spillway length of 389 feet. A walkway spans the spillway, providing access to the controls for the four drain gates and to a 15-ton revolving crane added to the dam in the mid-twentieth century to remove floating debris from the vicinity of the dam. Four, 66-inch diameter steel sluice pipes pass through the base of the dam. Flow through these pipes is controlled by 100-inch slide gates at the upstream face that were installed in 1940 to replace older gates, and 72-inch slide gates at the downstream face that were installed in 1938. A 24-inch cast iron minimum flow release pipe and an 8-inch drain line also pass through the dam, both of which were added during the modern period (**Figure 48**).

While the mass and primary outlet features of the dam remain largely as they appeared at 1923 construction, some features of the dam have been modified or upgraded as part of ongoing maintenance. These features include the mid-twentieth century addition of the revolving crane at the center of the dam's crest that required the addition of a central pier to support the crane; addition of slide gates for the sluice pipes; addition of a minimum inflow pipe, and other

[36] David H. Redinger, *The Story of Big Creek,* 96. Field survey did not note any remnants of this flume or coffer dam and no extant features have been recorded.

miscellaneous functional upgrades including reservoir measuring equipment and the placement of water cannons to clear debris from the face of the dam. These utilitarian alterations are minor and compatible in form and have served to preserve the ongoing function and operations of the dam. None undermine the resource's ability to convey significance as a contributing resource within the context of the district and the resource retains a high level of integrity.

Character defining features of the dam include its placement and orientation in relation to Powerhouse No. 8 and the Powerhouse No. 3 forebay; its towering curved concrete body that is framed by the rocky walls of the San Joaquin River canyon; its ungated spillway separated by concrete piers; its physical and functional relationship to the intake for Tunnel No. 3; and its four drain pipes that penetrate the base of the dam to the San Joaquin River streambed. The crane and water cannons were added to the dam during the mid-twentieth century and are not considered character defining features.

Powerhouse No. 3 and Powerhouse No. 3 Penstocks (Contributing Building)
Big Creek Powerhouse No. 3 is located on the San Joaquin River, approximately 5.5 miles downstream from its confluence with Big Creek and the site of Powerhouse No. 8. Flow to the powerhouse is provided by Tunnel No. 3. The surrounding landscape is rugged and mostly undeveloped except for hydroelectric industrial features, with the steep canyon walls of the river framing the powerhouse and rising to chaparral, oak, and pine studded hills above.

Powerhouse No. 3 was completed in 1923 and was the last new standalone powerhouse built during the great expansion of the 1920s (**Figures 49**, **50**, **51)**). At the time of its construction, the powerhouse was the largest in the Western United States, with period commentators dubbing the plant the "Electrical Wonder of the West" for its 105,000 kW of rated capacity. Like Powerhouse No. 8, Powerhouse No. 3 was designed for 220kV transmission, making it the second powerhouse in the world to operate at that capacity (after Powerhouse No. 8). Additionally, the outdoor switching yard at Big Creek No. 3 marks the transition from the early phase of power design in which transmission features were housed in generation buildings, as seen in Powerhouse Nos. 1 and 2, to the later widespread use of outdoor transformers and switchyards. While built with three generating units, the plant capacity was expanded over the twentieth century, first in 1948 and subsequently in 1980, and the facility now holds five generating units, with a current capacity of 181 MW. The powerhouse was designed with space for one more unit, but that unit has not been placed to date.[37]

The powerhouse consists of a reinforced concrete and steel generating and control building, and a reinforced concrete transformer platform that extends out from the base of the building, with

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[37] "Edison Project in Service: Electric Plant is Coast's Largest," *Los Angeles Times*, October 12, 1923; "Electric Giant is Being tested Out," *Los Angeles Times*, September 27, 1923; Powerhouse No. 3 has been recorded under the Historic American Engineering Record (HAER) program. This documentation provides the basis for the physical description herein and includes a wealth of detailed documentation regarding the development and operational components of Powerhouse No. 3. Daniel Shoup, *Historic American Engineering Record: Big Creek Powerhouse No. 3*, *HAER No. CA-167-H* (2012).

arched openings for the tailraces standing at the base of the transformer platform. As constructed, the generating room was 205 feet in length, 56 feet in width, and 66 feet high. Attached to the north side of the generating room was a smaller two story extension that housed the control, maintenance, and switching rooms. Like the other Big Creek powerhouses, Big Creek No. 3 was designed for later expansion, with the east wall of the building composed of metal lath and plaster. Such expansion did not occur until 1978-1980, when the east side of the generating room was enlarged with space for two additional units, one of which has been placed to date. In addition to this planned expansion, a machine shop was added to the southwest side of the building in 1948, making the building generally “L” shaped in plan. While the additions changed the overall form and plan of the building, they are of a utilitarian and functional form that does not undermine the integrity of the original design or subsume the building’s original plan.

The 1923 Powerhouse No. 3 construction included development of an associated system-wide dispatch and control center at the powerhouse site. The small utilitarian building is situated one-tenth of a mile west of the powerhouse, on a knoll above the San Joaquin River. The concrete building is rectangular in plan and of two story construction, with the first level set into the sloping hillside. Regular bands of windows set in recessed concrete sills line all elevations of the building. As described by Redinger, upon construction, the center housed “the dispatchers who control the output of all the Big Creek Plants, as well as the allocation of water from the reservoirs.” At present, the building is no longer in use as a control center, with primary dispatch and control operations now located at SCE Northern Hydro Headquarters in the town of Big Creek. While the building is generally intact, almost all of the original steel frame windows have been replaced with modern vinyl windows. Additionally, interior equipment has been upgraded over time as new computer operated technologies have come to govern the system.[38]

While earlier powerhouse development reflected an industrial design informed by a neoclassical architectural treatment, the aesthetic design of Powerhouse No. 3 reflects a more modern sensibility that alludes to the Art Deco style that was prevalent in 1920s architecture. Unlike Powerhouse Nos. 1, 2, and 8 that are largely characterized by symmetry and restrained classical composure, the smooth concrete walls of Powerhouse No. 3 are punctuated by bands of industrial windows in an alternating one-light/three-light pattern, lending an irregularity to the façade that is further heightened by subtle concrete stepping at the building’s corners. In addition, the building features an angular stepped parapet, with a triangular peaked apex centered over the primary entry on the west side. These Art Deco stylistic allusions also appear on a small concrete arch bridge that extends from the west side of the building, crossing Mill Creek and providing the main access point for the powerhouse through an industrial roll-up door. The bridge features a smooth concrete finish that is punctuated by angular concrete pedestal light standards. While the light standards are original, the light fixtures have been updated and remain in operation at present. While very spare in form, the small dispatch building features subtle banding and a curved entry surround that is indicative of the Art Deco style.

[38] Southern California Edison Company, *Property Data Book 1928*, on file at SCE Northern Hydro Headquarters Library, Big Creek, CA; David H. Redinger, *The Story of Big Creek,* 96.

While the aesthetic treatment reflects a subtly differing design sensibility, the overall functional design of the powerhouse is similar to that of Powerhouse No. 8, with penstocks entering the basement of the building from the hillside and adjoining vertical-shaft, single runner Francis-type reaction turbines at the basement of the building, which connect to generators on the first floor. Unlike the other BCHS powerhouses, a portion of the first floor level was designed to be open to the basement, so that operators could view both turbines and generators from the control gallery above the generating room floor. Most of the hydraulic equipment in the plant, including the main turbines, inlet pipes, draft tubes, governor oil pressure tanks, and relief valves, was purchased from the Wellman-Seaver-Morgan Company of Cleveland, Ohio (**Figure 52**). The house generator wheels were manufactured by the Pelton Water Wheel Company of San Francisco. The electrical equipment, including the main generators, house generators, exciters, and switchboards were developed by Westinghouse. A 125-ton Niles traveling crane spans the generating room floor.

Like the other BCHSHD powerhouses, Powerhouse No. 3 has been in continuous operation since its 1923 construction. The structure and its components have been subject to regular maintenance, overhaul, replacement, and expansion. Key original interior operational features that remain in generally the same configuration include the turbines and generators (**Figure 53**), which largely remain in their original casings despite the replacement of component parts including turbine wheels and/or buckets and the re-winding of the generators. Other notable original support features include the 125-ton traveling crane suspended over the generating room floor. Other areas of Powerhouse No. 3 have been continuously augmented to the present, including the control room and switchboard that has been modernized with computers and other office equipment and the transformers, switches, and busses that have been upgraded and replaced. The overall plan and function of the building has been altered, with the 1948 addition of a machine shop, and the 1948 and 1980 addition of generating units that enlarged the building and required the construction of additional penstocks and associated infrastructure. These ongoing alterations and maintenance activities do not undermine the integrity of the powerhouse, as they are all in keeping with the industrial design and operations of the structure, and the powerhouse is a contributing resource of the BCHSHD (**Figures 54, 55**).

At present, five riveted steel penstocks traverse the steep slope rising south of Powerhouse No. 3, extending approximately 1,300 feet from the Tunnel No. 3 portal above. Upon original construction there were only three penstocks, corresponding to the three generating units within the powerhouse. A manifold at the tunnel mouth connects to the five penstocks, with flow controlled by valves in a low concrete valve house that is set into the hillside adjacent to the portal. Air valves with vents line the penstocks just south of the valve house. While the overall layout and functional design of the portal-penstock connection, including the manifold, piping, and valve house, remains as it was designed in 1923, some components have been replaced, with alterations to the air valves and vents and the addition of Penstocks 4 and 5. In general, as a utilitarian industrial assemblage, the penstocks retain high integrity of function and design.

Character defining features of Powerhouse No. 3 include the powerhouse's location on the south bank of the San Joaquin River; its functional and physical connection to the powerhouse penstocks and subsequently Tunnel No. 3 Flowline; its monolithic rectangular form and mass, with a larger generating building stepped above the open air transformer platform; its concrete finish and industrial fenestration with Art Deco allusions, including the alternating rhythm of industrial windows coupled with articulated corner banding and the stepped parapet; its tailrace openings flowing to the San Joaquin River; and the stylistically and functionally integrated concrete arch bridge extending from the west entry; and the small dispatch building located to the west of the powerhouse.

Interior character defining features consist of the generally open industrial-scale volume of the large generating room floor and its open visual integration with the basement level turbine pits; the original generator and turbine casings; the traveling crane stationed above the generating room floor; and the penstock entries at the base of the building. Other areas including the control room and the transmission equipment have been replaced, augmented, and removed to the present. While these features remain operationally integrated and cohesive, they are reflective of a number of different development periods. Additionally, while Powerhouse No. 3's later generating units are functionally, operationally, and visually cohesive they are reflective of later development of the powerhouse and are not character defining features from the historic period. Additionally, the large outdoor switchyard located immediately to the west of Powerhouse No. 3 does not contribute to the significance of the Powerhouse, as it is comprised of utilitarian features that have been upgraded to the present, do not date to the period of significance, and do not reflect the significant development themes of the district.

Character defining features of Powerhouse No. 3's original three penstocks (Nos. 1, 2, and 3) include the general alignment that plunges from the Tunnel No. 3 Flowline, the welded steel body of the penstocks, and the associated concrete stabilization blocks. Penstocks 4 and 5 added in the 1940s and 1980s, respectively, as well as the associated air vents, are functionally and operationally cohesive to the overall system, but are not character defining features because they lack integrity to the historic period.

SCE Stream Gauges (Noncontributing Structure)
In addition to the large-scale construction efforts that occurred during the 1920s, a number of stream gauges were installed throughout the watershed to record stream flow, reservoir levels, and to provide baseline data for operational purposes. Development of this type of small-scale recording infrastructure has continued to the present, with a number of older gauges continuously modified and a number of new gauges added on an ongoing basis. The modification of older gauges has included the construction of new recorder houses, the placement of new or augmented concrete weirs, and the placement of modern measuring and recording instrumentation, including solar panels and associated electrical conduits. For the purposes of this discussion, the gauging stations are discussed as a class, as all of the gauges are of a minor and generally standardized form that shares a common functional and physical typology.

As a class of resources, the stream gauges are generally characterized by several basic features: small recorder's houses with associated gauging equipment; small concrete weirs that stabilize the water service for measurement purposes; access features, including metal handrails and dirt or wood plank/metal frame walkways or cables; and miscellaneous modern equipment including solar panels for power and operation and other associated monitoring infrastructure. The gauges that monitor flows in the district include the following, with dates of construction included in parentheses: SCE Gauge #99 (1988-1989); SCE Gauge #103 (1921); SCE Gauge #104 (1925); SCE Gauge #105 (1923); SCE Gauge #119 (1922); SCE Gauge #128 (1922); SCE Gauge #128S (circa 2009); SCE Gauge #129 (circa 1947); SCE Gauge #131 (circa 1916 and 1986).

As a class of minor support resources that have been altered substantially over time to accommodate new monitoring equipment and features, the stream gauges are noncontributing resources that do not convey significant themes associated with the BCHSHD. The structures have been physically altered and augmented since the construction period or are entirely modern in composition, do not have integrity to the historic period, and do not reflect the significant development themes of the district.

Contextual Overview: Development of the Upper Elevation Components of the BCHSHD
As the 1923 development of the massive Powerhouse No. 3 pushed the Big Creek System further down the San River Joaquin River, concurrent SCE plans sought to drive expansion of the system further up into the high alpine terrain of the Sierra, with the ultimate goal of introducing more water to SCE's ever-thirsty hydroelectric generating facilities. The upward expansion of the system presented a host of unprecedented engineering and construction challenges, with rugged terrain, seemingly impenetrable ridges, and geographic isolation standing between the waters of the high country and the powerhouses below. As discussed by Lawrence Shoup in *The Hardest Working Water in the World*:

> The key problem facing Edison during the 1920s was how to get additional water into the Big Creek System. Although located in the High Sierra, the Big Creek area lay in the southern part of that mountain chain where rainfall—and therefore available water—was less abundant than farther north… Edison planners had long been concerned with this problem and were searching for answers. Their ultimate solution was found in the early plans of John Eastwood who, even in 1902, had his eye on waters of the southern fork of the San Joaquin River, over Kaiser Ridge from Big Creek Basin. Eastwood's 1902 survey included running a line over Kaiser Pass to determine the length of tunnel needed to bring in water from the South Fork.
>
> In 1917, Edison followed up on Eastwood's work, sending one of its employees into the high country east of Huntington Lake to measure water flows and locate dam sites. On one of these trips a dam site was located near a small natural lake, called Florence Lake, at an elevation of about 7,200 feet. Since Huntington Lake was just under 7,000 feet in elevation, it was readily apparent that a tunnel could

be built from Florence to Huntington, diverting water from the South Fork of the San Joaquin River into the Big Creek System and more than doubling the drainage area available to that system.

Once the decision was made to go forward with this plan, several key problems still faced Edison planners. Of paramount concern was the fact that Kaiser Ridge—a mountain of granite rock over 9,000 feet in height—stood between Huntington and Florence Lakes. The direct route through this ridge was ten and ¾ miles long. Due to the height of Kaiser Ridge (about 2,500 feet higher than the tunnel line) following a direct route would allow tunnel work to proceed only from the intake and outlet ends, providing only two work faces. It would be impractical to drill the 2,500-foot shaft necessary to provide another two faces, but to drill a ten and ¾ mile tunnel from only two faces or headings would take several years longer than if other points of entry to the tunnel line could be established. Additional surveys were conducted, and it was found that by angling the tunnel line in a northwesterly direction before turning south, two additional points of entry could be engineered. Since this would save about two years in tunneling time, it was decided to bore the longer route—just over 13 miles in length. This construction effort would create the longest water tunnel in the world and one of the longest tunnels of any type ever constructed.[39]

Ward/Florence Lake Tunnel (Contributing Structure)
The centerpiece of this ambitious upper elevation expansion—the thirteen mile long granite tunnel—was developed between 1920 and 1925 as the Florence Lake Tunnel. The tunnel was subsequently renamed Ward Tunnel in 1936 in commemoration of the services of vice president in charge of construction and subsequent SCE President, George C. Ward. Extending between Florence Lake and Huntington Lake, the granite tunnel acted as a linchpin that connected the high water flows of the South Fork of the San Joaquin to the Huntington Lake watershed below. Additionally, the engineering audacity of the tunnel that bored through an over 9,000-foot high mountain ridge served as yet another high profile representation of the unprecedented engineering ambitions undergirding the Big Creek development. At the time of construction the tunnel was the longest of its type in the world.

Tunnel boring began October 15, 1920, with the first water flowing through the tunnel on April 13, 1925. Over the four year construction period, the painstaking labor of tunneling was conducted on a generally round-the-clock basis, with three, eight-hour shifts a day. While the efficiency of boring was aided by new developments in equipment, including larger X-70 Ingersoll Rand Rock Drills, higher capacity No. 25 Marion Steam Shovels, and larger and more efficient air blowers, the work of tunneling remained largely a brute competition between man and mountain. As recounted by David Redinger, "it was always a thrill, especially for tunnel crews who had been working toward each other for several years, when the first faint peck-peck

[39] Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System,* 114-115.

of the drills were heard in the opposite heading." A 1924 *LA Times* account of the holing through of the central section of the tunnel paints a vivid portrait, with SCE workers holding a, "weird midnight celebration in flickering light, amid cheers and handshakes far below the earth's surface." During this period, SCE consumed twelve million pounds of black powder dynamite, much of it spent deep under the granite of Kaiser Peak (**Figures 56, 57, 58, 59, 60**).[40]

Ward Tunnel is unlined for virtually its entire extent, with a generally horseshoe shaped cross section (**Figure 61**). The tunnel is fifteen feet in both width and height. Features of the tunnel included an intake and intake gate house located at Florence Lake, the two adits that supported construction, and a steel pipe outlet at Huntington Lake. While this basic configuration remains much the same, the tunnel has been altered since construction by the development of a number of flow systems that feed into the tunnel, providing more water to address increased demand, and by the 1950s addition of the small open-air Portal Powerhouse, located at the tunnel's terminus on Huntington Lake.

The Ward Tunnel intake and gatehouse are located at the northwest end of Florence Lake. The intake is submerged beneath the water level and is protected by a steel debris screen that measures approximately 16 feet by 30 feet. The intake tunnel extends approximately 318 feet to the main body of Ward Tunnel. Water flow into the tunnel is controlled by two steel gates that are controlled by hydraulic jacks located inside the gatehouse that stands 200 feet to the west of Florence Lake and directly above the intersection of the intake and Ward Tunnel. The gatehouse is a utilitarian structure that measures 22 feet by 29 feet and is of board formed concrete construction. The structure exhibits a spare industrial design, with regularly placed steel sash industrial windows with lug sills, a flat roof, and a smooth surface that is devoid of notable ornamentation. While the small building is original to construction, it has been augmented in the modern period by the addition of a shed roof sheathed work area, the blocking of some original entries and windows, and other minor utilitarian and mechanical upgrades. Despite these changes, the building operates much as designed and retains overall integrity of materials and workmanship.

Construction of the tunnel was supported by the development of two adits: Adit No. 1/Camp 62 Adit and Adit No. 2. Adit No. 1 was developed adjacent to a supporting construction work camp, Camp No. 62. The adit is unlined granite and is accessed through a small wood frame structure with a gable roof and vertical board siding. Adit No. 2 is 1,200 feet in length and of unlined granite. After the completion of construction in the late 1920s, the adit was blocked by a concrete plug approximately 180 feet from its intersection with the Ward Tunnel, with a vertical shaft developed adjacent to the plug to provide ongoing maintenance access. With the 1950s addition of Portal Powerhouse and its associated forebay, this vertical shaft was incorporated into use to provide water inflow and outflow for the Portal Project. Adit No. 2 has been continuously utilized and augmented to support ongoing expansion of the system.

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[40] "Blast Opens Great Tunnel," *Los Angeles Times*, October 31, 1924; David H. Redinger, *The Story of Big Creek*, 96.

While the main body and operational characteristics of the Ward Tunnel have remained in the same general state since 1925 completion, a number of new water sources have been added to the system since the initial development period. Additionally, while the tunnel originally flowed directly into Huntington Lake via an outlet pipe at Rancheria Creek, this terminus was altered by the 1950s development of Portal Powerhouse, powered by flows from Ward Tunnel.

The first addition to the Ward Tunnel flow system was the 1927 placement of the Mono-Bear Siphon that collects water from Mono and Bear Creeks and adjoins the Ward Tunnel near the Camp 62 Adit. The Mono-Bear Siphon and its constituent components are contributing resources of the BCHSHD and are discussed in detail later in this narrative.

Subsequent minor additions include the Bolsillo Creek Diversion, the Chinquapin Creek Diversion, the Camp 61 Creek East and West Diversions, and the Camp 62 Creek Diversion that were constructed in the 1940s, with the Camp 61 Creek East and West Diversions retired in the 1950s and the Chinquapin and Camp 62 Creek Diversions entirely rebuilt in 2001. The small concrete diversion dams were designed to divert water from small creeks adjacent to the Ward Tunnel and connect to the tunnel through small boreholes or pipelines. The structures are minor utilitarian resources that were developed after the period of significance and have been augmented to the present, with major components rebuilt and a variety of new instrumentation and support features developed. While the placement of these associated features does not undermine the integrity of the tunnel as they are compatible in design and function, they do not contribute to the significance of the Ward Tunnel or the district as a whole and the resources are noncontributing to the BCHSHD.[41]

The most substantial alteration to the Ward Tunnel was the 1955-1956 development of the Portal Powerhouse and associated forebay that utilizes water from the tunnel to run its single turbine and required augmentation of the tunnel's original outlet configuration. The small 10,000 kW open-air powerhouse is located on the east side of Huntington Lake, at the terminus of the tunnel. The powerhouse consists of a single Francis-type vertical shaft turbine that is stationed on a small concrete platform. Water flows through the turbine and discharges into Huntington Lake. Flow to the powerhouse is controlled by a surge chamber located at the end of the Ward Tunnel that controls flow into the powerhouse penstock. This powerhouse penstock is encased in the original outlet pipe for the Ward Tunnel that originally free-flowed into Rancheria Creek and subsequently Huntington Lake.

The construction of Portal Powerhouse also required the development of a regulating forebay, located near Adit No. 2 adjacent to the alignment of Ward Tunnel. The forebay has a surface area of 20 acres and a storage capacity of 325 acre feet. It is connected to the Ward Tunnel via a shaft that intersects Adit No. 2 and flows into the tunnel. The construction of the forebay also

[41] See California Office of Historic Preservation (OHP) Consultation FERC120306B: Determination of Eligibility for the Ely, Balsam, and Bolsillo Creek Diversion Facilities, FERC Project 2175, Fresno County, CA, April 13, 2012. In this consultation all the Bolsillo Creek Diversion was determined to be a non-contributor.

required augmentation of the small Camp 61 Creek East and West Diversion Dams that were altered to serve as stream gauging infrastructure and no longer provide flows to Ward Tunnel.

As a minor 1950s addition to the BCHS and the Ward Tunnel alignment, the 10,000 kW Portal Powerhouse and associated forebay do not contribute to the significance of either the Ward Tunnel or the BCHSHD as a whole. The powerhouse and forebay were developed after the period of significance and are of a standardized and utilitarian design that does not convey any significant engineering or technical significance. In contrast to the groundbreaking early twentieth century development of the district components, including the Ward Tunnel, the development of the small capacity Portal Powerhouse is indicative of a well-established engineering and design type that had been employed at hydroelectric projects across the state for decades. While the Portal Powerhouse and forebay do not contribute to the significance of the Ward Tunnel or district as a whole, the 1950s addition does not undermine the significance of the tunnel or the district, as the powerhouse is of a compatible use and functional design that is in keeping with the overall productive capacity of the system and did not cause substantial material alteration of the alignment as a whole.[42]

Character defining features of the Ward Tunnel contributing resource include its operational alignment that extends from Florence Lake to Huntington Lake; its unlined granite horseshoe-shaped tunnel; and its intake infrastructure including the concrete gatehouse, steel gates, and trash rack. While they have been somewhat altered to accommodate new infrastructural developments, the flowline's intact construction adits are character defining features, as they are indicative of the type, period, and method of construction of the resource.

Florence Lake Dam (Contributing Structure)
Upon completion of Florence Lake (later Ward) Tunnel in 1925, SCE turned in earnest to the development of Florence Lake Dam that would provide adequate flow to the tunnel and in turn the Big Creek powerhouses below. The high elevation, remote siting, and harsh site conditions dictated the pioneering multiple arch design of the dam, which was the longest of its type ever built and still stands as a preeminent representative of a multiple arch dam. As described by David Redinger:

> Various types of dams were investigated to find one suitable for the site and several estimates of cost were made with respect to selection of the most suitable and economical design. A rock-fill structure, using material from the Florence Lake Tunnel, and faced with either earth or asphalt covered planking to make it impervious, was given extensive study with facing to be replaced with concrete after settlement. Various disadvantages were foreseen with such a type, and test pits in nearby meadows indicated a possible shortage of material for the earth covering. Adopted finally was the multiple arch, which estimates showed to be

[42] See California Office of Historic Preservation (OHP) Consultation FERC020402A: Portal Hydroelectric Power Project, No. 2174-012, April 25, 2005 that determines Portal Powerhouse and Forebay as noncontributing.

> about ten percent lower in cost than any other type. John S. Eastwood is credited with having originated and developed the first designs for a dam of that type.
>
> In support of this selection were numerous important factors. The transportation of material from the rail head at Big Creek was a major item, and less cement would be required than for a gravity or part gravity structure—hence less tonnage; the large amount of the steel needed for reinforcing could be supplied by rail removed from the tunnel; concrete aggregate could be made by crushing the tunnel granite, examinations having shown it to be suitable; and although more lumber for forms would be required, it could be supplied by our mill in the vicinity.
>
> Full consideration was given to the possible effect of freezing temperatures on the concrete at that high elevation. It was felt that protection would be afforded by making concrete of the highest quality and placed under the best methods known at the time… To insure the best concrete possible, rigid inspection was provided which covered all phases—cement testing, batching, mixing, placing, testing concrete samples, etc. A well-equipped laboratory was built near the dam, including a temperature controlled moist-air curing room…Some idea may be had of the extent of the tests from the number made—over 800 field samples, and 1200 laboratory cylinders. The opinion is general, even today, that we went farther than was the usual practice to get a uniform concrete of the highest quality.[43]

The resulting Florence Lake Dam is a reinforced concrete multiple arch dam that is 3,156 feet long and 149 feet high at its maximum point. Its crest stands at 7,329 feet in elevation. The dam sits on the South Fork of the San Joaquin River and impounds runoff from a drainage area totaling 171 square miles and extending to over 14,000 feet in elevation. The dam is located in a rugged and remote high alpine terrain and accessed by a single route: the SCE-built Kaiser Pass Road (alternately Florence Lake Road). The surrounding landscape is characterized by a mix of coniferous forest and abundant glacially scoured granite exposures (**Figure 62**).[44]

The dam is composed of 58 arches in five tangent sections that follow the foundational mandates of the underlying bedrock (**Figures 63**, **64**, **65**, **66**). The tangents are connected at three points by angle buttresses and at the fourth point by the dam's spillway, with an abutment anchoring each end of the dam. A three-foot wide walkway runs the length of the dam, with a galvanized pipe handrailing. Access to the walkway is provided by concrete staircases on the upstream face of Buttresses 32 and 28. There are also steel ladders on the north and south spillway piers.

[43] David H. Redinger, *The Story of Big Creek,* 135.
[44] Florence Lake Dam has been recorded under the Historic American Engineering Record (HAER) program. This documentation provides the basis for the physical description herein and includes a wealth of detailed documentation regarding the development and operational components of Florence Lake Dam. Daniel Shoup, *Historic American Engineering Record: Florence Lake Dam*, *HAER No. CA-167-L* (2012).

The mechanical elements of the dam consist of five devices for releasing water from the reservoir. Four of the devices―including the spillway, sluice gates, Stoney gate, and fish water outlets—are used to regulate the level of the reservoir water and provide streambed outflow. The fifth device—the intake tunnel for Ward Tunnel―is used to supply water to the downstream hydroelectric facilities. The spillway is a reinforced concrete gravity block section located between Arches 36 and 37, with two floating drum gates regulating flow. The two sluice gates run parallel to the bed of the South Fork of the San Joaquin River and are located at the base of the dam flanking Arch 52. The gates measure 46 inches by 46 inches and are controlled by hydraulic jacks located on top of the dam. A Stoney gate is centered on Arch 52. The gate consists of a massive steel plate that measures 10 feet by 24 feet and weighs 22 tons. The gate is only used for emptying the reservoir completely at very low water levels. Two small fish water outlets are located at Arches 53 and 51. The eight inch pipes are protected by manually operated sluice gates and provide sufficient flows to maintain fish stocks in the downstream South Fork of the San Joaquin River.[45]

The overall form of Florence Lake Dam has remained essentially the same since construction, with very few modifications other than maintenance of the original mechanical features and the placement of modern monitoring and gauging equipment (**Figures 67, 68**). The most notable alterations relate to the ongoing repair and treatment of the dam's concrete body that has been subject to a number of coatings and treatments intended to prevent and correct spalling and deterioration. As noted by Redinger, the freezing temperatures and harsh conditions of Florence Lake proved the most challenging component of the dam's overall setting. Despite rigorous analysis of the concrete during construction, the wears of environmental damage became apparent soon after completion:

> In spite of efforts to produce concrete of highest quality possible, it was not long after completion of the dam before the effects of freezing were recognized. The water from snow melting on the walkway would run down over the concrete in the daytime and was followed by low temperatures at night. No doubt some of the trouble was due, too, to the concrete being more or less wet as the lake level went down. Many theories have been advanced about this frost action on concrete that causes it to spall or disintegrate. It has been a puzzling problem for years to engineers who have tried to reach the root of the trouble and make concrete which would not be vulnerable to freezing temperatures... As to what the final answer may be, time will tell.[46]

Almost immediately upon completion of the dam, SCE instituted an ongoing—and often experimental—treatment program to counteract environmental damage, a program that has continued to the present. Repair and preservation techniques have included the application of a

[45] A Stoney gate is a vertical gate moving on rollers. The gate is named after its inventor F.G.M Stoney, who developed the gate type in 1883 in Ireland.
[46] David H. Redinger, *The Story of Big Creek,* 143.

number of coatings to the dam, including Inertol, a coal tar coating; Gunite, a sprayable concrete; Asbestile, a concrete mixed with asbestos; reflective aluminum paint to reduce heat absorption; isolated placement of welded steel plates along the upstream face; and most recently the placement of a geotextile liner to the upstream side of the dam face that began in 2014 and will continue into 2016. During the mid-twentieth century, the maintenance challenges of the dam proved of such general interest to engineers and concrete manufacturers that SCE partnered with a number of bodies, including the Portland Cement Association, the State of California, and the United States Bureau of Reclamation to advance a testing and inspection program on the dam that included isolated application of a range of experimental treatments in order to develop treatment plans for both Florence Dam itself and other comparable high elevation concrete dams and related structures.[47]

While these treatments have been ongoing to the present, none have significantly changed the appearance of the dam, with the overall form, mass, and operational capacity remaining the same. Further, the applications have served to preserve the functional integrity of the dam in an often challenging and inhospitable environment. The ongoing maintenance program has not undermined the resource's ability to convey significance within the context of the district and the dam is a contributing resource of the BCHSHD.

Character defining features of the Florence Lake Dam include its placement and orientation on the South Fork of the San Joaquin River; its multiple arch concrete body, supporting buttresses, and abutments framed by the granite exposures surrounding the dam; its physical and functional relationship to the adjacent intake of the Ward Tunnel; and its outlet components including the spillway with two floating drum gates, sluice gates, Stoney gate, and fish release outlets.

Florence Lake (Contributing Structure)

Florence Lake was originally a small, natural high mountain lake prior to the development of Florence Lake Dam. With the placement of the dam, the size of the lake was substantially increased to 962 surface acres and a storage capacity of 64,406 acre feet (**Figure 69**). The majority of the water of the reservoir is sent through Ward Tunnel to Huntington Lake and the powerhouses below. Additional run-off is released from the dam to the South Fork of the San Joaquin River, and is used for recreational and aquatic conservation purposes.

As a hydroelectric resource, there have been few notable changes to Florence Lake since its inundation. Since construction of the dam, the reservoir has served the same basic function, to both store and supply water for the powerhouses located downstream in the project. Florence Lake retains integrity of materials, workmanship, design, setting, feeling, and association within the context of the district.

While the reservoir is characterized by continuity of function, design, and overall setting and is a contributing resource of the BCHSHD, the water body has been operationally augmented by the development of additional inflow during the middle part of the twentieth century. In the mid-

[47] David H. Redinger, *The Story of Big Creek,* 143-145.

1940s, SCE developed five small stream diversion structures around Florence Lake to capture run-off from small mountain streams in the vicinity. The development of the diversion systems was designed to provide additional capacity for power generation, as World War II energy demands caused a spike in oil prices that undermined SCE's growing reliance on urban steam generation plants. With increased steam costs, the company sought to garner additional flows that could help offset steam generation's increased expense.[48]

The small structures developed in this period include: Hooper Creek Diversion, North Slide Creek Diversion, South Slide Creek Diversion, Tombstone Creek Diversion, and Crater Creek Diversion, which together increased the annual energy output of the BCHS by a reported 2.7 percent at the time of construction. All of the small diversions consist of the same basic components, with a small concrete stream diversion dam and associated gates and above ground piping that drains to Florence Lake. Only Hooper Diversion and Crater Creek Diversion remain in use, with the others abandoned in the late twentieth century and largely dismantled. These minor diversion structures are of a modest utilitarian nature and were constructed decades after the period of significance for the district. In addition, most have been physically dismantled and are non-operational and lack both operational and physical integrity. These diversion structures do not contribute to the significance of Florence Lake or the BCHSHD as a whole.

While the overall environmental setting of Florence Lake remains rugged and remote, with the landscape characterized by exposed granite bedrock and pine studded alpine terrain, the area surrounding the lake has been somewhat modified for recreational purposes since the period of significance for the BCHSHD. Like many hydroelectric projects, the areas surrounding Big Creek's reservoirs have been developed over time with recreational amenities, including campsites, parking areas, and minor associated infrastructure including boat launches and docks. Currently, most of the land surrounding Florence Lake is designated National Wilderness Area and is therefore relatively undeveloped. The area on the northwest end of the lake that is not located within a designated wilderness area has been developed with basic recreation facilities, including a small picnic area, a boat launch, a convenience store, parking areas, and an equestrian pack station. This type of ancillary recreational development is common along reservoirs of this type, and is not considered within the boundary of the district as the recreational development does not convey significant engineering, design, or industrial themes related to hydroelectric development in general or the operation of the BCHS in particular. Rather, the ongoing adjacent development is indicative of an evolving twentieth century recreational, social, and tourism-related context that is overlapping with, and not within the scope of the BCHSHD.

Character defining features of Florence Lake Reservoir include its storage capacity; its functional and physical relationship to connecting infrastructure including Florence Lake Dam and Ward Tunnel; and its remote high elevation surroundings.

[48] W.C. Mullendore, Western Union Telegram to Federal Power Commission, July 12, Los Angeles, CA. Document Number 18951, part 7, Section A, Subsection 4, SCE, Rosemead, CA.

Contextual Overview: Expanding the System in the High Country

In addition to capturing the flows of the South Fork of the San Joaquin River, the 1925-1926 completion of Ward Tunnel and Florence Lake Dam enabled access to a variety of new high elevation water supplies. With the Ward Tunnel essentially serving as a 13 mile-long backbone, SCE engineers quickly introduced flows from several small high elevation watersheds to the Ward Tunnel, and subsequently the generation facilities below. Such incremental expansion was critical in keeping pace with the system's growing energy demands during the period, as the 1920s were a period of rapid expansion in nearly every sector—industry, agricultural, and domestic consumer growth. In addition to the development of Powerhouse Nos. 8 and 3, by the mid-1920s the capacity of Powerhouse Nos. 1 and 2 had doubled, with new turbines demanding ever more water.[49]

As the 58 arches of Florence Lake Dam were under construction, SCE surveyors and engineers were studying the high elevation terrain to the north of the lake, seeking suitable locations for additional diversion structures. Much like the development of Ward Tunnel, the analysis was guided by the early studies of John Eastwood, who had identified Bear and Mono Creeks as potential sites for hydroelectric development. The two creeks flowed to the north of Florence Lake, with the ultimate site of the Bear Diversion approximately four miles north of the reservoir and the Mono Diversion approximately six miles north. The intervening terrain was characterized by a rugged mountainous landscape of glacial boulders and impenetrable outcroppings, ushering in yet another complex construction campaign that spanned 1926 and 1927 and included the development of Bear and Mono Creek Diversions as well as the Mono Flowline, Bear Tunnel, and Mono-Bear Siphon that served to connect water diverted from Mono and Bear Creeks to the Ward Tunnel.[50]

Bear Creek Diversion Dam (Contributing Structure)

The Bear Creek Diversion Dam is an unreinforced concrete arch dam that is 293 feet long at its crest, with a maximum height of 49 feet. The dam is 9 feet 6 inches thick at its base, tapering to a width of four feet at its crest. The dam's overpour spillway is centered in the middle of the dam and located at 7,350 feet in elevation. The dam impounds a small reservoir on Bear Creek that has a capacity of 103 acre feet. The majority of the water from the reservoir is diverted into the Bear Tunnel intake, located on the north bank of Bear Creek above the impoundment. In conjunction with the Mono Diversion, located several miles to the northwest, the Bear Diversion Dam collects run-off from a 139 square mile area and delivers it via the Mono-Bear Siphon to the Ward Tunnel, Huntington Lake, and the powerhouses of the BCHS.[51]

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[49] David H. Redinger, *The Story of Big Creek,* 145.

[50] John S. Eastwood, "Comparative Estimate of Cost of Water-Power Transmission Plant vs. Steam Plant, for W.G. Kerckhoff, President, Pacific Light and Power Company," 1905. Document No. 12871, History and Information File, Northern Hydro Division Headquarters, Big Creek, CA.

[51] Bear Creek Diversion Dam has been recorded under the Historic American Engineering Record (HAER) program. This documentation provides the basis for the physical description herein and includes a wealth of detailed documentation regarding the development and operational components of the dam. Daniel Shoup, *Historic American Engineering Record: Big Creek Powerhouse No. 8*, *HAER No. CA-167-M* (2012).

The Bear Creek Diversion Dam was designed and constructed by SCE's Construction and Engineering Departments (**Figure 70**). Much of the construction material for the dam was derived from byproducts of the concurrently developed Bear Tunnel that connected the diverted water to the Mono-Bear Siphon and subsequently the Ward Tunnel. Rock waste from excavation was crushed to provide the aggregate for dam concrete, and rails used to transport tunnel muck were welded into trash racks for the sluice gates and tunnel intake.

The dam is equipped with two sluice pipes through the north side of the dam for excess outflow. The cast iron pipes are 4 feet 8 inches long and measure 24 inches in diameter. Water flow through the pipes is controlled by two 24-inch cast iron sluice gates, hand operated on a concrete control platform adjacent to the north abutment of the dam. The control platform is utilitarian in form and is encircled by a pipe railing and accessed by a walkway from the dam's north abutment (**Figure 71**).

The Bear Creek Diversion Dam largely retains its original appearance and equipment, including sluice gates and related features (**Figure 72**). Regular maintenance has been carried out, including repainting the upstream face and maintenance of the sluice pipes and associated infrastructure. Two minor structures have been added to the dam since the 1980s. The first is a small concrete fish weir that extends in front of the dam and forms a pool on the dam's downstream face. Water flows into the weir through a metal pipe that is affixed to the northern sluice pipe as it exits the dam's face. A modern stream gauge measures flow through the weir. The second modern addition is a corrugated metal sheathed shed that stands on a concrete platform at the north side of the dam, containing electronic monitoring devices. The structure measures 8 feet by 8 feet and is of wood frame construction. Solar panels mounted on the roof supply power to the equipment within.

Neither the modern utilitarian additions nor ongoing dam maintenance have significantly changed the appearance of the Bear Creek Diversion Dam, with the overall form, mass, and operational capacity remaining the same. Further, the applications have served to preserve the functional integrity and operational capacity of the dam. The dam retains high physical integrity and is able to convey significance as a contributing resource within the context of the BCHSHD.

Character defining features of the dam include its placement and orientation across Bear Creek; its curved unreinforced concrete body; its ungated spillway; its functional and physical relationship to the intake for the Bear Tunnel; and its gated sluice pipes and utilitarian control platform.

Mono Creek Diversion Dam (Contributing Structure)

Developed several miles to the northwest of the Bear Creek Diversion Dam, the Mono Creek Diversion Dam is an unreinforced concrete arch dam that is 156 feet long at its crest, with a height of 64 feet. The dam is 9 feet 6 inches thick at its base, tapering to a width of four feet at its crest. The dam's overpour spillway is centered in the middle of the dam and located at an elevation of 7,350 feet above msl. The dam impounds a small reservoir on Mono Creek that has a capacity of 46 acre feet and a surface area of 6.7 acres. The majority of the water from the reservoir is diverted into the Mono Flowline intake, located on the west side of the impoundment adjacent to the dam. In conjunction with the Bear Creek Diversion Dam, the Mono Creek Diversion Dam collects run-off from a 139 square mile area and delivers it via the Mono-Bear Siphon to the Ward Tunnel, Huntington Lake, and the powerhouses of the Big Creek System.

The Mono Creek Diversion Dam was designed and constructed by SCE's Construction and Engineering Departments. Much of the construction material for the dam was derived from byproducts of concurrent siphon and tunnel development work that connected the diverted water to the Mono-Bear Siphon and subsequently the Ward Tunnel. Rock waste from excavation was crushed to provide the aggregate for dam concrete and rails used to transport tunnel muck were welded into trash racks for the sluice gates and tunnel intake (**Figure 73**).

The dam is equipped with two sluice pipes through the south side of the dam for excess outflow. The cast iron sluice pipes measure 24 inches in diameter. Water flow through the pipes is controlled by two 24-inch cast iron sluice gates, hand operated on a concrete control platform that is supported by concrete piers and projects above the crest of the dam on its south side. The control platform is utilitarian in form and is encircled by a pipe railing and accessed by a walkway from the dam's south abutment.

The Mono Creek Diversion Dam largely retains its original appearance and equipment, including sluice gates and related features (**Figure 74**). Regular maintenance has been carried out, including maintenance of the sluice pipes and associated infrastructure. Several minor structures and features have been added to the dam since the 1980s. The first is a small concrete fish weir that extends in front of the dam and forms a pool on the dam's downstream face. Water flows into the weir through a metal pipe that is affixed to a sluice pipe as it exits the dam's face. A modern stream gauge measures flow through the weir. The second modern addition is a mechanical service structure that stands on the south side of the dam. The rectangular structure was added in 2006 and is of concrete masonry unit (CMU) construction. A stairwell extends from the mechanical structure to the gauging equipment and weir below, also added in 2006.

Neither the modern utilitarian additions nor ongoing dam maintenance have significantly changed the appearance of the Mono Creek Diversion Dam, with the overall form, mass, and operational capacity remaining the same. Further, the applications have served to preserve the functional integrity and operational capacity of the dam. The dam retains high physical integrity and is able to convey significance as a contributing resource within the context of the BCHSHD.

Character defining features of the dam include its placement and orientation across Mono Creek; its curved unreinforced concrete body; its ungated spillway; its functional and physical relationship to the intake for the Mono Tunnel; and its gated sluice pipes and utilitarian control platform. In addition, the surrounding undeveloped wooded hills framing Mono Creek are a contextual character defining feature of the dam.

Mono-Bear Flowline (Contributing Structure)

The Mono-Bear Flowline is a multicomponent water conveyance system consisting of three primary components: the Mono Flowline; the Bear Tunnel; and the Mono-Bear Siphon. Together, these three components carry water from the Bear Creek and Mono Creek Diversion Dams to the Ward Tunnel, with the connecting alignments generally forming a "Y." The conveyance system was developed concurrently with the Mono Creek and Bear Creek Diversion Dams in 1926-1927 and in its entirety is approximately six miles in length (**Figures 75, 76**). Because the associated tunnels were smaller than that which was typical, construction of the flowline system required some engineering improvisation, as recounted by David Redinger:

> The Mono-Bear Tunnels were too small for the use of our regular mucking equipment. To facilitate the loading of the cars, Tunnel Foreman Ed McCabe, who had been on the Florence Lake Tunnel, improvised the "McCabe Mucker." This contraption elevated the muck and dumped it into the cars. The men had to shovel it onto the endless belt, but this method was easier and faster than hand shoveling it onto the cars, as they would have had to raise the muck four or five feet. The excavation of the siphon was made mostly through hardest granite, a sizeable job in itself. The blasting echoes from the tunnels and siphon excavation reverberated through the canyon like the sound of huge guns on a terrific battlefront… Big trucks, as many as 25 in service at one time, hauled the steel pipe sections from the top of the main incline at Huntington Lake to the site, where the link-belt shovel, as a crane, unloaded and placed each in the proper position in the trench. In general, things clicked like clockwork.[52]

The Mono Flowline consists of two segments, the Mono Siphon and the Mono Tunnel. The flowline begins at the Mono Creek Diversion Dam, with an intake structure located on the southeast side of the diversion dam. The intake box is utilitarian in form and housed on a concrete platform, with a manually operated 6 foot by 9 foot slide gate protected by steel trash racks. From the intake, flow is conveyed into the Mono Siphon—a ¾ mile-long, 92-inch diameter riveted steel pipe that flows in a generally southerly direction. The pipe is buried beneath approximately three feet of granitic rock and dirt, placed to provide protection from freezing and environmental damage. The pipe is accessible at various points along the alignment by concrete hatch pads. The utilitarian pads are approximately 4 feet by 6 feet in size, with the access hatches covered with corrugated metal sheathing. The Mono Siphon connects to the Mono Tunnel, an unlined granite tunnel that is also approximately ¾ of a mile in length. The tunnel is approximately 9 feet wide and 7 feet tall and terminates at the Mono-Bear Siphon, where the flows from Mono Creek meet those of Bear Creek.

The Bear Tunnel begins at the Bear Creek Diversion Dam, flowing from the impoundment through an intake structure located on the northeast side of the dam. The intake is 7 feet, 6 inches wide and 15 feet tall, with flow screened by steel trash racks and controlled by a steel gate that is

[52] "New Diversion System Opens: Water Flows in Mono Bear Cut-Off Channel," *Los Angeles Times*, November 18, 1927; David H. Redinger, *The Story of Big Creek,* 149.

manually operated by controls housed in a small gate house that stands on a concrete platform above the intake. The gate house is utilitarian in form, with corrugated metal sheathed walls and roofing. From the intake, the underground tunnel flows 1.5 miles in a generally westerly direction, with the entirety of the tunnel of unlined granite and of a generally seven-foot by seven-foot diameter. One adit was constructed to support development of the tunnel approximately ½ mile from the Bear Dam.

The Mono Flowline and Bear Tunnel meet at the Mono-Bear Siphon (**Figure 77**) that carries the combined water flow approximately three miles south to the Ward Tunnel, entering Ward Tunnel through a connection near Ward Tunnel's Adit No. 2. Control of flow into the Mono-Bear Siphon from the two flowlines is controlled by gate valves housed in small valve houses. Both valve houses are utilitarian in form and plan, with wood frame construction, corrugated metal sheathing and a small six-foot by six-foot rectangular footprint.

The Mono-Bear Siphon is made of riveted steel, and measures from 72 inches to 102 inches in diameter. The pipe segments are generally 17 feet long, with 32 shorter expansion joints along the length that measure only five feet in length. For the majority of its length, the siphon is buried by approximately three feet of crushed gravel and dirt that forms a berm to protect from freezing and environmental damage. The pipe is exposed only where it crosses the San Joaquin River and Chinquapin Creek. At these points the pipe has been covered with aluminum cladding for protection. Concrete block access hatches appearing intermittently along the siphon's length, as do a small number of concrete support blocks that provide additional stability for the pipe. The blocks vary in size and dimension, but are generally small and of a low profile and utilitarian form. Like the Mono and Bear flowlines, flow through the Mono-Bear Siphon is controlled by valves and gauges housed in small utilitarian valve houses, four of which appear along the siphon's length. All are small and of a utilitarian design, with a wood frame construction and corrugated metal or wood sheathing.

As a water conveyance system, the constituent components of the Mono-Bear Flowline have served the same function since construction, to convey water from the Mono and Bear watersheds to the Ward Tunnel and ultimately the turbines below. The linear system has had no notable alterations to its overall design or overall operation since construction, with high integrity of materials, workmanship, design, setting, feeling, and association within the context of the district (**Figure 78**). The sole notable modern addition is the placement of a small concrete utility shed and wood lean-to adjacent to the Mono-Bear Siphon near the Chinquapin Creek crossing. The small shed houses measuring equipment and volume meters. This addition is utilitarian in form and in keeping with the design and function of the resource, and does not detract from integrity or significance of the Mono Creek Flowline as a contributor to the BCHSHD.

Character defining features of the Mono-Bear Flowline include its operational alignment that extends from the Mono and Bear Creek Diversion Dams to the Ward Tunnel; its multicomponent flowline comprised of sections of buried steel pipe and tunnel of unlined granite; its intake infrastructure at Mono and Bear Creek Diversion Dams including the Mono Creek Diversion Dam's utilitarian concrete platform, steel gate, and trash rack and the Bear Creek Diversion Dam's utilitarian gatehouse, gate, and associated trash rack; its utilitarian valve houses that control flow along the alignment; and its above grade stabilization and protection infrastructure, including concrete stabilization blocks and dirt and rock sheathing. The flowline's single construction adit is a character defining feature, as it is indicative of the type, period, and method of construction of the resource. The small concrete utility shed and wood lean-to adjacent to the Mono-Bear Siphon near the Chinquapin Creek crossing are modern additions and are therefore not considered character defining features.

Contextual Overview: Expanding Big Creek's Storage and Operational Capacity
Development of a complex hydroelectric system like that of Big Creek presents a constant tension between inflow, storage capacity, and energy production. More energy production requires more water, and in turn storage, so that supplies can be regulated and released as needed with minimal waste and run-off and sufficient flow. Following the major mid-1920s high country expansion campaign, SCE turned to the critical challenge of increasing downstream storage capacity for their newly gained water supplies.

At that time, the system's primary reservoirs—Florence Lake and Huntington Lake reservoirs—were not large enough to accommodate all of the additional water provided from the high country expansion. Diminutive Shaver Lake, still at this time impounded by the small Fresno Flume and Lumber Company 1890s rock-fill dam, was too small to serve any notable storage purposes. Further, Shaver Lake was not yet integrated into the upper portions of the system, with the reservoir's sole connection to the Big Creek system being Tunnel No. 5 that extended downstream to Powerhouse No. 2. Shaver Lake was isolated from any flows from the upper parts of the system, a storage deficiency SCE sought to rectify by construction of a new connecting tunnel and a greatly expanded dam. As recounted in a 1924 *LA Times* account of the Big Creek area, "Shaver Lake [was] an unsightly body of water impounded originally for a lumber mill. In the future it would spread itself over a far greater area and the lake would become one of the largest artificial lakes in the Sierra Nevada."[53]

In 1926, SCE initiated a major campaign to integrate Shaver Lake as the central storage facility for the project. The company dramatically expanded the storage capacity of Shaver Lake with the creation of a large concrete dam and integrated the reservoir with the upper components of the system by constructing a flowline from the higher elevation Huntington Lake. Following this major storage expansion, the company again turned to the creation of additional generating capacity, constructing Powerhouse 2A, that would be fed by the increased flows available from the newly integrated and expanded Shaver Lake.

Shaver Lake Dam (Contributing Structure)
In 1926 and 1927, SCE constructed the Shaver Lake Dam on the northwest side of Shaver Lake, across the natural channel of Stevenson Creek, enlarging the lake and replacing the previously

[53] "Trace Energy's Source," *Los Angeles Times*, July 6, 1924.

developed rock-fill dam (**Figures 79, 80**). The dam is of a concrete gravity design and stands 185 feet above the creek bed at an elevation at 5,371 feet. The crest, formed by a three-foot high concrete parapet wall, is 1,760 feet long. In plan, the dam's axis consists of two nearly equal tangents, intersecting at 26 degrees, connected by a 600-foot radius curve. Along the west side of the dam is an earthen-filled dike with a concrete core that extends the left end of the dam an additional 409 feet, for a total dam length of 2,169 feet.[54]

The dam's outlet works include a vertical shaft at the north abutment of the dam that connects to Tunnel No. 5. The shaft was constructed in 1921 to draw water for Powerhouse No. 2 and therefore pre-dates Shaver Lake Dam. In addition, the dam includes an overpour spillway that consists of a .9-foot notch that spans 250 feet across the center of the dam. Another notable original feature is an "inspection gallery" that runs much of the length of the dam a short distance above its base. According to David Redinger, the gallery was the only one of its type developed on any of the Big Creek dams and was designed to provide access for periodic inspections of leakage and to permit drilling to relieve pressure from seepage water if necessary. In 1930, an additional gallery was added at the very base of the dam to provide additional inspection access. According to SCE documentation, the galleries are approximately 12 feet in height and they are accessed by several doors on the downstream face of the dam. Original features of the dam include a concrete monitoring house located directly north of the spillway, extending above the crest of the dam. The small utilitarian structure is approximately eight feet tall and six feet wide and houses electrical equipment associated with a staff gauge and float well that is used for reservoir monitoring.[55]

While these original dam features are intact and remain in much the same configuration as they were when designed, Shaver Lake Dam has been subject to ongoing modifications and maintenance. Most notably, gunite and other superficial treatments including a geomembrane liner on the upstream face have been added to both the upstream and downstream face of the dam to address leakage. Additionally, a lower level outlet works was added after construction to provide minimum outflow. The outlet works include a 48-inch outlet pipe, a concrete valve house, and a ten inch fish release pipe. None of these features are from the historic period, with most developed in the 1980s. A number of pore pressure piezometers and associated electrical conduits have been added to the base of the downstream face of the dam, to measure pore pressure within the dam's underlying foundation.

Despite these alterations and additions, the dam remains an integral component of Shaver Lake and the Big Creek System and is a contributing resource that is reflective of the district's significant development context (**Figure 81**). Further, all alterations are in keeping with the utilitarian design of the concrete gravity structure, allowing the dam to retain overall integrity of materials, workmanship, design, setting, feeling, and association within the context of the district.

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[54] Remnant portions of this rock-fill dam remain in place in the lakebed. Because the remains are not associated with the BCHSHD development context they are not evaluated as a contributing element of the district.
[55] David H. Redinger, *The Story of Big Creek,* 153

Character defining features of Shaver Lake Dam include its placement and orientation across the natural channel of Stevenson Creek; its curved concrete gravity body coupled with a concrete core earthen fill dike; its physical and functional relationship to outflow through Tunnel No. 5; its ungated overpour spillway; and its original inspection gallery.

Shaver Lake (Contributing Structure)
Shaver Lake was initially developed in 1893 by C.B. Shaver of the Fresno Flume and Lumber Company, with a small rock-face dam impounding the flow of Stevenson Creek on the west edge of the Stevenson Creek Basin. At this time, the reservoir had a very small storage capacity of only 5,200 acre feet. With the 1927 completion of the Shaver Lake Dam, the lake became the largest of the Big Creek System, with a surface area of 2,184 acres and a storage capacity of 135,568 acre feet.

Shaver Lake was primarily developed as a storage reservoir to hold water conveyed from the higher elevation Florence and Huntington Lakes (**Figure 82**). The majority of the water conveyed to Shaver Lake comes from the Huntington-Pitman-Shaver Conduit (Tunnel No. 7 Flowline) that extends from Huntington Lake to the east side of Shaver Lake. The natural drainage area into Shaver Lake is 29 square miles so only a small portion of the water that enters Shaver Lake comes from natural flows. In addition to serving as a vast water storage body, Shaver Lake was developed to supply water for Powerhouse No. 2A, and subsequently Powerhouse Nos. 8 and 3 further down river, with water flowing from the west side of the Shaver Lake through Tunnel No. 5.

While the overall functional storage role of Shaver Lake has not changed since construction, the reservoir has been integrated into ongoing hydroelectric expansion within the system. Most importantly, between 1984 and 1987 SCE constructed the Balsam Meadows Project to the northeast of Shaver Lake, a pump storage project that includes the underground Eastwood Power Station and an associated small forebay, the Balsam Meadows Forebay. The project is physically connected to Shaver Lake via the Eastwood Inlet and Outlet Tailrace Tunnel that runs from the Eastwood Power Station to a portal on the northeast side of Shaver Lake. The power station includes one turbine that is fully reversible and can therefore both generate electricity and act as a pump for pump storage operations. Within this system, the tunnel can either release water into Shaver Lake, serving as a tailrace for the Eastwood Power Station after power generation, or pump water from Shaver Lake, sending it to the Balsam Meadows Forebay located upslope from the Eastwood Power Station. While the modern development of the Balsam Meadows Project is not within the BCHSHD because it does not share the BCHSHD's significant historical development context, the physically connected and functionally integrated Eastwood Inlet and Outlet Tailrace Tunnel does not detract from the significance or integrity of Shaver Lake or the district as a whole. This feature is in keeping with the functional and operational nature of the BCHSHD and does not undermine the integrity of the district.

While Shaver Lake has served the same basic storage and delivery needs for the BCHS and is a contributing resource of the BCHSHD, the area surrounding the lake has evolved from a largely undeveloped wilderness to a notable recreational enclave in the century since initial construction. Like many hydroelectric projects, the areas surrounding Big Creek's reservoirs have been developed over time with recreational, tourist, and community amenities as the resources have become integrated components of the landscapes of which they are part. Currently, the lands to the west of Shaver Lake are the most intensively developed of any of the system's adjacent lands, with Highway 168 running along the western shore and the small community of Shaver Lake situated immediately southwest. In addition, tracts of seasonal cabins and a variety of recreation facilities including campgrounds, picnic areas, vistas and boat ramps line the western flank of the reservoir. A number of modest, floating and/or removable boat docks are associated with this type of development, appearing intermittently around the lake, with the largest being Sierra Marina on the northern tip of the lake. This type of ancillary recreational development is common along reservoirs of this type, and is not considered within the boundary of the district as the recreational development generally does not convey significant engineering, design, or industrial themes related to hydroelectric development and operation of the BCHS. Rather, the ongoing adjacent development is indicative of an evolving twentieth century recreational, social, and tourism-related context that is overlapping with, and not within, the scope of the BCHSHD.

Character defining features of Shaver Lake include its holding capacity, the largest of the BCHSHD system; its functional and physical relationship to connecting infrastructure including the Tunnel No. 7 Flowline and the Tunnel No. 5 Flowline; and its impounding structure–Shaver Lake Dam.

Tunnel No. 7 Flowline/Huntington-Pitman-Shaver-Conduit (Contributing Structure)

The Tunnel No. 7 Flowline, also called the Huntington-Pitman-Shaver-Conduit, was developed between 1925 and 1928 to serve as the flow nexus between the upper portions of the BCHS and the vast storage area of the enlarged Shaver Lake (**Figures 83, 84**). As constructed, the tunnel extended from an intake at Dam No. 2 in Huntington Lake to an outlet on the North Fork of Stevenson Creek, where the water then followed the natural watercourse of the creek and flowed into the northeast side of Shaver Lake. The conveyance system provided SCE with a great deal of operational flexibility. Specifically, water could be held in Huntington Lake and released to Tunnel No. 1 and Powerhouse No. 1 or sent via Tunnel No. 7 to Shaver Lake and subsequently released directly to Powerhouse No. 2 and the soon-to-be constructed adjacent Powerhouse No. 2A, as well as downstream Powerhouse Nos. 8 and 3.

The flowline included approximately five miles of unlined granite tunnel and a little over one-half mile of riveted steel pipe, with the alignment running through undeveloped and mountainous wooded terrain between Huntington and Shaver Lakes. Construction of the tunnel was aided by the development of a single construction adit, Adit 72. According to David Redinger, construction benefitted greatly from 1920s advances in tunneling technology, with the deployment of newly patented mucking machines greatly expediting work.[56]

[56] David H. Redinger, *The Story of Big Creek,* 160.

During the course of construction, tunneling efforts were stymied by a major collapse approximately two miles from the outlet portal at Shaver Lake, where weak bedrock was encountered. In order to avoid the area, SCE engineers rerouted the tunnel. It was still necessary to reinforce portions of the rerouted tunnel with timber supports and a lining of reinforced concrete to accommodate for weak ground conditions, one of the only such instances in the Big Creek tunneling efforts. In addition to these construction complications, the Tunnel No. 7 campaign was visited by one of the worst natural disasters to occur during the development of the BCHS. In the early morning hours of February 15, 1927 an avalanche struck Construction Camp 72, sweeping up the temporary buildings of the camp in the snow and debris and killing 13 people. Recovery of all of the dead took ten days, slowed by heavy snowfall and harsh weather.[57]

The completed Tunnel No. 7 Flowline includes sections of both buried and above ground riveted steel pipe as well as segments of granite tunnel. Flow into the tunnel is controlled by a ten-foot by ten-foot slide gate with trash rack that is located at the tunnel intake at Huntington Lake. The gate controls are located in a gate house that stands above the intake on the crest of Dam No. 2. The board formed concrete building is utilitarian in form, with smooth walls, a flat roof, and evenly spaced industrial steel frame windows.

After passing through the intake gate, water is conveyed through a ten-foot diameter steel pipe through the base of Dam No. 2. A small valve house is located on the downstream side of the dam, largely buried by rock and rip-rap, that controls flow from the ten-foot pipe to a larger diameter twelve-foot pipe that runs for 680 feet from the base of the dam to the first granite segment of the tunnel. The riveted steel pipe is buried for its length but is accessible through steel plates anchored by concrete blocks that appear intermittently along the pipe at the ground surface. In addition, a single 130-foot tall steel air vent pipe rises from the alignment, where the steel pipe meets the first segment of granite tunnel. This segment of granite tunnel, called Segment 1, is approximately one-half mile in length. The tunnel is fourteen feet in diameter and of a generally horseshoe shape. Tunnel Segment 1 conveys water to a steel siphon that runs for another one-half mile, carrying flow across a steep valley. The riveted steel pipe is anchored by concrete saddle blocks and ranges in diameter from 96 inches to 120 inches. After crossing the valley, the flowline again enters a granite tunnel, Segment 2 that is of the same diameter as Segment 1 and travels approximately four miles to the flowline's outlet portal at Stevenson Creek, where water then follows the natural watercourse for approximately two miles to meet Shaver Lake. Flow from this tunnel outlet is controlled by a vertical slide gate that is approximately 11 feet by 10 feet in size.

While the primary physical and operational features of Tunnel No. 7 remain much as they were designed and the resource is a contributing resource of the BCHSHD, there have been several changes that have altered the flowline system, most notably the 1980s development of the Balsam Meadows Project included in the description of Shaver Lake. Water for this modern

[57] David H. Redinger, *The Story of Big Creek,* 162.

project is drawn from the Balsam Diversion Tunnel that extends from the outlet portal of Tunnel No. 7, where it meets Stevenson Creek. The water then flows approximately one mile north to the Balsam Meadows Forebay. The 1980s development of this diversion tunnel required some augmentation of the Tunnel No. 7 outlet, including the rebuilding of the concrete retaining structure surrounding the outlet. While the modern Balsam Diversion Tunnel does not contribute to the significance of the BCHSHD and is not within the district's boundary, the development is utilitarian in form and is in keeping with the ongoing use and function of the Tunnel No. 7 Flowline, which is to convey water for hydroelectric generation. The modern placement of the Balsam Diversion Tunnel does not undermine the integrity of the Tunnel No. 7 Flowline or the district as a whole.

The other notable change to the Tunnel No. 7 Flowline is the mid-twentieth century reconstruction of Adit No. 72 that was rebuilt and lined with concrete to provide maintenance access to the main body of the tunnel and to allow for ongoing repair of the tunnel sections that bored through weak bedrock. This minor structural augmentation has not undermined the ability of the tunnel as a whole to convey significance through its ongoing use, design, and engineering, and the Tunnel No. 7 Flowline retains high integrity of materials, workmanship, design, setting, feeling, and association within the context of the district.

Character defining features of the Tunnel No. 7 Flowline include its operational alignment that extends from Huntington Lake to Shaver Lake; its multicomponent flowline that includes sections of unlined and lined granite tunnel as well as above and below grade steel pipe; its intake infrastructure including the concrete gatehouse, steel gate, and trash rack; its single vent pipe; its associated concrete saddle blocks and fill material including rock and rip-rap; and its outlet slide gate that controls flow into Stevenson Creek. The flowline's single construction adit was rebuilt in the mid-twentieth century and does not possess sufficient integrity to convey significance as a character defining historic period feature.

Pitman Creek Diversion Dam (Noncontributing Structure)
Pitman Creek Diversion Dam is a small concrete diversion dam that was developed in 1928 to provide additional flows into the Tunnel No. 7 Flowline. The diversion spans Pitman Creek approximately two miles south of Huntington Lake. The dam collects water from Pitman Creek and conveys flows to the tunnel through a vertical borehole that connects into the tunnel near Pitman Creek. As originally constructed, the facility consisted of a small diversion dam, intake grid, three hoist operated slide gates, and a vertical shaft intersecting Tunnel No. 7.

In 2000-2001 the dam was largely rebuilt to comply with contemporary gauging requirements, with the removal and replacement of slide gates, coring through the dam and the placement of a fish release pipe and new intake structure, and the removal and redevelopment of all gauging equipment and housing.

The Pitman Creek Diversion Dam was developed as a modest utilitarian accompaniment to the development of Tunnel No. 7 Flowline, providing additional water to Shaver Lake and subsequently the lower level powerhouses. The small diversion has been substantially altered since the construction period, with virtually all components of the dam replaced or substantively augmented. Because it served as a minor support element and lacks physical integrity, the diversion does not contribute to the significance of the district and is a noncontributing resource.

Powerhouse No. 2A (Contributing Building)

Powerhouse No. 2A was constructed between 1926 and 1928 and was designed to capture flows from the newly enlarged Shaver Lake. The powerhouse was developed immediately adjacent, and attached to, the 1913 Powerhouse No. 2, on the south bank of Big Creek approximately 3.5 miles from the town of Big Creek (**Figure 85**). Powerhouse No. 2A was the last new power facility developed during the district's period of significance.

Powerhouse 2A utilized water from Tunnel No. 5 that had been constructed in 1921 to convey water from Shaver Lake to adjacent Powerhouse No. 2. Upon completion of Powerhouse No. 2A, flow from Tunnel No. 5 was redirected from Powerhouse No. 2 to the adjacent Powerhouse No. 2A's penstock, the longest built in the Big Creek System descending over 6,000 feet from the steep slopes of Musick Mountain to the south (**Figure 86**).

In addition to setting records in length, Powerhouse No. 2A's penstock had the highest head of any developed in the United States at that time, falling 2,400 vertical feet as it descended the steep canyon above Powerhouse No. 2A. Powerhouse No. 2A's turbines set records upon installation, with the two horizontal shaft double over-hung impulse wheels being the largest of their type ever built. Upon completion, the powerhouse's two generating units produced 46,500 kW of electricity each, transmitting at 220 kV, a generation capacity that dwarfed the capability of earlier hydroelectric developments in the system.[58]

In many senses, construction of Powerhouse No. 2A was far less arduous than that of previous developments. Because Tunnel No. 5 was already in place, the project did not include the massive tunneling efforts that preceded the development of the system's other powerhouses. Additionally, because Powerhouse No. 2A was constructed adjacent to Powerhouse No. 2, the site was already served by an incline railroad, a vehicular road, electricity, and other infrastructural support amenities, thereby eliminating the need for new support infrastructure. Development of the building's foundation did pose some unexpected complications, with a weekly construction report noting that during foundation excavation for Unit 1, powerhouse engineers failed to find adequate bedrock, forcing a quickly improvised solution. As recounted in one of the weekly reports, "good rock was not reached in the base of the Allis Chalmers unit, so a five foot slab of concrete, tied together with rail-road iron, was poured over the whole pit" to provide the needed foundational stability.[59]

[58] *Electrical West*, "Edison Adds 237,000 Horsepower in 1928," Vol. 61, No. 5, November 1, 1928, 252-256.
[59] Southern California Edison, *Weekly Letter Reports 1927, Big Creek Powerhouse No. 2*. Archive Room, Big Creek Powerhouse No. 2/2A, Big Creek, CA.

Powerhouse No. 2A is composed of reinforced concrete and structural steel. The building measures 210 feet in length, 66 feet in width, and is of two story construction with a height of 60 feet. A 27-foot by 107-foot extension lines the north side of the building, developed to house the low-tension busses and transformers, and a concrete platform extends from the north side of the building, extending over the tailraces and forebay below. The powerhouse is attached to the northeast wall of Powerhouse No. 2, with the two buildings adjoining and sharing a common industrial breezeway that is accessed by a warren truss steel bridge that crosses Big Creek and the Dam No. 5 impoundment. Steep canyon hillsides studded with chaparral and pine rise behind the powerhouse complex, undeveloped except for the penstock and associated hydroelectric infrastructure.

The powerhouse was designed by the Construction and Engineering Department of SCE. Steel for the penstocks was purchased from several suppliers, including the Ferrum Company of Poland and Pennsylvania's Midvale Iron and Steel and Bethlehem Steel. The turbine for Unit 1 was supplied by Allis-Chalmers of Milwaukee, with the turbine for Unit 2 built by the Pelton Waterwheel Company of San Francisco. Generators were developed by Westinghouse, with transformers and circuit breakers developed by General Electric. Two traveling cranes for the generator room floor were supplied by Western Manning, Maxwell, and Moore Company of Michigan.

Although SCE designers had experimented with a more innovative Art Deco style with the mid-1920s construction of Powerhouse No. 3, the stylistic sensibilities of Powerhouse No. 2A mirror that of its 1913 neighbor, Powerhouse No. 2. The building reflects a restrained neoclassical style that is nearly identical to Powerhouse No. 2, with vertically oriented wood frame industrial windows separated by smooth and rhythmic vertical banding of concrete pilasters. The sole marked difference between the two buildings is that of height, with Powerhouse No. 2A being only single story and Powerhouse No. 2 being five stories. The reduced height of Powerhouse No. 2A is reflective of the 1920s innovation of outdoor bussing and switching equipment, with all such equipment for Powerhouse No. 2A located on an outside concrete platform, rather than within the powerhouse as was common during the 1910s.[60]

The interior of Powerhouse No. 2A is composed of a single large generator room, characterized by high ceilings, an open floor plan, and ample light from the generous vertical rows of windows that line the building (**Figure 87**). The two generating units are evenly spaced on the generating room floor, with the massive generating units, including penstock entries and turbine and generator casings towering above the otherwise spare and empty floor. The building does not include a control room, as operation of Powerhouse No. 2A is controlled from adjacent Powerhouse No. 2.

[60] Powerhouse No. 2A has been recorded under the Historic American Engineering Record (HAER) program. This documentation provides the basis for the physical description herein and includes a wealth of detailed documentation regarding the development and operational components of Powerhouse No. 2A. Daniel Shoup, *Historic American Engineering Record: Big Creek Powerhouse No. 2 and 2A*, *HAER No. CA-167-F* (2012).

There have been very few alterations to the original form and operational components of the interior and exterior of Powerhouse No. 2A since 1928 construction (**Figure 88**). While the turbines have been rewound on several occasions and constituent components have been replaced or upgraded, the turbines and generators of the powerhouse are in their original housing, with major components remaining the same as initially installed. Exceptions to this are the transformers and switching equipment that have been replaced and upgraded to the present with new innovations in transmission technology and operational wear and deterioration. In addition, a small domestic water treatment building was developed adjacent to the east side of the powerhouse in 2008. The prefabricated building has a gable roof and plywood siding and is of a minor utilitarian nature. While it does not contribute to the significance of the powerhouse or the district as a whole, it does not undermine the physical or contextual integrity or significant associations of the powerhouse as a contributing resource of the BCHSHD.

Powerhouse No. 2A is fed by one penstock that descends the steep canyon slope that frames the powerhouse complex, bifurcating twice near the powerhouse, so that four individual penstock pipes penetrate the south wall of the powerhouse. The single penstock begins at the terminus of Tunnel No. 5 and travels above ground through densely forested terrain in a shallow ditch for almost its entire length, except for three areas where it crosses under vehicular roads. The penstock ranges in size from 66 to 108 inches in diameter and is a combination of riveted, forge welded, and forged seamless steel pipe. The penstock is supported by concrete piers and saddles along its length and passes through several large concrete anchor blocks that provide rigidity and stability. In addition, dry stacked stone retaining walls appear intermittently along the length of the line, acting as erosion control and slope stability features. The single penstock bifurcates a short distance above Powerhouse 2A, with a line for each generating unit. These single lines split yet again immediately above the powerhouse, with a jet for the double wheels of each turbine. Control of water flow and air pressure in the Powerhouse No. 2A penstock assemblage is controlled by several valve houses and air vent features. A small wood-frame valve house stands immediately adjacent to the Tunnel No. 5 portal, providing 10-inch air valves to control pressure. The small building stands on a concrete foundation, is clad in board and batten siding, and has a gable roof. Slightly downslope, a 102-inch butterfly valve house controls water flow through the line. The utilitarian structure is set into a rocky hillside and is of board formed concrete construction with a flat roof and minimal industrial fenestration. The structure houses an electric-motor driven butterfly valve that can be operated locally or remotely. Two small air vent houses stand immediately downslope of the valve house, with board and batten siding and gable roofs that mirror the structure that stands at the Tunnel No. 5 outlet.

The Powerhouse No. 2A penstock assemblage retains a very high level of physical and operational integrity, with the penstock length, the associated valve and vent features, and the stabilization features largely being original to construction. The penstock assemblage readily reflects the significant themes of the BCHSHD.

Character defining features of Powerhouse No. 2A include the powerhouse's location on and orientation toward Big Creek; its functional and physical connection to the powerhouse penstock assemblage and Tunnel No. 5 Flowline; its overall rectangular form and mass and physical and functional linkage to Powerhouse No. 2; its concrete finish and industrial fenestration with neoclassical allusions, including the vertical bands of industrial windows coupled with smooth concrete pilasters; and its tailrace openings flowing to Big Creek. Interior character defining features consist of the generally open industrial-scale volume of the building's single large generating room; the original generator, governor, and turbine casings for the generating units; the original traveling crane stationed above the generating room floor; and the penstock entries that penetrate the wall of the generating room.

Character defining features of Powerhouse No. 2A's penstock includes the length and alignment of the single penstock that plunges from Tunnel No. 5 Flowline to the powerhouse; the welded steel penstock that travels above grade and its associated concrete and rock stabilization walls, anchor blocks, and piers; and the utilitarian valve house and associated vents that mark the transition between Tunnel No. 5 Flowline and the penstock.

Contextual Overview: The End of Expansion
With the 1928 completion of Powerhouse No. 2A and Tunnel No. 7, the major foundational expansion phase of the Big Creek Hydroelectric System came to an abrupt close. In 1929, a second generating unit was added to Powerhouse No. 8. The system essentially remained in operational stasis until the post-World War II period.

As depicted in period documentation, this abrupt cessation was not by design. While SCE planners and engineers had envisioned further expansion though the 1930s, assuming as did most that the rapid growth of the 1920s would continue in perpetuity, the onslaught of the Depression and the subsequent decline in consumer demand and industrial output undercut both the basis and capital for further hydroelectric growth. Further, private hydroelectric utility systems like BCHS were pressured during the period by increasingly ambitious government-led forays into power generation—most notably that of the Boulder Canyon Project—commonly known as Hoover Dam. By 1930, SCE had entered into contracts to purchase power from the federal project, ushering in an era of large-scale public works that departed markedly from the relatively smaller projects that were spearheaded by private industry in decades past. By the end of the 1920s, steam-based generation plants were gaining ascendency in the market, with far fewer construction constraints, shorter transmission distances, and increasingly abundant oil and gas supplies marking a shift in energy development. Thus, while the 1910s and 1920s were characterized by a nearly unceasing pace of physical growth and expansion, the decades that followed consisted largely of system maintenance and oversight.[61]

The 1910s and 1920s development of the BCHS served to transform a rugged wilderness to a complex and sprawling industrial system, unrivalled during the period by any other hydroelectric development in the state in terms of scale, design, and engineering innovation. By 1929, the

[61] "Edison Power Supply Boosted: Transmission Line to Hoover Dam Plant Placed in Operation," *Los Angeles Times*, June 22, 1939; David H. Redinger, *The Story of Big Creek,* 163; Duncan Hay, *Hydroelectric Development in the United States 1880-1940* (Washington DC: Edison Electric Institute, 1990) xii.

number of generating units had grown from an initial four to 15, with the generating capacity leaping from 56 to 345 MW. Construction of the integrated system of dams, tunnels, and powerhouses had set records for development speed, physical scale, and technical innovation. Collectively, development of the BCHS enabled SCE to control and utilize an over one thousand square mile watershed, with water from the High Sierra providing the basis for urban growth hundreds of miles away. As documented in this narrative, while this remarkable arrangement arose from the development of many innovative individual components, with the powerhouses, flowlines, and dams setting records in their own right, the true significance and engineering grandeur of the system can be attributed to its physical and functional integration, with each component of the system acting in concert to form an unprecedented whole.

Electrical Transmission Resources
The BCHSHD includes transmission lines and associated distribution facilities and substations that were developed concurrent with the core hydroelectric generation resources. These transmission lines and associated facilities are discussed here in relation to the BCHSHD as a whole. The narrative is organized chronologically, following the development trajectory of the system.

The BCHSHD includes three major transmission lines, with several smaller powerhouse-to-powerhouse segments, which represent one of the key innovations of the BCHS as a whole, carrying electricity generated in the San Joaquin River Watershed hundreds of miles to Southern California. Indeed, without these lines the system could not have been developed as the lines integrated the raw hydroelectric output with the burgeoning consumer market for electricity. In the initial years of hydroelectric development in California, energy production, and in turn consumption, was impeded by the inability to transmit power over long distances. By the early twentieth century, advances from direct current (DC) applications to alternating current (AC) paved the way for the transmission of electricity over increasingly longer distances, with Big Creek acting as a capstone for this phenomenal period of innovation. The initial lines were the longest built to date, extending 248 miles to Los Angeles, dwarfing any previous transmission efforts.[62]

Big Creek East and West Transmission Lines (Contributing Structure)
The Big Creek East and West Transmission Lines extend 241 miles from Powerhouse No. 1 to the Eagle Rock Substation, northeast of Los Angeles (**Figures 89**, **90**, **91**). After leaving Big Creek, the transmission route traverses Fresno County's eastern foothills in a generally southwesterly direction, crossing the Kings River and hugging the eastern side of the San Joaquin Valley through Tulare and Kern Counties, climbing the Transverse Range to the Eagle Rock Substation in the Los Angeles Basin. The parallel lines were surveyed in 1912 and completed in 1913, with the first test electricity carried on November 8, 1913:

[62] James C. Williams, *Energy and the Making of Modern California* (Akron, OH: The University of Akron Press, 1997), 168-199.

> Electrical Energy from the far-off Sierras stretched a hand robed with lightening across the gulf of valleys and mountains to the doors of this city yesterday morning… At 8:38, or thereabouts, it came: first a tiny trickle of power, then a rippling wave, accurately detailed on the electrometers, then the full swell from one unit of the mammoth revolving turbines at the upper plant of Big Creek… For two years, men have worked unceasingly in the Big Creek Valley to create power generating devices which would assure Southern California of an amplitude of the caressing mercury fluid for at least 50 years to come… It will find much to do, for officials say that every foot-pound of the energy has been contracted for. The Los Angles Railway Corporation will use part of it—enough it is said by officials of that concern to put new life into the yellow cars. Private consumers will use the rest and part will go to the Pacific Electric.[63]

Like the other initial components of the system, the two lines were constructed by Stone & Webster Construction Company, under contract to Pacific Light and Power. As initially designed, the lines carried 150 kV of power, but the lines were upgraded in 1923 to 220 kV when the entire BCHS was converted to 220 kV. Through the period of significance the lines set a number of records: in 1913, the lines were the longest ever built, carrying the highest voltage of any hydroelectric project to date. Upon upgrade in 1923, the lines were the first to carry 220 kV, again setting the standard for long-distance energy transfer that defined electrical development during the era.[64]

While composed of two distinct lines, the East and West lines are identical in design and have always been considered a single functional entity, with the lines standing approximately 80 feet apart in a narrow 150-foot right of way. As constructed, the lines included three standardized tower types, with a total of 3,341 transmission towers originally installed along the length of the corridor.

The most common tower type is referred to as the Big Creek Standard Tower that features an A-frame profile steel lattice tower supporting one horizontal cross-arm with insulators mounted at a 45-degree position or suspended vertically. As originally designed, the towers stood 43 feet in height, but the towers were raised between 10 and 30 feet across the system in 1922-1923 to accommodate the conversion to 220 kV. The square, four-footed base of the towers measures 18 feet by 20 feet, with raised concrete footings anchoring the towers to the ground. The typical span between Standard Towers is 660 feet, with a span of 550 feet in higher elevations where

[63] "Big Creek Power Put to Work in this City," *Los Angeles Times*, November 9, 1913.
[64] Portions of the Big Creek East and West Transmission Lines have been recorded under the Historic American Engineering Record (HAER) program. This documentation provides the basis for the physical description herein and includes a wealth of detailed documentation regarding the overall development and operational components of the line. Urbana Preservation & Planning, LLC, *Historic American Engineering Record: Big Creek Hydroelectric System: East & West Transmission Line*, *HAER No. CA-167-N* (2012). A HAER addressing the entirety of the East West Line is under draft by SCE at the time of this nomination; "Finish Highest Power Line," *Los Angeles Times*, May 10, 1923.

snow and sleet occur. The maximum span between Standard Towers is 1,822 feet. A total of 2,565 Standard Towers were constructed on the East and West Lines.

The second type of tower used along the alignment of the East and West Transmission Lines is the Anchor Tower/Dead End Tower, of which 772 were originally installed. This tower type is shorter and heavier than Standard Towers, and originally stood 37 feet in height with the same A-frame configuration. Like the standard towers, the Anchor Towers were raised when the system was converted to 220 kV. The tower spread at the base is 24 feet by 24 feet. The Anchor Towers were placed in areas where the span changed direction or elevation, and were designed to withstand increased tension on the transmission line. The typical span of the anchor towers mirrors that of the Standard Towers.

The last tower type used to support the East and West Transmission Lines is the Special Standard Tower, of which only four were originally placed. This tower type was largely comparable to the Standard Tower except for a difference in the allocation of weight above the tower foundation, with the Special Standard Tower being heavier, stronger, and composed of more steel. This tower type was developed to span long distances at the line's two major river crossings on the Kings and Kern Rivers.[65]

As a functioning transmission system, there have been very few changes to the Big Creek East and West Transmission Lines and support structures. The system retains high operational and physical integrity to the historic period, and is a contributing resource of the BCHSHD. The most notable change was the 1922-1923 upgrade of the towers and lines when the system was converted to 220 kV, which was completed during the period of significance for the BCHSHD and was a significant engineering accomplishment in its own right. Subsequent changes have been primarily limited to ongoing operations and management (O&M) activities including in-kind replacement of insulators, ground wires, and conductor cables and recasting of the concrete foundations in order to maintain the operational integrity of the system. In a small number of cases, isolated towers or small sections of towers have been replaced or moved because of structural failure, new transmission tie-ins, or construction. The majority of the lines are composed of the original towers. Additionally, in many areas of the alignment, additional transmission lines and new adjacent substations have been erected in proximity to the alignment, as SCE has expanded its electrical infrastructure.

Character defining features of the Big Creek East and West Transmission Lines are the system alignment that extends from Big Creek Powerhouse No. 1 to the Eagle Rock Substation, the original steel frame towers, and the operational integrity of the line as a transmission feature of the BCHSHD. While operationally critical, constituent components of the line, including insulators, ground wires, and conductor cables, are not considered character defining features as they have been upgraded and replaced over time to maintain operational integrity of the system.

Big Creek No. 8—Big Creek No. 2 Transmission Line (Contributing Structure)

[65] All specifications from *HAER No. CA-167-N* that contains written material and period plans.

The development of Powerhouse No. 8 in 1921 required the construction of a short-distance transmission line, including 27 towers, between Powerhouse No. 2 and the newly constructed Powerhouse No. 8. The line served to connect the two generating facilities and subsequently send the electricity generated at Powerhouse No. 8 to the Big Creek East and West Lines. The transmission line extends approximately 2 miles from Powerhouse No. 2 to Powerhouse No. 8, running along the undulating foothill terrain spanning between the Big Creek Canyon and the San Joaquin River Canyon.

The transmission line support structures are of the same standardized SCE design that was developed for the Big Creek East and West Lines, specifically an A-Frame steel lattice structure with a four-footed square base. The alignment included both the Standard Tower Type and the Anchor Tower Type, which was shorter and had a wider base to accommodate greater tension.

There have been very few changes to the Big Creek No. 8—Big Creek No. 2 alignment. The lines retain high operational and physical integrity to the historic period and are a contributing resource of the BCHSHD. While initially run at 150 kV, the line was developed to accommodate 220 kV transmission and was not substantively altered when it was converted to 220 kV. Subsequent changes have largely been limited to ongoing O&M activities including in-kind replacement of insulators, ground wires, and conductor cables and recasting of the concrete foundations in order to maintain the operational integrity of the system.[66]

Character defining features of the line include: the overall alignment, extending from Big Creek Powerhouse No. 8 to Big Creek Powerhouse No. 2; the original steel frame towers; and the operational integrity of the line as a transmission feature of the BCHSHD. While operationally critical, the insulators, ground wires, and conductor cables are not considered character defining features as they have been upgraded and replaced over time to maintain operational integrity of the system.

Big Creek No.3—Big Creek No. 8 Transmission Line (Contributing Structure)
The development of Powerhouse No. 3 in 1923 required the construction of a short-distance transmission line between Powerhouse No. 8 and the newly constructed Powerhouse No. 3. The line served to connect the two generating facilities and subsequently send the electricity generated at Powerhouse No. 3 to the Big Creek East and West Lines to Southern California. In 1927, this transmission capacity was augmented with the completion of the 220 kV Vincent Line, which ran from a switchyard at Powerhouse No. 3 to Gould Substation in Southern California. The Big Creek No. 3-Big Creek No. 8 transmission line extends approximately 5.5 miles from a switchyard adjacent to Powerhouse No. 3 to Powerhouse No. 8, running along the undulating foothill terrain spanning between the Big Creek Canyon and the San Joaquin River Canyon.

[66] R.J.C. Wood, "220 kV Transmission: Southern California Edison Company System, and some 220 kV Researches," *Journal of the American Institute Electrical Engineers*, July 1922, 471-488; Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System,* 102.

The transmission line support structures are of the same basic standardized SCE design that was developed for the Big Creek East and West Lines, specifically an A-Frame steel lattice structure with a four-footed square base. The alignment included both the Standard Tower and Anchor Tower, which was shorter and had a wider base to accommodate greater tension.

There have been very few changes to the Big Creek No. 3—Big Creek No. 8 alignment. The line retains high operational and physical integrity to the historic period and is a contributing resource of the BCHSHD. The line was developed for 220 kV transmission, with the entire Big Creek No. 3 Powerhouse built to operate at 220 kV. Ongoing changes have largely been limited to O&M activities including in-kind replacement of insulators, ground wires, and conductor cables and recasting of the concrete foundations in order to maintain the operational integrity of the system.

Character defining features of the line include: the overall alignment, extending from Big Creek Powerhouse No. 8 to Big Creek Powerhouse No. 2; the original steel frame towers; and the operational integrity of the line as a transmission feature of the BCHSHD. While operationally critical, the insulators, ground wires, and conductor cables are not considered character defining features as they have been upgraded and replaced over time to maintain operational integrity of the system.

Vincent Transmission Line (Contributing Structure)

The Vincent Transmission Line was constructed between 1925 and 1927 to provide additional long distance transmission capacity for the expanding BCHS (**Figures 92**, **93**, **94**). The line runs from a switchyard at Powerhouse No. 3 in a generally southerly direction, running along the low foothills just west of the San Joaquin Valley. After running through the SCE Magunden Substation in Bakersfield, the line crosses the Tehachapi Mountains and Antelope Valley, climbs the rugged Transverse Ranges, and descends into the Los Angeles Basin through the Gould Substation, where it connects to the Eagle Rock Substation. Although the line runs adjacent to the original Big Creek East and West Lines for short segments, at the beginning of the alignment adjacent to the BCHS powerhouses and at the Magunden Substation in Bakersfield, the Vincent Line generally travels between 15-30 miles to the east of these previously constructed lines.[67]

The design and operation of the Vincent Line echoes that of the Big Creek East and West Lines, with few substantive differences other than size. The original 879 towers are A-Frame structures with a steel truss system anchored by four concrete footings and suspended top-hung insulators. The Vincent Line was designed to operate at 220 kV. The towers were of a larger scale to accommodate the larger insulators and heavier wire required for 220 kV transmission. Sizing was not uniform throughout the line, and was dependent upon a number of factors, including terrain, slope profile, span distance, and alignment orientation. To accommodate different requirements, the towers were designed with extension legs that could be raised without

[67] "Power Line Completed," *Los Angeles Times*, December 2, 1926; the Vincent Line was documented in its entirety in March 2012 as part of the *NRHP/CRHR Eligibility Evaluation of the Vincent 220 kV Transmission Line Study*, (P-54-005027 and P-10-006255, on file at the SJVIC).

disturbing the underlying foundation, as described by consulting engineers C.B. Carlson and H. Michener:

> Extension heights of 7, 14, and 21 feet were those which seemed to supply the needs of the profile. These extension legs were arranged to permit combinations of any of them on a tower to a more economically fit profile. This latter arrangement has proved useful, as much of the country traversed was rocky and difficult to excavate.
>
> Special cases required the combination of the 14-foot and 21-foot extensions, making a 35-foot in all, and in the case of the Tule River Crossing two special 120-foot towers were used. It was also necessary to supply certain other specialties such as transposition frames, attachments for towers to solid rock, footing extensions where uplift cover resistance was not available, and single leg extensions without bracing to main structure.[68]

It is interesting to note that aside from the general differences in size, the 220 kV alignment had only modest operational and conceptual differences from its 150 kV predecessors. As described by SCE Engineer, R.J. C. Wood, although 220 KV was entirely new and untested prior to its development as part of the BCHS, in execution the matter was fairly straightforward and largely one of scale. In this sense, while 220 kV represented a 1920s milestone in transmission capacity, it was primarily an amplification of the great strides in three-phase transmission that had been made in decades prior.

> The results of the laboratory and field tests lead to the firm belief that nothing extraordinary will happen with 220 kV transmission. The difference between operation at this voltage and existing voltages will be only of degree. There seems to be no pressing need of new design of insulators… the modern 10-inch suspension insulator has reached a high perfection and can be bought of several manufacturers. Several years were required to bring this insulator up to its present excellence and to prove it. The insulator is an innocent looking little thing, but it is doubtful if the manufacturer, and still less the user, can always foresee the troubles that arise from making even apparently minor changes in its shape. It this appeared logical and better business to use the standard insulator whose behavior and endurance are fairly well known.[69]

As a functioning transmission line, there have been very few changes to the Vincent Line. The line retains high operational and physical integrity to the historic period and is a contributing resource of the BCHSHD. Changes have been largely limited to O&M activities including in-

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[68] Carlson, C.B. and H. Michener, "The Vincent 220-Transmission Line: Engineering and Construction Features," *Transactions of the American Institute of Electrical Engineers*, Volume XLV, January 1926, 1053-1061.
[69] R.J.C. Wood, "220 kV Transmission: Southern California Edison Company System, and Some 220 kV Researches," 474.

kind replacement of insulators, ground wires, and conductor cables and recasting of the concrete foundations in order to maintain the operational viability of the system. In a small number of cases, isolated towers or small sections of towers have been replaced or moved due to structural failure, new transmission tie-ins, or construction. The majority of the line is composed of the original towers. Additional transmission lines and substations have been erected in proximity to the Vincent Line, as SCE has expanded its electrical infrastructure. All historic period features of the associated Gould Substation terminus have been demolished, with only modern utilitarian features remaining on site. The detailed resource description follows on page 93.

Character defining features of the Vincent Transmission Line include: the overall alignment, extending from Big Creek Powerhouse No. 3 to the Gould Substation, the original steel frame towers, and the operational integrity of the line as a transmission feature of the BCHSHD. While operationally critical, the insulators, ground wires, and conductor cables are not considered character defining features as they have been upgraded and replaced over time to maintain operational integrity of the system.

Minor Electrical Distribution Infrastructure (Noncontributing Structure)
In addition to the major transmission facilities that relayed power from the BCHS to Southern California, a number of smaller distribution lines were installed to transmit and provide power to individual BCHS facilities and to neighboring camps and public and private developments and/or residences in the San Joaquin Watershed. In general, these features consisted of utilitarian wood pole mounted distribution lines and associated utilitarian infrastructure that supported power dissemination at low voltage levels (less than 50 kV) for local use.

This type of infrastructure is ubiquitous throughout the BCHSHD and does not contribute to the significance of the district. Distribution lines have been removed and added over time, with new poles, lines, and associated small-scale outdoor substations added to the present. In general, the life cycle of this type of distribution resource is 30 to 50 years, with most wood poles and associated features from the period of significance removed at present. Additionally, this type of ubiquitous infrastructure is a minor component of the hydroelectric system that is not indicative of the significant development themes of the BCHSHD.[70]

Substations
Several substations were developed along the East and West Transmission Lines during the period of significance to support electrical transmission and to disseminate power to population centers along and at the end of these lines. These substations include: Eagle Rock Substation, the terminus of the Big Creek East and West Lines, located in Los Angeles and completed in 1913;

[70] SCE is under consultation with the California Office of Historic Preservation to develop a programmatic guidance document for assessing the NRHP eligibility of transmission and distribution infrastructure. This evaluation of minor distribution components is in keeping with the methodology employed in this guidance document, see: Southern California Edison Company, *Historic-Era Electrical Infrastructure Management Program: A Program for the Identification, Review, Exemption, and Treatment of Generating Facilities, Transmission Lines, Sub-Transmission Lines, Distribution Lines, and Substations within the SCE Service Territory*, November 2014, on file at SCE, Monrovia, CA.

Magunden Substation, located in Bakersfield and completed in 1913; Vestal Substation, located in Richgrove and completed in 1920 for distribution to local San Joaquin Valley farms; and Rector Substation, located near Visalia, and completed in 1928 for local distribution to surrounding communities. These substations are described further in the following.

Eagle Rock Substation (Contributing Structure)
The Eagle Rock Substation was developed in 1913 as the southern terminus of the Big Creek East and West Transmission Lines (**Figures 95**, **96**, **97**). The substation is located on a 120 acre parcel nestled against the San Rafael Hills north of Los Angeles. The contextual surroundings of the substation are characterized by both open space and urban development, with chaparral covered hills to the north of the substation and urban sprawl of the Los Angeles Basin to the south.[71]

The substation was constructed in 1912-1913 and brought on-line on November 8, 1913. Like all of Big Creek's initial construction, the building was constructed by Stone & Webster Construction Company under contract to Pacific Light and Power. In construction and design, the massive building mirrored Big Creek's powerhouses, with a monolithic reinforced concrete design imparted with subtle classical overtones articulated by rhythmic vertically oriented industrial windows. As described in period press, the 21,000 square-foot building was a "monster… designed to harness Big Creek's 80,000 horsepower at the front door of Los Angeles." There have been very few notable physical changes to the exterior of the Eagle Rock Substation since the period of significance, with the building retaining high integrity as a contributing element of the BCHSHD.[72]

The substation is generally rectangular in plan and is oriented to the southeast, with the front of the building facing a vehicular access drive, North Figueroa Street. Simple concrete entry pillars frame the drive as it approaches the substation, with smooth facing that replicates the concrete treatment of the powerhouse walls. The substation has a stepped massing, with a three story section in the front backed by a much larger six story mass to the north. The building is defined by vertical bands of industrial wood sash and frame windows that line the building in regular spans and are separated by smooth concrete pilasters. A small number of windows are of steel frame design, replacements of the original after a 1923 fire. Subtle concrete stringcourses line both sections of the building, with a banded concrete cornice punctuating the mass. On the six story section, a smooth triangular parapet rises above the cornice, framing the flat roof. There are few entries to the building, with single sets of industrial wood plank doors punctuating the east, west, and north elevations and an additional metal door lining the north side. The north side of

[71] The Eagle Rock Substation was inventoried and evaluated for National Register Eligibility in November of 2014: Urbana Preservation and Planning, LLC, *Historical Resource Analysis Report/Historic Property Survey Report, Southern California Edison Company, Eagle Rock Substation Property*, submitted to SCE. The California Office of Historic Preservation concurred on the eligibility of the Eagle Rock Substation as a contributor to the BCHSHD in a letter dated April 21, 2015 (FERC-2015-0414-001). This description is adapted from this detailed recordation.
[72] "Tremendous Electric Force at our Door," *Los Angeles Times*, November 2, 1913.

the building is defined by recessed concrete bays and irregularly placed windows, with this side of the building largely rebuilt after the 1923 fire.

As designed, much of the operational equipment was housed inside the building, with the transmission lines feeding into transformer banks and switch and bus rooms in the building. This design was in keeping with transmission standards from the period, with outdoor transmission and distribution yards developed during the 1920s and later becoming the industry standard. At the time of construction, the three story southern section of the building housed condensers, with the transformers, switching and bus rooms housed in the larger section. At construction, the building operated with 12 internal transformers, with a spare, that were the largest of their type ever built to date. By the late 1920s, this original configuration had been altered, with outdoor equipment developed for distribution. At present, the substation building is framed by outdoor operational transmission and distribution equipment, altered and upgraded over time to the present.

As a component of the BCHSHD, the Eagle Rock Substation was pivotal in the development of Los Angeles and its satellite communities during the period of significance, supplying power to the growing businesses and residences of the city, as well as the Los Angeles Railway. With its monumental form and function, the building served as an important physical and psychological nexus between the BCHS and the urban markets of Los Angeles. While operation of the substation has changed over time, with interior operations ceding to exterior facilities, the primary mass of the building and its functional associations have remained constant over time, with the substation building at the center of SCE’s distribution network for Los Angeles and surrounding communities.

Character defining features of the substation include its overall stepped mass and reinforced concrete form and detailing; its subtle design features including the parapet and stringcourse features; its original fenestration including industrial wood doors and windows; the simple concrete entry columns framing the entrance to the facility to the south and the viewshed to the facility from the entrance to the south; and its overall setting at the urban periphery. While the transmission and distribution yards surrounding the building are operationally integral, they have been upgraded over time and are utilitarian and standardized in form and do not contribute to the significance of the facility. In addition, remnant components of historic period development, including fragmented concrete foundations associated with dismantled worker housing, a small utilitarian guard house, and a small corrugated metal shed do not contribute to the significance of the substation as they are minor features that lack any direct or important associations.

Magunden Substation (Contributing Structure)
The Magunden Substation was developed in 1913-1914 to support and regulate electrical delivery along the Big Creek East and West Transmission Lines (**Figure 98**). In 1927, the Vincent Transmission Line was also integrated into the substation, extending from the BCHS through Magunden to Gould Substation north of Los Angeles. The Magunden Substation is located along Edison Highway approximately four miles east of central Bakersfield. The

complex is sited on four parcels totaling 17.28 acres in size, with a generally triangular form that is bound by a railroad line running along its southern border and a surrounding mix of industrial and residential development. The substation complex consists of a 1914 substation building, the sprawling transmission yard, and several ancillary service and support buildings including several minor storage buildings.

The 1914 substation building is rectangular in plan, measuring 68 feet in width and 114 feet in length, and of three story construction, with an industrial design that incorporates a classical revival aesthetic treatment. The reinforced concrete building stands on a poured concrete foundation, with a four foot high concrete apron spanning the base of the building and smooth concrete walls. The roof is of a very low pitch gable design, with modest concrete eaves. While the building is industrial in form and function, subtle classical allusions serve to convey a heightened architectural form. Fenestration is regular and symmetrical, with vertically oriented rhythmic bands of industrial inset between smooth concrete bays; a smooth concrete belt course separating the second and third stories and breaking the monolithic mass; and a simple concrete cornice extending from the sloping roofline (**Figures 99, 100**).

Fenestration generally consists of one-over-one wood frame windows in multi-light configurations, which line all walls except for the eastern wall that is of solid concrete massing. All windows have been painted over. Doors consist of replacement, solid metal personnel doors and a small, metal roll-up door. A low metal carport supported by metal posts extends the length of the southern wall, providing covered vehicle parking. Along the first floor there are several two and three-part aluminum sliding glass windows that are insertions to the original building. As originally designed, electricity was conveyed directly to the building, with prominent concrete canopies extending off of the north side of the building to protect incoming lines and associated equipment. With the transfer of switching facilities to outside the building, these exterior features were removed. The interior presently serves maintenance, office, storage, and administrative functions. The interior crane remains intact, as do many interior rooms, although they are no longer used for their original purpose. The large central room that originally housed transformer and condenser equipment has been subdivided into several smaller rooms.

The large switching station yard stands east of the substation building. High voltage transmission lines enter the northern property boundary. The yard is composed of rock and gravel fill and consists of predominately modern (1960s through 2000s) electrical equipment constructed on concrete footings. The transmission yard contains support equipment for electrical transfer, including disconnect switches, circuit breakers, transformers, lightning arrestors, and a series of dead end racks that connect to the transmission towers. All of this equipment has been upgraded to the present, with the transmission yard consisting of modern operational components that are modern replacements to original features.

All of the minor support buildings located north and west of the substation building were constructed after 1968 and do not contribute to the significance of the property. They consist of modern, prefabricated metal warehouse buildings as well as several ancillary buildings used for fuel and hazardous materials storage and a portable building with vertical grooved wood siding, which functions as the transmission crew office.

As a component of the BCHS, the Magunden Substation was pivotal in the delivery of power along the Big Creek East and West Transmission Lines, and subsequently the Vincent Transmission Line, during the period of significance. With its monumental form and function, the building served as an important physical and contextual nexus between the BCHS and the urban market of the San Joaquin Valley, reflecting the same engineering and aesthetic considerations that governed the development of the generating facilities of the project. While operation of the substation has changed over time, with interior operations ceding to exterior facilities, the primary mass of the building and its functional associations have remained constant over time, with the substation building remaining vital to the system's energy transmission. The substation is a contributing resource of the BCHSHD.

Character defining features of the substation include the footprint of the original substation, the mass of the building, its smooth concrete walls, industrial fenestration including steel frame windows, and its subtle classical detailing including vertically oriented fenestration, concrete bay articulation, belt course detailing, and an understated cornice line. In addition, the building's operational and functional orientation to the 220 kV Big Creek East and West and Vincent Transmission Lines is an operational character defining feature, as this functional relationship defined the development of the facility. Because it has been substantially modified to the present, the interior of the building does not contribute to the significance of the resource. Additionally, although the general functional role of the substation's transmission equipment retains operational importance, these associated resources, including transmission yards and associated equipment, have been updated to the present and do not contribute to the historical significance of the resource. The carport addition to the building, as well as other minor modern ancillary construction, including storage, warehouse, and support buildings are noncontributing.

Vestal Substation (Contributing Structure)
The Vestal Substation was constructed in 1920 to support transmission along Big Creek's East and West Transmission Lines and to provide localized power delivery to agricultural interests in the San Joaquin Valley (**Figures 101**, **102**, **103**). The facility is located on Richgrove Drive, north of the rural community of Richgrove, on an approximately 44 acre utility parcel. The substation complex consists of a 1920 substation building, dispatch building, and associated water tank, with a control building, garage, storage buildings, and transmission yards that date to later construction periods.

The 1920 substation building is of a two story classical revival design, with a rectangular plan measuring 67 feet north-to-south by 130 feet east-to-west. The building is highly symmetrical in design, with fenestration and aesthetic articulation reflecting the well-ordered massing and design of the classical style. In its design, the building mirrors the BCHS powerhouses that were built contemporaneously—particularly Powerhouse Nos. 1, 2, and 8—that also featured subtle classical detailing and articulation.

The building is constructed on a poured concrete foundation, with board formed concrete walls rising from an approximately six foot high concrete apron running the base of the building. The flat concrete roof is framed by a low board formed concrete parapet. The building is generally oriented east to west, with massive arched industrial entryways framed by arched quoining defining the east and west sides and rhythmic bands of recessed arched industrial metal sash windows lining the north and south sides, framed by concrete pilasters. A concrete cornice with modest dentil details frames the roofline, with concrete quoins lining the corners of the building.

While largely intact, the building's original fenestration has been altered, resulting in limited operability. The industrial metal sash windows have all been painted over and are no longer operable. The east and west industrial entries, which once accommodated a railroad spur and featured generous glass lights, have also been painted over and gated off, with the railroad spur removed. Two original smaller personnel entries flank the industrial opening that continues to provide staff access. The metal panel doors feature a decorative arched concrete door surround and two globe wall sconces.

A low, sloping shed roof addition extends from the north side of the building. It is of wood frame construction with tar paper roofing and enclosed on all side by multi-pane windows covered by metal screens.

Adjacent to the substation building is a single story classical revival dispatch building, also constructed in 1920. The small building has a rectangular plan and is 32 feet north-to-south and 20 feet east-to-west. The building stands directly southeast of the substation and is connected to the substation by electrical wires and communication equipment mounted on a steel lattice tower. The building stands on a concrete foundation, with concrete walls, a flat concrete roof, and spare symmetrical fenestration reflective of the classical style. A simple concrete cornice lines the roofline. Simple inset windows with lug sills line the building, all of which have been filled and painted over. The north and south sides of the building feature centered solid metal panel doors, framed by decorative concrete surrounds.

The substation complex houses an approximately 40-foot tall water tower located north of the substation building, also built in 1920. The water tank is supported by a lattice-iron frame and has a riveted metal tank with a conical top. A caged ladder provides access to a narrow metal gangway and angle-iron balustrade encircles the tank. Two metal pipes protrude from the bottom of the tank, one is capped, with the other extending to the ground.

The remainder of the buildings do not contribute to the significance of the substation, as they were constructed after the period of significance or generally lack integrity and significance. These buildings include a concrete block control building dating from 1963; a plywood framed storage building from 1963; two post-1970 metal pre-fab sheds; and a 1920 wood frame storage building that has been modified with new windows and doors during the modern period.

The remainder of the complex is comprised of electrical substation equipment located along the north and west sides of the property. The property contains electrical equipment for both transmission and distribution. At the northeast corner of the property, the 220 kV Big Creek East and West Transmission Lines enter the property and connect with the 220 kV transmission yard. Some of the electricity is stepped-down through a series of transformers to a second transformer yard located just west of the 220 kV yard. This 66 kV yard distributes local electricity through distribution lines extending from the substation property. Electricity is further stepped-down through additional transformers located in two additional distribution yards, one on the northwest (33 kV) and one on the southwest (11 kV) corner of the property. The transmission and distribution yards contain support equipment for electrical transfer, including disconnect switches, circuit breakers, transformers, lightning arrestors, and a series of dead end racks that connect to the transmission towers or distribution poles. All of this equipment has been upgraded to the present, with the transmission and distribution yards consisting of modern operational components that are modern replacements to original features.

The entirety of the substation complex is surrounded by a chain link utility fence topped by barbed wire. Access is provided by a gate on the south side of the property. Security considerations precluded access to the interior of the entirety of the substation complex. Review of SCE records and interview with SCE staff indicates that original interior features have been augmented and removed to the present, with the primary substation building and other support buildings renovated because of upgrades and adjustments in technology on an ongoing basis.

While the Vestal Substation has been augmented through alterations to operating equipment and the placement of several modest additions, the overall form and utility function of the substation has been retained to the present. The substation continues to serve as a key SCE facility along the 220 kV Big Creek East and West Transmission Lines and continues to provide local distribution services for SCE. The property continues to reflect the engineering, design, and functional attributes that undergirded the property's development as part of the BCHS and the substation is a contributing resource of the BCHSHD.

Character defining features of the Vestal Substation include the footprint of the original substation, the mass of the building, its smooth concrete walls, industrial fenestration including steel frame windows and metal doors, and its subtle classical detailing including arched windows and door openings, decorative concrete articulation and quoining, and overall symmetry of form. Character defining features of the control building are the building's footprint and mass, its relationship to the adjacent substation, its detailing including symmetrical inset windows with lug sills, and its centered metal access doors. Character defining features of the water tower are its height, support structure, and prominent tank with balustrade. In addition, the complex's operational and functional orientation to the 220 kV Big Creek East and West Transmission Lines is an operational character defining feature, as this functional relationship defined the development of the facility.

Rector Substation (Contributing Structure)

The Rector Substation was constructed in 1928 to provide electrical transmission capacity for the Big Creek East and West Transmission Lines (**Figure 104**). The substation is located south of Visalia in rural Fresno County on two rectangular parcels totaling 23.97 acres, and is surrounded by agricultural parcels and scattered farmstead complexes. The utility complex consists of a 1928 substation building with multiple additions; 220 kV, 66 kV, and 11 kV transmission switch yards; and several modern storage, maintenance, and utility buildings.

The substation building contains subtle elements of Art Deco styling and form, with smooth concrete massing coupled with subtle stepped banding, recessed ribbon windows, and prominent angled parapets. The original portion of the building is generally rectangular in form and of a substantial height, with a small single story wing extending from the northwest corner. Two single story additions extend from the original building, one completed in 1954 and the second in 1987. The utilitarian additions extend from the north of the building, lending the assemblage an irregular floor plan that measures roughly 130 feet north-to-south by 120 feet east–to-west.

The original portion of the substation building is constructed on a poured concrete foundation, with a four-foot high concrete apron and board formed concrete walls. The building has a flat concrete roof reinforced by steel trusses. The original portion of the building is generally oriented east-west, with angled parapets and oversize multi-light window configurations lining the east and west sides of the building and rhythmic bands of narrow recessed industrial windows lining the north and south sides of the building. Windows are of steel-frame design, with 9 to 12 lights on the north and south sides, with the east and west sides characterized by expansive groupings of 66 lights. While portions of the windows were designed as operable awning-type openings, all hardware and operational mechanisms have been removed. In addition, windows are sealed closed by plywood placed inside the building. Some windows have been replaced by large HVAC ducts along the southern wall. Access to the building is provided by offset modern double doors on the south side of the building. The doors, and surrounding wood wall, are an infill of the original openings that were industrial in scale and accommodated a railroad spur that accessed the building, since removed.

The 1954 and 1987 concrete block additions extend from the north side of the original building. The additions are utilitarian in form and one story in height, standing at a far lower profile than the much larger mass of the original substation. A small metal breezeway links the 1954 addition to a prefabricated, Butler-type communications building that measures 15 feet north-to-south by 20 feet east-to-west. The building is accessible by two, solid metal doors, with a large conduit feeding multiple electrical and telecommunication lines through the northern wall.

The substation property contains electrical equipment for both transmission and local distribution. At the northeast corner of the parcel, the 220 kV Big Creek East and West Lines enter the property and connect with the 220 kV transmission yard located south of the substation building. A bank of four 220/66 kV transfer racks separates the 220 kV yard from the 66 kV yard. This 66 kV yard distributes electricity for local use through distribution poles extending off the substation property. All of this equipment has been upgraded to the present, with the transmission and distribution yards consisting of modern operational components that are modern replacements to original features.

The interior of the substation building has also been substantially modified since construction. The building originally housed large condensers, batteries, switches, and frequency changers, which are no longer extant (**Figure 105**). At present, SCE has developed a large steel chamber that fills much of the building, housing a host of electronic equipment used in regulating voltage and transfer of electricity. In this sense, the original interior volume has been filled by the modern chamber, with the exterior walls acting as an operational shell. All key interior features have been removed or obscured, including the original overhead gantry crane, windows, and interior features and spaces.

While the Rector Substation has been augmented through alterations to operating equipment and the placement of several modest additions, the overall form and utility function of the substation has been retained to the present. The substation continues to serve as a key SCE facility along the 220 kV Big Creek East and West Transmission Lines and continues to provide local distribution services for SCE. The property continues to reflect the engineering, design, and functional attributes that undergirded the property's development as part of the BCHS and the substation is a contributing resource of the BCHSHD.

Character defining features of the Rector Substation include the original substation building footprint and mass, its smooth concrete walls, industrial fenestration including steel frame windows, and its subtle Art Deco detailing including stepped concrete banding and angled parapets (**Figure 106**). In addition, the building's operational and functional orientation to the 220 kV Big Creek East and West Transmission Lines is an operational character defining feature, as this functional relationship defined the development of the facility. Because it has been substantially modified to the present, the interior of the building does not contribute to the significance of the resource. Additionally, although the general functional role of the substation's transmission equipment retains operational importance, these associated resources, including transmission yards and associated equipment, have been updated to the present and do not contribute to the historical significance of the resource. The 1954 and 1987 additions to the building, as well as other minor modern infill including modern doors and HVAC equipment are noncontributing.

Gould Substation (Noncontributing Structure)
Gould Substation was constructed in association with the Vincent Transmission Line and was completed in 1926. The small substation was located approximately five miles north of the Eagle Rock Terminus and served to relay the 220 kV electricity to Eagle Rock and local distribution points. In contrast to other substations developed along the alignment during the period of significance, which generally displayed a monumental classical form in keeping with the powerhouses of Big Creek, the Gould Substation facilities were comparatively modest in form and scale. The station largely consisted of a utilitarian outdoor transmission yard and a small Mission Revival style station house, which held the station controls. In addition, the station had

several small operators' cottages. This smaller scale was indicative of the steady shift to outdoor transmission yards during the period.

All original buildings associated with the development period were demolished in the mid-1960s, and a new utilitarian station control building was constructed in 1966, which is of a utilitarian concrete block form. Similarly, electrical equipment has been upgraded and replaced, with new transmission and distribution features developed to the present. Because of this overall loss of physical integrity, Gould Substation does not contribute to the significance of the district. The substation is a mid-1960s utilitarian assemblage that does not convey the significant early twentieth century development themes of the district. While the substation does not contribute to the significance of the district, it does not undermine the ability of the district as a whole to convey its significance through the integrity of its generation and transmission features and layout.

Construction and Operations Support Resources

The BCHSHD is characterized by several broad classifications of resources: Hydroelectric Generation Resources, Electrical Transmission Resources, and Construction and Operations Support Resources. The following section addresses the last of these general resource types: Construction and Operations Support Resources. This type of resource includes transportation and circulation networks, construction camps, and administrative services and housing. While this broad classification encompasses a number of distinct resource types, in general the resources are united by a shared developmental and functional context, with all critical to the development key hydroelectric features that make up the BCHSHD, and ongoing operation and maintenance of the system.

Transportation and Circulation Networks

Although the San Joaquin River Watershed had been surveyed and evaluated for potential hydroelectric development from as early as the 1890s, on the eve of the BCHSHD's development the area remained rugged, remote, and largely inaccessible except for a single wagon road that accessed Fresno Flume and Lumber Company's Shaver Lake. While the Watershed offered tremendous vertical elevation differences conducive to hydroelectric development, this foundational characteristic proved immensely challenging from a transportation standpoint, with steep and rugged terrain requiring a costly and concerted transportation infrastructure campaign. The development of project transportation corridors continued throughout the period of significance, with each new project expansion requiring a parallel campaign of targeted infrastructural development. Many of these transportation features have continued to serve the BCHS to the present, with others abandoned and mostly removed. The following section describes the development of this resource type, tracing the project's key transportation infrastructure through the period of significance.[73]

<u>*Huntington Lake Road-Shaver Lake to Big Creek* (Noncontributing Structure)</u>

[73] David H. Redinger, *The Story of Big Creek,* 19.

Project-related road construction began in late 1909, with Pacific Light and Power extending the existing Fresno Flume and Lumber Company Road north from Shaver Lake to the present site of Big Creek, then named Cascada. Upon construction, the road served to provide access for preliminary developments of the BCHS. This road alignment is currently signed Huntington Lake Road and is a modern and well-traveled secondary highway that carries traffic from Shaver Lake to the town of Big Creek and adjacent recreational developments. At present, the road is paved and measures approximately 30 feet in width shoulder-to-shoulder, approximately double the size of initial development.

While the Huntington Lake Road alignment dates to the initial development period of the district, it does not possess sufficient integrity to convey significance as part of the district. The road has been substantially widened, paved with asphalt, and developed with modern signage and pavement markings and does not reflect direct physical associations to the development period. Further, while the road was designed to support the development of the BCHS, the Huntington Lake Road currently acts as a general transportation corridor for all vehicular traffic from the recreational community of Shaver Lake to the town of Big Creek and does not serve as an integral or readily discernible BCHSHD component.

Huntington Lake Road/Huntington Lodge Road-Big Creek to Dam No. 1 (Contributing Structure)
In 1910, Pacific Light and Power developed a road from the site of the Big Creek Camp, or Cascada, to the Big Creek Basin, soon to be Huntington Lake. As developed, the road extended north from the camp, rising nearly 2,000 feet in elevation to the west side of the Big Creek Basin, terminating at the development site of Huntington Lake Dam No. 1 (**Figure 107**). Work on the 15-foot wide, approximately 4.5 mile gravel roadway was undertaken by ten men, one team of horses, a plow, and a scraper. While a maximum grade of 12% was anticipated in plans, in sections the ultimate grade was considerably steeper to accommodate the surrounding slopes. The general surroundings of the road were characterized by steep rocky hillsides, dense coniferous growth, and expansive views to the Big Creek and San Joaquin River Canyons. As designed, the road was intended to provide supplementary access to the site of Huntington Lake, with an adjacent rail incline serving as the primary construction support corridor.[74]

Through the period of significance, the road alignment supported project construction and operation, running adjacent to Huntington Lake Dam Nos. 1, 2, 3, and 3A as well as associated construction camps. In addition, the road served to access Huntington Lake Lodge, constructed in 1915 as a company-operated recreational resort on the west side of Huntington Lake (demolished in 1949). To the present, the road has continued to serve as a primary SCE access alignment for the Huntington Lake facilities. While the road remains critical to operation and management of BCHS facilities, it has also come to support a host of recreation developments along the west shore of Huntington Lake, including small camps and cabins that utilize the road for access. While much of the road is accessible to the public, it is controlled by an SCE gate to the west of Huntington Lake Dam No. 2.

[74] David H. Redinger, *The Story of Big Creek,* 20.

The road alignment between the town of Big Creek and Huntington Lake Dam No. 1 was an integral component of the system's initial development, providing access for construction and allowing for ongoing maintenance through the period of significance to the present. While the road has been altered since construction, most notably by the application of pavement and several areas of widening, the addition of a small number of modern signs, and the development of adjacent recreational facilities and associated small USFS roads, the alignment continues to convey significance as a contributing resource of the BCHSHD through physical and operational integrity. The road continues to connect Project Headquarters in Big Creek to Huntington Lake and is still reflective of the original alignment and designed scale. Further, the contextual surroundings, characterized by pine studded slopes, broad vistas, and largely undeveloped mountains, remains indicative of the original development period.

The boundary of the resource is defined by an access gate that stands at the north edge of the town of Big Creek, following this alignment to the intersection of Huntington Lake Road and Huntington Lodge Road. From this point, the alignment follows Huntington Lodge Road to its terminus at Huntington Lake Dam No. 1. Character defining features of the resource are the operational and physical alignment, the approximately 15-foot narrow width, and the surrounding broad canyon vistas. Paving, signs, modern gates, and other basic infrastructural features have been altered and added over time and do not contribute to the significance of the resource.

San Joaquin and Eastern Railroad Alignment and Infrastructural Landscape Features: Auberry Mission Road to Powerhouse No. 1 (Contributing Structure)
Even as Pacific Light and Power Corporation developed a basic roadway network in 1909-1910, the scale of the project's construction needs—and the pace at which it was desired—dwarfed the modest transportation infrastructure. In the early 1900s, trucks and other forms of auto transport were only slightly more than a novelty, with high tonnage hauling largely relegated to mule teams. Company officials soon realized that conveying the massive amounts of construction materials needed for development via roadway was largely impossible, turning instead to development of a dedicated railroad to serve the construction effort.[75]

In 1911, Pacific Light and Power Corporation organized the San Joaquin & Eastern Railroad Company as a subsidiary, hiring the Stone & Webster Construction Company to begin construction in January of 1912 (**Figures 108**, **109**). As designed, the San Joaquin & Eastern Railroad (SJ&E) extended 56 miles from the Southern Pacific Mainline at El Prado, heading northeast through low foothills to Auberry and up the steep San Joaquin River Canyon to its terminus in the town of Big Creek (**Figures 110**, **111**, **112**, **113**). The company broke ground on February 5, 1912, with the last spike driven on July 10 of that year, a feverish pace that belied the exceedingly challenging engineering and labor constraints surrounding the project. As

[75] For a detailed accounting of the development and decline of the SJ&E Railroad refer to Hank Johnston, *The Railroad that Lighted Southern California* (Los Angeles, CA: Trans-Anglo Books, 1965), 9-17. The work contains a detailed history and a wealth of primary material including lists of rolling stock, photographs of features and general operation, and company receipts and records.

succinctly recorded by historian Hank Johnston in his thorough 1965 accounting of the railroad, *The Railroad That Lighted Southern California:*

> The route headed in a general northeasterly direction across the low foothills of the Sierra on a 1.4% rise for the first 5 ½ miles. The grades were increasingly steeper for the next 33 miles except for one almost level stretch near Auberry. Maximum grade in this lower section of the road was 2.4% and the sharpest curvature was 20 degrees. Above Auberry, the railroad was literally hacked out of the mountainside with grades as steep as 5.2% and curves reaching 60 degrees. One stretch of 4.5 miles on this portion of the line averaged 4.8% grade. Forcing a railroad through this rugged country was a herculean task particularly in view of the limited equipment available.
>
> All work was handled by wheelbarrow, mule team and scraper. Drilling for blasting, of which there was considerable, was done by hand by either one man, or two men working as a team. Construction was carried on seven days a week and at least 10 hours a day. F.M. Thebo, Stone & Webster Superintendent, was in direct charge of the crews which reached more than 1200 men at times with the average being 800. Wages were about 27 cents an hour and the turnover was large. It was unusual for a man to last more than a few weeks before he headed for greener pastures with a paycheck in his pocket. Nearly all of the labor force except for the foremen consisted of laborers, teamsters, and drillers.
>
> The last spike was driven on July 10, 1912, so the railroad was completed in 157 days which must have constituted a record of some sort. There were 255 grades and 1078 curves in the original line, some reaching the aforementioned 60 degrees, so the Big Creek Railroad can be called without fear of contradiction, the crookedest railroad ever built in the world.
>
> No tunnels, steel bridges, or pilings were needed but 43 wood frame trestles were required… The rail was laid to standard gauge… the used rail came from the Santa Fe and Southern Pacific who were replacing some of their trackage at the time with heavier steel.[76]

Construction of the railroad included stations at El Prado, Auberry, and Big Creek, as well as up to twenty smaller platforms along the route to service project construction camps as well as neighboring ranching landholders. The three primary stations were rather rudimentary in form, consisting of single story, wood frame and tar paper-roof buildings with small rail yards, fuel tanks, and other associated utilitarian infrastructure. In addition to the series of small stops along

[76] Hank Johnston, *The Railroad that Lighted Southern California*, 19.

the alignment, there were 11 water tanks, ten passing sidings, up to six section houses, and 48 switches along the line (**Figure 114**).[77]

During the period of significance, the railroad held a total rolling stock of 18 locomotives. Five were rod engines that were used on the lower portions of the grade to Auberry, with the other 13 geared locomotives for the steep grades and curves of the upper portions of the alignment. The system also included ten passenger cars during its years of active operation, with all but one purchased used from other railroads (**Figure 115**). Virtually all of the freight cars were standard flat cars, used to carry the heavy equipment and construction material for the project. Other rolling stock included one tanker, three caboose, a wrecker, a snowplow, water car, and an assortment of maintenance speeders. In addition, the company had two open-air bleacher cars, specially constructed by SCE employees from standard flat cars to provide Big Creek visitors with unimpeded viewing of the dramatic canyon surroundings.[78]

In the first year of operation, the railroad carried a reported 125,712,000 pounds of construction materials to the developing hydroelectric project. At the height of operations, the SJ&E carried over 50,000 passengers a year, primarily SCE workers, with a corresponding one million dollars in yearly hauling receipts. The line serviced virtually all of the construction effort, carrying the system's specialized equipment and raw building materials as well as thousands of personnel engaged in operations. In addition, the line played a modest role in the development of recreational amenities in the area, servicing a small number of tourist facilities developed during the period, most notably SCE's Huntington Lake Lodge.[79]

With cessation of project construction in 1929, the SJ&E's freight and passenger receipts plummeted, with only 444 riders in 1930 and receipt revenue of only $27,000. The following year, ridership had decreased to 104 passengers. While the rapid decline of the fortunes of the railroad can be largely attributed to the dramatic effects of project completion, the line faced additional pressures from the steady uptick in vehicular transport during the period. By the early 1920s, truck and automobile traffic was increasingly common, and by 1930 the town of Big Creek was served by a dedicated bus line—that ultimately came to serve a majority of passengers as well as institutional needs including mail and supply delivery.[80]

In March of 1933, SCE appeared before the California State Railroad Commission to petition for the abandonment of the railroad. As described in the application, "completion of Big Creek construction and extensive development of good roads in Fresno County render service of the

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[77] San Joaquin & Eastern Railroad Photographs of the Michael J. Semas Private Collection, Auberry, California; San Joaquin & Eastern Railroad Company Time Table No. 25, on file at SCE Northern Hydro Headquarters Archives; Hank Johnston, *The Railroad that Lighted Southern California*, 19.
[78] Hank Johnston, *The Railroad that Lighted Southern California*, 107-124.
[79] Subjugating Nature's Tremendous Forces to Man's Uses in Southern California," *Los Angeles Times*, June 15, 1913; "Outing Trips By Railroads, Huntington as Host at Big Creek" *Los Angeles Times*, May 24, 1914; David H. Redinger, *The Story of Big Creek,* 17.
[80] SCE SJ&E Freight and Passenger Receipts, as recorded in Hank Johnston, *The Railroad that Lighted Southern California*, 117.

railroad unnecessary and its operating revenue inadequate to meet expenses." The application was approved and on August 15, 1933 the line ceased operation. While some of the rolling stock had already been sold as the primacy of the railroad declined, at the time of abandonment all remaining physical assets of the railroad were sold to a consortium of San Francisco based scrap dealers for $50,000. Dismantling of the railway started almost immediately, with wrecking crews working from Big Creek to El Prado, loading all salvageable material on to SJ&E locomotives.

On October 23, 1933 much of the salvaged material was auctioned at the SJ&E Railyards in Auberry, with circulars advertising, "Machinery, tools, 10,000 tons of rails, corrugated buildings, locomotives, cars, coaches, etc." As reported in the *Los Angeles Times*, scrap dealers began negotiations with the Japanese government to sell portions of the rails and rolling stock to that country. It is unclear whether this came to fruition. Smaller buildings and structures along the alignment, including section houses, sidings, water tanks, and other small-scale infrastructure were torn down or sold to local ranchers to be moved. By 1935, the cleanup was largely complete. The majority of the right of way below Auberry was returned to original landowners, with only the alignment between Auberry and Big Creek adapted as an intact vehicular alignment. This portion of the remnant railroad grade was converted to an unpaved road by the Forest Service following dismantling, and is now identified as USFS 8S08.[81]

The SJ&E was central to the conception and execution of Big Creek's foundational construction, carrying hundreds of thousands of tons of construction material and equipment, thousands of personnel, and an array of consumer goods that sustained life in Big Creek for the entirety of the period of significance. In addition, as the first large-scale construction project undertaken in support of hydroelectric development at Big Creek—the development of the railroad was indicative of the project's immense engineering and material challenges, and the equally innovative ways in which these challenges were addressed. With all major physical components of the railroad removed following the cessation of initial development in 1929, the SJ&E in many senses serves as a bookend for the significant period of development of the BCHS, with the construction and ultimate dissolution of the line representative of a distinct framework of technological, material, and engineering conditions that contextualizes and frames the significance of the district.

While the primary physical features of the railroad grade are gone, including rails, ties, and trestles, portions of this critically important linear transportation alignment retain interpretive value as contributing resources of the district. In particular, the approximately 16 mile section of the alignment that runs between Jose Basin Road, seven miles northeast of Auberry, and the south bank of Big Creek adjacent to Powerhouse No.1 retains a sufficient level of contextual

[81] "Edison Acts to Abandon Rail", *Los Angeles Times*, February 21, 1933; San Joaquin and Eastern Tracks Being Torn Up, Materials May be Sold to Japanese Government," Los Angeles Times, September 1, 1933; Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System,* 163; Theodoratus Cultural Research, *Oral History Interviews Pertaining to the Big Creek Hydroelectric Project*, Van Fleet 35-37, prepared for Southern California Edison, 1989, on file at SCE Northern Hydro Headquarters Library.

associations and fragmentary landscape elements to convey significance as a contributing element of the BCHSHD. This section remains in use as a cohesive transportation corridor (USFS 8S08), and is the only section that is able to convey significant associations through its overall forested undeveloped setting, linear alignment, and integration with BCHSHD project features. In addition to linear cohesion, this portion of the alignment contains a large number of small-scale landscape features from the period of significance, most notably dry-laid stone retaining walls, board formed concrete box culverts, and fragmentary bridge footings, which in totality serve as evocative landscape elements that convey associations to the historic period. The following summary presents an overall description of the present conditions of the this 16 mile section as well as a representative discussion of associated feature types and character defining features.[82]

This 16 mile section of the former SJ&E linear alignment remains in active use as a vehicular corridor and is characterized by a number of distinct layers, with utilitarian features dating from the historic period to the present. The western extent of the road begins at USFS 8S08 and is gravel with an average width of approximately 15 feet, excluding isolated turnouts. Development along this portion of the alignment is sparse, with rugged wooded hills and vistas of the San Joaquin River Canyon coupled with views of the working hydroelectric infrastructure of Big Creek, including powerhouses, penstocks, and transmission towers. This remote and undeveloped setting is reflective of the period of significance and allows the remnant alignment and associated landscape features to reflect significant associations.

The road remains accessible to the public through its intersection with Huntington Lake Road where it is gated for access by SCE on the east side of the intersection. From this point the grade travels above Huntington Lake Road crossing once more before terminating across from Powerhouse No. 1, where a trestle, since removed, once carried the alignment across Big Creek to the powerhouse and company headquarters at Big Creek. The alignment becomes narrower in these last two miles, with an average width of 13 feet that is generally reflective of the width of the original railroad alignment.

Because the present-day roadway was built atop the abandoned railroad grade the corridor is characterized by a mixture of infrastructural features that are reflective of the historic period as well as ongoing development to the present. The roadway includes a number of mid-twentieth century and modern bridges, culverts, signage, and other miscellaneous infrastructure that are utilitarian and standardized in form. These infrastructural elements do not contribute to the significance of the alignment or in turn the district as a whole. Underlying these modern features is a significant concentration of historic period transportation infrastructure remnants related to the initial SJ&E alignment. The linear corridor includes approximately 50 recorded remnant

[82] The remaining approximately 38 miles of the alignment that extends to El Prado does not appear to retain sufficient features or strong visual associations that would contribute the significance of the BCHSHD. The alignment right-of-way has been altered by pavement and surrounding rural residential development, with much of the alignment abandoned and currently in sectionalized private ownership. Should future research or inventory reveal important or cohesive features, they should be evaluated within this overall context.

railroad features, with others likely present, including large stretches of dry-laid rock retaining wall adjacent to the road bed, small concrete and rock culverts, and remnant footings and piers associated with since-removed trestles. While these features are fragmentary in nature, as an assemblage they are illustrative of the type, period, and method of construction of the SJ&E alignment.[83]

Notable examples of remnant features and resources along the alignment include a board formed concrete culvert and retaining wall with dry-laid stone wing walls on the downhill side of the grade at Mill Creek (app. 1.54 miles east of intersection of Jose Basin Road and USFS 8S08); the collapsed remains of a water tank atop a concrete retaining wall at the former Feeney Station (10.1 miles east of intersection of Jose Basin Road and USFS 8S08); a board formed concrete box culvert spanning the Powerhouse No. 2A penstock; and an approximately 120-foot long concrete and stone retaining wall across Big Creek (Dam No. 4 impoundment) from Powerhouse No. 1. While these features are not a comprehensive listing of the small-scale infrastructural remnants that remain, they are representative of the general type and distribution that is found on the alignment. In addition to these small-scale features, the alignment includes a single component of a railroad station at Shaver Crossing, approximately .5 mile west of Huntington Lake Road. While the original rudimentary wood station has been redeveloped as a residence and altered through additions and structural alterations, the orientation of the small building in relation to the SJ&E and its surrounding setting contributes to the setting of the railroad alignment.

The interpretive value of this remnant alignment stems from several character defining features that serve to illustrate the overall development history and significance of the district. Character defining features include the location of the alignment as it extends through SNF to the Big Creek river bank south of Powerhouse No. 1. While the alignment no longer carries rail and has been widened in some areas, it follows the same course that was developed and is spatially and contextually representative of the method by which virtually all construction material and personnel accessed the remote system. In many areas, the alignment is of a width that is comparable to that of the development period, conveying a sense of time and place within the context of the BCHSHD through its overall linear form. Additionally, the alignment passes through a surrounding environmental context that is generally reflective of the development period, with winding curves that pass through rugged hills and forest, and expansive vistas to BCHSHD project features (**Figure 116**). The linear alignment conveys significance through its

[83] The section of the former SJ&E that is included as a contributing element of the BCHSHD in this nomination has been inventoried on several occasions. Most comprehensively, the alignment was recorded by Suzanne Baker and Laurence H. Shoup in the 1999 *Preliminary Archaeological Survey: San Joaquin and Eastern Railroad Grade, Sierra National Forest, Fresno County, California.* The report was submitted to SCE and documented 49 fragmentary features associated with the alignment. In addition to this comprehensive survey, smaller sections of the alignment have been inventoried, including four miles of the grade adjacent to its intersection with Huntington Lake Road (CA-FRE-1631H Update May 1, 2012). Both reports are on file with the Southern San Joaquin Valley Information Center (SSJVIC) of the California Historic Resources Information System (CHRIS). Field work undertaken in support of this project also conducted reconnaissance level survey of the entire approximately 30 mile transportation route in order to field check previous recordation and identify current conditions.

design, setting, feeling, association, and location. Additionally, while fragmentary in nature and framed with modern roadway features, the dispersed concentration of SJ&E railroad infrastructure is a character defining feature of the resource, including its retaining walls, culverts, footings, and abutments that convey significance through design, materials, workmanship, setting, feeling, association, and location. Viewed as a system, the isolated features along this linear corridor form a cohesive landscape system that conveys an important physical interpretation of the BCHSHD development context.

Incline No. 1/Big Creek Incline/Basin Railroad (Noncontributing Structure)
Incline No. 1, alternately the Big Creek Incline, was built in 1912 to support the construction of Dam Nos. 1, 2, and 3 at Huntington Lake. The single-track hoist line extended 6,000 feet from the terminus of the SJ&E in Big Creek to the foot of the Big Creek Basin, where it met an approximately nine mile railroad that led to the reservoir construction site (**Figures 117, 118**). The approximately 2,100 vertical feet that separated the SJ&E terminus from the Huntington Lake site necessitated tremendous grades, with portions of the incline reaching 80% grade. Virtually all construction material used in the creation of Huntington Lake was transferred via this incline and associated railroad system.[84]

The incline was powered by a 250 horsepower electric hoist that was stationed in a steel frame and concrete hoist house at the top of the grade. The hoist house was located slightly upslope from the vent stacks of the Powerhouse No. 1 penstocks. A 12,000 foot-long steel cable, 1 ½ inches in diameter, was used as a hauling line, with the cable spooling on a large metal drum in the hoist house. The cars used for hauling were standard railroad flat cars, with wood and steel bulkheads to prevent loads from slipping on the nearly vertical ascent. According to Stone & Webster records, 112 such cars were employed on the project, in addition to several locomotives that were hauled up the incline and used to pull cars on the associated Basin Railroad.[85]

While this transportation feature was a significant engineering and construction facet of the early development of the BCHS and critical to the impoundment of Huntington Lake, very little discernible material remains at present, with virtually all physical vestiges of the alignment removed or physically compromised. As constructed, the line ran through the Big Creek Camp (now the town of Big Creek) from the SJ&E Depot, ascending to the site of Huntington Lake. Survey of the former alignment indicates that only the foundation of the hoist house and an isolated approximately 1,000-foot section of highly degraded rail ties remain, with the remainder of the linear alignment removed and the grade repurposed such that it is not identifiable as a cohesive linear system. Much of the former alignment has been redeveloped with a distribution line, the East Incline Distribution Line/Big Creek-Portal 33kV, with another portion repurposed as USFS 8S301. Other portions have been entirely superseded by modern development, particularly in the town of Big Creek, where modern roads and residential growth obscure any sense of the original alignment. In the Huntington Lake Basin itself, the line was inundated with development of the lake, leaving only remnant physical vestiges of the alignment (**Figure 119**).

[84] Hank Johnston, *The Railroad that Lighted Southern California*, 26.
[85] Hank Johnston, *The Railroad that Lighted Southern California*, 30.

Incline No. 1/Big Creek Incline and the associated Basin Railroad System is highly fragmented and cannot convey any significant physical or informational associations, with a diminished linear integrity and an insufficient number of extant physical components to convey significance as a contributing element of the BCHSHD.[86]

Powerhouse No. 1 Penstock Incline (Contributing Structure)

The Powerhouse No. 1 Penstock Incline was developed in 1912-1913 in conjunction with the construction of the Powerhouse No. 1 penstocks. The incline was of a three-foot gauge and ran approximately 3,000 feet from the north side of Powerhouse No. 1 to the top of the powerhouse penstocks, midway between Kerckhoff Dome and Sunset Point. The primary function of the incline was to haul the steel penstock pipes for placement along the steep grade (**Figure 120**).

The construction incline serviced a number of small cars, including basic flat cars and rudimentary steel frame cars with wood cradles and cable for lashing of the penstock sections. The line was serviced by an incline hoist house stationed at the top of the penstocks. The hoist house stood on a concrete foundation and was of a utilitarian steel sided design, with the large cable drum housed within. The line serviced initial construction and remained in use through at least the 1950s to facilitate repair along the penstock alignment.[87]

While the incline is no longer in operation, substantial components of the linear alignment remain intact, with rails, ties, and cable pulleys extending from the north side of Big Creek Road, directly above Powerhouse No. 1, up the slope to the top of the penstocks. Although the alignment retains its original orientation, the majority of the rails and ties are replacements from those of the historic period, and generally date from the 1940s when the line was used to repair sections of the penstocks after a rock slide. Despite the replacement material, the newer features are generally in-kind replacements and the resource retains its overall linear form and is readily interpreted as an incline system. The hoist house also remains in place at the top of the grade. While the sheet metal walls are replacements to the original, also dating to the mid twentieth century, the building retains its original foundation and overall utilitarian form, with an extant cable leading from the pulley drum inside the building to the intact grade below. As an assemblage, the remains of the incline are indicative of the significant associations of the district and are contributing resources to the district, with the linear feature and associated hoist house representative of the method of construction underlying the initial development and operation of the system.[88]

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[86] P. Allen, D. Andolina, M. Rossi, Cardno, Inc., Reconnaissance Documentation of Big Creek Incline/Incline No. 1, October 29, 2014; K. Larsen, M. O'Neill, M. Greenberg, Pacific Legacy, Inc., *Archaeological Reconnaissance Report for the Southern California Edison Huntington Lake Dam 1 Replace Power and Control Project*, 2011. Report on file at SCE and the SSJVIC.

[87] Huntington Digital Library, Southern California Edison Photographs and Negatives, G. Haven Bishop Collection, Big Creek #1, 6-25-1924, Call Number 02-12249; Southern California Edison, *Annual Report for the year ending December 31, 1952, Northern Division Hydro Generation*, A.C. Werden, April 24, 1952 and R.T. Enloe, February 6, 1952. On file at SCE Northern Hydro Headquarters, Big Creek, CA.

[88] SCE, *1944 Annual Report: Big Creek #1*, on file at SCE Northern Hydro Headquarters, Big Creek, CA.

Character defining features of the Penstock No. 1 Incline includes its linear orientation between Powerhouse No. 1 and the top of the powerhouse penstocks and its overall utilitarian form, with wood ties, rails, and metal pulley. While a single steel frame flat car stands at the top of the grade, the car dates to the mid-twentieth century and is not a character defining feature from the historic period.

Incline No. 2 (Noncontributing Structure)
Incline No. 2 was developed in 1912 to facilitate construction of Powerhouse No. 2 (**Figure 121**). The incline descended from the West Portal stop of the SJ&E to the site of Powerhouse No. 2, generally following the same alignment as the powerhouse's penstocks. The configuration of the incline was much the same as that of the Incline No. 1/Big Creek Incline. The line was approximately one mile in length, with a vertical rise of 2,000 feet and a maximum grade of 80%. The line was standard gauge and designed to carry standard railroad flat cars with specially designed freight buttresses at the rear end, called strong-backs, to prevent slippage. A hoist house stood at the top of the alignment, several thousand feet above the SJ&E grade. The hoist house featured a massive concrete foundation and a wood-framed body with steel siding, housing the cable hoist within. As initially designed, the incline crossed over the SJ&E via a wood railroad trestle, with the tracks descending the steep canyon below. Upon reaching the powerhouse, the incline was carried over Big Creek via a wood trestle, accessing facilities and storage yards on the north side the powerhouse.[89]

The incline was critical in construction of Powerhouse No. 2 and its subsequent expansion in 1921. In addition, the incline was repurposed to support construction of Powerhouse No. 2A in 1926. A new hoist house was built on the top of the alignment for Powerhouse No. 2A's construction, and the original wood trestle crossing Big Creek was replaced with a steel lattice frame trestle.[90]

While this transportation feature was a significant engineering and construction facet of the early development of the project and critical to the construction of Powerhouse No. 2 and subsequently Powerhouse No. 2A, very little discernible material remains at present, with virtually all physical vestiges of the alignment removed or physically compromised such that the alignment can no longer convey significance as a linear system. As constructed, the line ran from the West Portal stop of the SJ&E, extending for approximately one mile to Powerhouse No. 2. Survey of the former alignment indicates that very little of a cohesive linear system remains, with only isolated fragments that are indicative of the original system. Extant documented features include the foundations of the original hoist house above the former SJ&E grade as well as the 1926 hoist house that was developed for completion of Powerhouse No. 2A. In addition,

[89] Hank Johnston, *The Railroad that Lighted Southern California*, 30; David H. Redinger, *The Story of Big Creek,* 29; Huntington Digital Library, Southern California Edison Photographs and Negatives, G. Haven Bishop Collection, Big Creek #2 variant of 02, 1-26-1922, Call Number 02-07440a.
[90] M. O'Neill, M. Pomerleau, H. Blind, K. Vallaire, and F.H. Arellano, Pacific Legacy, Inc., *Southern California Edison Company Shaver Lake District Deteriorated Distribution Line Poles Replacement Project*, Submitted to Southern California Edison Company, Report on file at SCE and the SSJVIC.

the steel frame trestle crossing Big Creek remains, no longer attached to any extant incline features. A single small stretch of intact rails and ties extends for approximately 600 feet above the former SJ&E grade. This stretch of grade appears to have been rebuilt in the mid-twentieth century. The remainder of the linear alignment has been removed and the grade repurposed and overgrown such that it is not identifiable as a cohesive linear system and cannot convey significance as a contributing element of the BCHSHD.[91]

Canyon Road (Contributing Structure)

The first section of Canyon Road was developed circa 1913 to provide vehicular access between Big Creek Headquarters and Powerhouse No. 2. As initially designed, the road extended from Huntington Lake Road, two miles west of the town of Big Creek, down the southern slope of the Big Creek Canyon, terminating at Powerhouse No. 2. While the bulk of heavy construction equipment and materials for Powerhouse No. 2 were transported via the SJ&E and Incline No. 2, Canyon Road was developed to provide ongoing access for company personnel and materials.[92]

In October of 1920, the road was extended approximately 1.5 miles down the Big Creek Canyon to the site of Powerhouse No. 8 that was completed in 1921 (**Figure 122**). The alignment of the road generally followed the Tunnel No. 8 alignment, allowing access to the tunnel's single construction adit that was concurrently being used for tunnel driving. The road was excavated using a Marion No. 1 Steam Shovel, operated by compressed air, and extensive application of dynamite, with crews blasting the canyon walls to provide a level grade. Construction of this section of the road was completed by December of 1921.[93]

The entirety of the approximately 5.5 mile Canyon Road, from Huntington Lake Road to Powerhouse No. 8, remains in use at present as an SCE service road, providing access to Powerhouse Nos. 2, 8, and 3 as well as other downstream facilities. The general surroundings of the road are characterized by dense coniferous growth, giving way to expansive views of the Big Creek Canyon and BCHSHD hydroelectric features. The alignment of the road is winding, following the topography of the canyon walls. The width of the road varies, with some sections of a generally single-lane width that is reflective of the original construction period, approximately 13 feet, and other sections that have been widened to accommodate modern SCE truck traffic, with some sections over 20 feet in width.

The Canyon Road alignment was an integral component of the system's initial development, providing personnel access and allowing for ongoing operations through the period of significance and to the present. While the road has been altered since construction, most notably by the application of pavement and several areas of widening, the widespread replacement of

[91] P. Allen, D. Andolina, M. Rossi, Cardno, Inc., Reconnaissance Documentation of Incline No. 2, October 30, 2014; M. O'Neill, M. Pomerleau, H. Blind, K. Vallaire, and F.H. Arellano, Pacific Legacy, Inc., *Southern California Edison Company Shaver Lake District Deteriorated Distribution Line Poles Replacement Project*, 2011.
[92] Audry Williams, Southern California Edison, Inventory and Evaluation of Upper and Mid Canyon Road, Fresno County, California, 9-10-2012, on file at SCE and the SSJVIC; David Redinger, *The Story of Big Creek*, 82-83.
[93] Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System*, 96.

bridges and culverts, and the ongoing addition of modern signage, the alignment continues to convey significance as a contributing resource of the BCHSHD through physical and operational integrity. The road still connects Project Headquarters in Big Creek to the lower powerhouses and largely continues to reflect the original alignment and designed scale. The contextual surroundings, characterized by pine studded slopes, broad canyon vistas, and key BCHSHD operational features, remains indicative of the original development period. Additionally, as a dedicated SCE Service Road, with locked gates controlling access, the alignment is still wholly devoted to project operations and indicative of the infrastructural underpinnings of the system.

The boundary of the resource is defined by the SCE access gate that stands at the north side of Huntington Lake Road's intersection with Canyon Road, following the Canyon Road alignment to Powerhouse Nos. 2 and 8 and subsequently the intersection of Million Dollar Mile Road above Powerhouse No. 8. Character defining features of the resource are the operational and physical alignment, the alignment's generally narrow single-lane width, and the surrounding broad canyon vistas and hydroelectric features including Powerhouse Nos. 2 and 8 and their associated infrastructure. Paving, post-period of significance culverts and bridges, road signs, modern gates, and other basic infrastructural features do not contribute to the significance of the alignment.

Incline No. 8 (Noncontributing Structure)

As initially conceived, construction materials for development of Powerhouse No. 8 were transported from Incline No. 2 via wagons on the Lower Canyon Road. Both the bulk and the specialization of the materials soon precluded wagon transport. SCE developed a dedicated cable incline for Powerhouse No. 8 in 1920-1921 (**Figure 123**). The incline descended from the SJ&E Railroad Grade at Feeney Station, extending 10,800 feet (2.04 miles) to Powerhouse No. 8. The incline grade ranged from 6% to 50%, with a total vertical rise of 2,470 feet. With a single cable, the alignment was rated for 35 tons, with the potential for a double line that could carry 70 tons. Because of the incline's length, it was equipped with two hoists, so that material could be moved on the upper and lower portions of the alignment simultaneously, thereby alleviating bottlenecks along the alignment.[94]

While Incline No. 8 was a significant engineering and construction facet of the early development of the project and critical to the construction of Powerhouse No. 8, very little discernible material remains at present, with virtually all physical vestiges of the alignment removed or physically compromised such that the incline can no longer convey significance as a linear resource. As constructed, the line ran from Feeney Station on the SJ&E, extending for approximately two miles to Powerhouse No. 8. Survey of the former alignment indicates that very little of a cohesive linear system remains, with only isolated fragments that are indicative of the original system. Extant documented features are limited to a small number of isolated sections of intact rail and several dry laid stone retaining walls and abutments. Much of the line

[94] Hank Johnston, *The Railroad that Lighted Southern California*, 84; David H. Redinger, "Progress on the Big Creek Hydro-Electric Project," Los Angeles, CA: Southern California Edison Company (originally published in *Compressed Air Magazine*, Vol. XXVII and Vol. XXIX, 1923-1924).

is thickly overgrown with manzanita and brush, and the majority contains no extant rails, ties, or associated features. Large sections of the line have been graded and redeveloped to serve as vehicular access alignments for the Powerhouse No. 8 Penstocks. Because of this overall lack of physical integrity, the former incline alignment is not identifiable as a cohesive linear system and does not convey significance as a contributing element of the BCHSHD.[95]

Million Dollar Mile Road (Contributing Structure)
Million Dollar Mile Road was constructed in 1921 to support construction and operation of Powerhouse No. 3 and its associated Tunnel No. 3 water conveyance line. The eleven mile road, also called Lower Road, connected Powerhouse No. 3 to the upper portions of the project and SCE Headquarters in Big Creek, winding along the steep and precipitous south wall of the San Joaquin River Canyon. The alignment was built in conjunction with an incline railroad that served Powerhouse No. 3 and Incline No. 3, with the railroad servicing the bulk of construction needs and Million Dollar Mile intended for long term operations and ongoing personnel access. Million Dollar Mile Road proved critical to the development of the Powerhouse No. 3 system and continues to serve as an important project alignment, with the roadway remaining in use as a dedicated project transportation corridor.[96]

Construction of Million Dollar Mile Road spanned from August of 1921 to May of 1922. SCE crews worked simultaneously from both the north and south ends of the alignment to speed construction, and the alignment's relatively low elevation allowed for work through the winter months. The south end of the roadway extended from a stop on the SJ&E Railroad, Hairpin, located approximately 1.2 miles from the site of Powerhouse No. 3. The north end of the alignment descended from Canyon Road, directly above Powerhouse No. 8. Construction of the northern end of the roadway proved both costly and difficult, earning the road its Million Dollar Mile moniker. Substantial swaths of the road bed were cut into sheer granite walls above the San Joaquin River. As recounted by David Redinger, "cuts into solid granite, fifty to one hundred feet high were not uncommon… as there were no footholds from which to start work, these had to be made by men hanging on ropes anchored to trees or rocks as much as 500 feet above." Following initial blasts to secure even the slightest footholds, the road was then excavated by several railroad steam shovels, which "ate their way down the canyon" using compressed air supplied by a four inch pipe that followed construction crews (**Figures 124, 125**).[97]

As a linear alignment, Million Dollar Mile Road remains physically intact and much as it was developed in the historic period (**Figure 126**). The contributing area between Canyon Road and Powerhouse No. 3, the road is gated and acts as a dedicated SCE service corridor, accessing Powerhouse No. 3 as well as other downstream facilities.

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[95] P. Allen and M. Rossi, Cardno, Inc., Reconnaissance Documentation of Incline No. 8, September 11, 2014; SCE has previously consulted with the California State Office of Historic Preservation (SHPO) regarding the eligibility of Incline No. 8. In a letter dated June 25, 2012, Reference No. FERC120521A, SHPO concurred with SCE's finding that Incline No. 8 was ineligible for listing in the NRHP as a contributing element of the BCHSHD because of a lack of integrity.
[96] David H. Redinger, "Progress on the Big Creek Hydro-Electric Project," *Compressed Air Magazine*, 1924.
[97] David H. Redinger, *The Story of Big Creek,* 90.

The general surroundings of the road are characterized by dramatic views of the San Joaquin River Canyon, with sheer rock faces and chaparral studded hills framing much of the alignment, and vantages of key project features including the penstocks for Powerhouse Nos. 8 and 3. In addition, the road crosses the natural watercourse of Stevenson Creek that free-flows under a bridge that carries the roadway. The alignment of the road is winding and circuitous, following the rugged topography of the canyon walls. The width of the road varies, with many sections of a narrow single-lane width that is reflective of the original construction period, approximately 11-13 feet, and other sections that have been widened to accommodate modern SCE truck traffic, with some widened sections and pullouts that are over 20 feet in width.

Million Dollar Mile Road was an integral component of the BCHSHD's initial development, providing personnel access to Powerhouse No. 3 and allowing for ongoing operations through the period of significance and to the present. While the road has been altered since construction, most notably by the application of pavement and several areas of widening, the uniform replacement of bridges and culverts with modern utilitarian upgrades, and the ongoing addition of modern signage, the roadway and contextual surroundings continue to convey significance as a contributing resource of the BCHSHD through physical and operational integrity. The road still connects the isolated Powerhouse No. 3 with the remainder of the project and it largely continues to reflect the original alignment and designed scale. The contextual surroundings, characterized by steep cliff faces, broad canyon vistas, and key BCHSHD operational features, remains indicative of the original development period. Additionally, as a dedicated SCE Service Road, with locked gates controlling access for the majority of the alignment, the road is still largely devoted to project operations and indicative of the infrastructural underpinnings of the system.

The boundary of the resource begins at Million Dollar Mile's intersection with Canyon Road above Powerhouse No. 8, extending to Powerhouse No. 3. Character defining features of the resource are its operational and physical alignment, the alignment's generally narrow single-lane width, the surrounding steep canyon vistas and views of hydroelectric features including Powerhouse Nos. 8 and 3 and their associated infrastructure including penstocks. Paving, post-period of significance culverts and bridges, road signs, modern gates, and other basic utilitarian infrastructural features are not character defining features that contribute to the significance of the alignment.

Incline No. 3 (Noncontributing Structure)
1921 construction of Powerhouse No. 3 included the development of both a dedicated project road and a railway incline-Incline No. 3. The incline left the SJ&E Railroad at Hairpin, also the southern terminus of Million Dollar Mile Road, descending approximately 1.2 miles to the site of Powerhouse No. 3 on the south bank of the San Joaquin River. The incline had a maximum

grade of 45%, with a hoist house at Hairpin and 15,000 feet of 1 ½ inch steel cable, which could be strung either singly or doubly depending on load requirements (**Figure 127**).[98]

While Incline No. 3 was a significant engineering and construction facet of the early development of the project and critical to the construction of Powerhouse No. 3, very little discernible material remains at present, with virtually all physical vestiges of the alignment removed. SCE archival documents indicate that the hoist itself was moved in the 1960s, with the rails, ties, and associated features of the alignment likely removed in generally the same period, or prior, following the dissolution of the SJ&E in the early 1930s.

Survey of the former alignment indicates that no cohesive elements of the system remain, with the sole documented features limited to several concrete footing remnants on a slope adjacent to Powerhouse No. 3, and a small section of remnant ties that enters the powerhouse building from the west. No other extant rails, ties, or sections of road bed were observed along the alignment, with many areas thickly overgrown by brush and manzanita and other areas redeveloped with modern utility features including a switchyard adjacent to Powerhouse No. 3 and small project access roads that cross alignment's original course. Visual inspection of the Hairpin site revealed only a fragment of concrete in a highly disturbed road pull-out. While the small concrete fragment likely relates to the incline or associated development, it is devoid of any surrounding contextual material, physical associations, or linear linkages. Because of this overall lack of physical integrity, the former incline alignment is not identifiable as a cohesive linear system and does not convey significance as a contributing element of the BCHSHD.[99]

Kaiser Pass Road (Contributing Structure)

Kaiser Pass Road (alternately USFS 5S08, modern portions signed Florence Lake Road) was developed between Huntington Lake and Florence Lake to support the upper elevation expansion of the BCHS. Construction of the approximately 21 mile road was begun in 1920 and completed in 1922, with two intervening high Sierra winters punctuating construction activities. As designed, the road extends from the east side of Huntington Lake, winding through rugged mountain terrain to the northwest shore of Florence Lake. The road was developed to serve immediate construction needs—providing critical access for the construction of Ward (then Florence) Tunnel, Florence Lake, and subsequently the Mono-Bear development. In addition, Kaiser Pass Road was envisioned as a permanent linkage for the BCHS, providing the sole route over the 9,000-foot Kaiser Pass and permanently connecting the upper and lower operating areas of the hydroelectric project. Both functionally and physically, Kaiser Pass Road remains much as it was developed in the 1920s. The road continues to service all of the BCHSHD's upper

[98] Hank Johnston, *The Railroad that Lighted Southern California*, 86; David H. Redinger, "Progress on the Big Creek Hydro-Electric Project," Los Angeles, CA: Southern California Edison Company (originally published in *Compressed Air Magazine*, Vol. XXVII and Vol. XXIX, 1923-1924).
[99] P. Allen and M. Rossi, Cardno, Inc., Reconnaissance Documentation of Incline No. 3, September 9, 2014; M O'Neill, D. Sterling, and M. Pomerleau, Pacific Legacy Inc., "Powerhouse No. 3 Footings DPR 523 Form," *Southern California Edison Company Shaver Lake District Deteriorated Distribution Line Poles Replacement Project Cultural Resources Inventory in Fresno and Madera Counties*, 2006. On file at SCE and the SSJVIC.

elevation hydroelectric features and largely reflects its original scale, design, and contextual surroundings.

Construction of Kaiser Pass Road began at Huntington Lake in the summer of 1920 (**Figures 128, 129**). As recorded by David Redinger, crews included SCE laborers accompanied by teams of mules, plows, scrapers, and a wood-burning donkey engine to remove trees and boulders:

> Although a preliminary survey had been made, the actual location took place as the men, mules, and scrapers pushed ahead. The wood-burning donkey engine, with its long reels of cable, pulled itself along and was used to remove boulders, trees, etc., that were too much for the mules… The road crew continued pushing down on the far side of Kaiser Pass, dodging huge boulders and removing many others. Spared wherever possible were the junipers-those sturdy denizens of the High Sierra which have withstood the elements through so many centuries.[100]

The first phase of road construction spanned from Huntington Lake to the site of Ward Tunnel's Adit 61, with a large construction camp developed at the adit site to support tunneling crews. The second segment of road, extending from Adit 61 to Florence Lake, was not begun until the summer of 1922, as SCE readied itself to construct Florence Lake Dam and the upper portions of Ward Tunnel. The road was completed to Florence Lake by autumn of 1922, allowing SCE to begin preparations at the dam site. The road serviced all of the upper elevation project development, carrying trucks and traffic in the summer months, and a regular run of SCE dog sleds during the winter (**Figures 130, 131**).[101]

As a linear alignment, Kaiser Pass Road remains physically intact and much as it was developed in the historic period. The road serves as the only access corridor for the upper parts of the system, remaining vital to project operations, and retains much of its original design, setting, feeling, association, and functional attributes. The general setting of the road is characterized by mountainous terrain, with glaciated forested hillsides ceding to rocky high elevation peaks in the distance. A number of mature pines and junipers flank the roadway, and large boulders are strewn across the rocky slopes adjacent to the road bed. Several high mountain meadows appear adjacent to the roadway and in the upper portions of the road scoured glaciated slopes predominate, with lighter forest cover. There is very little development along the roadway, with the majority of adjacent land undeveloped USFS wilderness. Exceptions to this include the hydroelectric features related to the Portal Powerhouse and Forebay, the High Sierra Ranger Station at Bolsillo Creek, and several small recreational pull-outs and parking areas with rudimentary USFS facilities including bathrooms and signage.

The alignment of the road is winding and circuitous, following the rugged topography of the forested slopes and avoiding major obstacles including boulders and mature trees. The width of the road varies, with much of the road between 13 and 17 feet in width and generally single lane.

[100] David H. Redinger, *The Story of Big Creek,* 100.
[101] David H. Redinger, *The Story of Big Creek,* 105.

Notable exceptions to this are the first five miles of the road, extending from Huntington Lake to a modern USFS road control gate, which have been widened substantially to approximately 30 feet in width. Additionally, the last segment of road at Florence Lake has been updated and modernized with parking and pull-outs for recreational activities at Florence Lake. The entire road has been paved.

Kaiser Pass Road was an integral component of the BCHSHD's initial development, providing the sole access over Kaiser Pass and to the site of development for Florence Lake and Ward Tunnel. In addition, the road served as the backbone for subsequent high country development, including that of the Mono and Bear Diversions and Flowline. While the road has been altered since construction, most notably by the application of pavement and several areas of widening, the uniform replacement of bridges and culverts and associated railings with modern utilitarian upgrades, and the ongoing addition of modern signage, the roadway and contextual surroundings continue to convey significance as a contributing resource of the BCHSHD through physical and operational integrity. The road still connects the high elevation areas of the system with the remainder of the project and it largely continues to reflect the original alignment and designed scale. The contextual surroundings, characterized by rugged forest land and high mountain vistas coupled with views of key project features including Florence Lake and Dam, remain indicative of the original development period. Additionally, while open to public and recreational traffic, the road is still largely devoted to project operations and indicative of the infrastructural underpinnings of the system.

The boundary of the resource begins at Huntington Lake at the intersection of Kaiser Pass Road and Highway 168, extending to the road's termination at the Florence Lake Work Camp at the northwest side of the lake. Character defining features of the resource are its operational and physical alignment, the alignment's generally narrow single-lane width, the surrounding contextual vistas including mountainous exposures and views of BCHSHD hydroelectric features including Florence Lake and Dam. Paving, post-period of significance culverts and bridges, road signs, modern gates, and other basic utilitarian infrastructural features are not character defining features that contribute to the significance of the alignment.

Mono-Bear Road/Lake Edison Road (Contributing Structure)
The Mono-Bear Road, later Lake Edison Road, was constructed in 1925 to provide construction and operations access for the Mono and Bear Diversions and the Mono-Bear Siphon (**Figure 132**). During construction, the road was termed the "C & N," or Cheap and Nasty, for its difficult terrain and punishing construction conditions:

> Between six and seven miles of road had to be built through the worst terrain imaginable. Boulders the size of houses, and huge ledges of the hardest granite, were encountered. Steep grades and sharp turns resulted from dodging such obstacles. The routes appeared to be almost impossible, since many large trucks would have to be used for the delivery of material.[102]

[102] David H. Redinger, *The Story of Big Creek,* 147.

The alignment of the Mono-Bear Road extends north from Kaiser Pass Road at the location of the Mono-Bear Siphon's intersection with Ward Tunnel. The road follows a generally northeasterly course, paralleling the buried Mono-Bear Siphon, with the mounded rock and gravel covering the siphon evident along much of the alignment (**Figure 133**). Because of the rugged topography of the high elevation terrain, the road is somewhat circuitous in its path, winding around boulders, ledges, and other natural obstacles. The road is carried over the South Fork of the San Joaquin River on a steel trestle bridge, constructed in 1963. The steel pipe of the Mono-Bear Siphon runs directly to the east across the river, providing a dramatic project focal point. After crossing the river, the transportation corridor splits into a "Y" as it extends to the Bear Diversion site to the east and the Mono Diversion site to the west.

The width of the road varies, with much of the road between 13 and 17 feet in width and generally single lane. A number of small dirt pull-outs flank the roadway along its length. The entirety of the road is paved but for the approximately two mile section of road that extends from the main alignment to the Bear Creek Diversion. This section of road is very primitive, with an unpaved surface that runs over rough and uneven boulder strewn bedrock and crushed gravel.

The Mono-Bear Road was an integral component of the BCHSHD's initial development, providing the sole access to the Mono and Bear Diversions and associated siphon. While the alignment has been altered since construction, most notably by the application of pavement and several areas of widening, the uniform replacement of bridges and culverts and associated railings with modern utilitarian upgrades, and the ongoing addition of modern signage, the roadway and contextual surroundings continue to convey significance as a contributing resource of the BCHSHD through physical and operational integrity. The road still connects the high elevation areas of the system with the remainder of the project and it largely continues to reflect the original alignment and designed scale. The contextual surroundings, characterized by rugged alpine land and high mountain vistas coupled with views of key project features including the Mono-Bear Siphon and the Mono and Bear Creek Diversions, remain indicative of the original development period. Additionally, while open to public and recreational traffic, the road is still largely devoted to project operations and indicative of the infrastructural underpinnings of the system.

The boundary of the resource begins at Kaiser Pass Road at the intersection of Kaiser Pass Road and Lake Edison Road extending to the road's "Y" and subsequent termination at both Bear Creek Diversion and Mono Diversion. While the road continues a short distance further to Lake Thomas A. Edison, this portion is not part of the contributing linear resource as it is associated with later development themes that are not part of the district's significant period of development. Character defining features of the resource are its operational and physical alignment, the alignment's generally narrow single-lane width, the surrounding contextual vistas including mountainous alpine exposures and views of BCHSHD hydroelectric features including the Mono-Bear Siphon and the Mono and Bear Diversions. Paving, post-period of significance culverts and bridges, road signs, modern gates, and other basic utilitarian infrastructural features are not character defining features that contribute to the significance of the alignment.

Dawn Railroad (Noncontributing Structure)
The 4.6 mile Dawn Railroad was constructed in 1925 from the main alignment of the SJ&E to the west side of Shaver Lake. The standard gauge branch railroad was developed to support construction of Shaver Lake Dam, carrying cement, lumber, and other support supplies (**Figure 134**). As designed, the railroad snaked through forested mid-elevation hills, with a generally steady grade and few—if any—notable engineering features in addition to the dirt and gravel railroad bed, rails, and ties. Upon completion of the dam, the railroad was abandoned, and today the grade carries a narrow, gravel USFS road.[103]

While the Dawn Railroad was important in the development of Shaver Lake Dam, very little discernible material related to the railroad grade remains at present, with virtually all physical vestiges of the alignment removed but for the grade itself. This lack of physical and contextual integrity, coupled with the rather confined context of operational significance of the grade, precludes inclusion as a contributing resource to the BCHSHD. In contrast to the SJ&E, which served as a vital artery for project inception and completion, the Dawn Railroad was limited in size, scale, and operational integration, serving only one specific development feature of the project. Additionally, the remnant grade does not include any notable landscape or engineering features that are indicative of its development history, appearing much as any other USFS four-wheel drive road and lacking physical and associational integrity.

Survey of the former branch railroad alignment indicates that no cohesive elements of the railroad system remain, with the sole intact component being the gravel roadbed. No other extant rails, ties, or related features were observed along the alignment, with only diffuse and scattered historic period debris noted including isolated metal cable, cans, and nails in several locales that likely relate to railroad's period of operation. Because of this overall lack of physical integrity and interpretive value and the comparatively isolated operational role of the system, the former railroad alignment does not convey significance as an integrated rail corridor and is not a contributing element of the BCHSHD.[104]

Contextual Overview: Evolution of the Big Creek Transportation and Circulation System
Development of the Dawn Railroad was the last notable infrastructural addition to Big Creek's transportation system during the period of significance, and the last rail-related feature to be developed in association with the BCHS. By the mid-1920s, all operating components of the BCHS were accessible by company built roads which, as a transportation system, continue to serve the project to the present. By the late 1920s, the capabilities of auto transportation had grown substantially, with increasingly more powerful and capable automobiles and trucks largely supplanting rail transportation in commercial, industrial, and manufacturing settings. This large-

[103] Hank Johnston, *The Railroad that Lighted Southern California*, 88-89.
[104] P. Allen and M. Rossi, Cardno, Inc., Reconnaissance Documentation of Dawn Railroad Alignment, September 9, 2014; M O'Neill, D. Sterling, and M. Pomerleau, Pacific Legacy Inc., "Powerhouse No. 3 Footings DPR 523 Form," *Southern California Edison Company Shaver Lake District Deteriorated Distribution Line Poles Replacement Project Cultural Resources Inventory in Fresno and Madera Counties*, 2006. On file at SCE and the SSJVIC.

scale transition shaped the development of the BCHS circulation system, with company roads largely replacing dedicated rail lines. Within this context, the BCHS inclines and railroads went through a period of attrition beginning in the late 1920s, as the company moved exclusively to vehicular roadways for ongoing access and service. In the 1930s and 1940s the railroad and inclines were largely abandoned. In 1933, the SJ&E was dismantled. During the same period, the construction inclines were abandoned and salvaged, with some portions completely removed and others left in place and subject to neglect, deterioration, and exposure to encroaching vegetation. The present-day transportation system is characterized by multiple layers, with vehicular corridors from the historic period that have continuously been utilized and maintained to the present coupled with abandoned vestiges of historic period rail alignments that were instrumental in the system's establishment and subsequently eclipsed by changing technology and transport mandates.

Construction Camps (Noncontributing Site)

While the BCHSHD is characterized by a monumental industrial form, with massive hydroelectric facilities connected through permanent transportation infrastructure, the historical underpinnings of the district are rooted in a comparatively ephemeral concentration of labor, all of which was supported by a temporary system of company-built construction camps (**Figures 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146**). Beginning in 1911, Pacific Light and Power, and subsequently SCE, developed a far-flung network of temporary camps to support the massive influx of labor that undergirded development of the BCHS. As recounted in a 1913 *LA Times* article detailing the project:

> At the summons of capital, thousands of men went into the silent wilderness with pick and shovel, pointed steel and giant powder. With bent backs they made paths through the world-old granite; threw dams across the canyons; grappled with the plunging streams—dug, scraped, blasted, and built. After years of fierce toil that tried muscles, hearts, and souls the mastery over the mountains has been won. The waters have been subdued. The long silence of the mountain shall soon be restored. The boom of the blast, the sound of the riveter, the shouts of the mule drivers, the curses of men frenzied with labor will shortly pass away.

Although rather florid in tone, the article conveys an important historical characteristic of the BCHSHD. At its essence, the development of the system was a highly concentrated physical endeavor. Construction required the labor of thousands, all of whom entered a veritable wilderness at the outset of the project. The operational and design response to the challenges of this substantial and often dispersed labor pool was the development of a large number of temporary camps that could be developed and subsequently disbanded with maximum efficiency as project needs dictated (**Figure 147**). The legacy of this particular development context has lent the BCHSHD a multifaceted identity, in which scattered and largely isolated vestiges of the large-scale human labor behind the system stand intermixed with its enduring industrial operational features.

The following section presents a discussion of this system of construction camps, tracing the development of the camp network through the period of significance and analyzing the current conditions, associated features, and integrity of this type of resource as it relates to the significant themes of the district. The discussion is based upon contextual and archival research of the camps' development framework and reconnaissance inventory of all documented former camp sites undertaken for this study. Documented camps include all those that were identified in the historic period record through archival sources and mapping as well as any camp sites that have been inventoried and evaluated as part of previous cultural resource identification efforts.[105]

In general, the spatial orientation and layout of the system's construction camps followed the progression of hydroelectric development, with camps sited in direct relation to Big Creek's infrastructural development. As related by David Redinger, "So many camps, instead of one central location, were justified because a camp near the job had advantages over distant quarters." Within this context, the scattered camps operated as something of a singular functional network, with isolated camps built adjacent to construction activities and bound by central supply chains, standardized operational procedures, and common property types.

Through the duration of the project, camps were numbered sequentially, with different "series" that corresponded to the associated construction endeavors. Generally, camps were occupied only until completion of adjacent tasks, with operational infrastructure and facilities disbanded, abandoned, burned, or otherwise repurposed upon completion. As recounted by Glenn Burns, an SCE pack supplier of the camps in the 1920s:

> They just abandoned the camps, they just abandoned everything, then tore all the buildings down, that was a big expense a lot of people sure didn't like. They'd send a big crew and tear these buildings down, pull the nails out of the lumber, pile the lumber up there and another crew would come and burn it up.[106]

In many cases occupation spanned months, or less than a year; a smaller number of camps were occupied for longer terms that coincided with complex construction campaigns, such as that of the Ward Tunnel. In a few cases, camp sites were incorporated into permanent operational areas, in particular in the case of the town of Big Creek which became SCE's permanent headquarters and has continued to develop as a modern town and company support center.[107]

Camp construction was decidedly rudimentary in form. As evidenced by historic period photographs, PLPC and SCE plans and schematics, and textual documentation, buildings were

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[105] The survey methodology incorporates pertinent guidance from *National Register Bulletin: Guidelines for Evaluating and Registering Archaeological Properties*, United States Department of the Interior, National Park Service, 2000; *National Register Bulletin 24: Guidelines for Local Surveys: A Basis for Preservation Planning*, United States Department of the Interior, National Park Service,1977 (revised 1985).

[106] Theodoratus Cultural Research, *Oral History Interviews Pertaining to the Big Creek Hydroelectric Project*, Glen Burns pages 14-15, prepared for Southern California Edison, 1989, on file at SCE Northern Hydro Headquarters Library.

[107] David H. Redinger, *The Story of Big Creek,* 147.

uniformly of wood frame construction, with vertical board or canvas tent siding, and steel, wood shingle, or canvas roofs (**Figures 148**, **149**, **150**). In general, lower elevation camps were more likely to feature spare canvas-sided tents while higher elevation camps were built with lumber siding, attesting to rugged high elevation winter conditions. Buildings were generally constructed on timber framing or posts, with few—if any—concrete foundations other than those small foundations developed for operational machinery and infrastructure including air compressors and other mechanical equipment at tunnel camps and related construction sites. Beginning in the 1920s, development at the camps included a number of portable wood frame buildings and bunkhouses that were shipped via the SJ&E in ready to assemble pieces. In general, the rather primitive construction techniques and light materials attest to both the expediency of development and the temporary nature of the facilities that were only intended to serve immediate company purposes. As recounted by David Redinger, "it was not always easy to pick out desirable campsites, which had to be placed where the job would be served to the best advantage. Visitors seeing some of our former camp locations today are reluctant to believe we had such camps." [108]

Across the system, the construction camps were bound by a fairly uniform functional and material typology. Camps generally contained varying numbers of bunk houses or tents, a cook house, recreation hall, commissary, office, barns, warehouses, and various storage sheds. Some locations were developed with specialized facilities, including field hospitals, married quarters, and processing facilities including butchering and slaughtering yards for camp food supplies. As relayed in oral history interviews from the period, social and physical amenities were few, as workers spent the majority of their days—and daylight hours—on site at their respective construction campaigns, with only limited opportunity for recreation.[109]

Camps had a spectrum of rudimentary utility features, including in some cases piped water from adjacent creeks and fire hydrants and water towers for regulating water supply and fire protection. As evidenced by historic period plans, piping generally extended only to mess halls and larger bunk houses. As recorded by David Redinger, garbage was generally burned in the camps in the period of early development, with a hog disposal program developed for widespread garbage disposal by the early 1920s. Under this program, an SCE herd of several hundred hogs moved between camps to dispose of garbage and in turn were incorporated into the camp food supply chain. Records have not revealed a uniform sanitation system or method, with

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[108] Pacific Light and Power Corporation, "Big Creek Power Development, Topography West End Tunnel No. 1 and Camp No. 1," circa 1911. Schematic on file at SCE Northern Hydro Headquarters Library; Pacific Light and Power Corporation: "Map of Initial Development," as presented in Hank Johnston's *The Railroad That Lighted Southern California*, 36; Stone & Webster Engineering Corporation, Big Creek Construction Photos, Call Number 13-Vol 012, Southern California Edison Photographs and Negatives, The Huntington Library Photo Archives; Theodoratus Cultural Research, *Oral History Interviews Pertaining to the Big Creek Hydroelectric Project*, 8-9; David H. Redinger, *The Story of Big Creek,* 92.
[109] Plans and Schematics of Pacific Light and Power and Southern California Edison Camps on file at SCE Northern Hydro Headquarters Library; David H. Redinger, *The Story of Big Creek,* 102, 103, 160.

camps likely employing a varying system of privies and primitive disposal methods based upon camp size, complexity, occupation length, and geographic context.[110]

In addition to basic utility infrastructure, many camps were supplied with electricity that was delivered by local distribution lines from the Big Creek powerhouses. By the 1920s, some camps were also equipped with radio and telegraph capabilities for both company business and entertainment, with Big Creek's Camp 61-C on Kaiser Pass reported to have the highest radio station in the world in the 1920s. By the 1920s, movies were occasionally shown in camp recreation halls, a small luxury that was touted by company officials and workers alike.[111]

The most notable physical differences between camps related to geographic and environmental context. Because the project spanned thousands of feet of elevation, from the lower San Joaquin River Canyon to the high elevation Sierra, the terrain of the camps differed widely, with each camp exhibiting notable differences in surrounding landscape, slope, and environmental constraints. A number of the lower canyon camps were constructed on exceedingly steep terrain, particularly those between Powerhouse No. 8 and No. 3. The upper level camps, particularly those that related to the development of Florence Lake, were perched on scoured granite outcroppings, with heavy environmental exposure. These environmental differences contributed to the differing design solutions, with lower camps more likely to be comprised of tents and higher elevation camps of slightly more durable wood construction. This differing environmental context also has had a notable effect on the current conditions of extant camp features, with the scoured granite underlying much of the system precluding retention of notable ground surface features across many of the camps.

The construction camp table provides a listing of all construction camps that have been identified through archival research, review of previous cultural resource studies, and field surveys undertaken in support of this nomination. The table is organized by project facility and/or feature, with each associated camp listed in the adjacent column. While the list is representative of the major camps that supported construction, it is possible that there were additional temporary camps or small-scale settlements that were developed for various purposes during the period that have not yet been identified or inventoried. In addition, this overall resource type includes small-scale remnants not associated with established camps found throughout the project area, including cans, light historic period debris scatters, and small-scale concrete foundations that were utilized during the development period and subsequently abandoned. Additional Documentation includes a resource map depicting the location of each known camp site listed here. For the purposes of the Section 5 resource count, the construction camp property type is counted as a single noncontributing site.[112]

[110] David H. Redinger, *The Story of Big Creek,* 83-84.
[111] Plans and Schematics of Pacific Light and Power and Southern California Edison Camps on file at SCE Northern Hydro Headquarters Library; David H. Redinger, *The Story of Big Creek,* 111-112.
[112] Primary sources of information regarding the development of construction camps are SCE Plans and Archival Maps, on file at SCE Northern Hydro Headquarters Library in Big Creek, David Redinger's *The Story of Big Creek*, and numerous cultural resource inventories that have been conducted throughout the BCHSHD that have documented cultural material, artifacts, and likely camp sites.

BCHSHD Project Facility/Feature	Associated Construction Camp
Huntington Lake	• Camp 1 • Camp 1A • Camp 1C • Camp 1E
Tunnel No. 1 Flowline	• Camp 1B • Camp 1D • Camp 10
Powerhouse No. 1/Dam No. 4 Company Administration	• Camp 2 (Big Creek)
Tunnel No. 2 Flowline	• Camp 3 • Camp 4 • Camp 5
Powerhouse No. 2	• Camp 6 • Camp 7
Tunnel No. 5	• Camp 19
Shaver Lake Dam	• Camp 21 • Camp 22
Tunnel No. 8	• Camp 31 • Camp 32
Powerhouse No. 8	• Camp 33 • Camp 42
Incline No. 8	• Camp 42
Million Dollar Mile Road	• Camp 39 • Camp 39A
Tunnel No. 3	• Camp 34 • Camp 35 • Camp 36 • Camp 37
Powerhouse No. 3	• Camp 38
Powerhouse No. 3 Incline	• Camp 39
Upper Elevation Access and Support (Florence Lake, Ward Tunnel, Mono-Bear)	• Camp 59 • Camp 60 • Camp 61A, B, C, D, E • Camp 61 • Camp 62
Florence Lake Dam/Florence Lake	• Camp 63 • Camp 64 • Camp 65

BCHSHD Project Facility/Feature	Associated Construction Camp
Tunnel No. 7	• Camp 71 • Camp 72 • Camp 73
Pitman Creek Diversion	• Camp at Pitman Creek
Mono Diversion Dam	• Camp 80
Bear Diversion Dam	• Camp 86
Mono-Bear Siphon and Tunnel	• Camp 81 • Camp 82 • Camp 83 • Camp 84 • Camp 85
San Joaquin and Eastern Railroad (support and operation)	• Stevenson Creek Camp • Camp 30 • Camp 41
Dawn Railroad	• Camp 30

As a key infrastructural network established to support construction of the BCHSHD hydroelectric facilities, this sprawling system of construction camps has the potential to provide important insights and associations within the context of the BCHSHD. The development of the camps correlate with the physical establishment and expansion of the hydroelectric system, with camp construction and operation reflective of the ways in which Pacific Light and Power and subsequently SCE addressed the immense labor challenges involved to construct the BCHS. In this regard, study of the system could present the day-to-day labor, social, and environmental conditions that defined project development for the thousands of workers who found themselves in the wilderness above the San Joaquin River.

Despite this potential significance, a marked lack of physical integrity undermines the ability of the camp system to contribute to the significance of the BCHSHD. Prior NRHP evaluation of a cross section of individual camps has uniformly found that the camps lack sufficient physical integrity to convey significant associations or information regarding development of the BCHSHD, with system-wide documentation undertaken for this district nomination also finding that the resource type uniformly lacks integrity to convey significant associations. In general, the diminished integrity stems from a lack of built environment or engineering features, lack of any extant spatial relationships or organizational patterns, and the absence of notable or cohesive historic period deposits or archaeological resources that would yield significant informational potential about the period of development or operation.[113]

[113] See California Office of Historic Preservation (OHP) Consultation USFS081002: Determination of Ineligibility of CA-FRE-3378H, October 20, 2008 (Camp 1A); OHP Consultation USFS110415A: Determination of Ineligibility of CA-FRE-3409H, June 1, 2011, (Camp 7); OHP Consultation USFS081103E: Determination of Ineligibility of FS#05155301154, December 1, 2008 (Camp 36); OHP Consultation USFS071102A: Determination of Ineligibility of P-10-005539/FS#05531272, November 29, 2007 (Camp 61C); OHP Consultation USFS081103E: Determination

Field documentation and archival study of the system undertaken for this nomination effort revealed a consistent loss of physical and contextual integrity that appears to preclude coherent interpretation within the framework of the district. Documentation was undertaken in August, September, and October of 2014 and included background review and reconnaissance survey of all sites in order to characterize extant features and general characteristics of the site. For those sites that had the potential to convey any depth of deposits, survey incorporated metal detection and targeted probing to generally characterize the nature and depth of artifact deposits. The purpose of the field documentation was to characterize the physical characteristics and spatial organization of the sites as a system and to develop an informational framework for research potential, interpretation, and evaluation. While this system-wide analysis was intended to provide an evaluative framework for the documented camp sites in relation to the BCHSHD, it is possible that subsequent inventory and evaluation efforts may yield additional historic period features or undocumented resource types that will require further analysis under this general framework.[114]

Based upon this system-wide analysis, the camp system lacks sufficient integrity to convey physical associations or information within the context of the district. As temporary camps that were rapidly developed and largely disbanded and destroyed upon project completion, the camps present a uniform loss of physical material that precludes cohesive interpretation or association as part of the BCHSHD. The lack of integrity stems from both the temporary expediency of the camps' construction program and the almost universal program of abandonment that followed project completion, which rendered the sites physically and functionally obsolete only months or several years after establishment. Coupled with this immediate removal program, ongoing environmental and human exposure has continued to degrade physical and informational components of the camps over time, with environmental degradation and continuous human alteration further severing associations to the historic period.

At their essence, the camps were intended to house workers for brief and defined periods of time. Light timber framing defined development, with few permanent foundations or infrastructural features other than isolated foundations for small compressors and other construction elements. In addition, the layout of the camps reflected temporary mandates, with little overarching design, plan, or spatial orientation evident other than proximity to project features. The underlying

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of Ineligibility of CA-FRE-3375H, December 1, 2008 (Camp 62); P-10-05512/FS-05-15-53-1245 (Camp 64), recorded June 14, 2001, Pacific Legacy, Inc., in Jackson et al., *Inventory and Evaluation of Cultural Resources, Southern California Edison Company Big Creek Hydroelectric System Relicensing (FERC Project Nos. 67, 120, 2085, 2175*, 2005, On file at SCE Northern Hydro Headquarters, Big Creek, CA and SSJVIC; OHP Consultation USFS110307A: Determination of Ineligibility of CA-FRE-2928H, April 12, 2011 (Camp 71); OHP Consultation USFS081103E: Determination of Ineligibility of CA-FRE-1608H, April 22, 2009 (Camp 72); OHP Consultation FERC110901A: Ineligibility of CA-FRE-2929H, February 27, 2012 (debris associated with Camp 10).

[114] Michella Rossi, Darren Andolina, and Polly Allen, *SCE Site Monitoring Reports for BCHSHD Construction Camps*, submitted to SCE Northern Hydro Headquarters November 2014; United States Department of the Interior, National Register Bulletin 36: Guidelines for Evaluating and Registering Archaeological Properties, 2000.

infrastructure of the camps was comprised of only the most basic utility features, with limited water, sewer, electrical, and communication capacity.

Because of this generally temporary construction program and occupation framework, the subsequent period of abandonment, removal, and destruction effaced virtually all major physical features of the sites. Almost all major buildings, structures, and objects were removed, whether through salvage, destruction, or subsequent inundation. Because foundations and other notable infrastructure elements were generally absent, the removal program also undermined any discernible spatial relationships or physical associations within the camp sites. With some notable exceptions, following completion of the system in 1929 the bulk of the construction camps largely consisted of abandoned sites with few physical features other than scattered debris, small-scale infrastructural remnants, and only isolated buildings, structures, and objects. While other sites, including the town of Big Creek, continued to develop, original camp layouts and materials were eroded over time as ongoing development subsumed initial construction. Because of this near universal removal program, the former camp sites uniformly lack built environment features that would be indicative of the camps' significant period of development and operation, spatial relationships, or original built form.

Ongoing environmental exposure and human alteration has also continued to degrade the camp sites over time, further severing the sites from coherent associations to the development period. Many of the camps were developed in rugged mountainous terrain, clinging to cliffs as in the case of those along the San Joaquin River Canyon, and sited on bare granite bedrock as was the case with virtually all of the upper elevation camps associated with Florence Lake and the Mono-Bear System. While some lower elevation camps were sited in forested areas with thin soil cover, both the harsh conditions and unyielding bedrock below have served to leave little trace of development, with remaining artifacts generally scattered lightly on ground surfaces and limited to small-scale items including nails, wire, and small fragments of weathered wood or sheet metal. While several sites retain evidence of small subsurface artifact deposits, including cans and other small-scale debris, the isolated artifacts mirror those which appear at the ground surface. While these scattered items are indicative of the development period, they do not appear to have the potential to convey cohesive or representative information about camp life.

In addition to ongoing environmental degradation, continuous site disturbance has further eroded the spatial and physical integrity of any extant features associated with the camps. Most former camp sites have been subject to continuous recreational use, site disturbance, and in some cases ongoing redevelopment and forest management activities. In some cases, former camp sites have been entirely redeveloped for ongoing use by SCE, as many of the sites were developed in close proximity to working features of the system and therefore continue to serve as operational support areas. In other cases, sites have been disturbed through forest management activities, with some lower elevation sites located in USFS timber harvest areas. Many of the sites have been subject to ongoing vandalism and pothunting, with small-scale artifacts moved or removed from the sites over time and new materials introduced. Many of the sites display a mixture of artifacts from a range of time periods, from the 1910s to the present that preclude diagnostic analysis or interpretation.

Because of this pattern of diminished integrity, as a system the camps and scattered occupational remnants do not appear to yield physical associations, spatial relationships, or information that augments or enhances an understanding of the BCHSHD. As a resource type, the camps present a fragmented and physically diminished lens, with a paucity of physical relationships, spatial organization, and material that is indicative of the significant period of development. In contrast, the documentary record for the camps is robust, with oral histories, census records, periodicals, and SCE administrative records and photographs presenting a comprehensive portrait of camps and camp life that continues to convey the labor conditions of the system in a far more rich and illuminating context. In addition, the adjacent hydroelectric features themselves—including the dams, powerhouses, and massive tunnels—remain as testament to the immense labor required to develop the system, and remain important repositories for interpretation and understanding of Big Creek's labor context.

Administrative Services and Housing
While the majority of the construction of the BCHSHD was supported by temporary facilities for the project's large labor force, a smaller number of more substantial administrative and residential resources were developed to support project needs during the period of significance. The majority of these resources were located in the town of Big Creek, developed adjacent to Powerhouse No. 1 along the north side of Big Creek in 1911. Initially the settlement was simply termed Camp No. 2, reflecting the standardized naming convention of the camp system. As the site emerged as the company's headquarters and administrative center, the settlement was renamed Cascada, and subsequently Big Creek, with SCE Chairman John B. Miller appreciating the latter name's "ruggedness and big outdoors" sentiment.[115]

Big Creek Townsite (Noncontributing Site)
As initially developed, the settlement at Big Creek served as the linchpin for 1910s and 1920s system development, serving as the terminus of the SJ&E and the staging area for Incline No. 1, which delivered all construction equipment and materials to the Big Creek Basin above. The camp served as the company's administrative and operational center, with offices and dwellings for administrative level personnel and visiting officials and engineers. During the 1910s period of development, the camp was characterized by only rudimentary facilities, with scattered bunk houses, small guest houses, a commissary and cook house, and operational facilities including offices, a black smith shop, machine shop, and a small depot for the SJ&E. Additionally, two small barns and a small warehouse stood at the western edge of the site adjacent to the hoist line for Incline No. 1.[116]

[115] David H. Redinger, *The Story of Big Creek,* 13.
[116] Pacific Light and Power Corporation, "Map of Camp 2," August 14, 1912. Schematic on file at SCE Northern Hydro Headquarters Library.

By the 1920s, permanent dwellings and support buildings largely replaced the original structures, greatly expanding the scale and size of the camp. During this period a number of residential cottages were built for permanent employees, along with bunkhouses and dormitories for both personnel and visiting engineers and officials. In addition, by the 1920s the town had developed into two distinct spheres: with the lower half of the site, approximately 50 acres in size, a "company town" owned and managed by SCE and the upper portion, approximately 25 acres in size, a private town that was characterized by a range of residential and commercial development that largely catered to the adjacent SCE system (**Figures 151**, **152**).[117]

Big Creek continued to evolve through the twentieth century. From 1945 to 1955, SCE constructed 75 new residential cottages and a range of support buildings to accommodate ongoing operation of the BCHS. Concurrently, the company modernized older dwellings, with a siding program sheathing many of the 1920s buildings in asbestos shingles. In recent years, the majority of extant 1920s resources have been demolished, as SCE has embarked on a modernization campaign that has included substantial amounts of new residential construction as well as construction of a large headquarters building at the southeast entrance to town, completed in 2013.[118]

In 1999, the portions of Big Creek that dated to the 1910s and 1920s period of significance were documented as a contributing element to the BCHSHD, with all recorded as a single district called the Big Creek Townsite. At that time, the townsite included 13 resources from the period of significance, including 11 single-family houses and two dormitory buildings. In 2000, SCE entered into a Memorandum of Agreement (MOA) with the California State Historic Preservation Office that governed removal of resources related to the townsite under Section 106 of the National Historic Preservation Act (NHPA). Since that time, SCE has removed all of the townsite buildings except for Building 109: Redinger's House (constructed 1924); Building 176: Cookhouse (constructed 1924); and Building 177: Dormitory (constructed 1924). As stipulated by the MOA, representative building types were recorded under the Historic American Buildings Survey (HABS) Program.[119]

Field survey and analysis undertaken for this nomination finds that the ongoing physical removal of the majority of pre-1929 properties, along with the introduction of modern development into the townsite, has served to undermine the Big Creek Townsite's ability to convey significance as a cohesive contributing component of the BCHSHD. The comprehensive removal of buildings has had a cumulative effect upon the townsite by diminishing the integrity of the district's design, setting, materials, and workmanship, with both the physical buildings and structures and

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[117] Ward Hall, Big Creek Townsite DPR 523 Documentation, recorded June 1999, on file at SCE Northern Hydro Headquarters.
[118] Ward Hall, Big Creek Townsite DPR 523 Documentation; Laurence H. Shoup, *Life at Big Creek Town 1929-1947: Historic Context Statement and National Register of Historic Places Significance Evaluation,* submitted to SCE, December 1997.
[119] Ward Hall, Big Creek Townsite DPR 523 Documentation; *Memorandum of Agreement Between the Federal Energy Regulation Commission and the California State Historic Preservation Officer Regarding Removal of Big Creek Town Site Domestic Structures, Big Creek, Fresno County (MOA)*, January 2000.

accompanying spatial relationships undermined. This ongoing loss of physical fabric has degraded the feeling and association of Big Creek Town Site as a cohesive representative of the early twentieth century domestic and community development of the Big Creek Hydroelectric System. The Big Creek townsite does not appear to retain sufficient integrity to merit recognition as a distinct district contributor to the larger BCHSHD.

While the Big Creek townsite as a whole does not appear to retain sufficient integrity to merit consideration as a BCHSHD contributor, the extant 1920s buildings within the townsite—Cottage 109 and Buildings 176 and 177—do appear to retain sufficient integrity to merit continued eligibility as contributors to the BCHSHD. While the contextual and physical integrity of the three resources has been somewhat undermined by physical alteration and ongoing surrounding redevelopment, the three resources retain their ability to provide physical associations to the period of significance and continue to serve as personnel support facilities for the surrounding hydroelectric project.

Building 109 (Contributing Building)

Building 109 stands at the northwest corner of Big Creek Road and Manzanita Road, at the northeast edge of the town of Big Creek. The residential building was constructed circa 1912 as a cottage for upper-level project personnel and visitors and was occupied from the early 1920s to 1947 by Resident Engineer David Redinger and his wife Edith (**Figure 153**). Since then, the building has served as lodging and guest quarters for various SCE personnel and visitors. The cottage is the only residential dwelling that remains in Big Creek from the period of significance.

As designed, the building was of a simple front-gable cottage design, with a prominent raised porch running under the gable and a steeply pitched roof sheathed in metal. Originally wood-sided on a concrete perimeter foundation, the building is now sheathed in asbestos tile added in the 1960s as part of a modernization program. The roof remains metal-clad, with a modern standing seam roof. Several additions have altered the original front gable plan. In 1924, the building was enlarged with a cross gable addition lending the building a generally "T" shaped plan that frames the prominent raised porch. An exterior cobblestone chimney rises from the eastern wall of this latter addition. In the 1960s, the building was further modified by the placement of a prominent bay window feature on the southeast wall of the building. A rear addition was added in the modern period, which further extends the building into the sloping hillside. Windows appear irregularly throughout the building, with all featuring modern vinyl-framed inserts.

The residence stands on a gentle slope, with a vantage to the Big Creek Canyon below. Several mature pines stud the property, as well as several species of small domestic shrubs and fruit trees, likely planted during Edith Redinger's residence. Isolated areas of simple stone terracing line the hillside behind the house, also likely dating to the Redinger period. In addition to this modest landscaping, a modern concrete patio extends from the northeast side of the building.

The interior of the property has been subject to numerous renovations, with virtually all finishes, floor coverings, and fixtures of modern material and design. In addition, it appears that the original configuration has been altered by ongoing changes to room layout and partitions.

While the Redinger Cottage has diminished physical integrity by ongoing interior and exterior alterations including additions, exterior material replacements, and interior alterations, as the last of the original project cottages from the historic period the building retains significance as a contributing resource to the BCHSHD. The cottage retains strong integrity of location, setting, feeling, and association within the context of the hydroelectric district and exhibits a sufficient number of design features to convey associations to the historic period. Character defining features of the building include its location and setting in Big Creek, characterized by a sloping hillside extending to the Big Creek Canyon; its cross-gable design, excluding the post-period of significance additions, with a steeply pitched metal-clad roof, prominent front gable, and prominent chimney; and its centered raised porch accessed by wood stairs. While obscured by asbestos tile, any intact wood siding remains as a character defining feature. In addition, the modest landscaping surrounding the property, with pines and domestic shrubs and modest terracing remains as a contextual character defining feature. The interior of the house does not contribute to the significance of the building, as it lacks sufficient design and material integrity.

Building 176 (Contributing Building)

Building 176 was built in 1919 as a cookhouse and mess hall for SCE employees (**Figure 154**). The building is located between Cedar Avenue and Poplar Avenue, just west of Manzanita Road in Big Creek. A small grassy area studded with trees and shrubs frames the building, with a paved parking area extending from its west side.

The building is generally rectangular in plan, with a steeply pitched side gable metal-clad roof and concrete perimeter foundation. Small gable roof-covered porch entries extend from either end of the building, added in 1949. As designed, the building was sided in wood. Mid-twentieth century alterations included the addition of cement plaster to the lower half of the building and asbestos tiles to its upper half. Fenestration is rather spare, with the majority of the building featuring regularly placed wood frame six-over-six double-hung windows in wood surrounds. A small number of windows located on the west side of the building are tilt-out six-light casement, dating from the 1940s porch addition. Glazed entry doors appear at either gable end, both of which appear to be replacements to the original.

The interior of the cookhouse is generally divided into three spaces, from east to west: a lounge area, a dining room, and a kitchen. The upper floor features six small dormitory rooms that flank a central hallway, with two common restrooms and shower areas on the western side of the second floor. The interior reflects a number of different periods, with mid-twentieth century plywood and fiberboard walls and drop ceilings, fluorescent lighting, and modern fixtures coupled with historic period moldings, wainscoting, baseboards, and doors.

As a remaining personnel support facility from the period of significance, Building 176 contributes to the significance of the BCHSHD. Character defining features of the cookhouse include its location and setting within Big Creek, its rectangular plan with steeply pitched metal-clad roof, its regularly placed six-over-six wood frame windows in wood surrounds, and its original interior materials including moldings, baseboards, window framing, and wainscoting. In addition, its operational layout, defined by dining, cooking, and social areas on the first floor coupled with dormitory dwellings on the second, is of importance in that it is reflective of the building's continuous institutional use from the historic period.

Building 177 (Contributing Building)
Building 177 was constructed in 1919 as a cookhouse and subsequently used as guest quarters for SCE employees and visitors. The building is located on a triangular lot formed by Poplar and Spruce Avenues in Big Creek, directly south of Building 176. The north side of the building is fronted by a small lawn with shrubs and shade trees and the south side of the building is accessed by a small parking lot.

The building stands on a concrete perimeter foundation and is of a rectangular side-gable design, with prominent hipped roof dormer windows running along the north side and punctuating an otherwise spare design. Simple eave brackets appear throughout, providing an additional decorative allusion. The building extends into the slope of the hill, with a basement and two upper stories. As designed, the building had wood siding that was sheathed in asbestos shingle in the mid-twentieth century. The primary entrance is centered on the north side of the building, with a secondary service entrance on the south side. Fenestration consists of regularly placed six-over-six double hung wood frame windows, with several replacement single pane windows flanking the secondary service entrance. The primary entrance on the north side is a glazed multi-pane design, with sidelights, while the rear entrance is a recessed utilitarian service door. The roof is sheathed in modern standing seam metal.

The interior of the building consists of a lounge at the first level, surrounded by rooms that have been converted for office use. The upper level consists of four dormitory rooms, a storeroom, and bathroom. The layout and spaces have been reconfigured from the historic period, with the first floor adapted for use as offices and the placement of modern fiberboard, drop ceilings, and modern fixtures and floor coverings.

As a remaining personnel support facility from the period of significance, Building 177 contributes to the significance of the BCHSHD. Character defining features of the building include its location and setting within Big Creek, its rectangular plan with steeply pitched metal-clad roof and prominent dormer windows and eave brackets, its regularly placed six-over-six wood frame windows in wood surrounds, and extant original interior materials including moldings, baseboards, and window surrounds. The operational layout is of lesser continued importance, as the first floor has been reconfigured for office use and does not retain operational integrity, with only the second floor remaining in use as guest quarters.

Satellite Facilities

While the bulk of permanent residential and institutional construction was centered in Big Creek, ongoing operation of the hydroelectric system during the period of significance required the development of a number of satellite support facilities. Construction was largely centered around the system's remote powerhouses, with small residential communities adjacent to each powerhouse to house operators, supervisors, and maintenance personnel. In addition, several dam tenders' cottages were built during the period. Each powerhouse typically had a station chief and three to five operators working each shift, with round-the-clock shifts. In addition to this core staff, each powerhouse had maintenance and cleaning staff including electricians, machinists, oilers, and floormen. Because of the remote location of the powerhouses, all regular staff generally lived on site. Dam operation and maintenance was a more limited endeavor, typically limited to a single family or operator.[120]

Beginning in the mid-twentieth century and accelerating to the present, increased system mechanization and streamlined transportation undercut much of the rationale for continued occupation of the system's remote facilities. Increasingly, powerhouses required fewer operators and maintenance staff. For those that did remain, improved autos and smooth roads allowed for ease in previously untenable commutes. From the mid-twentieth century to the present, the majority of the satellite communities from the period of significance were demolished and removed or redeveloped, with housing at Powerhouses 2, 8, and 3 demolished and cleared. While isolated small-scale infrastructural features including concrete pads, retaining walls, and overgrown site vegetation remain in place within the vicinity of the powerhouse sites, these small-scale and utilitarian features lack integrity and associations to the period of significance. Only three contributing vestiges of this community development period remain intact at present and retain integrity to the historic period. In addition to these three contributing resources, extant satellite facilities from the historic period include two small domestic diversion dams that supplied drinking water for Big Creek, discussed later in this section.[121]

Huntington Lake Dam Tender's Cabin (Contributing Building)

The Huntington Lake Dam Tender's Cabin stands immediately southwest of Dam No. 2. The small wood frame residence was built circa 1913 to support operations and maintenance of the Huntington Lake Dam and is currently in residential use by the Fresno County Sheriff's Department. The building is sited on a granite outcropping overlooking the lake, framed by exposed granite, pines, and low shrubs.[122]

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[120] Ward Hill, *Historic Architecture Assessment of Worker Housing at Powerhouses 2/2A and 8, Big Creek Hydroelectric Project, Big Creek, CA*, submitted to SCE, October 1993, on file at SCE Northern Hydro Headquarters, Big Creek, CA.

[121] Laurence Shoup, Life at Big Creek Town 1929-1947: Historic Context Statement and National Register of Historic Places Significance Evaluation, submitted to SCE, December 1997, on file at SCE Northern Hydro Headquarters, Big Creek, CA.

[122] Pacific Legacy, Inc., *Southern California Edison Company Shaver Lake District Deteriorated Distribution Line Poles Replacement Project, Fresno and Madera Counties, California*, submitted to SCE, 2007 (see Dam Tender's DPR 523, P-10-005602).

The channel-wood sided building stands on a concrete perimeter foundation and is of a front-gable design, with a steeply pitched corrugated metal clad roof. The north side of the building facing Huntington Lake features a stepped-gable covered elevated porch that wraps around the northwest corner of the building and is accessed by wood stairs. A garage/shop entry lines the northeast side of the building, covered by a wood panel over-hung door. A small number of original three-over-three double hung windows appear throughout the building, with replacement wood panel doors on the north and west sides of the building. In general, fenestration is minimal and reflects a largely utilitarian and spare aesthetic.

The Huntington Lake Dam Tender's Cabin retains strong integrity to the period of significance and is a contributing resource of the BCHSHD. Character defining features of the building are its location and orientation toward Huntington Lake, its simple front gable plan with offset gable porch, wood siding, corrugated metal roof, and spare fenestration consisting of wood frame three-over-three windows. The interior of the building has been altered continuously to the present and does not contribute to the significance of the building.

Powerhouse No. 3 Hospital (Contributing Building)

The Powerhouse No. 3 Hospital was constructed in 1922 to support construction and operation at Powerhouse No. 3, the system's most isolated powerhouse during the period of significance (**Figures 142, 155**). Following completion of powerhouse construction, the building transitioned into use as a boardinghouse and cookhouse. The building remained in use as a cookhouse and recreation hall through much of the twentieth century, and is currently in use as an office facility for Powerhouse No. 3 operating personnel.[123]

The wood frame building is L-shaped in plan and perches on the southern lip of the San Joaquin River canyon, just south of Powerhouse No. 3. As originally designed, the building was framed by a wrap-around porch, enclosed in the 1920s to accommodate use as a boardinghouse. The building stands on a concrete perimeter foundation. As originally designed, walls were sheathed in lap wood siding that was covered in asbestos shingle in the mid-twentieth century. The roof is currently sheathed in corrugated metal, which while modern appears to be in-kind replacement of the original roofing material. Windows throughout have been replaced with modern aluminum, with all doors also replaced in the modern period.

Although the Powerhouse No. 3 Hospital has been altered to the present, with changes to the building's plan and historic period materials, it retains sufficient integrity of location, setting, feeling, association, and design to convey significance as a contributing resource of the BCHSHD. Character defining features of the resource include its prominent location on the San Joaquin River Canyon, and its L-shaped plan and gable profile. While currently obscured by shingles, any extant wood siding is also of importance. The interior of the building has been

[123] Southern California Edison, "Request for Concurrence under 36 CFR 800 Proposed Modifications to Big Creek No. 3 Clubhouse, Big Creek Hydroelectric Project Historic District, FERC Project 120," March 3, 2010, consultation with California OHP, on file at SCE Northern Hydro Headquarters, Big Creek, CA.

continuously modified and repartitioned and does not contribute to the significance of the building.

Florence Lake Dam Tender's Cabin (Contributing Building)
The Florence Lake Dam Tender's Cabin stands on the northwest shore of Florence Lake, immediately west of the Florence Lake Dam. The small wood frame residence was built in 1925 to support operations and maintenance of the isolated Florence Lake Dam. When constructed, the building was sited in a temporary work camp, Camp 64, which has since been redeveloped for continued staging and operations and is called the Florence Lake Work Camp. The buildings and infrastructure of the work camp date from a number of periods to the present, with the Dam Tender's Cabin the only remaining building from the period of significance.[124]

The small front gable residence is exceedingly spare in design. The building stands on granite bedrock, with a concrete perimeter foundation, and a combination of lap wood and board and batten siding. The steeply pitched roof features corrugated metal cladding and exposed wood rafter tails. A small number of regularly placed six-over-six wood frame windows line the building, with most covered in plywood or milled wood to protect from the harsh elements. A centered entry protected by a gable roof porch extension lines the east side of the building, facing Florence Lake, with an offset entry on the west side. Doors appear original or close to original in material and design. Dry laid stone terracing extends from the east and west sides of the building, with the remainder of the building surrounded by a combination of modern asphalt and granite bedrock. A single small shrub flanks the building, with no other notable landscaping. A small shed stands to the west of the building, mirroring the cabin in material and gable design. While appearing to date to the construction of the cabin, the shed has been altered by the placement of new windows and doors and the construction of new access stairs to the entry.

The Florence Lake Dam Tender's Cabin retains strong integrity to the period of significance and is a contributing resource of the BCHSHD. Character defining features of the building are its location and orientation toward Florence Lake, its simple front gable plan with centered gable porch, board and batten wood siding, steeply pitched corrugated metal roof, and spare fenestration consisting of wood frame three-over-three windows. The interior of the building has been altered continuously to the present and does not contribute to the significance of the building. Additionally, the modest shed in the rear of the building, of a utilitarian design and altered to the present, does not contribute to the significance of the building. The surrounding modern work camp, while indicative of continued operations and maintenance at Florence Lake, does not contribute to the significance of the cabin or the district as a whole.

Pitman Creek Domestic Diversion (Noncontributing Structure)
The Pitman Creek Domestic Diversion was built in the 1920s to provide water for localized use in the town of Big Creek. The small diversion is located approximately 0.5 miles east of

[124] Pacific Legacy, Inc., *Southern California Edison Company Shaver Lake District Deteriorated Distribution Line Poles Replacement Project, Fresno and Madera Counties, California*, submitted to SCE, 2007 (see Dam Tender's House DPR 523, P-10-005602).

Powerhouse No. 1 on Pitman Creek, with piping originally extending west to Big Creek. The diversion has been modified and is no longer in use, with the associated piping largely dismantled but for remnant portions.

As originally designed, the dam was a simple sand bag structure, augmented in 1929 by the development of a concrete dam that has been continuously augmented by sections of new concrete. The small dam is approximately 45 feet in length and ranges in height from 4 feet to 2 feet along its length. A notched spillway is centered on the dam. A remnant of the metal release gate is located on the north side of the dam, consisting of a one-foot diameter release gate and pipe with all operational hardware missing. Only small sections of intake piping extend below the dam, with water free-flowing into the creek.

The Pitman Creek Domestic Diversion was developed as a minor utilitarian accompaniment to support the development and occupation of the town of Big Creek. The dam has largely been dismantled, with key operational features missing or highly degraded. Because it served as a minor support element and lacks physical integrity, the diversion does not contribute to the significance of the district and is a noncontributing resource.

SnowSlide Creek Domestic Diversion (Noncontributing Structure)
The Snowslide Creek Domestic Diversion was built in 1929 to provide water for localized use in the town of Big Creek. The small diversion is located approximately 1.5 miles south of Powerhouse No. 1 on Snowslide Creek, with piping originally extending west to Big Creek. The diversion has been modified and is no longer in use, with the associated piping mostly dismantled except for remnant portions.

The small dam is approximately 45 feet in length and six feet in height, with a crest that is one-foot in width. A ten-foot spillway is centered on the dam, with an outlet pipe extending from the east side of the dam. The piping is broken and removed in some areas and is a mixture of historic period material and 1940s replacement piping. The dam is currently non-operational and is obscured by fallen trees and debris.

The Snowslide Creek Domestic Diversion was developed as a minor utilitarian accompaniment to support the development and occupation of the town of Big Creek. The dam has largely been dismantled, with key operational features missing or highly degraded. Because it served as a minor support element and lacks physical integrity, the diversion does not contribute to the significance of the district and is a noncontributing resource.

District Integrity
As a multi-component operating assemblage, the BCHSHD retains strong integrity to the period of significance. The contributing resources of the district retain key physical characteristics, operational and spatial relationships, and design features that readily illustrate the historic identity and significant themes of early twentieth century hydroelectric development. In addition, the resources of the BCHSHD largely continue to operate as designed, with the system

continuing to generate hydroelectricity in the manner in which it was envisioned. In this sense, the BCHSHD provides both a significant portrait of early twentieth century hydroelectric design and an illustrative model of the enduring engineering and design themes that undergird the continued operational significance of the district.

While the operational features of the BCHSHD generally retain a consistently high level of physical and functional integrity, the system's underlying support resources, including transportation networks, construction camps, and administrative services and housing convey a spectrum of integrity conditions, with some entirely lacking critical aspects of integrity and others retaining sufficient physical characteristics to convey significance. Many of these related resources have been abandoned or removed over time, particularly in the case of the construction camps and housing sectors. Additionally, key historic period transportation features have been abandoned or augmented with some conveying strong integrity to the historic period and others largely effaced at present.

Within this general integrity framework, the district as a whole readily demonstrates all aspects of integrity, including location, design, setting, materials, workmanship, feeling, and association. Contributing resources of the district convey a strong sense of time and place and illustrate the system's significant themes of development. Noncontributing resources, while lacking critical aspects of integrity that preclude inclusion, do not undermine the district's ability as a whole to convey significance. Further, the district's setting within a larger modern operating hydroelectric system does not undermine the integrity of the assemblage. Rather, the continued foundational and functional importance of the BCHSHD at the heart of the modern operating BCHS underscores the innovative engineering, design, and construction of the historic district.

Each of the seven aspects of integrity is discussed here with district-wide analysis related to each aspect. Focused integrity discussions related to all contributing and noncontributing resources are included in the resource discussions that preceded this section.[125]

Location

The placement and location of resources, both individually and as an interconnected system, is of vital importance to the BCHSHD. The system's dams, flowlines, powerhouses, and transmission features were designed and constructed to operate as an interconnected whole, with the location of each mandated by precise environmental and engineering constraints. Within this context, BCHSHD retains strong integrity of location, with the contributing resources of the district remaining in the same location and exhibiting the same spatial and operating relationships as developed in the period of significance.

Design

The BCHSHD was designed to develop and transmit hydroelectricity from the mountains of Fresno and Madera Counties to urban spheres in Los Angeles. While the resources of the district

[125] *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, United States Department of the Interior, National Park Service,1990 (revised 1997).

include a spectrum of property types, all associated resources aligned with this overarching principle that remains the central design and operational tenet of the BCHSHD today. In general, the district retains high integrity of design, with all contributing resources conveying significant design features, through their physical form, structural and operational plan, and engineering design. Additionally, while the majority of district contributors are industrial in design and form, those resources that were developed with aesthetically heightened design treatments—most notably the powerhouses and substations—retain these significant design overtones at present, including neoclassical and Art Deco stylistic elements that separate the resources of the district from the more utilitarian features of the modern period.

The key design feature governing the development of the BCHSHD was the interconnectivity of resources, with each element of the system designed to function within an operational whole. In this sense, the monumental form of a powerhouse was designed in relationship to both the watershed and surrounding environmental terrain, as well as to the accompanying hydroelectric facilities including dams, flowlines, and transmission facilities. After over a century of operation, the resources of the district still retain this design integration, with each major resource continuing to operate as designed.

While many resources have been maintained and rehabilitated over time, including repair and replacement of constituent components and upgrade of engineering and operational features, such ongoing maintenance has exhibited a compatible industrial design and served to assure operational integrity. Further, these functional alterations have generally left key historic period design features in place, including massing, plan, and detailing, with contributing resources displaying integrity through their historic period engineering and aesthetic design features.

While the BCHS as a whole has continued to expand to the present, the operational and physical design of the historic core of the BCHSHD retains much of its original operational and physical form, with only isolated areas that have been altered by the ongoing development of new hydroelectric features. Further, this ongoing hydroelectric expansion, while modern and utilitarian in form, is of the same basic industrial and operational character and is therefore compatible with the significant themes of the district.

Although BCHSHD's primary operational features, including dams, flowlines, powerhouses, and transmission features, exhibit strong integrity of design, the majority of the system's construction support, administrative, and residential resources exhibit compromised design integrity, with widespread removal and alteration throughout the system. The design and layout of the construction camps has been largely effaced by removal and ongoing environmental degradation, entirely undermining integrity of design. Similarly, because the majority of the system's historic period residential facilities, including those of the town of Big Creek, have been removed, this property type generally lacks integrity of design and is not able to convey significant design themes within the framework of the district. These support resources generally do not reflect sufficient integrity of design to contribute to the significance of the district.

Setting

Setting is of particular importance to the BCHSHD, as the industrial form of the system was developed and defined in relation to the surrounding physical environment. Hydroelectric resources were placed in accordance with surrounding terrain, with the development of reservoirs dependent on the surrounding watershed, and flowlines and powerhouses placed in relation to surrounding topography and terrain conditions. In this sense, the manmade resources of the district were developed in constant interplay with the surrounding natural setting, with one informing and defining the other.

In general, the contributing resources of the BCHSHD retain high integrity of setting. During the period of significance, the setting of the district was one of virtual wilderness, with little development other than the industrial features of the system and an environmental context that was defined by mountainous exposures, steep canyons, forested slopes, and marked drops in elevation. This environmental context remains, with BCHSHD features surrounded by largely undeveloped USFS lands that provide a visual backdrop that is reflective of the development period. While the century since development has continued to see expansion of recreational and residential development around the BCHSHD, in general this ancillary growth does not undermine the ability of the district to convey significance through integrity of setting. Most major project features remain geographically and physical isolated, framed by steep canyons, mountainous exposures, and forested slopes. In this sense, the setting remains comparable to that which defined development, and the interrelationship of project features and surrounding environmental constraints is readily discernible.

The most notable diminishment of setting occurs along the transmission corridors leading from the project, including the Big Creek East and West Lines and the Vincent Line and their associated substations. Because these linear alignments extend through populated areas of the San Joaquin Valley and Los Angeles environs, the surrounding setting is characterized by a spectrum of ongoing development, including agricultural, suburban, and urban growth. Despite this continued evolution, the transmission corridors, and their relationship to both the BCHS hydroelectric facilities and the associated transmission substations, continue to convey cohesive engineering and operational associations within the framework of the district.

An additional area of compromised setting generally includes several of the district's reservoirs that have been developed with recreational and community facilities, in particular Shaver and Huntington Lakes. While this development impinges upon the generally wilderness setting that was a hallmark of the period of significance, the reservoirs do retain a sufficient integrity of setting that can convey both their relationship to the district as a whole and their relationship to the surrounding terrain and watersheds. Further, a number of the reservoirs, including those of the high elevation—Florence, Bear, Mono—and those small reservoirs serving as powerhouse forebays remain generally undeveloped with much the same setting as that of the historic period.

Materials

The monumental industrial form of the BCHSHD is comprised of a small number of core materials, all of which retain high integrity to the period of significance. The system's powerhouses and substations were primarily constructed of concrete and steel; tunnels and flowlines of steel, concrete, dry-laid rock, and blasted granite; dams of concrete and steel; and transmission features of steel, aluminum, and concrete. In most senses, the bulk of this original material remains, with only modest alterations to that which was initially developed. In the case of the tunnels, in particular, material integrity is exceedingly high, with the rock tunnels entirely reflective of the construction period.

The most notable areas of diminished material integrity include a number of dams, where earth fill has been placed against the original concrete to prevent spalling and damage. While this placement has visually undermined material integrity, the original concrete form remains and is of essential importance in the operation of the features. A second area of diminished material integrity includes the interior operational features of the powerhouses and substations, where original operational components have been replaced or moved. While some original features remain, most notably original casing for the turbines and generators, much of the original material has been removed or augmented in order to maintain operability and technological viability. In this sense, these material alterations are key to the continued operation of the system and are generally compatible in form and do not diminish material integrity such that the resources cannot convey significance. Third, the district' s circulation networks, including roads and rail networks, exhibit a spectrum of material conditions, with some areas very poor and mostly removed, and others generally reflective of the material conditions of the development period. The material integrity of the district's construction camps and residential components is generally poor, as these features have been removed or are highly materially degraded.

Workmanship

The BCHSHD's complex integration within the framing natural environment conveys a strong sense of workmanship that retains high integrity. As envisioned by John Eastwood, and subsequently expanded by SCE, the BCHSHD was designed to harness natural forces related to hydrology and environmental terrain to generate electricity. This energy transfer was accomplished by strategically placed tunnels, reservoirs, and generating facilities, which together continue to convey a sense of industrial workmanship in relation to this overall task. In particular, the district's 36 miles of tunnels convey a strong sense of workmanship, with countless blasts of dynamite etched into rock faces deep underground. Additionally, the system's sprawling interconnections convey important elements of industrial workmanship, with district features operationally bound over hundreds of miles. In this sense, the BCHSHD conveys a strong sense of workmanship not by finely wrought details or small embellishments, but instead through its sheer scale and engineering audacity.

While much of the district's workmanship is readily conveyed, some elements of workmanship have been undermined, most notably as it relates to residential and construction elements as well as elements related to the district's rail systems. For these resources, integrity of workmanship is generally fair to poor, with most physical vestiges removed.

Feeling

Because the BCHSHD has continued to operate in much the same manner as it was designed, the district readily conveys significance through strong integrity of feeling. The significance of the district is derived from its pioneering role in early twentieth century hydroelectric generation, a feeling that is consistently conveyed by the contributing resources at present through their integrity of location, design, setting, workmanship, and materials. A strong sense of feeling is conveyed by individual resources themselves—whether the churning tailraces of a powerhouse, plunging vertical line of a penstock, or meandering curve of a primitive canyon access road. Additionally, the assemblage as a whole evokes feelings of the period of significance, with the integration of the features readily illuminating a sense of time and place.

While the district generally conveys strong integrity of feeling, this aspect has been compromised as it relates to the construction camps and other residential amenities of the district. Because these features lack integrity of design, workmanship, materials, and setting they are unable to convey feelings within the framework of the district.

Association

As a historic component of an operating hydroelectric system, the BCHSHD retains rich associations with hydroelectric generation in California. The district retains a continuity of function, physical form, and spatial layout that is devoted to hydroelectric generation and is therefore readily associated with many significant themes of development within this context. Further, as the layout of the BCHSHD continues to be largely the same as that which was envisaged in early surveys, the district retains intimate physical and structural associations to the development period.

Character Defining Features

The BCHSHD retains a spectrum of key physical features, spatial relationships, and operational linkages that enable the district to convey significance as a pioneering early twentieth century hydroelectric development. The character defining features of the district are summarized here, with character defining features for all contributing resources included as part of the individual resource descriptions in the preceding pages of this section.

- Cohesive functional and operational linkages between hydroelectric resources.
- Within the core district area that includes the hydroelectric resources, a surrounding terrain that is characterized by mountainous exposures, heavily forested steep hillsides, and a generally rugged, undeveloped surrounding context.
- A sprawling engineering and operational plan that is characterized by substantial distances between resources and a linear operational relationship that extends from the hydroelectric generating facilities to the Southern California transmission-related facilities.

- A generally massive industrial scale, with large powerhouses, dams, tunnels, and water conveyance pipes.
- A range of industrial property types, including power houses, tunnels, flowlines, reservoirs, transmission lines, and substations that exhibit differing materials, massing, and structures but are bound by a common operating framework.
- A design and form that fuses industrial mandates with key architectural allusions, including Classical Revival and Art Deco influences.
- A dedicated project circulation system, with generally rugged, small-scale secondary roads accessing project features.
- Immense vertical distances between project features.
- A surrounding environmental and developmental context that spans from the generally remote mountains of Fresno and Madera Counties to the urban environs of Los Angeles.
- Project features that are deeply integrated to surrounding landscape, with hard rock tunnels, reservoir basins, vertical penstock descents, and bedrock foundations for major generation facilities.
- Cross-district vistas, with district contributors separated by miles of terrain evident from key view points within the district.
- Continuity of operation, with BCHSHD contributors continuing to function within their original physical development context.

8. Statement of Significance

Applicable National Register Criteria
(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing.)

- [X] A. Property is associated with events that have made a significant contribution to the broad patterns of our history.
- [ ] B. Property is associated with the lives of persons significant in our past.
- [X] C. Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.
- [ ] D. Property has yielded, or is likely to yield, information important in prehistory or history.

Criteria Considerations
(Mark "x" in all the boxes that apply.)

- [ ] A. Owned by a religious institution or used for religious purposes
- [ ] B. Removed from its original location
- [ ] C. A birthplace or grave
- [ ] D. A cemetery
- [ ] E. A reconstructed building, object, or structure
- [ ] F. A commemorative property
- [ ] G. Less than 50 years old or achieving significance within the past 50 years

Areas of Significance
(Enter categories from instructions.)
COMMUNITY PLANNING AND DEVELOPMENT
ENGINEERING

Period of Significance
1909-1929

Significant Dates
N/A

Significant Person
(Complete only if Criterion B is marked above.)

Cultural Affiliation

Architect/Builder
Eastwood, John S [Engineer]
Pacific Light and Power Company/Corporation
Stone and Webster Construction Company
Southern California Edison

Statement of Significance Summary Paragraph (Provide a summary paragraph that includes level of significance, applicable criteria, justification for the period of significance, and any applicable criteria considerations.)

The Big Creek Hydroelectric System Historic District (BCHSHD) is eligible for the National Register of Historic Places under Criterion A in the area of Community Planning and Development and in the area of Engineering at the state level of significance for its association with the physical development of California and its influence on California's hydroelectric generation industry. The significance stems from the direct influence on the power supply of a rapidly developing early twentieth century Los Angeles and environs and its role as a catalyst and template for subsequent hydroelectric generation projects across the state that ultimately served to foster urban community growth across the state. The district is also eligible under Criterion C in the area of Engineering at the state level of significance as an unparalleled California representative of early twentieth century hydroelectric engineering and development. The period of significance for the district is 1909-1929. The period begins with initial construction of the hydroelectric system and spans the years of intensive foundational development that wrought a hydroelectric system that was at the vanguard of technological and engineering innovation. In addition, the period of significance encompasses a critical phase of development for the hydroelectric industry as a whole. During this period, the industry developed and maintained an unrivalled centrality in California's explosive urban, industrial, and agricultural growth, with the complex engineering framework of water storage, conveyance, and generation providing the structural basis behind urban development hundreds of miles away. Following the period of significance that was characterized by a rapid succession of critical technological advances—many at Big Creek—the primacy of the hydroelectric industry was increasingly overshadowed by subsequent steam-based energy innovation that dominated California's electrical grid by the mid-twentieth century. Within this development context and period of significance, the BCHSHD stands as a physical, technological, and environmental testament to the intimate and evolving relationship between water and energy in California's historical development.

Narrative Statement of Significance (Provide at least **one** paragraph for each area of significance.)

Historical Development Context

"Electricity is destined to be one of the most powerful factors entering our social condition, it must bring forth changes in the social order which are even now hardly realized."

Scribner's Magazine, 1890

"It gives me great pleasure to inform you that I have completed the survey for a tunnel line to the junction of Pitman and Big Creeks and I can place before you the most remarkable power project yet presented."

John Eastwood, 1902

Origins of California's Hydroelectric Industry

By the closing decades of the nineteenth century, the development and consumption of electricity had come to define the possibilities of modernity for both California and the nation. Ushering in a host of modern marvels, including widespread civic and residential lighting, public transportation, industrial development, and a radically altered commercial and domestic sphere, the advent of electricity became a singular fixation, transforming the lives of millions in mere decades. In its initial years of popular advancement, the nascent industry was defined as much by its constraints as its possibilities, with seemingly intractable physical and technological barriers preventing widespread development and public adoption. Overcoming these barriers to mass production became the central theme of early electrical expansion, with engineers, financiers, and an engrossed public marking every advancement with fanfare, pomp, and a seemingly universal conviction of electricity's ultimate transformative power.[126]

California's nineteenth century electrical industry was hampered by two primary material deficiencies, with the first stemming from a paucity of readily exploited fuels. The state lacked critical coal deposits and other readily utilized carbon resources, with oil exploration still in relative infancy. In addition, while areas of the state boasted abundant forests, much of the state was devoid of extensive tree cover. As a result, early electrical generation schemes were limited in both scalability and reach, with only isolated success stories involving gas, coal, wood, and other traditional fuel sources.[127]

Although California failed in these measures of material abundance, the state's nascent electrical industry soon realized the vast untapped potential of a seemingly limitless resource of mountain water; in particular, the waters that thundered down the steep flank of the Sierra Nevada. Unlike the relatively flat rivers of the east and Midwest, the state's water flows were characterized by widely disseminated watersheds with astonishingly steep descents, with the snowpack of the Sierra continuously relaying flows to the valleys below via an intricate network of abundant rivers and streams. Within this geographic context, the Sierra Nevada presented ideal conditions for hydroelectric generation, which requires sharp drops and sustained flows to produce power.[128]

In many senses, the commercial exploitation of hydropower was not wholly new, and owed much to California's intensive mining era. Primitive hydroelectric systems had emerged from California's mining industry as early as the 1870s, with a number of mines producing sufficient supplies for private use, thereby increasing efficiencies and yield. In addition, the commercial

[126] Joseph Wetzler, "The Electric Railway of Today," *Scribner's Magazine*, April 1890, 7; Coleman, Charles M. *PG&E: The Centennial Story of Pacific Gas and Electric Company, 1852-1952*. (New York: McGraw Hill Book Company, Inc., 1952), 189.
[127] James C. Williams, *Energy and the Making of Modern California* (Akron, OH: The University of Akron Press, 1997), 168
[128] Thomas P. Hughes, *Networks of Power: Electrification in Western Society: 1880-1930* (Baltimore: Johns Hopkins University Press, 1983), 278-280; James C. Williams, *Energy and the Making of Modern California*, 168-198.

expansion of the hydroelectric industry was founded upon basic mining principles that had been in use for decades, including tunnel driving and hydraulic engineering. The profound shift that vaulted commercial hydroelectric development to the forefront of electrical advancement related to the solution of the state's second material constraint: the development of effective transmission methods over large-scale distances.[129]

While the towering wall of the Sierra had long been known to present lucrative opportunities for hydro-generation, the great distances separating the mountains from the state's major population centers had always precluded viable statewide development. As late as the 1880s, effective transmission was largely limited to an approximately ten mile sphere, with available direct current (DC) technologies precluding reliable service delivery outside of an exceedingly limited radius. Solving the transmission puzzle became the defining electrical pursuit of the late nineteenth century, leading to the revolutionary adoption of alternating current (AC) systems that phased and stepped power along the transmission corridor to conserve and maintain voltage levels. AC experimentation began in Europe in the 1870s, and by the 1890s had proved to be vastly superior to DC current, with a test demonstration of 112 miles between Lauffen and Frankfurt, Germany in 1891 leading to widespread adoption and development.[130]

By the 1890s, three-phase AC electrical transmission had been implemented at a number of early hydroelectric plants in California, including: Redlands Electric Light and Power Company's Mill Creek Power Plant, the Sacramento Electric Power and Light Company's Folsom Power House, and the San Joaquin Electric Company's Powerhouse No. 1 on the San Joaquin River. At Mill Creek, AC transmission sent 2400 volts of power 7.5 miles to the City of Redlands; at Folsom, two years later, transmission length had jumped to 22 miles, with an output of 11,000 volts; the same year, the San Joaquin Powerhouse sent 11,000 volts 37 miles to Fresno. While these distances and voltages seem modest in scale related to modern applications, they proved revolutionary in establishing the commercial viability of AC hydroelectric generation in California. By 1895, the burgeoning long-distance hydroelectric industry was central to California's conception of future growth, with the *San Francisco Call* summarizing the phenomenon:

> A new kind of hustler has arisen within the past three or four months, he has been rapidly multiplying and filling the earth. He is the promoter of new electrical enterprises, and especially the promoter of schemes for the long-distance transmission of electric power. The air of the whole Pacific Coast has all at once been filled with talk about setting up water wheels in lonely mountain places and making them give light and cheaply turn other wheels in towns miles away.[131]

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[129] James C. Williams, *Energy and the Making of Modern California,* 168-170.
[130] James C. Williams, *Energy and the Making of Modern California,* 174.
[131] Darrell W. Heinrich, "Mill Creek No. 1: Pioneering Commercial Electric Power," *Hydro Review,* October 2002; *San Francisco Call* Article quoted in *Energy and the Making of Modern California,* 177.

Thus, by 1900, hydroelectricity had become one of the central tenets of California's physical growth and economic expansion. As chronicled by James C. Williams, a central historian of the development of energy in California, "before the mid-twentieth century, electric power in California meant hydroelectricity," with energy development and hydroelectric expansion virtually synonymous. With the ready abundance of ideal natural watersheds coupled with the radical strides in AC transmission technology, the state became an ideal proving ground for advancements in the industry, with both engineers and investors flocking to the rapidly evolving arena. The origins of the BCHS stem from this development framework, with the planning and engineering of the system representative of the next great stride in electrical advancement, in which the experimental—and comparatively small—successes of the industry's early advances were writ large in an entirely unprecedented manner.[132]

Early Planning of the BCHS

Within this overarching early twentieth century hydroelectric context, the BCHS emerged as California's most ambitious and advanced development scheme, with development of the system providing an unparalleled engineering model for subsequent hydroelectric growth in the state. Located in the rugged Sierra Nevada, approximately 240 miles from Los Angeles, the area was endowed by precipitous drops, abundant water channels, and strategic powerhouse development sites, characteristics that were critical in hydroelectric development. Translating this latent physical potential to viable operational reality was a decade long process, with the earliest formal surveys and engineering plans dating to 1902, and completion of the first phase of the project in 1913. The engineering and construction campaign was decidedly the most complex and expansive undertaken by the hydroelectric industry to date, and culminated from a distinct ensemble of key figures, economic mandates, and development trends.[133]

While development of a hydroelectric system is predicated upon precise environmental conditions, the massive capital outlay that undergirds such development is driven by demand. Thus, while hydroelectric systems are generally remote and far-removed from population and capital centers, they are thematically, functionally, and operationally intertwined with the urban and populated areas they serve. In the case of the BCHS, development arose from the staggering growth of Los Angeles at the cusp of the twentieth century. In 1880, the City of Los Angeles had a population of just over ten thousand; by 1900, the city boasted 102,000, booming to 319,000 by 1910. This growth was accompanied by widespread suburban expansion, with cities and towns springing up around the historic confines of the city. The radical population explosion cemented the city as Southern California's premier urban area, and necessitated a sustained expansion of civic, commercial, residential, and institutional development. Within decades, satellite rings of urban and suburban developments ringed the Los Angeles Basin, transforming a largely rural hinterland to a modern and thriving twentieth century hub. The rapidity of change became a defining characteristic of the era, with the *Los Angeles Times* opining in 1895, "So brief a time has elapsed since Los Angeles was a quiet, easy-going town, in the center of a pastoral community, that even our residents have scarcely yet become accustomed to regarding this as a

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[132] James C. Williams, *Energy and the Making of Modern California*, 168;
[133] Myers, *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company,* 102-105.

commercial city, but it is not too much to say that many of our citizens who are today past middle age will live to see Los Angeles classed among the leading commercial cities of the United States."[134]

Within this dynamic early twentieth century development context, real estate and railway entrepreneur Henry E. Huntington emerged as one of Los Angeles' most powerful civic figures, serving as much of a self-appointed, and self-interested, urban planner in the rapidly developing milieu. The nephew of "Big Four" founder Collis P. Huntington, Henry had established himself as Vice President of the Southern Pacific Railroad (SPRR) by the 1890s. In 1900, after losing operational control following his uncle's death, Huntington sold SPRR shares for a substantial fortune, moving from San Francisco to Los Angeles. Once in Los Angeles, Huntington turned to real estate development and, perhaps most importantly, the architecture of an expansive streetcar system. The streetcar system, which ultimately grew to over a thousand miles in breadth, did much to define the terms of Los Angeles physical development. Additionally, the large energy demands of this sprawling urban transportation system predicated the development of the BCHS, with the BCHS providing the infrastructural means toward Huntington's primary development ambitions that included the interurban rail network and his real estate development interests in the Huntington Land Improvement Company (HLI).[135]

In 1902, Huntington assumed control of the Los Angeles Electric Railway Company and formed the interurban Pacific Electric Railway Company, establishing the "Red Car" and "Yellow Car" as the area's formative mass transit. Concurrently, Huntington turned to the task of powering these emerging enterprises, joining utility entrepreneurs William G. Kerckhoff and Allan C. Balch in the formation of Pacific Light and Power Company (PLPC) in 1902. Kerckhoff and Balch had been very active in the electric utility industry since the 1890s, forming the San Gabriel Electric Company in 1896. By 1909, the trio, under the masthead of PLPC, held five hydroelectric plants and three steam powered generating plants, supplying power for the rapidly expanding railway system as well as a range of commercial, agricultural, and urban lighting endeavors. While Huntington's substantial financial reserves formed the basis behind much of the development of this utility empire, in day-to-day managerial and operational practice he relied heavily on Kerkchoff and Balch and an array of engineers and mid-level managers, instead focusing much of his attention on his urban portfolio of rail and real estate.[136]

During this period of consolidation, Kerckhoff and Balch acquired the San Joaquin Electric Company, run by one of the era's most accomplished and audacious hydroelectric engineers, John Samuel Eastwood. In 1895, Eastwood had developed San Joaquin Powerhouse No. 1, with the world's longest commercial transmission line, at 37 miles, running to Fresno. While

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[134] 1850-2010 Historical US Census Populations of Counties and Incorporated Cities/Towns in California, California Department of Finance, accessed at http://www.dof.ca.gov/research/demographic/reports_papers/index.php#reports, July 1, 2015; "Commercial and Financial: A Commanding Location," *Los Angeles Times*, January 1, 1896.
[135] Myers, *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company,* 52.
[136] William B. Friedricks, *Henry E. Huntington and the Creation of Southern California* (Columbus: Ohio State University Press, 1992) 48-67, 117.

Eastwood was a remarkably adept engineer, he proved a far less savvy businessman, with his San Joaquin Electric Company bankrupt by 1899. Although Eastwood had lost operational and financial control of his enterprise, he soon became integral to the ambitious expansion of PLPC, providing the overarching blueprint for the company's development at Big Creek.[137]

In light of Eastwood's unrivalled intimacy with the Southern Sierra watershed and his proven engineering acumen, Balch, Kerckhoff, and Huntington commissioned him to continue conducting surveys of the mountains east of Fresno, funding his expenses and offering him a ten percent stake in any project that ultimately came to fruition. Eastwood had been traversing the area since the 1890s, developing a patchwork of water rights claims and conceptual plans in addition to his San Joaquin Powerhouse No. 1. Unable to secure financial backing, and lacking necessary capital, Eastwood's larger ambitions had generally gone unrealized, with the scale of his vision far outpacing available capital and technology. Following his alignment with the PLPC, Eastwood gained a ready audience for grandiose plans, gradually honing in on the basic framework for the BCHS that included Huntington Lake, Shaver Lake, and three powerhouse sites (Powerhouse Nos. 1, 2, and 3) that could provide an unprecedented 185,000 horsepower of energy. Importantly, Eastwood's vision also included significant potential for expansion, with a 1903 report noting the as-of yet unincorporated power potential of the main branch of the San Joaquin River.[138]

Even considering the financial resources and ambitious nature of Huntington's expanding urban utility and transportation empire, the scope of Eastwood's proposed project was massive, with anticipated initial costs soaring well past ten million dollars and engineering mandates that surpassed any undertaken to date. Between 1903 and 1910, the key players wrestled with these issues, weighing the burgeoning energy demand of Los Angeles, relative efficiency of steam-based and smaller-scale hydro schemes, and calculating technical feasibility. By autumn of 1910, the company concluded that the basic premise behind the system was sound and the incipient development of Big Creek had become a reality, with the project's water rights, financing, and basic form organized under a newly expanded and capitalized PLPC. In an unfortunate twist for engineer Eastwood, the capitalization of the BCHS resulted in his virtual exclusion from the project, with Huntington levying a capitalization fee on all shares, thereby forcing Eastwood to relinquish the shares in what was essentially his ultimate—and landmark—engineering vision.

From 1910 to 1913, the PLPC embarked in earnest on construction, hiring engineer George Ward to oversee the project and constructing the foundational elements of the system, including the SJ&E and Powerhouses No. 1 and 2 and associated conveyance infrastructure. Even as the first 60,000 kW arrived in Los Angeles, organizational changes were imminent for the BCHS, with Huntington's continued operational interest in the PLPC steadily waning during the period.

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[137] Myers, *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company,* 100-107.
[138] Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System,* 33-36; *John S. Eastwood, Engineers Report: Big Creek Power Plant*, August 1903, on file Huntington Library, as recorded by Shoup; Donald C. Jackson, *Building the Ultimate Dam, John S. Eastwood and the Control of Water in the West* (Norman, OK: University of Oklahoma Press, 1995), 66-74.

In large Huntington's interest and immense financing for the project were driven by his core development aims, that of interurban rail and land development. With the desperately needed power supplies generated, Huntington seems to have held little appetite for continued utility involvement, handing most direct responsibility for PLPC and other utility interests to a core group of trusted advisors. By 1915, Huntington had further withdrawn from the system, agreeing to merge PLPC with SCE. While Huntington remained SCE's largest shareholder, with 38 percent of the stock at the time of the merger, the union represented a pronounced divestment of utility development, and centrally, Big Creek. By 1916, Huntington assessed his aims wryly to the *Los Angeles Examiner*, "I am now out of the business. I would like to sell all my interests and get clear of it." Instead, Huntington reported, he sought to, "fool away money on books and other things that give me pleasure," a task that he took to readily with the subsequent development and fruition of the renowned Huntington Library. In all, despite the transformative role of his capital and underlying urban-based development interests, Huntington visited the BCHS only once, touring the facility in 1913 as the turbines prepared to spin, generating the electricity to power Los Angeles, and in turn Huntington's development empire.[139]

Criteria and Areas of Significance and Justification of Period of Significance

Under Criterion A, the BCHSHD illustrates the transformative role of hydroelectric engineering in California's economic, social, and physical development during the early twentieth century. As detailed in the ***Historical Development Context***, the development of a viable hydroelectric industry was a central component in California's transition from a largely pioneer economy to its growth as an increasingly populated and economically sophisticated western state. With a paucity of viable local fuel sources, the state's growth was predicated upon harnessing energy from the immense watersheds of the Sierra, an engineering feat that came to define utility development, and in turn community development, during the first decades of the twentieth century. The BCHSHD stands as an archetypal representative of this phenomenon. The system was originally developed to power a rapidly growing Los Angeles, utilizing the most innovative, expansive, and costly engineering program of its time. While this development was an engineering triumph, the significance of the system lies equally in its foundational role in supporting and contributing to California's urban, suburban, and agricultural growth. In this sense the district was central as an infrastructural foundation in the area of Community Planning and Development in early twentieth century Southern California.

In the area of Community Planning and Development and in the area of Engineering under Criterion A, the BCHSHD represents a series of significant themes in California's statewide development, including the role of technology, urban growth, and capital development. At a foundational level, the system was inextricably linked to the burgeoning physical and economic expansion of Southern California as a major state population center, with the rapid influx of population and accompanying civic development requiring previously unimaginable technological innovations and economic outlays. While isolated in its geography and separated

[139] William B. Friedricks, *Henry E. Huntington and the Creation of Southern California*, 118. Hank Johnston, *The Railroad that Lighted Southern California*, 34.

from Los Angeles by hundreds of miles, construction of the BCHS was a direct reflection of the growing complexity, scale, and economic hegemony of the city, with the growing urban sphere requiring an unprecedented scale of environmental industrialization and engineering. As described by Huntington, "Los Angeles is destined to become the most important city in this country. It can extend in any direction as far as you like…We will join this region into one big family." The BCHS, by providing much of the power that fueled this urban knitting, was an integral component of this expanding urban vision, and is significant for its foundational role in this urban expansion.[140]

While the BCHS was developed within a complex framework of rapidly developing hydroelectric capacity across California, the district is of state significance as an embodiment of the vital role of hydroelectricity in the state's early twentieth century community development. The project was larger, more physically ambitious, and more costly than any undertaken in the state to date and afforded a level of capacity that profoundly reshaped Los Angeles and its largely rural hinterland, providing the foundation for one of California's major population centers and shifting the development trajectory of the state. The system centrally supported extensive streetcar development and commercial, residential, and industrial electrical supply, becoming nearly synonymous with Southern California's growth potential. As articulated by SCE Vice President R.H. Ballard speaking of Big Creek in 1924, "there is no shortage of power in sight, when the people come the power will be there." The engineering of the system also provided a model for subsequent system development and investment, with later projects including Pacific Gas & Electric's Pit River System and Great Western Power Company's initial development of the North Fork of the Feather River utilizing the construction, planning, and engineering concepts pioneered by Big Creek, including long distance high voltage transmission lines, efficient high head turbines, and advanced hydraulic tunneling methods.[141]

Under Criterion C, the BCHSHD is an exemplar of hydroelectric engineering, with the district's design, construction, and functional operation of state significance in the area of Engineering. From initial conception by master engineer John S. Eastwood to the close of the period of significance, the BCHSHD tested all limits of hydroelectric generation and transmission in its response to California's particular geographic and environmental mandates. The system's powerhouses, conveyance features, and dams were some of the largest and most innovative of their type, transmission spans were the longest of their era, and voltages were the most advanced of the period, all of which reflected California's particular geographic constraints. Coupled with this functional dominance, the BCHSHD was engineered and constructed in the most challenging of California's environmental contexts, with geographic, environmental, and technical constraints framing every significant engineering and design development. In this sense, the engineering, construction, and ultimate design of the district served as an emphatic baseline for subsequent hydroelectric development in the state, testing and defining the

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[140] William B. Friedricks, "A Metropolitan Entrepeneur Par Excellence: Henry E. Huntington and the Growth of Southern California 1898-1927," *The Business History Review*, Vol. 63, No. 2, 1989, 329-355.
[141] "No Shortage of Power in Sight," Los Angeles Times, January 17, 1924.

parameters of the industry through an engineering and construction campaign that was unprecedented in scale and breadth.

The planning, execution, and operation of the system during the period of significance presents a host of significant design, construction, and engineering themes that solidify the district's immense engineering importance in the history of California's hydroelectric development under Criterion C. With the first transmission of electricity from the project on November 9, 1913, period commentators marveled at the, "hand robed with lightning, stretching across the gulf of valleys and mountains, from Big Creek to the doors of this city." Behind this seemingly ethereal vision was an unparalleled engineering and construction campaign that largely defined the notion of what was possible in hydroelectric development, serving as an emphatic benchmark in the annals of California's history of hydroelectric development.

The Narrative Description includes a detailed chronology of construction of the district resources, presenting the contributing and noncontributing resources within a contextual development narrative. In addition, the BCHS has been the subject of extensive primary and academic inquiry, with notable texts including David Redinger's *The Story of Big Creek* and Laurence Shoup's *The Hardest Working Water in the World* presenting detailed development narratives of the system during the period of significance, and numerous HAERs addressing specific features of the system. While the Narrative Statement of Significance is derived from much of this material, weaving a contextual narrative from these sources as well as a range of other primary and secondary sources, the aim of this narrative is to present a distilled statement of significance, with the discussion ordered by the significant design, engineering, and construction themes that define the district rather than by a strict recounting of the construction program.

In general, the significance of the district's physical development during the period of significance arises from three overarching facets. The first, the *scale of the Big Creek Hydroelectric System*, relates to the entirely unprecedented size and complexity of Big Creek during the period of significance, with the system representing an entirely new conceptualization of hydroelectric output for the era. The second relates to the *scope and constraints of the engineering and construction campaign*, with the environmental constraints, physical complexities, and technical solutions representative of an apex in early twentieth century industrial construction. A major theme of significance is derived from the *construction and engineering accomplishments* of the individual components of the system itself, with Big Creek's resources from the period of significance boasting a range of significant engineering and design themes and operational records. These underlying themes convey significance under both Criteria A and C, as the engineering and construction of the system provided a superlative model for the expanding field of hydroelectric engineering across the state and served to establish a system that remains a significant physical representative of hydroelectric engineering.

Scale of the BCHS during the Period of Significance

As recounted by Duncan Hay, an authoritative historian of the hydroelectric industry and author of the evaluative aid *Hydroelectric Development in the United States: 1880-1940,*

> In order to understand innovation in power plant design, it is necessary to understand individual components and subsystems fairly closely…yet these individual structures and pieces of hardware were seldom significant in and of themselves. Their importance lay in their role within complete power plants and, in some cases, within basin-wide or regional developments.

Hay's observation is particularly apt in relation to the development of the BCHS during the period of significance, with the engineering significance of the district largely stemming from the unprecedented scale of the inter-related operational functions of the system's various components. In essence, while many of the system's individual features, including dams, powerhouses, tunnels, and transmission lines, were individually advanced in their design and engineering, it was the combined ensemble that vaulted the BCHS above and beyond the stature of all hydroelectric peers.[142]

The BCHS initially envisioned by Eastwood in his first major report of 1903 was of a larger and more integrated scale than any hydroelectric facility to date, essentially existing as the era's first mega-project. The 1903 plan consisted of only three powerhouses, generally the realized sites of Powerhouse Nos. 1, 2, and 3, as well as storage in Huntington Lake―then called Big Creek Basin Reservoir―and Shaver Lake. In his initial estimates, Eastwood posited that the three plants combined would ultimately produce a grand total of 185,000 horsepower, far more in entirety than any predecessor plants. While this plan would have been remarkable in and of itself, Eastwood's vision was far more grand, remarking in his report that he, "also wished to note the [additional] power possibilities on the main San Joaquin River…the attractive feature most apparent, outside of the fact that any one of the plants can be installed very cheaply, is that they can be installed progressively, without the slightest interruption of previously built works." This scalable sense of progression envisioned by Eastwood came to be a defining characteristic of the BCHS during the period of significance. Even after the development of the system deviated from Eastwood's original plans, specifications, and technological constraints, progressive development based on consumer demand remained central to Big Creek's identity, with a 1922 SCE Annual Report touting the system's, "progressive plan of development," that was designed to satisfy all load requirements.[143]

Upon initial construction, the system was solely comprised of Powerhouse Nos. 1 and 2, with an output of 80,000 horsepower. With a lag in capital and consumer demand during World War I, the BCHS remained in relative stasis for several years, only to undergo dramatic expansion at the

[142] Duncan Hay, *Hydroelectric Development in the United States 1880-1940*, 27.
[143] John S. Eastwood, *Engineers Report, Big Creek Power Plant*, on file Huntington Library, San Marino, California; *Southern California Edison Annual Report 1922*, Los Angeles, California, on file at SCE Northern Hydro Headquarters, Big Creek, CA.

close of the 1910s and into the 1920s, with the construction of Powerhouse Nos. 8, 3, 2A and the placement of additional turbines for a 1929 capacity of 462,000 horsepower derived from fifteen generating units in five powerhouses. In addition to the expansion of generating capacity, the BCHS boasted an increasingly intricate holding capacity, with a series of storage reservoirs and diversions that capitalized on a sprawling watershed and hedged against drought interruptions. In this sense, the progressive development of the BCHS was a radical departure from earlier hydroelectric development, which generally consisted of lone powerhouses, relatively confined engineering plans, and only limited storage capacity. In essence, the BCHS gave weight to the term "system" and a barometer to gauge the ultimate potential of, and corresponding demand for, hydropower. Tracing this barometer through the district's period of significance provides a wealth of insight into the evolution and relative weight of the hydroelectric industry during the period of significance, in large depicting both the meteoric rise and comparative wane of the industry.

At its essence hydroelectric development is an engineering solution to consumer energy demand. In short, sufficient consumer demand must be in place to justify the massive outlay necessary for development. Additionally, with its high costs and complexity of engineering, the desirability of hydroelectric development is largely defined by its comparative competitiveness with other forms of electrical generation. Development of the BHCS is a valuable case study in this regard, illuminating these underlying industry tensions through the system's growth during the period of significance.

At its outset, construction of the BCHS proved the viability of large-scale hydropower systems. The initial project was the most expensive and complex undertaken to date, with the most electrical output of any system during the period. The generated power was readily absorbed by Los Angeles and its environs, with "every foot pound of energy immediately contracted for," upon 1913 operation. This early success paved the way for the system's successive development during the late 1910s and 1920s, with ongoing multimillion dollar developments associated with the BCHS illustrating to Southern California residents, pundits, and financiers that, "hydroelectric power development unquestionably is the greatest factor in the future development of California agriculturally, industrially, and commercially."[144]

This perceived centrality drove project planning for the BCHS during the early 1920s, with period analysts theorizing that annual increases of a minimum of 50,000 horsepower were necessary to keep pace with Southern California's rampant development. By 1922, SCE forecasts called for a continuous expansion of the BCHS through the 1940s to a capacity of 1,407,000 horsepower. A 1923 SCE informational planning illustration includes renderings of 14 powerhouses sprawled across this system, depicting unceasing growth for decades, with 18 included in 1924 (**Figure 156**). In many senses, this early 1920s period of planning and expansion is representative of the zenith of hydroelectric primacy, with the decade's rapid

[144] "Harnessing the Streams of the High Sierra," *LA Times*, January 1, 1921; "Big Creek Power Put to Work in this City," *LA Times*, November 9, 1913.

population growth nearly entirely coupled with seeming unending expansion of hydroelectric capacity.[145]

While development of the BCHS did continue unabated through the 1920s, this grandiose vision of uninterrupted system expansion to 1,500,000 horsepower by 1940 failed to come to fruition. Completion of the second unit in Powerhouse No. 8 in 1929 yielded a total operating capacity of 462,000 horsepower that would remain essentially unchanged to the 1950s. This diminished development trajectory is an important indicator of a general decline in the primacy of hydroelectricity, as the centrality of the industry was usurped by advances in steam generation. While this phenomenon gained momentum in the 1940s and Post-World War II period, with steam power accounting for nearly 70 percent of California's energy development by 1950, the seeds of the transition can be discerned through the development trajectory of the BCHS in the 1920s, with the shift in large part dictating the end of the district's period of significance in 1929.[146]

From initial construction to the early 1920s, development of the BCHS had been considered the foundation for Southern California growth. "The power generating devices at Big Creek will assure Southern California of an amplitude of the mercury fluid for at least 50 years to come," claimed the *LA Times* in 1913, a sentiment that was repeated by SCE in its Annual Report of 1923 that declared that the system was the company's, "major power development program… designed to take care of a population of six million people in ten counties of Southern and Central California." By 1924, a cycle of increasingly severe droughts gripped California, with the winter of 1924-1925 yielding an abysmal 12 inches of precipitation. The water shortage caused ripples across the hydroelectric industry that relied on abundant rains to keep turbines spinning.[147]

By 1924, SCE found itself 15 percent short of satisfying the region's energy demands, with service reductions, streetcar closures, and consumption mandates becoming a new, and highly unnerving, norm. Within this context, SCE announced the first major expansion of steam-based facilities since the rise of the BCHS—with a six and a half million dollar expansion and renovation of the company's Long Beach Steam Plant as well as a myriad of investments in smaller plants across the region. The Long Beach work involved installing two modern 50,000 horsepower steam units, with one additional 12,000 horsepower unit. The improved plant was the state's first truly high-pressure, high-temperature steam turbine plant, and boasted thermal efficiencies twice that of any other steam plant in the state. In many senses, the Long Beach expansion was the precursor to California's modern steam industry, paving the way for steam in much the same manner as the BHCS did in the hydro realm. While SCE Vice President R.H.

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[145] *Southern California Edison Annual Report 1922*, Los Angeles, California, on file at SCE Northern Hydro Headquarters, Big Creek, CA; "Popular Map of Big Creek Layout," 1923, Huntington Library Photo Archives, Image SCE_02_10659.
[146] James C. Williams, *Energy and the Making of Modern California*, 197.
[147] "Big Creek Power Put to Work in this City," *LA Times*, November 9, 1913; *Southern California Edison Annual Report 1923*, Los Angeles, California, on file at SCE Northern Hydro Headquarters, Big Creek, CA; James C. Williams, *Energy and the Making of Modern California*, 277-284.

Ballard was clear to note that the steam development, "does not in any way curtail the development of hydroelectric power in Big Creek under its adopted plan," the expenditure signaled a subtle shift in utility planning, with the relative cost burden, geographical proximity, ever greater efficiencies, and critical production stability of steam generation steadily gaining momentum even as Big Creek continued to expand through the 1920s.[148]

By 1926, SCE's Ballard articulated a slightly differing conception of the relationship between steam and hydropower generation, "Efficient and economic operation of an electric utility demands a proper balance between steam and water power generation." In the interest of this balancing act, Ballard authorized a third steam plant at Long Beach, which was initiated in 1927 and completed in 1930. With the completion of the third plant, Long Beach produced 562,000 horsepower through eleven generators, supplanting Big Creek as the largest power resource in the SCE system. At the same time, in 1929 SCE announced the "consummation of the company's 18 year program of development in the High Sierra," declaring the Big Creek Project complete with the placement of Powerhouse No.8's second turbine. While the company maintained provisions for expansion of the BCHS, it would be several decades until any new development occurred, and the hydroelectric capacity of the BCHS would never again be the dominant force behind's SCE's Southern California utility grid. In a broader sense, while hydropower would continue to be integral to energy production and consumption across the state of California, after the energy upheavals of the 1920s and the stagnation of the 1930s, the industry as a whole ceded the mantle of California's energy primacy to steam-based generation.[149] Today, the entire system generates about 1,000 megawatts of power, which is approximately 20% of SCE-owned power generation capacity.

The scale of the BCHS during the period of significance is indicative of key themes in hydroelectric development. The project existed as California's first true mega-project, with a number and complexity of generating units that transcended any efforts undertaken to date. In this sense, the BCHS was the first large scale application of key principles in hydroelectric generation that were first tested on micro levels in the late nineteenth and very early twentieth century. In addition, the district's evolution during the period of significance is an important indicator of the role of hydroelectricity in California's development, with the physical expansion of the system directly pegged to the state's continuing dialogue over the role of hydroelectricity in energy production.

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[148] "New Edison Plant Will Go Up Soon," *LA Times*, February 22, 1924; James C. Williams, *Energy and the Making of Modern California*, 277-284; Myers, *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company,* 158-159.
[149] "Edison Outlay to be Greater," *LA Times*, January 6, 1927; "New Power Unit in Use," *LA Times*, May 31, 1929; "Edison Votes huge budget," *LA Times*, November 20, 1930; Myers, *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company,* 160; "Electric Companies Aid Rapid Southland Growth," *LA Times*, June 1, 1958.

Scope and Constraints of the BCHS Engineering and Construction Campaign during the Period of Significance

Writing about the BCHS years after construction, Resident Engineer David Redinger summarized the early development of the system by remarking, "It is amazing what men with determination, portable air compressors, jack hammers, and powder can accomplish when once started." The sentiment well encapsulates the significance of the engineering and construction program of the district, which was characterized by arduous and isolated conditions, untested methods and adaptations, and complex labor conditions. Development of the BCHS during the period of significance was a program that rivaled any major late nineteenth century and early twentieth century engineering feat, with a level of complexity and physical difficulty that echoed throughout the period of significance. In addition, the construction campaign was indicative of a rapidly evolving industrial capability, with the mules, rails, and hand instrumentation of the district's earliest development ceding to increasingly modern mechanized and automated advancements by the late 1920s. In this sense, the district represents a particular moment after the industrial revolution, in which construction methods and constraints largely derived from the nineteenth century were applied and adapted to increasingly complex industrial mandates of the twentieth.

Geographic Isolation

One of the primary development hurdles for the BCHS was overcoming the area's profound isolation and geographic complexity that surpassed any hydroelectric development to date. Separated from Los Angeles by over 200 miles, at the outset of construction the Big Creek region was also separated from the nearest rail corridor by over 50 miles and lacked any notable transportation access. Further, within the Watershed, development sites were separated by hundreds of square miles and thousands of feet of elevation, with the hydroelectric system sprawled across some of the most punishing high elevations and steep canyon ravines. The very same virtues that dictated the development potential of the site—steep drops and abundant water channels—served as obstacles to construction, presenting immense physical challenges for industrial development. Overcoming this physical isolation and accessing these complex development sites was a major component of construction during the period of significance, and remains a significant underlying theme of the BCHSHD's design, engineering, and construction. This foundational infrastructural network enabled the transformation of a wilderness into a vast working industrial enterprise. Further, the multifaceted network is indicative of major construction constraints of the period and a significant evolution in transportation and industrial technology during the period of significance.

Amidst these significant development challenges, the district was largely born of rail, with the completion of the SJ&E railroad and its associated construction inclines providing the foundation for the growth of the BCHS. As initially conceived, the project was to be developed by team and cart. As discussed by historian Hank Johnston, "It was the first intention to haul the necessary material and supplies from the nearest railroad in the usual manner by teams, but when estimates were actually made it was discovered that it would require the use of 10-horse teams leaving the railroad siding every five minutes for seven years to complete the entire development." The 56 mile project-dedicated railroad, then, was a direct repudiation of the system's isolation, providing the central transportation spine for the entirety of construction during the period of significance. Through its life, the SJ&E hauled 400,000 tons of project freight and 361,000 passengers, mostly SCE employees. Each of the inclines hauled thousands of tons of site-specific materials over grades reaching 80 percent, enabling remote powerhouse and dam construction. In many senses, the SJ&E and associated inclines were the first industrial tethers linking the Big Creek site with Los Angeles, providing the underlying framework for the system even before it was transmitting energy. These transportation features provided a platform upon which the system could rise and served to connect the wilderness with industrial channels that enabled development.[150]

Within this primarily rail-based development context, the project's vehicular roads played an increasingly important role through the period of significance, and by the close of the period had largely supplanted rail as the system's primary operational network. At project inception, the system's roads were of secondary importance, providing limited personnel and maintenance access for a system that was largely governed by the operational power of rail and incline. With the development of Powerhouse No. 3 in the lower canyon and the upper areas of the project surrounding Florence Lake, vehicular access roads served increasingly critical roles, providing permanent access for far-flung system construction and operation in areas that were never accessed by rail.

The ways in which this multifaceted transportation network overcame the raw isolation of the BCHS is a core facet of the BCHSHD's physical significance. The rail-based resources entirely enabled construction, allowing far-flung development that could be supported by viable industrial channels. Vehicular roads provided permanent service corridors and have ultimately come to serve as the system's primary transportation mechanism, with the district's roads remaining as the only connection between project facilities. The development trajectory of this transportation network further defines the period of significance for the BCHSHD, as it illustrates the particular development constraints that accompanied construction during the period of significance and the overarching erosion of rail in the face of auto ascendency. Thus, while the rail line was central to construction of the system during the period of significance, by the close of the period it was deemed surplus property, with SCE declaring in a petition for abandonment that, "extensive development of good roads rendered service unnecessary." Such a complete reversal, from engineering marvel to institutional relic, is indicative of a particular framework of industrial construction that unites the features of the BCHSHD and the pace of change that shaped development of the massive system.[151]

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[150] Myers, *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company,* 105; Hank Johnston, *The Railroad that Lighted Southern California*, 117; The Big Creek Development of Pacific Light and Power Company, *General Electric Review* (Schenectady, NY: General Electric Company, Vol. XVII, No. 8, August 1914)
[151] "Edison Acts to Abandon Rail," *LA Times*, February 21, 1933.

Construction Methods and Technology during the Period of Significance

In the same sense that the system's geographic isolation provided one of the most formative development challenges during the period of significance, available industrial methods and technology shaped both the design and ultimate significance of the BCHSHD. In many senses the BCHS was a large scale twentieth century project framed by nineteenth century experience and industrial capacity. In no arena is this more relevant than in the district's striking array of construction and engineering methods that ranged from primitive to notably mechanically advanced. Ultimately, this development framework is indicative of both the sheer scale of labor undergirding the development of the resources of the district and the rapid pace at which labor-intensive methods of the nineteenth and early twentieth century ceded to increasingly mechanized capabilities by the close of the period of significance.

Although the earliest construction of the BCHS was led by Stone and Webster, one of the most experienced industrial contracting firms in the hydroelectric industry, the general framework for construction was based on labor-intensive methods that differed little from the nineteenth century. In general, even construction works on an industrial scale of the BCHS were beholden to severe technological constraints, namely a lack of readily available mechanical power and a lack of mechanical mobility. As described by historian of technology William R. Haycraft, "Despite great industrial advances, major earth-moving through the nineteenth century continued to be largely a pick and shovel process." This proved true in the development of the BCHS in the 1910s. The arduous construction of the SJ&E railroad and other project-related alignments was "handled by wheelbarrow, mule team, and scraper." Tunnel muck from Tunnel Nos. 1 and 2 was hand loaded and hauled out by teams of mules (**Figure 27**). Drilling tools were rudimentary, with nineteenth century piston-style drills that were hand sharpened by in-situ blacksmith shops at tunnel mouths. Engineering was similarly constrained, with teams of surveyors repeatedly checking alignments and directions following each hand-laid dynamite blast. In a similar fashion, surveying was an arduous on-foot process, often conducted contemporaneously with project development. In the case of Kaiser Pass Road, surveyors were in the field, directing mule teams in and around boulders and other major obstacles on an essentially real-time basis. Even placement of transmission lines remained animal powered, in the 1910s with four-up teams of mules pulling conductors to tension on the 150 kV Big Creek East and West Transmission Lines.[152]

While such hand-powered methods continued through much of the period of significance, SCE construction records and first-person accounts indicate that a steady influx of improved mechanical methods came to shape development of the BCHS, particularly by the mid-1920s. These methods served to both speed construction and standardize procedures, and are indicative of the rapid technological advancements that framed industrial construction during the period. By the late-1910s, piston drills were uniformly being replaced by improved jack-hammers, with compressed air powering efficient pneumatic tunnel drilling. By 1923, newly developed

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[152] William R. Haycraft, *Yellow Steel: The Story of the Earth Moving Equipment Industry* (Urbana, IL: University of Illinois Press, 2002), 2; David H. Redinger, *The Story of Big Creek,* 33; "Development of Big Creek," *Stone & Webster Public Service Journal*, (Boston: Stone & Webster Company, Volume 13, July-Dec 1913).

Ingersoll-Rand Model X-70 drills had been introduced to tunnel work, notably speeding drilling efforts. During the same period, SCE experimented with the first detachable bit drills in the drilling of Ward Tunnel. Additionally, the project's earliest muck-hauling mules were replaced with electric locomotive-driven muck cars, and by the late 1910s pneumatic "Shuveloader" mucking machines assisted in tunneling efficiency, as did Marion 40 Railroad Steam Shovels (**Figure 28**). While mule teams continued to haul heavy equipment and scrapers for road construction, by the mid-1920s SCE utilized a newly developed track-laying Marion 21 Caterpillar Steam Shovel, excavating the roadway near Powerhouse No. 3. Additionally, by the mid-1920s a growing fleet of trucks were being utilized to access and service the Project facilities, steadily supplanting stables with garages and machine shops. In 1925, the BCHS construction fleet included three Benjamin Holt 60 Best Tractors, which were unleashed at Florence Lake to haul trees, structures, and other heavy debris in the lakebed prior to inundation. Speaking long after construction, David Redinger mused, "One can only conjecture what the saving in time and money would have been in such a huge development if all of this had been available in 1912."[153]

In addition to steadily incorporating newly developed equipment into project construction, construction planners spearheaded a campaign of steady adaptation and augmentation, reflecting both the unprecedented nature of the work and the overarching physical constraints. For example, during construction of Powerhouse No. 8, incline load limitations precluded shipment of the assembled powerhouse generator, which was 22,500 kW and of a correspondingly massive tonnage. The generator was shipped and hauled in pieces and built in-situ in the field, with a platform of heavy timbers cradling the unit until it could be rested on the turbine and framed by the powerhouse walls. In the driving of Ward Tunnel, the longest California hard-rock water tunnel ever drilled and the longest of its diameter in the word at the time, SCE experimented with a number of critical ventilation methods in the process, incorporating newly developed industrial fans carried by a series of wood stave pipes and corrugated iron pipes that led to tunnel recesses. To develop the system's high elevation dams, particularly Florence Lake Dam, extensive experimentation of concrete mixtures was a key part of construction, in order to determine the most ready mixture to withstand the freeze-thaw challenges of the high elevation terrain. Throughout the period of significance, project engineers and foreman were essentially conducting a series of calculated adaptations, testing materials, methods, and construction approaches against an exceedingly complex and evolving industrial backdrop.

The rapid transitional characteristics of Big Creek's engineering and construction methods reinforces the significance of the district's contributors that were developed at the cusp of a labor intensive nineteenth century and an increasingly mechanized era that framed much twentieth century construction. Within this shifting context, the engineering and construction requirements necessary to construct the BCHS were reflective of a scale and complexity that was largely unprecedented, in a sense providing the basis for the type of mechanical equipment that was being introduced. In this manner, development of the BCHS during the period of significance

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[153] David H. Redinger, *The Story of Big Creek,* 172-178; Theodoratus Cultural Research, *Oral History Interviews Pertaining to the Big Creek Hydroelectric Project*.

was something of a proving ground for both entrenched nineteenth century capabilities and methods, and the rapid onslaught of new mechanical capabilities that arose during the period. This industrial and mechanical development trajectory further defines the period of significance for the BCHSHD, as it illustrates the overarching engineering, construction, and mechanical capabilities that framed the development of the system during the period. At inception, construction of the BCHS tested the limits of all available technology, but by the close of the period of significance, a host of readily available heavy equipment transformed engineering and construction into a far more standardized, streamlined, and efficient affair. In this manner, the contributing resources of the district are distinct from later BCHS construction, which was undertaken decades later utilizing far more established and standardized modes of design, engineering, and construction.

Scale of Labor
The scope and complexity of the BCHSHD is further illustrated by the scale of human labor that undergirded development of the system. Due to the system's profound geographic isolation and the relatively constrained mechanical methods available for development, the construction campaign was defined by a massive human effort that included tens of thousands of workers throughout the period. At its height in the mid-1920s, construction of the BCHS simultaneously employed 5,000 workers, with 2,000 alone engaged in the multi-year drilling of Florence (later Ward) Tunnel. According to period press, in the 1910s alone, PLPC and subsequently SCE had upward of 60,000 distinct names on the payroll for the project, with a labor pool that was characterized by rapid turnover and continuous cultivation of new labor recruits. The cultivation and management of this large labor force was a defining characteristic of the construction period, with the procuring, housing, and supplying of labor a key consideration in project construction.[154]

Throughout the 1910s and 1920s, the development of the BCHS was continuously advertised across the state of California and the West, with regular classifieds broadcasting "Fares Paid to the Big Creek Power Plants" for ready and willing laborers, who comprised the majority of the workforce with a far smaller number of specialized engineers, draftsman, and other skilled professionals engaged on the project. An October 1917 classified included postings for "80 more laborers, 10 carpenters, 1 screw tender, 2 camp flunkies, and a cook." As advertised, fares were paid to the site, with dedicated train cars leaving major cities and embarkation points. "The special car leaves tonight," heralded the *San Francisco Chronicle* in 1916, "All aboard for the famous Big Creek job." The steady influx of labor is corroborated by David Redinger, who served as a Construction Engineer during the 1910s and 1920s, "the turnover was large, as men did not have to look far for work. It was unusual for a man to have more than one hundred hours' time in a month, and timekeepers did not have to worry much about classifications, which consisted almost entirely of laborers, teamsters, and drillers." As recounted by Redinger, "There

[154] Myers, *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company,* 112; *Southern California Edison Annual Report of 1929 Big Creek Division*, on file at SCE Northern Hydro Headquarters Library, Big Creek, CA; "Subjugating Nature's Tremendous Forces to Man's Use in Southern California," *LA Times*, June 15, 1913.

were pay-days for thousands of employees, who were divided into three groups—one working, one coming, and one going. Those days we could give jobs to all comers."[155]

From the outset of construction, company officials and period commentators equated this massive Big Creek labor force to an army, with roving forces tasked to complete each facet of project development. "Moving in platoons like soldiers in motion behind the lines, and falling into position for their last assault on the rock fortress, that to me appeared the march of the Edison men," recounted an *LA Times* correspondent in 1925. As recounted in a *General Electric Review* from 1914:

> It was necessary that work be rushed on day and night basis and every provision be made to guard against delays. To accomplish this, camps were established at various dam and tunnel sites, as well as at the two powerhouses, and an army of 4200 men were employed at one time, while before the completion of the incline 1300 horses were in use. To care for this army of men, bunkhouses were constructed having a capacity of 3800 men and dining halls capable of feeding 4250. In one camp alone, 865 men could be fed at one time. A main hospital was established, with complete surgical equipment including an X-ray outfit, and first aid stations were located at all other camps. Food was kept in stock at times to feed 4,000 men for six months; ham and bacon were ordered in carload quantities; flour by the five car loads.

Period accounts regularly marveled at the sheer number of supplies needed for project laborers: 21,000 tons of commissary in 1913; a million dollars of groceries in 1924, with an additional $48,000 in coffee; twelve million pounds of ham and bacon and eleven million eggs from 1921-1925; two millions pounds of fresh meat and 17,770,000 pounds of Idaho potatoes for the Florence Lake Tunnel crews alone. Such statistics litter SCE records and period accounts, attesting to the massive human orchestration that lay behind development.[156]

The complexity was further heightened by the spatial and logistical layout of the camps. By necessity, camps followed project features, with each area of development requiring an associated construction camp. As PLPC and subsequently SCE turned to the construction of new facilities, the first operational task was generally camp development, with rapid erection of bunkhouses, mess halls, and other associated infrastructure. To keep pace with project demands, standardization and expediency generally drove camp development, with camp features generally of a rudimentary design developed to withstand heavy use for a narrowly defined period dictated by construction mandates.

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[155] "Tonight's the Night," *San Francisco Chronicle*, October 15, 1916; "Fare Paid to the Big Creek Power Plant," *San Francisco Chronicle*, May 11, 1917; David H. Redinger, *The Story of Big Creek,* 12, 121.
[156] The Big Creek Development of Pacific Light and Power Company, *General Electric Review,* 830; "Power Plants on Big Creek," *LA Times*, March 16, 1913; "Millions to be Spent by Utilities for Expansion," *LA Times*, May 19, 1924; "Edison Tunnel Crews Praised," *LA Times*, February 14, 1925.

Within this large scale and often nameless labor context, key period records provide a more nuanced account of the labor demographics used to construct the project during the period of significance. While United States Federal Census Records miss peak years of construction, the Census of 1920 records upward of 500 project personnel and families scattered across the BCHS construction camps and operating facilities. The overwhelming majority of the workers are classified as laborers, particularly those documented at construction camps. A smaller number include assorted specialized trades, with electrician, foreman, teamster, carpenter, steam shovel engineer, chauffer, mechanic, blacksmith, painter, carpenter, surveyor, draftsman, civil engineer, cook, machinist, cement finisher, and timekeeper all listed. In addition, by 1920 the system included a number of powerhouse operators and associated staff, many of whom lived with wives and children in company housing. While this type of expanding family structure was evident among powerhouse operators and more permanent employees, the construction camps themselves remained largely male, with very few wives and no children documented. In general, camp laborers reflected a wide spectrum of ages, with the youngest in their twenties and the oldest approaching sixty. Similarly, workers hailed from a striking number of locales, with relatively few born in California. While most were domestically born, birth states spanned the country, with a significant concentration from the Midwest and South. A considerable number were born abroad, primarily from Western European countries. All ranges of trades, from laborers to skilled draftsman and project engineers reflected a similar diversity of provenance.[157]

Oral histories also provide an evocative portrait of the BCHS labor force during the period of significance, illustrating underlying themes shaping construction of the system. In 1988, engineer William Flannery recalled his work on the project in the 1920s:

> I went down to Howard Street in San Francisco; that used to be where all the IWWs—you know, I won't work type?—yeah, that's what they used to call IWWs. But I went down there and they were offering bull cooks—we used to call them bull cooks—and laborers. So I said, hell that sounds interesting. It said something about Big Creek. I didn't know where Big Creek was. I knew it was in the mountains somewhere. So it was Southern California Edison. I went, they paid my—put me on a train, gave me enough money to get on a train, and I rode up there with some old IWW. He was trying to sell me on how to do things, not to work too fast… We had men from all over the country… Each of us felt, we're building something here that's going to conserve water, it's going to create power and electricity which will serve the people. And I think that was the prevailing spirit. We were rather proud of what we were doing, every one of us. There was always, you know, a bit of—pardon the expression—bitching bunch of guys, but most of the time we had no problem.

Flannery's account both corresponds with period sources in its description of the workforce, and adds to an understanding of important underlying labor themes. While his characterization of the

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[157] *United States Federal Census of 1920* (California, Fresno County, Cascada, Supervisor's District No. 6, Enumeration District No. 69, Sheets 1A-6A).

collective pride of the system is telling, so too is his reference to Industrial Workers of the World (IWW) influence on labor at Big Creek. As a labor organizing institution, IWW was at its zenith during the period, with the union campaigning for bettered labor conditions and wages across the industrial sphere. IWW strikes were recorded at Big Creek as early as 1913, with approximately 300 workers "walking out" in January of 1913 with demands for eight hour days, overtime and holiday pay, and an array of conditional demands including, "hot water in the washrooms and relief from crowded conditions in the bunkhouses." While PLPC's recorded response was emphatic—removing all "disaffected" personnel from the job—the presence of labor unrest was a specter that shaped policies during the period of significance, ushering in ongoing reform and workplace improvements.[158]

By the 1920s, eight hour shifts were standard across the construction program. Wages, that in 1914 had been $2.50 a day for laborers, had climbed to $4.00 per eight hour shift. As recounted by tunnel mucker Cecil Wright, "Fifty cents an hour in those days was pretty high, and over a period of time, connecting all the companies, Edison was a leader, 'cause other outfits had to come, pay scales to that, what Edison was." In addition to these core reforms, the BCHS construction program steadily instituted a broad recreational component to camp life throughout the period of significance, with recreation halls, movies, radio programs, sporting events, and other social amenities introduced to ameliorate the isolated conditions. In a broader sense, as reflected by yearly reports from Big Creek from the 1910s to the 1920s, the company became increasingly concerned about workplace conditions and safety, implementing "Careful Clubs" for crews across the system that largely served as precursors to the contemporary workplace safety practices that define labor today.[159]

The volume of labor, and corresponding supply and operational chain, underlying development of the BCHS during the period of significance is an important development theme within the district. During the period of significance, construction of the BCHS was defined by thousands of personnel and a complex operational network, which would never again be surpassed by subsequent operational needs of the system. By 1929, at the close of the large scale development period, BCHS staffing was limited to several hundred, and primarily limited to operational personnel. While the physical vestiges of this labor theme were ephemeral, with the system's construction camps and supply networks dismantled soon after construction and thousands of workers disbanded, the historic record itself abounds with an abundance of illustrative material, with PLPC and SCE Archival Records, oral histories, and other primary material conveying both a personal and contextual accounting of construction and labor life that adds to the interpretation and significance of the district. Further, the contributing resources of the district remain as links

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[158] "Big Creek Strike," *San Francisco Call*, January 7, 1913 and January 8, 1913; Theodoratus Cultural Research, *Oral History Interviews Pertaining to the Big Creek Hydroelectric Project*, William Flannery page 2, prepared for Southern California Edison, 1989, on file at SCE Northern Hydro Headquarters Library.

[159] Theodoratus Cultural Research, *Oral History Interviews Pertaining to the Big Creek Hydroelectric Project*, Cecil Wright page 7, prepared for Southern California Edison, 1989, on file at SCE Northern Hydro Headquarters Library; "Southern California Careful Club," Huntington Digital Library, Southern California Edison Photographs and Negatives, G. Haven Bishop Collection, Call Number 02-13865; *Southern California Edison Annual Report of 1927 Big Creek Division*, on file at SCE Northern Hydro Headquarters Library, Big Creek, CA.

to this human context, with the tunnels, dams, powerhouses, and associated infrastructure remaining as testament to the immense human capital behind the project.

Construction and Engineering Accomplishments and Records during the Period of Significance
In addition to the significance of the operational scale of the BCHSHD and the scope, breadth, and complexity of its construction campaign and infrastructural development, the physical and operational significance of the district is defined by the series of singular records and achievements. Through the period of significance, individual components of the system tested nearly all operational boundaries for hydroelectric development, providing viable and lasting models for modern hydroelectric development in the realm of transmission length and voltage; hydro head; turbine, generator, and aggregate plant size and capacity; and dam size and tunnel length. Each of these records is indicative of the system's highly significant engineering and design, with the individual components of the BCHSHD existing as exemplars of their functional and structural type.

Transmission
The BCHS transmission lines set multiple records for transmission length and capacity during the period of significance. At initial operation in 1913, the Big Creek East and West Lines ran at 150 kV, far surpassing any earlier commercial efforts, with a 240 mile span that was the longest transmission corridor at that time. The development and success of the transmission line was central to the BCHS, as it allowed the generated hydroelectricity to be regulated and efficiently transmitted to the Los Angeles market. "The transmission line is of course the element of greatest importance in satisfactory commercial operation, lauded the American Institute of Electrical Engineers in 1914, "entailing some conditions of operation that are rather striking."[160]

As noted by period engineers, the issue of voltage regulation was the central problem addressed by the 150 kV lines, with the successful application of the "constant potential system" (i.e., operation at the same voltage at the generating and receiving stations) allowing for successful delivery of the high voltage. In general, while groundbreaking in its operation, the 1913 application of the new transmission system proved to be remarkably straightforward in execution, with only a handful of short circuits and failures in the first years of operation, generally caused by common hazards including bird fly overs, downed trees, isolated insulator flashovers, and in one case, cable failure. This relative groundbreaking ease was repeated in 1923, when the Big Creek transmission system was seamlessly converted to 220 kV, another world record in hydroelectric development.[161]

[160] Edward Woodbury, "150,000-Volts Transmission System: Some Operating Conditions of the Big Creek Development of the Pacific Light and Power Corporation," *Proceedings of the American Institute of Electrical Engineers*, (New York:AIEE, Volume XXX111, July 1914) 1359-1370; "The Increase in Transmission Voltages," *The Electric Journal*, (Pittsburgh: The Electric Journal, Volume X, August 1913) 713-773.
[161] Edward Woodbury, "150,000-Volts Transmission System: Some Operating Conditions of the Big Creek Development of the Pacific Light and Power Corporation," *Proceedings of the American Institute of Electrical Engineers*, 1359-1370.

By the early 1920s, continuously rising energy demands dictated the conversion of the Big Creek East and West Transmission Lines to 220 kV, which generally doubled the transmitting capacity of the system. Between 1922 and 1923, the transmission lines were upgraded to carry the higher voltage, with enlarged towers, new shield rings to prevent energy flashovers, and automated relay systems to regulate energy transmittal along the lines. The conversion made the Big Creek East and West alignment the first to transmit at 220 kV, setting another world record in capacity for the system. The 220 kV conversion was predicated upon years of internal applied research and experimentation undertaken by SCE's Engineering Department in collaboration with Stanford University and a number of large electrical corporations including General Electric, who in essence saw the Big Creek lines as an essential prototype in transmission technology.[162]

The successful operation of the upgraded lines, along with the 220 kV Vincent Line established several years later, served as the baseline for subsequent high voltage transmission, proving the physical application behind decades worth of evolving theoretical development. Concluding in the 1924 Transactions of the American Institute of Electrical Engineers, SCE Engineer R.J.C. Wood summarized the groundbreaking role of the lines as follows, "Transmission at 220 kV has been invested with a certain glamour, and the further investigation has been carried [at Big Creek] the more certain it appears that transmission at this voltage will only differ in degree from transmission at lower voltages with which we are familiar." In this sense, both the 150 kV and subsequent 220 kV served as significant engineering barometers for the period, proving the feasibility of high voltage, long distance transmission and providing a physical and theoretical template for subsequent development.[163]

Hydro Head

The BCHSHD was record setting in its development of high head hydroelectricity. The vertical distance that water falls to powerhouse turbines is the most important factor for hydroelectric development, dictating the system's generating capacity. At the time of its construction, Big Creek Powerhouse No. 1's vertical head of 2,131 feet was the highest developed to date in the United States with Powerhouse No. 2's 1,858 foot vertical head ranking third. In 1928, the construction of Powerhouse No. 2A was also groundbreaking, with a vertical head of 2,418 feet, which was the second highest to date, and only 143 feet lower than California's highest Bucks Creek that was completed the same year by PG&E.

Beneath these figures lies a range of significant operational and structural components, from the difficulty of staging and laying penstocks for such an extreme plunge, to the development and maintenance of lap welded steel and reinforcing mechanisms to withstand the associated

[162] "Enormous Development Program of Southern California," *Engineering World* (Chicago: International Trade Press, Inc., Volume 20, Number 4, April 1922)221-222.
[163] R.J.C. Wood, "220 kV Transmission," *Transactions of the A.I.E.E* (New York: A.I.E.E, Volume X.L.I, 1922)471-488; "Transmission at 220 kV on the Southern California Edison System," presented at the Pacific Coast Convention of the A.I.E.E, Pasadena, CA, October 13-17, 1924, published 1924 by the *Transactions of the A.I.E.E* (New York: A.I.E.E, Volume XLIII) 1222-1237.

pressure. A *Western Engineering* article from 1914 summarizes the material complexity of Powerhouse No. 1's penstocks:

> The two penstock pipes begin their descent in two parallel lines, seven feet apart, with varying horizontal and vertical angles to correspond to the topography of the steep and rocky slope to the powerhouse. The maximum slope angle is about 43º corresponding to a gradient of 93%. The pipes are lap-welded steel tubes, each about 20 feet long and of varying diameter and thickness. At the upper end, where the pressure is least, they are 42 inches in diameter and 3/8 of an inch thick, while at the powerhouse, the point of maximum pressure, they are 24 inches in diameter and 1 inch thick. For pressure not exceeding 1,460 feet the circular joints are riveted; but for greater pressures they are flanged and bolted, the joint being specially designed to withstand such great pressure.[164]

Turbine and Generator Size and Capacity
Due to the extremely high head afforded by the operational layout of the BCHS, the system's powerhouses set a number of records during the period of significance for the size and capacity of their turbines and generators. Both individually and collectively, the powerhouses of the system stood at the vanguard of productive capacity during the period. Powerhouse Nos. 1 and 2 featured the largest and highest horsepower impulse water turbines constructed to date, with generators that boasted the largest kilowatt capacity and size: Powerhouse No. 1's generators weighing 292,250 pounds and Powerhouse No. 2's 240,900 pounds. Several years later, Powerhouse No. 8 also broke records, with that powerhouse the first designed to operate at 220kV transmission and one of the first to employ an improved Francis-type vertical reaction turbine, which allowed for an enormous generation capacity at relatively low head. Powerhouse No. 8 also set capacity records, with the single initial turbine of the plant almost matching that of both units in Powerhouse 1 combined.[165]

The 1920s powerhouses continued the groundbreaking trajectory established by the initial construction of the BCHS. Powerhouse No. 3, dubbed "The Electrical Giant of the West," was the largest hydroelectric plant in the west at the time of construction, with an aggregate capacity of 75,000 kW. The powerhouse retained this mantle until 1928, when it was unseated by Big Creek's Powerhouse No. 2A, which boasted an 80,000 kW capacity that was the largest of the era. Thus, by 1929, all of the BCHS powerhouses held a place in the top tier of generation capacity, with five of the top ten California plants in kW production those of the Big Creek System.[166]

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[164] "Development of Big Creek," *Stone & Webster Public Service Journal*, (Boston: Stone & Webster Company, Volume 13, July-Dec 1913).
[165] "Development of Big Creek," *Stone & Webster Public Service Journal*, (Boston: Stone & Webster Company, Volume 13, July-Dec 1913); Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System*, 191-207.
[166] "Electric Plant is Coast's Largest," *LA Times,* October 12, 1923*; "Electric Giant is Being Tested Out," LA Times,* September 27, 1923.

Dam and Reservoir Size

Big Creek's dams, reservoirs, and tunnels were some of the largest and most structurally complex of the era. Huntington Lake's concrete gravity dams were some of the largest of the period, and the impounded reservoir the largest of its type in California at construction. The enlarged Shaver Lake featured the longest crest gravity dam in California during the period, as well as the largest acre-feet capacity at construction. Florence Lake Dam stood as a record setting multiple arch dam, with its 58 arches and 3,156 foot crest the longest developed to date, in by far the most inhospitable terrain. Florence Lake Dam remains an exemplar multiple arch type dam today.

Tunnel Length

In the same manner, the system's tunnels were groundbreaking, with all of the tunnels together representative of the most advanced and integrative conveyance system developed in California to date and the Ward Tunnel itself setting individual records as one of the longest hydroelectric tunnels ever drilled. As lauded in the *LA Times*, "The completion of the longest tunnel in the world [was] observed by the engineering and construction fraternity of the world's continents, its completion marks the most daring and original piece of engineering of Southern California Edison's Big Creek Project."[167]

An Unrivalled Operational System

The significance of the BCHSHD stems from both the unrivaled scale of the system's integrated network of operational resources and the individual structural and engineering form that characterizes the system's facilities and features. All facets of the system were defined by the most advanced and innovative solutions, with each component testing and defining technical feasibility for the period, when viewed in isolation and as a system. This myriad of design and operational records, engineering achievements, and singular innovations serves to underscore the significance of the district, with the BCHSHD characterized by highly significant individual operating features acting in exceedingly significant concert.

Conclusion

Under Criteria A and C, the BCHSHD stands as one of the most significant hydroelectric developments in California. The conception and construction of the district presents an evocative portrait of early twentieth century California development, with the generating system intimately linked to the state's population growth, industrial and commercial expansion, and national standing. Further, the district illustrates the intimate ways in which California's urban growth was predicated upon a complex and evolving relationship with the terrain and natural features of the state, representing an industrialization of nature that remains central to the state's identity.

In engineering, design, and construction methodology, the BCHSHD presents a highly significant portrait of hydroelectric development. The construction history of the system is a premier example of hydroelectric applications, presenting a wealth of significant engineering and

[167] "Blast Opens Great Tunnel," *LA Times*, October 31, 1924; Laurence Shoup, *The Hardest Working Water in the World: A History and Significance Evaluation of the Big Creek Hydroelectric System*, 191-207.

design associations stemming from both the ways in which the system was initially designed and completed, and the groundbreaking operational layout of the individual resources themselves. In this sense, the BCHSHD is a significant testament to both a particular era of hydroelectric construction and design and the enduring role of this innovative period of growth in California's environmental, infrastructural, and economic identity.

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Previous documentation on file (NPS):

____ preliminary determination of individual listing (36 CFR 67) has been requested
____ previously listed in the National Register
____ previously determined eligible by the National Register
____ designated a National Historic Landmark
____ recorded by Historic American Buildings Survey #____________
____ recorded by Historic American Engineering Record # _CA-167-A through CA-167-N
____ recorded by Historic American Landscape Survey # ___________

Primary location of additional data:

__X__ State Historic Preservation Office
____ Other State agency
__X__ Federal agency (United States Forest Service)
____ Local government
____ University
__X__ Other

Name of repository: Southern California Edison Archives located at Northern Hydro Division Headquarters in Big Creek, CA and Southern California Edison Headquarters in Rosemead, CA; Huntington Library, San Marino, CA; Central Sierra Historical Society, Shaver Lake, CA; Special Collections of CSU Fresno.

Historic Resources Survey Number (if assigned): ________________

10. Geographical Data

Acreage of Property ____37,074 acres_______

UTM References (See Additional Documentation for BCHSHD Boundary Points Maps)
Datum (indicated on USGS map):

☐ NAD 1927 or ☒ NAD 1983

1. Zone: 11 Easting: 324414.4 Northing: 4137507.5
2. Zone: 11 Easting: 327232.0 Northing: 4130590.0
3. Zone: 11 Easting: 328049.5 Northing: 4124703.1
4. Zone: 11 Easting: 327714.2 Northing: 4123480.7
5. Zone: 11 Easting: 320347.2 Northing: 4130937.3

6. Zone: 11 Easting: 316667.2 Northing: 4131809.8
7. Zone: 11 Easting : 313347.2 Northing: 4127872.1
8. Zone: 11 Easting : 308210.2 Northing: 4123427.2
9. Zone: 11 Easting: 299255.2 Northing: 4109199.2
10. Zone: 11 Easting: 289485.8 Northing: 4107588.4
11. Zone: 11 Easting: 320181.6 Northing: 4028938.7
12. Zone: 11 Easting: 325671.5 Northing: 3918851.6
13. Zone: 11 Easting: 397216.5 Northing: 3818052.8
14. Zone: 11 Easting: 390938.8 Northing: 3779358.4
15. Zone: 11 Easting: 362700.7 Northing: 3797866.0
16. Zone: 11 Easting: 298485.5 Northing: 4019388.5
17. Zone: 11 Easting: 280737.9 Northing: 4082429.1
18. Zone: 11 Easting: 286815.7 Northing: 4112286.5
19. Zone: 11 Easting: 287373.3 Northing: 4113963.4
20. Zone: 11 Easting: 293343.7 Northing: 4120888.1
21. Zone: 11 Easting: 299552.2 Northing: 4120961.4
22. Zone: 11 Easting: 301448.8 Northing: 4123471.2
23. Zone: 11 Easting: 308716.0 Northing: 4126610.3
24. Zone: 11 Easting: 313513.3 Northing: 4132803.0
25. Zone: 11 Easting: 320373.7 Northing: 4131467.5
26. Zone: 11 Easting: 323001.4 Northing: 4136770.4

Verbal Boundary Description (Describe the boundaries of the property.)

The boundary of the BCHSHD is defined by the sprawling operational and physical layout of the hydroelectric system and consists of a series of physical and functional linkages that define the significance of the district. Descending from the upper elevations, the BCHSHD boundary encompasses the following hydroelectric generation facilities: Mono and Bear Diversions and Flowline, Florence Lake and associated diversions, Ward Tunnel, Huntington Lake and associated dams, Tunnel No. 1, Powerhouse No. 1, Dam No. 4, Tunnel No. 2, Powerhouse No. 2, Powerhouse No. 2A, Tunnel No. 5, Tunnel No. 7, Dam No. 5, Tunnel No. 8, Powerhouse No. 8, Dam No. 6, Tunnel No. 3, and Powerhouse No. 3. In addition, the BCHSHD encompasses the following transmission facilities: Big Creek East and West Transmission Lines, Vincent Transmission Line, Vestal Substation, Rector Substation, Magunden Substation, and Eagle Rock Substation. Within this spatial boundary, the district includes a number of related infrastructural resources that are associated with the construction and ongoing operation of the core hydroelectric generating facilities. For an overview depiction of the BCHSHD Boundary, refer to the BCHSHD Overview Boundary Map [Sections 9-end page 348].

Boundary Justification (Explain why the boundaries were selected.)

The boundary includes all operational and infrastructural support features of the BCHS that were developed between 1909 and 1929 as part of the significant foundational construction of the system. This boundary conveys the spatial and operational layout of the hydroelectric and transmission system during the period of significance, and conveys significant physical associations and historic themes of development associated with early twentieth century hydroelectric generation and urban growth.

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11. Form Prepared By

name/title: __Linda Pollack; Polly Allen; Joshua Peabody______________________________
organization: __Southern California Edison; Cardno, Inc.______________________________
street & number: __P.O. Box 100____
city or town:______Big Creek________ state: ___CA______ zip code:___93605___________
e-mail__Linda.Pollack@SCE.com; Polly.Allen@cardno.com__________________________
telephone: Point of Contact: Linda Pollack (559) 893.2009___________________________
date:___September 2015, Revised December 2015__________________________________

Additional Documentation

Submit the following items with the completed form:

- **Maps:** A **USGS map** or equivalent (7.5 or 15 minute series) indicating the property's location: See BCHSHD Overview Boundary Map in Additional Documentation.
- **Sketch map** for historic districts and properties having large acreage or numerous resources. Key all photographs to this map. See Sketch and Photo Reference Map Series in Additional Documentation.
- **Additional items:** (Check with the SHPO, TPO, or FPO for any additional items.) Historic Period Archival Plans and Photographs included following Photo Log.

Photographs

Submit clear and descriptive photographs. The size of each image must be 1600x1200 pixels (minimum), 3000x2000 preferred, at 300 ppi (pixels per inch) or larger. Key all photographs to the sketch map. Each photograph must be numbered and that number must correspond to the photograph number on the photo log. For simplicity, the name of the photographer, photo date, etc. may be listed once on the photograph log and doesn't need to be labeled on every photograph.

Photo Log

Name of Property:	Big Creek Hydroelectric System Historic District
City or Vicinity:	Big Creek, CA (See Section 10 for greater detail)
County:	Fresno, Kern, Los Angeles, Madera, Tulare
State:	California
Photographer:	Cardno, Inc.; SCE (sub-consultant: D. Shoup)
Date Photographed:	2009-2015; see photograph captions for specific date
Location of Original Files:	Cardno, 701 University Ave., Suite 200, Sacramento, CA 95825; SCE Northern Hydro Headquarters, Big Creek, CA 93605

Number of Photographs: 121

Note: Each Photograph is depicted on the Sketch and Photo Reference Maps included in the Additional Documentation Section.
The Map Sheet Number is included in the Photo Log.

Description of Photograph(s) and number, include description of view indicating direction of camera:

Photograph #1
Huntington Lake Dam No. 1, camera facing east, 2013
Sketch and Photo Reference Map, Sheet 16

Photograph #2
Huntington Lake Dam No. 2, camera facing west, 2013
Sketch and Photo Reference Map, Sheet 16

Photograph #3
Huntington Lake Dam No. 3, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 17

Photograph #4
Huntington Lake, camera facing east, 2014
Sketch and Photo Reference Map, Sheet 16

Photograph #5
Tunnel No. 1 Flowline, camera facing west, 2013
Sketch and Photo Reference Map, Sheet 17

Photograph #6
Powerhouse No. 1, camera facing north, 2009
Sketch and Photo Reference Map, Sheet 19

Photograph #7
Powerhouse No. 1, Generating Room, camera facing west, 2009
Sketch and Photo Reference Map, Sheet 19

Photograph #8
Powerhouse No. 1, camera facing southeast, 2009
Sketch and Photo Reference Map, Sheet 19

Photograph #9
Powerhouse No. 1, Penstocks and Stone Anchor Wall, camera facing north, 2009
Sketch and Photo Reference Map, Sheet 19

Photograph #10
Dam No. 4, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 19

Photograph #11
Tunnel No. 2, Adit 7 ½, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 23

Photograph #12
Tunnel No. 2 Surge Chamber Gate House, camera facing southeast, 2014
Sketch and Photo Reference Map, Sheet 23

Photograph #13
Adit 8 Creek Diversion Dam, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 23

Photograph #14
Powerhouse No. 2 and No. 2A, camera facing southeast, 2015
Sketch and Photo Reference Map, Sheet 24

Photograph #15
Powerhouse No. 2, Generating Room, camera facing east, 2013
Sketch and Photo Reference Map, Sheet 24

Photograph #16
Powerhouse No. 2, Station Crane, camera facing east, 2013
Sketch and Photo Reference Map, Sheet 24

Photograph #17
Powerhouse No. 2, Penstocks Entering Powerhouse, camera facing north, 2009
Sketch and Photo Reference Map, Sheet 24

Photograph #18
Powerhouse No. 2, Tailrace Detail, camera facing south, 2009
Sketch and Photo Reference Map, Sheet 24

Photograph #19
Tunnel No. 5, Intake Gate House, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 27

Photograph #20
Tunnel No. 5, Surge Chamber Ventilation Shaft, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 23

Photograph #21
Tunnel No. 8, Intake Structure at Dam No. 5, camera facing west, 2009
Sketch and Photo Reference Map, Sheet 24

Photograph #22
Tunnel No. 8, Outlet Structure and Pipe to Surge Tank, camera facing southwest, 2013
Sketch and Photo Reference Map, Sheet 25

Photograph #23

Tunnel No. 8, Surge Tank with Powerhouse No. 8 Penstocks in foreground, camera facing, southeast, 2015
Sketch and Photo Reference Map, Sheet 25

Photograph #24
Dam No. 5, camera facing southwest, 2009
Sketch and Photo Reference Map, Sheet 24

Photograph #25
Powerhouse No. 8 with Dam No. 6 in background, camera facing south, 2009
Sketch and Photo Reference Map, Sheet 25

Photograph #26
Powerhouse No. 8, with Penstocks rising in background, camera facing south, 2009
Sketch and Photo Reference Map, Sheet 25

Photograph #27
Powerhouse No. 8, Generating Room, camera facing southwest, 2009
Sketch and Photo Reference Map, Sheet 25

Photograph #28
Powerhouse No. 8 Penstocks, camera facing northwest, 2009
Sketch and Photo Reference Map, Sheet 25

Photograph #29
Powerhouse No. 8 Penstocks entering Powerhouse, camera facing southwest, 2014
Sketch and Photo Reference Map, Sheet 25

Photograph #30
Tunnel No. 3 Intake Gate House, with Powerhouse No. 8 in background, camera facing northeast, 2013
Sketch and Photo Reference Map, Sheet 25

Photograph #31
Tunnel No. 3, Adit 35, on Million Dollar Mile Road, camera facing southeast, 2013
Sketch and Photo Reference Map, Sheet 28

Photograph #32
Tunnel No. 3, Adit 34 Bulkhead, camera facing southeast, 2013
Sketch and Photo Reference Map, Sheet 28

Photograph #33

Tunnel No. 3 Outlet Manifold at right, with Powerhouse No. 3 Penstocks extending to Powerhouse No. 3, aerial view, camera facing north, 2014
Sketch and Photo Reference Map, Sheet 29

Photograph #34
Tunnel No. 3 Surge Chamber Ventilation Shaft, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 29

Photograph #35
Dam No. 6, camera facing upstream to north, 2013
Sketch and Photo Reference Map, Sheet 25

Photograph #36
Powerhouse No. 3, camera facing southeast, 2009
Sketch and Photo Reference Map, Sheet 29

Photograph #37
Powerhouse No. 3 Access Bridge with rail remnants, camera facing east, 2009
Sketch and Photo Reference Map, Sheet 29

Photograph #38
Powerhouse No. 3, Generating Room, camera facing southwest, 2009
Sketch and Photo Reference Map, Sheet 29

Photograph #39
Powerhouse No. 3, Penstock detail at Powerhouse, camera facing northeast, 2013
Sketch and Photo Reference Map, Sheet 29

Photograph #40
Powerhouse No. 3, top of penstocks, camera facing north, 2013
Sketch and Photo Reference Map, Sheet 29

Photograph #41
Ward Tunnel Intake Area in Florence Lake, camera facing west, 2013
Sketch and Photo Reference Map, Sheet 9

Photograph #42
Ward Tunnel Intake Gate House, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 9

Photograph #43
Ward Tunnel, Adit No. 1, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 11

Photograph #44
Ward Tunnel Outlet, augmented by Portal Powerhouse, camera facing northeast, 2014
Sketch and Photo Reference Map, Sheet 14

Photograph #45
Florence Lake Dam, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 9

Photograph #46
Florence Lake Dam, aerial view, camera facing north, 2014
Sketch and Photo Reference Map, Sheet 9

Photograph #47
Florence Lake Dam, camera facing east, 2013
Sketch and Photo Reference Map, Sheet 9

Photograph #48
Florence Lake Dam, camera facing southeast, 2013
Sketch and Photo Reference Map, Sheet 9

Photograph #49
Florence Lake Dam Spillway, camera facing northwest, 2013
Sketch and Photo Reference Map, Sheet 9

Photograph #50
Florence Lake Dam Concrete Arch Detail, camera facing northeast, 2013
Sketch and Photo Reference Map, Sheet 9

Photograph #51
Florence Lake Overview from Kaiser Pass Road, camera facing south, 2014
Sketch and Photo Reference Map, Sheet 9

Photograph #52
Bear Creek Diversion Dam, camera facing east, 2014
Sketch and Photo Reference Map, Sheet 4

Photograph #53
Mono Creek Diversion Dam, camera facing northwest, 2013
Sketch and Photo Reference Map, Sheet 3

Photograph #54
Mono-Bear Flowline Anchor Block, camera facing north, 2013

Sketch and Photo Reference Map, Sheet 11

Photograph #55
Mono-Bear Flowline crossing the San Joaquin River along the Mono-Bear/Lake Edison Road, camera facing southeast, 2014
Sketch and Photo Reference Map, Sheet 2

Photograph #56
Bear Tunnel Outlet Structure, camera facing east, 2013
Sketch and Photo Reference Map, Sheet 2

Photograph #57
Shaver Lake Dam, camera facing southwest, 2013
Sketch and Photo Reference Map, Sheet 27

Photograph #58
Shaver Lake Dam concrete curve detail, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 27

Photograph #59
Shaver Lake, viewed from CA-168, camera facing southwest, 2014
Sketch and Photo Reference Map, Sheet 22

Photograph #60
Tunnel No. 7 Gatehouse, at Huntington Lake Dam No. 2, camera facing northwest, 2013
Sketch and Photo Reference Map, Sheet 16

Photograph #61
Tunnel No. 7 Outlet to Siphon, camera facing north, 2014
Sketch and Photo Reference Map, Sheet 16

Photograph #62
Tunnel No. 7 Siphon, camera facing south, 2014
Sketch and Photo Reference Map, Sheet 16

Photograph #63
Tunnel No. 7 Outlet at Stevenson Creek, camera facing south, 2013
Sketch and Photo Reference Map, Sheet 22

Photograph #64
Powerhouse No. 2A, with Powerhouse No. 2 in background, camera facing southwest, 2015
Sketch and Photo Reference Map, Sheet 24

Photograph #65
Powerhouse No. 2A Generating Room, camera facing southwest, 2009
Sketch and Photo Reference Map, Sheet 24

Photograph #66
Powerhouse No. 2A, penstocks entering south side of powerhouse, camera facing west, 2009
Sketch and Photo Reference Map, Sheet 24

Photograph #67
Big Creek East and West Transmission Lines Anchor Towers adjacent to Powerhouse 2/2A Penstocks, camera facing southeast, 2014
Sketch and Photo Reference Map, Sheet 23

Photograph #68
Big Creek East and West Transmission Lines Standard Towers at Vestal Substation, camera facing north, 2015
Sketch and Photo Reference Map, Sheet 35

Photograph #69
Big Creek No. 3—Big Creek No. 8 Transmission Line adjacent to Powerhouse No. 3, camera facing southwest, 2015
Sketch and Photo Reference Map, Sheet 28

Photograph #70
Big Creek No. 3—Big Creek No. 8 downslope and No. 8—Big Creek No. 2 upslope, adjacent to Powerhouse No. 8, camera facing east, 2015
Sketch and Photo Reference Map, Sheet 25

Photograph #71
Vincent Transmission Line, adjacent to San Joaquin and Eastern Railroad Alignment, camera facing north, 2014
Sketch and Photo Reference Map, Sheet 29

Photograph #72
Vincent Transmission Line at Left Entering Magunden Substation, Bakersfield, camera facing northeast, 2014
Sketch and Photo Reference Map, Sheet 37

Photograph #73
Overview of Big Creek East and West crossing Friant Kern Canal, Tulare County, camera facing north, 2013
Sketch and Photo Reference Map, Sheet 32

Photograph #74
Eagle Rock Substation, camera facing north, 2012
Sketch and Photo Reference Map, Sheet 42

Photograph #75
Eagle Rock Substation, camera facing southeast, 2012
Sketch and Photo Reference Map, Sheet 42

Photograph #76
Magunden Substation, camera facing southeast, 2015
Sketch and Photo Reference Map, Sheet 37

Photograph #77
Magunden Substation with Transmission Yard, camera facing west, 2015
Sketch and Photo Reference Map, Sheet 37

Photograph #78
Vestal Substation, camera facing northwest, 2015
Sketch and Photo Reference Map, Sheet 35

Photograph #79
Vestal Substation, camera facing northeast, 2015
Sketch and Photo Reference Map, Sheet 35

Photograph #80
Rector Substation, camera facing northwest, 2015
Sketch and Photo Reference Map, Sheet 33

Photograph #81
Rector Substation, with Big Creek East and West Alignment in background, camera facing east, 2015
Sketch and Photo Reference Map, Sheet 33

Photograph #82
Huntington Lake Road/Huntington Lodge Road, camera facing east across Big Creek Canyon, 2014
Sketch and Photo Reference Map, Sheet 22

Photograph #83
Huntington Lake Road/Huntington Lodge Road, camera facing southwest with SJ&E Railroad grade and Big Creek East and West Transmission Line in background along hillside, 2014
Sketch and Photo Reference Map, Sheet 22

Photograph #84
San Joaquin and Eastern (SJ&E) Railroad Grade with concrete culvert and stone retaining wall feature, camera facing east, 2014
Sketch and Photo Reference Map, Sheet 28

Photograph #85
SJ&E Railroad Grade with Big Creek East and West Transmission Alignment overhead, camera facing northwest, 2014
Sketch and Photo Reference Map, Sheet 28

Photograph #86
SJ&E Railroad Grade typical section, camera facing southeast, 2014
Sketch and Photo Reference Map, Sheet 22

Photograph #87
SJ&E Railroad Grade, camera facing northeast to Powerhouse No. 2/2A Penstocks and Big Creek East and West Transmission Corridor, 2014
Sketch and Photo Reference Map, Sheet 23

Photograph #88
SJ&E Railroad Grade, cut in granite slope, camera facing east, 2014
Sketch and Photo Reference Map, Sheet 23

Photograph #89
SJ&E Railroad Grade, camera facing northeast toward Powerhouse No. 1 Penstocks descending Big Creek Canyon at left, 2014
Sketch and Photo Reference Map, Sheet 19

Photograph #90
SJ&E Railroad Grade, camera facing east toward Powerhouse No. 1 and Dam No. 4, 2014
Sketch and Photo Reference Map, Sheet 19

Photograph #91
SJ&E Railroad Grade, camera facing southwest from Powerhouse No. 1, depicting curvature and stone retaining wall, 2014
Sketch and Photo Reference Map, Sheet 19

Photograph #92
Powerhouse No. 1 Penstock Incline, camera facing southwest down incline with Big Creek Townsite in background, 2014
Sketch and Photo Reference Map, Sheet 22

Photograph #93
Powerhouse No. 1 Penstock Incline, camera facing north up incline with Powerhouse No. 1 Penstocks at left, 2014
Sketch and Photo Reference Map, Sheet 19

Photograph #94
Canyon Road alignment, with Powerhouse No. 2A Penstock, camera facing west, 2014
Sketch and Photo Reference Map, Sheet 24

Photograph #95
Canyon Road alignment representative vantage, camera facing east, 2014
Sketch and Photo Reference Map, Sheet 24

Photograph #96
Million Dollar Mile Road, beginning of alignment under Powerhouse No. 8 Penstock, facing west, 2014
Sketch and Photo Reference Map, Sheet 25

Photograph #97
View of San Joaquin River Canyon from Million Dollar Mile Road, camera facing southwest, 2014
Sketch and Photo Reference Map, Sheet 28

Photograph #98
Million Dollar Mile Road, typical vista, camera facing southwest, 2014
Sketch and Photo Reference Map, Sheet 28

Photograph #99
Million Dollar Mile Road, typical vista, camera facing northeast, 2014
Sketch and Photo Reference Map, Sheet 28

Photograph #100
Million Dollar Mile Road crossing Stevenson Creek, camera facing southeast, 2014
Sketch and Photo Reference Map, Sheet 28

Photograph #101
Kaiser Pass Road, typical vista, camera facing east, 2014
Sketch and Photo Reference Map, Sheet 1

Photograph #102
Kaiser Pass Road with granite domes above Florence Lake, camera facing northeast, 2014
Sketch and Photo Reference Map, Sheet 1

Photograph #103
Kaiser Pass Road framed by Juniper and Pine, camera facing north, 2014
Sketch and Photo Reference Map, Sheet 1

Photograph #104
Mono-Bear Road/Lake Edison Road, with Mono-Bear siphon at right, camera facing northeast, 2014
Sketch and Photo Reference Map, Sheet 2

Photograph #105
Mono-Bear Road/Lake Edison Road, typical vista, camera facing south, 2014
Sketch and Photo Reference Map, Sheet 2

Photograph #106
Mono-Bear Road/Lake Edison Road, gravel and granite roadbed to Bear Creek Diversion Dam, camera facing northeast, 2014
Sketch and Photo Reference Map, Sheet 2

Photograph #107
High elevation vista from Mono-Bear Road/Lake Edison Road, camera facing south, 2014
Sketch and Photo Reference Map, Sheet 4

Photograph #108
Remnant compressor foundations at site of Camp 86, camera facing north, 2014
Sketch and Photo Reference Map, Sheet 4

Photograph #109
Remnant tunnel muck at site of Camp 1D, camera facing north, 2014
Sketch and Photo Reference Map, Sheet 17

Photograph #110
Remnant can scatter, Camp 3, camera facing north, 2014
Sketch and Photo Reference Map, Sheet 22

Photograph #111
Remnant apple trees, Stephenson Creek Camp along the SJ&E Railroad Grade, camera facing southwest, 2014
Sketch and Photo Reference Map, Sheet 28

Photograph #112
Big Creek Townsite, modern SCE housing, camera facing northeast toward Kerckhoff Dome, 2014
Sketch and Photo Reference Map, Sheet 19

Photograph #113
Big Creek Townsite, SCE Northern Hydro Headquarters completed 2013, camera facing south across Big Creek Canyon, 2014
Sketch and Photo Reference Map, Sheet 19

Photograph #114
Big Creek Townsite, representative streetscape vista, camera facing west, 2014
Sketch and Photo Reference Map, Sheet 19

Photograph #115
SCE Building 109, camera facing northwest, 2014
Sketch and Photo Reference Map, Sheet 19

Photograph #116
SCE Building 176, camera facing northwest, 2014
Sketch and Photo Reference Map, Sheet 19

Photograph #117
SCE Building 177, camera facing southeast, 2014
Sketch and Photo Reference Map, Sheet 19

Photograph #118
SCE Huntington Lake Dam Tender’s Cabin, camera facing southeast, 2014
Sketch and Photo Reference Map, Sheet 17

Photograph #119
SCE Powerhouse No. 3 Hospital, camera facing southeast with Powerhouse No. 3 Penstocks in background, 2014
Sketch and Photo Reference Map, Sheet 29

Photograph #120
SCE Florence Lake Dam Tender’s Cabin, camera facing southwest, 2014
Sketch and Photo Reference Map, Sheet 9

Photograph #121
San Joaquin River Canyon, with Million Dollar Mile Road at right on canyon wall, aerial photo facing northeast, 2014
Sketch and Photo Reference Map, Sheet 28