STATE OF CALIFORNIA — THE RESOURCES AGENCY GRAY DAVIS, *Governor*

CALIFORNIA ENERGY COMMISSION
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September 11, 2002

SUPPLEMENT TO THE PRELIMINARY STAFF ASSESSMENT

COSUMNES POWER PLANT (01-AFC-19)

On August 7, 2002, California Energy Commission staff filed the Preliminary Staff Assessment (PSA) that included all subject areas except for Alternatives, Visual Resources, Visible Plumes, and the Water Supply and Cooling Options (Appendix A) for the Cosumnes Power Plant project (CPP) Application for Certification, proposed by the Sacramento Municipal Utility District (SMUD). On September 11, 2002, staff filed the remaining preliminary analysis sections (enclosed). The Energy Commission's PSA is now complete.

Please insert the enclosed PSA technical sections into the August 7th portion of the PSA, as appropriate, and replace the Table of Contents and Preparation Team with the enclosed, revised pages.

Any questions or comments regarding this supplement, the PSA, or the project should be addressed to Kristy Chew, the Energy Commission project manager at (916) 654-3929, at kchew@energy.state.ca.us, or at the address above.

Public comments regarding the supplement to the PSA are welcome and are encouraged to be received in writing by **October 11, 2002**.

Enclosures: Revised Table of Contents
Alternatives section of the PSA
Visual Resources section of the PSA
Visible Plumes section of the PSA
Water Supply and Cooling Options of the PSA
Revised Preparation Team

COSUMNES POWER PLANT (01-AFC-19)
PRELIMINARY STAFF ASSESSMENT

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VISUAL RESOURCES

Michael Clayton

SUMMARY

Energy Commission staff analyzed the proposed Cosumnes Power Plant (CPP) project, except for its plumes, in regard to its impacts on visual resources and the compliance of the project with applicable laws, ordinances, regulations, and standards (LORS) regarding visual resources. The proposed project would be located adjacent to the existing Rancho Seco Power Plant (currently being decommissioned) in a predominantly agricultural and rural residential landscape. At this time, staff's conclusions are as follows:

- As presently proposed, the project's structures would result in direct adverse but not significant visual impacts. However, project structures would contribute substantially to adverse and significant cumulative visual impacts in conjunction with the existing Rancho Seco cooling towers. Staff has proposed two mitigation measures and two Conditions of Certification (**VIS-2** and **VIS-3**) to reduce the proposed project's direct adverse visual impacts and its contribution to adverse and significant cumulative visual impacts. Staff also proposes that a workshop be convened to discuss the feasibility of specific approaches to landscape screening to meet the requirements of **VIS-3**.
- Staff has concluded that in the three cases of the project's inconsistency or partial consistency with local LORS, either the inconsistencies did not initially produce significant visual impacts, or with effective implementation of staff's conditions of certification, the visual impacts causing the inconsistencies would not be significant.
- The proposed project's night lighting has the potential to cause significant visual impacts on nearby residences. Proper implementation of staff's proposed Conditions of Certification **VIS-4** and **VIS-5**) would keep lighting impacts at levels that would not be significant.

INTRODUCTION

Visual resources are the natural and cultural features of the environment that can be viewed. This analysis focuses on whether CPP would cause significant adverse visual impacts and whether the project would be in compliance with applicable laws, ordinances, regulations, and standards. The determination of the potential for significant impacts to visual resources resulting from the proposed project is required by the California Environmental Quality Act (CEQA).

ORGANIZATION OF ANALYSIS

This analysis is organized as follows:

- Description of analysis methodology;
- Description of applicable laws, ordinances, regulations, and standards;
- Description of the project aspects that may have the potential for significant visual impacts;

- Assessment of the visual setting of the proposed power plant site and linear facility routes;
- Evaluation of the visual impacts of the proposed project on the existing setting;
- Evaluation of compliance of the project with applicable laws, ordinances, regulations, and standards;
- Identification of measures needed to mitigate any potential significant adverse impacts of the proposed project and to achieve compliance with applicable laws, ordinances, regulations, and standards.
- Conclusions and Recommendations; and
- Proposed Conditions of Certification

ANALYSIS METHODOLOGY

Visual resources analysis has an inherently subjective aspect. However, the use of generally accepted criteria for determining impact significance and a clearly described analytical approach aid in developing an analysis that can be readily understood.

Significance Criteria

Commission staff considered the following criteria in determining whether a visual impact would be significant.

State

The CEQA Guidelines define a “significant effect” on the environment to mean a “substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project including...objects of historic or aesthetic significance (Cal. Code Regs., tit.14, § 15382).

Appendix G of the CEQA Guidelines, under Aesthetics, lists the following four questions to be addressed regarding whether the potential impacts of a project are significant:

1. Would the project have a substantial adverse effect on a scenic vista?
2. Would the project substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?
3. Would the project substantially degrade the existing visual character or quality of the site and its surroundings?
4. Would the project create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?

Local

Energy Commission staff considers any local goals, policies, or designations regarding visual resources. Conflicts with such laws, ordinances, regulations, and standards can constitute significant visual impacts. See the section on Laws, Ordinances, Regulations, and Standards.

Professional Standards

Professionals in visual impact analysis have developed a number of questions as a means of evaluating the potential significance of visual impacts (see Smardon 1986). The questions listed below address issues commonly raised in visual analyses for energy facilities. Staff considers these questions in assessing whether a project would cause a significant impact in regard to any of the four CEQA criteria listed above.

- Will the project substantially alter the existing viewshed, including any changes in natural terrain?
- Will the project deviate substantially from the form, line, color, and texture of existing elements of the viewshed that contribute to visual quality?
- Will the project eliminate or block views of valuable visual resources?
- Will the project result in significant amounts of backscatter light into the nighttime sky?
- Will the project be in conflict with directly identified public preferences regarding visual resources?
- Will the project result in a significant reduction of sunlight, or the introduction of shadows, in areas used extensively by the community?

Impact Duration

The visual analysis typically distinguishes three different impact durations. **Temporary impacts** typically last no longer than two years. **Short-term impacts** generally last no longer than five years. **Long-term impacts** are impacts with a duration greater than five years.

View Areas and Key Observation Points

The proposed project would be visible from a number of areas in the project region. Energy Commission staff evaluated the visual impact of the project from each of these areas. Staff used Key Observation Points[1], or KOPs, as representative locations from which to conduct detailed analyses of the proposed project and to obtain existing conditions photographs and prepare visual simulations. KOPs are selected to be representative of the most critical locations from which the project would be seen. However, KOPs are not the only locations that staff considered in each view area.

Evaluation Process

For each view area, staff considered the existing visual setting and the visual changes that the project would cause to determine impact significance. Staff conducted a site visit and concluded that the KOPs presented in the Application for Certification were appropriate for this analysis. The results of staff's analysis are summarized in **Visual Resources Appendix VR-1**. Existing conditions photographs and photosimulations from each KOP are presented with all other figures in **Visual Resources Appendix VR-3**.

[1] The use of KOPs or similar view locations is common in visual resource analysis. The U.S. Bureau of Land Management (USDI BLM 1986a, 1986b, 1984) and the U.S. Forest Service (USDA Forest Service 1995) use such an approach.

Elements of the Visual Setting

To assess the existing visual setting, staff considered the following elements:

Visual Quality

Visual quality is an expression of the visual impression or appeal of a given landscape and the associated public value attributed to the visual resource. This analysis used an approach that considers visual quality as ranging from outstanding to low. Outstanding visual quality is a rating reserved for landscapes that would be what a viewer might think of as "picture postcard" landscapes. Low visual quality describes landscapes that are often dominated by visually discordant human alterations, and do not provide views that people would find inviting or interesting (Buhyoff et al., 1994).

Viewer Concern

Viewer concern is a measurement of the level of viewer interest regarding the visual resources in an area. Official statements of public values and goals reflect viewers' expectations regarding a visual setting. This analysis also employed land use as an indicator of viewer concern. Uses associated with 1) designated parks, monuments, and wilderness areas, 2) scenic highways and corridors, 3) recreational areas, and 4) residential areas are generally considered to have high viewer concern. However, existing landscape character may temper viewer concern on some State and locally designated scenic highways and corridors. Similarly, travelers on other highways and roads, including those in agricultural areas, may have moderate viewer concern depending on viewer expectations as conditioned by regional and local landscape features. Commercial uses, including business parks, typically have low-to-moderate viewer concern, though some commercial developments have specific requirements related to visual quality, with respect to landscaping, building height limitations, building design, and prohibition of above-ground utility lines, that indicate high viewer concern. Industrial uses typically have the lowest viewer concern because workers are focused on their work, and generally are working in surroundings with relatively low visual value.

Viewer Exposure

The visibility of a landscape feature, the viewing distance to the landscape feature, the number of viewers, and the duration of the view all affect the exposure of viewers to a given landscape feature. Visibility is highly dependent on screening and angle of view. The smaller the degree of screening and/or the closer the feature is to the center of the view area, the greater its visibility is. Increasing distance reduces visibility. Viewer exposure can range from low values for all factors, such as a partially obscured and brief background view for a few motorists, to high values for all factors, such as an unobstructed foreground view from a large number of residences.

Visual Sensitivity

The overall level of sensitivity of a view area to impacts due to visual change is a function of visual quality, viewer concern, and viewer exposure and can range from low to high.

Types of Visual Change

To assess the visual changes that the project would cause, staff considered the following factors:

Contrast

Visual contrast describes the degree to which a project's visual characteristics or elements (consisting of form, line, color, and texture) differ from the same visual elements established in the existing landscape. The degree of contrast can range from low to high. The presence of forms, lines, colors, and textures in the landscape similar to those of a proposed project indicates a landscape more capable of accepting those project characteristics than a landscape where those elements are absent. This ability to accept alteration is often referred to as visual absorption capability and typically is inversely proportional to visual contrast.

Dominance

Another measure of visual change is project dominance. Dominance is a measure of a feature's apparent size relative to other visible landscape features and the total field of view. A feature's dominance is affected by its relative location in the field of view and the distance between the viewer and the feature. The level of dominance can range from subordinate to dominant.

View Blockage

View blockage describes the extent to which any previously visible landscape features are blocked from view by the project. Blockage of higher quality landscape features by lower quality project features causes adverse visual impacts. The degree of view blockage can range from none to high.

LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

The following discussion of Federal, State, and Local laws, ordinances, regulations, and standards is based on Section 8.11.2 (LORS) of the Application for Certification (SMUD 2001a, pp. 8.11-1 and 8.11-14 through 9.11-21) and an independent review of the Sacramento County General Plan and Zoning Ordinance and the Yolo County General Plan.

FEDERAL

No federal LORS relating to visual resources apply to the proposed project.

STATE

In the project vicinity, there are no state designated or eligible scenic highways (Caltrans 2002). When a highway has been designated "scenic," the local jurisdiction is required to enact a scenic corridor protection program that protects and enhances scenic resources. A properly enforced program can mitigate the effects of uses that might otherwise detract from the scenic values of the corridor landscape. A corridor protection program would typically stipulate specific siting, landscaping, and screening requirements; as well as require appropriate structural characteristics and surface treatments to make new development more compatible with the existing environment.

LOCAL

The proposed generating facility site, transmission interconnection, and the gas line are located in Sacramento County and would be subject to any county laws, ordinances, regulations, and standards (LORS) pertaining to the protection and maintenance of visual resources in Sacramento County. The natural gas compressor station in Yolo County would be subject to any applicable Yolo County LORS.

Twenty-nine applicable LORS from Sacramento County are found in the Public Facilities and Land Use Elements of the Sacramento County General Plan and the Sacramento County Zoning Ordinance. The relevant local LORS and an assessment of the project's LORS consistency are presented in a later section of this analysis. Fifteen policies from the Yolo County General Plan pertain to the protection and/or maintenance of visual resources within scenic highway, waterway, or riverbank corridors, or in areas of scenic value. However, staff determined that none of the fifteen policies are directly applicable to the gas compressor station.

PROJECT DESCRIPTION

The following section describes the aspects of the project that may have the potential for significant visual impacts and includes the power plant and associated facilities, switchyard, electric transmission interconnection, natural gas pipeline and compressor stations, and water supply pipeline (see **Project Description Figure 2**).

POWER PLANT AND ASSOCIATED FACILITIES

The proposed project would be located in Sacramento County, 25 miles southeast of the City of Sacramento. The project site would occupy approximately 30 acres of 2,480 acres owned by Sacramento Municipal Utility District (applicant). The site is situated between Rancho Seco Power Plant on the north and Clay East Road on the south. **Visual Resources Table 1** presents the heights for a number of the project's key components. The most visible features of the proposed project would include the four 165-foot tall HRSG stacks; the four 107-foot tall HRSG structures; the 65-foot tall air inlets to the combustion turbine generators (CTGs); the two 40-foot tall, 2.5-million-gallon raw water storage tanks; and the 43-foot tall, 864-foot long 18-cell cooling tower structure (see **Visual Resources Figure 1**). Other features associated with the generation site include ancillary structures; parking areas; an 8-foot chain link fence, with an additional two feet of barbed or razor wire; and lighting (which is addressed in a separate section later in this analysis).

Visual Resources Table 1
Dimensions of Key Project Components

Component	Height[1] (feet)	Length (feet)	Diameter / Width (feet)
HRSG Structure (to top of highest relief valve)	107		
HRSG Drums (to top of highest)	97		
HRSG Stacks	165		18.5
HRSG Casings	72	120	32
Gas Combustion Turbine Air Inlet Filters	65	85	40
Steam Turbine Generator Enclosure	40	100	40
Cooling Tower Structure	43	864 (18 cells)	66
Deionized Water Storage Tanks	40		32
Raw Water Tanks	40		105
Switchyard Conductor Take-off Structures	70	580	110
Transmission Towers	100 to 125		

1 Source: SMUD 2001d, Data Adequacy Response, pp. 13-14)

SWITCHYARD

A new on-site switchyard would be located immediately west of the power generation facilities. Components of the new switchyard would have an industrial appearance similar to that of other components associated with the power generation facilities and would include transformers, A-frame take-off structures, and other electrical equipment. The takeoff structures would be the tallest switchyard components and would be approximately 70 feet in height (see **Visual Resources Figure 1**). The switchyard facilities are visible in **Visual Resources Figure 3B**.

ELECTRICAL TRANSMISSION INTERCONNECTION

Power generated by the proposed project would be transferred over a 0.4-mile double circuit 230 kV transmission interconnection to the existing switchyard at Rancho Seco Power Plant, which is located immediately north of the proposed project site. The transmission line would be 100 feet to the east of and parallel to an existing PG&E 230 kV transmission line right-of-way. The transmission line would be carried on six single-pole tubular structures.

NATURAL GAS PIPELINE

Natural gas would be delivered to the project site via a 24-inch diameter, 26-mile long underground pipeline from the Carson Ice-Generation Facility. The underground gas pipeline would also require the installation of several aboveground facilities including one interconnection station, three valve stations, a measurement station, and two compressor stations (which would be required at the time that the second phase of the project is completed and the third and fourth HRSGs are brought on line). At the valve stations, all valves would be below ground. The only components that would be aboveground would be the high head extensions for the valves (about 3.5 feet above the ground surface), a blow off stack (about 8 feet above the ground surface and up to 10 inches in diameter), and a Remote Terminal Unit (RTU) for the supervisory control and data acquisition system (a metal box about 3 feet x 3 feet x 4 feet tall). The RTU would be enclosed in a 5-foot x 8-foot x 8-foot structure. At the interconnection station and valve station 3, there would also be a pig launcher (a “pig” is a torpedo- or sphere-shaped device that is used to inspect or clean gas pipelines). The launcher would be about 10 feet x 10 feet x 5 feet tall.

All facilities would be enclosed by a slatted, 6-foot cyclone fence topped with barbed wire. The slats would be tinted to blend with the surrounding background of each area. The locations of these aboveground facilities are as follows based on the applicant’s response to staff’s Data Request #89 (SMUD 2002a, pp. 41-43):

- **Interconnection Station** – This station would occupy an area 75 feet by 75 feet on the southwest corner of Laguna Station Road and Glacier Road. The station facilities would include above ground valves, buried valves with elevated stems, a pipeline blow down stack, a pig launcher, and control equipment.
- **Valve Station 1** – This station would occupy an area 50 feet by 50 feet on the west side of Bruceville Road, approximately 0.5 mile north of Eschinger Road. This station would include buried valves with elevated stems, a pipeline blow down stack and control equipment.
- **Valve Station 2** – This station would occupy an area 50 feet by 50 feet on the northwest corner of Arno and Valensin Roads. This station would include buried valves with elevated stems, a pipeline blow down stack and control equipment.
- **Valve Station 3** would occupy an area 100 feet by 100 feet on the southwest corner of Valensin and Alta Mesa Roads. This station would include buried valves with elevated stems, a pipeline blow down stack, a pig launcher, and control equipment.
- **Measurement Station** – This station would occupy an area 100 feet by 100 feet at the proposed power plant site. This station would include aboveground valves, buried valves with elevated gearing, a pipeline blow down stack, a pig receiver, metering equipment, and control equipment. The power plant slatted site fencing would also enclose the Measurement Station.
- **Compressor Station in Yolo County near Winters** (second phase) – A compressor would be installed within the existing inter-tie station located at 27700B County Road 29 in Yolo County. The compressor is anticipated to be skid mounted, approximately 10 feet by 20 feet by 8 feet high, within a slatted fence enclosure.
- **Compressor Station at Carson Ice Generation Plant** (second phase) – A compressor would be installed within the existing inter-tie station located at the crosstie measurement and valve station 190, which is located on an un-named access road between Franklin Boulevard and the Carson Ice-Generation Plant. The compressor is anticipated to be skid mounted, approximately 10 feet by 20 feet by 8 feet high, within a slatted fence enclosure.

WATER SUPPLY PIPELINE

Water for the proposed project would be obtained from an existing pipeline from the Folsom-south Canal (SMUD 2001a, p. 8.11-7) and would not require off-site pipeline construction. However, a package water treatment plant would be required to treat the water from the canal (SMUD 2001a, p. 1-1). The package water treatment plant would be located inside the deionized water treatment building at the proposed power plant site (SMUD 2002a, Data Response 92).

SETTING

REGIONAL LANDSCAPE

The proposed project would be located in a sparsely developed region of southeast Sacramento County in a landscape characterized by rolling hills, vineyards, cattle grazing land, open space, rural residences, and energy production and transmission infrastructure. The most prominent features in the regional landscape are the Rancho Seco Power Plant's twin 426-foot-high parabolic cooling towers, which will remain standing following the decommissioning of Rancho Seco. In the distance to the east are the Sierra Nevada Mountains, which are visible on days when they are not obscured by haze. Other noticeable features in the primarily rural landscape are the electric transmission lines that converge on the Rancho Seco substation; and utility lines along Twin Cities Road, the principal east-west roadway in the project vicinity that passes north of the project site. The principal recreation facility in the region is Rancho Seco Park, located approximately 1.6 miles southeast of the project site. The park offers day use swimming, picnicking, and fishing, and overnight camping.

PROJECT VIEWSHED

The distance zones used within this analysis are defined as *foreground* (0 to 1/2 mile), *middleground* (1/2 to 2 miles), and *background* (beyond 2 miles). Within these zones of influence are relatively few viewing opportunities due to the screening provided by the rolling terrain and the sparsely populated nature of the viewshed. Most viewing opportunities are from the west and south of the project site and some available views are unobstructed and panoramic, encompassing broad vistas of agricultural lands and expansive distances of sky. Views from Twin Cities Road in the immediate project vicinity are partially screened by the intervening rolling terrain. Foreground to middleground views of the proposed project are available from (a) Clay East Road east of Twin Cities Road (immediately adjacent to the south side of the site), (b) the nearest residences on Clay East Road (0.2 mile southwest of the site – KOP 1), (c) a small cluster of residences approximately 1.1 miles southwest of the site along the east side of Kirkwood Street (KOP 2), and (d) the recreational use areas of Rancho Seco Park approximately 1.6 miles southeast of the site (KOP 4). A middleground to background view of the site is available from several hilltop residences west of the project site including one on Clay Station Road (KOP 3), approximately 2 miles northwest of the project site.

The gas pipeline would be underground and would not be visible during project operation.

IMMEDIATE POWER PLANT VICINITY

Similar to the project region, the immediate power plant vicinity presents a mosaic of uses comprised primarily of rural residential intermixed with vineyards, cattle grazing, undeveloped open space, and energy production. The visual character of the immediate project vicinity, while decidedly rural, is dominated by the industrial character and structural prominence of the Rancho Seco Power Plant and the transmission lines converging on the power plant. The 30-acre project site is characterized by level terrain supporting primarily annual grassland, which is used as pasture

ELECTRICAL TRANSMISSION INTERCONNECTION

The proposed electrical transmission interconnection is located within the power plant vicinity, described above.

GAS PIPELINE

The proposed gas pipeline would pass through areas that are characterized as urban residential, rural residential, light industry, agriculture, and open space. The pipeline would follow a railroad alignment; existing utility corridors; and roadways, and would cross some agricultural fields. The view looking south along the proposed gas pipeline alignment from the Laguna Boulevard overcrossing of the Union Pacific Railroad shows baseball diamonds to the east in the foreground, and residential land uses to the east and west. The proposed gas pipeline alignment would parallel the railroad tracks in this area. The view of the proposed gas pipeline alignment from Ed Rau Road looking northeast across agricultural fields shows an existing transmission line alignment. The landscape in this area is primarily agricultural with a few rural residences. The remainder of the route to the project site passes through landscapes characterized by agricultural and rural residential uses.

WATER SUPPLY PIPELINE

The proposed 0.4-mile water supply pipeline connection to an existing 66-inch diameter underground water supply pipeline currently serving Rancho Seco Power Plant is located within the power plant vicinity, described above.

CONSTRUCTION LAYDOWN AREAS

The proposed construction laydown areas are located within the power plant vicinity, described above.

VIEWING AREAS AND KEY OBSERVATION POINTS

Staff evaluated the visual setting and proposed project in detail from several viewing areas represented by four key viewpoints including: (1) Clay East Road, (2) Kirkwood Street, (3) Clay Station Road, and (4) Rancho Seco Park.

Each of these key observation points is shown on **Visual Resources Figure 2**. At each KOP a visual analysis was conducted, the results of which are presented in Appendix VR-1. Existing conditions photographs are presented in Appendix VR-3. A discussion of the visual setting for each KOP is presented in the following paragraphs.

KOP 1 – Clay East Road

KOP 1 is located at the front yard of 14460 Clay East Road, approximately 0.2 mile southwest of the project site. This viewpoint was selected to represent the view from the two residences closest to the project site. It also represents views from eastbound Clay East Road which dead ends just past the project site at the entrance road to a private ranch. **Visual Resources Figure 3A** shows the view from KOP 1 to the northeast toward the proposed project site.

Visual Quality

From this viewpoint, the most prominent features in the predominantly rural landscape are the flat, open agricultural fields that occupy the foreground and middleground; Rancho Seco Power Plant with its complex industrial character and prominent twin parabolic cooling towers in the middleground, the electric transmission and utility infrastructure that crosses the foreground fields and parallels Clay East Road, and the linear form of Clay East Road. Also visible in the background when not obscured by haze are the distant Sierra Nevada Mountains. Although the overall landscape character is rural agricultural, landscape character becomes more industrial in appearance in close proximity to Rancho Seco Power Plant. As a result, the visual quality of the view from KOP 1 is low-to-moderate.

Viewer Concern

The residential viewers represented by KOP 1 anticipate a foreground to middleground rural agricultural landscape with a dominant energy infrastructure presence. However, viewers' expectations would also include open panoramic vistas across the flat to rolling agricultural fields to the north and east. Although such views are partially obscured by the existing power plant and the intermittent presence of electric transmission and road side utility structures, any additional blockage of vista views along either roadway or introduction of features with industrial character would be perceived as an adverse visual change and viewer concern is moderate-to-high.

Viewer Exposure

Site visibility is high because the view of the site from KOP 1 is open and unobstructed at a foreground viewing distance of approximately 0.2 mile, and the duration of view is extended. However, a very low number of potential viewers can outweigh other exposure factors, leading to a low rating for overall viewer exposure, which is the case for the two residences that have this view.

Although the AFC identified an annual average daily traffic of 3,800 for Clay East Road (SMUD 2001a, Table 8.10-3), almost all of those vehicles either turn south on or travel west from Kirkwood Street. The eastern-most segment of Clay East Road represented by KOP 1 ends just east of the viewpoint and has very little vehicle traffic. The very low number of motorists outweighs other exposure factors, leading to a low rating for overall viewer exposure.

Overall Visual Sensitivity

The low-to-moderate visual quality and low viewer exposure somewhat offsets the moderate-to-high viewer concern at KOP 1. The resulting overall sensitivity for KOP 1 is low-to-moderate.

KOP 2 – Kirkwood Street

KOP 2 is located at the back yard of 11615 Kirkwood Street, near the intersection with Clay East Road. This viewpoint is approximately 1.1 miles southwest of the project site. This viewpoint was selected to represent the slightly elevated perspective from the four residences along Kirkwood Street that are closest to the intersection with Clay East Road. It also somewhat represents the motorist view from eastbound Clay East Road, as the road begins to descend the slight rise from Kirkwood Street. This view is also somewhat similar to views experienced by approximately 50 residences in the area from west of the plant to south of the site. **Visual Resources Figure 4A** shows the existing view to the northeast from KOP 2 toward the project site.

Visual Quality

This viewpoint affords panoramic views of a foreground to middleground flat agricultural landscape with a prominent presence of energy and electric transmission infrastructure in the middleground, backdropped by foothills and the distant Sierra Nevada mountain range. Aside from the foreground flat agricultural fields, the most prominent features in the landscape are the twin parabolic cooling towers at Rancho Seco Power Plant with its complex industrial character. Other noticeable features in the landscape include electric transmission and utility infrastructure and the linear form of Clay East Road. Overall visual quality is moderate.

Viewer Concern

The residential viewers represented by KOP 2 anticipate a foreground to middleground rural agricultural landscape with a dominant energy infrastructure presence in the middleground. However, viewers' expectations also include open panoramic vistas across the flat-to-rolling agricultural fields to the east to the foothills and mountains. Any additional view blockage of natural features (agricultural fields, foothills, or mountains in the background) by project structural elements or introduction of features with industrial character would be perceived as an adverse visual change and viewer concern is moderate-to-high. Eastbound travelers on Clay East Road are almost all either residents of the area or their visitors, so the level of viewer concern is also moderate-to-high for travelers.

Viewer Exposure

Site visibility is high in that the view of the site from KOP 2 is open and unobstructed at a middleground viewing distance of approximately 1.1 miles. Approximately 20 residences represented by this KOP have similar views of the project site, so the number of residential viewers is moderate. The extended duration of viewing opportunities for the residents result in a high value for duration of view. For the moderate number of residences represented by KOP 2, the project's high visibility and the long duration of view result in moderate to high viewer exposure.

Motorists on Kirkwood Street would generally not be able to see the project site except near the intersection with Clay East Road because views to the east are generally screened by residences and vegetation along most of the length of the street. At the Clay East Road intersection, the attention of the motorist traveling northbound on Kirkwood Street is primarily drawn to the west away from the project site because most of the oncoming traffic is approaching from the west and then turns south on Kirkwood Street. Eastbound motorists on Clay East Road would also have a brief view of the site at the intersection with Kirkwood Street before turning south on Kirkwood Street (there is no stop for traffic on Clay East Road). Overall, for motorists visibility is low to moderate and duration of view is low.

The AFC identified an annual average daily traffic of 3,800 for Clay East Road (SMUD 2001a, Table 8.10-3). Approximately half of those vehicles would be traveling westbound away from the project, having originated from Kirkwood Street or the eastern-most dead end segment of Clay East Road. The remaining 1,900 vehicles would be traveling east on Clay East Road with most turning south on Kirkwood Street and a few continuing east on Clay East Road past Kirkwood Street. This constitutes a moderate number of viewers. Considering the low to moderate visibility, low duration of view, and moderate number of viewers, overall viewer exposure for motorists represented by KOP 2 is low to moderate.

Overall Visual Sensitivity

For the residences represented by KOP 2, the moderate visual quality, moderate-to-high viewer concern, and moderate-to-high viewer exposure result in an overall moderate-to-high level of visual sensitivity. For motorists, the moderate visual quality, moderate-to-high viewer concern, and low-to-moderate viewer exposure result in an overall moderate level of visual sensitivity.

KOP 3 – Clay Station Road

KOP 3 is located at the backyard of 11540 Clay Station Road, slightly over two miles northwest of the project site. This viewpoint represents the elevated perspective available to approximately two hilltop residences. **Visual Resources Figure 5A** shows the view from KOP 3 to the southeast toward the proposed project site.

Visual Quality

This viewpoint affords panoramic views of a foreground to background flat agricultural landscape with a prominent presence of energy and electric transmission infrastructure, backdropped by the distant Sierra Nevada mountain range. Aside from the foreground to middleground flat agricultural fields, the most prominent features in the landscape are the twin parabolic cooling towers at Rancho Seco Power Plant with its complex industrial character on the middleground to background margin. Other noticeable features in the landscape include electric transmission lines converging on the power plant. Overall visual quality is moderate.

Viewer Concern

The residential viewers represented by KOP 3 anticipate a foreground to background rural agricultural landscape with a prominent energy infrastructure presence. However, viewers' expectations also include open panoramic vistas across the flat to rolling agricultural landscape to the distant Sierra Nevada Mountains. Any additional view blockage of natural features (agricultural fields or mountains in the background) by project structural elements or introduction of features with industrial character would be perceived as an adverse visual change and viewer concern is moderate-to-high.

Viewer Exposure

Site visibility is moderate-to-high at this near background viewing distance of slightly over two miles. Although the duration of view is extended, the number of viewers is very low. As discussed above, a very low number of potential viewers can outweigh other exposure factors, leading to a low rating for overall viewer exposure, which is the case for KOP 3.

Overall Visual Sensitivity

For KOP 3 moderate visual quality, moderate-to-high viewer concern, and low overall viewer exposure result in moderate overall visual sensitivity.

KOP 4 – Rancho Seco Park

KOP 4 is located at the swimming and picnic area at Rancho Seco Park. This viewpoint is approximately 1.6 miles southeast of the project site. This viewpoint was selected to represent the recreational views of park users. **Visual Resources Figure 6A** shows the existing view from KOP 4 to the northwest toward the proposed project site.

Visual Quality

This viewpoint affords panoramic views of a foreground to middleground reservoir and park landscape, backdropped by the low reservoir dam and prominent parabolic cooling towers of Rancho Seco Power Plant in the distant middleground. The prominent blue color of the reservoir waters contrasts with the green of the park turf areas, adding visual interest and variety to the view from KOP 4. Overall visual quality is moderate.

Viewer Concern

The recreational viewers represented by KOP 4 anticipate a foreground to middleground park landscape dominated by the level reservoir waters and the prominent features at Rancho Seco Power Plant. However, viewers' expectations also include open panoramic vistas across the reservoir to the predominately open skies beyond. Any additional view blockage of natural features (sky) by project structural elements or introduction of features with industrial character would be perceived as an adverse visual change and viewer concern is moderate-to-high.

Viewer Exposure

Site visibility is moderate at this middleground viewing distance of 1.6 miles. Although the number of viewers is moderate, the duration of view is extended and overall viewer exposure is moderate.

Overall Visual Sensitivity

The moderate-to-high viewer concern is tempered by the moderate visual quality and viewer exposure that would be experienced. The resulting overall sensitivity of the visual setting experienced from KOP 4 is moderate.

IMPACTS

CONSTRUCTION IMPACTS

Construction of the proposed power plant and linear facilities would cause adverse visual impacts due to the presence of equipment, materials, and workforce. Construction would involve the use of cranes, heavy construction equipment, temporary storage and office facilities, and temporary laydown/staging areas. Construction would include site clearing and grading, digging for construction of underground linear facilities, construction of the actual facilities, and site and rights-of-way cleanup and restoration. Project construction would span a period of approximately four years. Construction of the first phase of the project would occur over a 24-month period. Construction of the second phase of the project would occur over a 20-month period, which could follow three months or years after completion of the first phase (SMUD 2001a, p. 8.11-10). Due to the short-term nature of project construction, the adverse visual impacts that would occur during construction would not be significant. However, this conclusion assumes that complete restoration of construction areas and rights-of-way is accomplished. Proper implementation of Condition of Certification **VIS-1** would ensure that the visual impacts associated with project construction remain less than significant.

Also, while the majority of construction activities would occur during daylight hours when supplemental lighting would not be needed, some construction activity may occur at night to make up schedule deficiencies or to complete critical construction activities. Additionally, some construction activities during the startup phase would continue 24 hours a day, 7 days a week (SMUD 2001a, p. 2-17). Also, if nighttime pipeline construction activities occur, standard white construction lights that are approximately six to eight feet tall would be used to illuminate the immediate construction activity. In order to ensure that significant construction lighting impacts do not occur, staff recommends Condition of Certification **VIS-4**, presented later in this analysis.

There are approximately 530 residences located along the 26-mile pipeline that are within 500 feet of the pipeline alignment (SMUD 2002a, p. 43, Data Response #90). However, it is likely that not all of the 530 residences would have a view of the pipeline construction because of the elevation of residences relative to the pipeline, the orientation of the residence relative to the pipeline, and the presence of vegetation, fencing, or other structures that would obstruct views from the residence.

A typical pipeline construction spread would include a bulldozer, backhoe, boom trucks, excavation diggers, material delivery trucks, welding trucks and inspection vehicles. In traffic areas, the spread would be less than 500 feet in length. In rural or agricultural areas, the spread would depend on safety and construction efficiency. Generally, the speed of construction would be 100 feet to 500 feet per day depending upon width of construction easement, equipment type, soil, and weather conditions (SMUD 2002a, pp. 43-44, Data Responses #90 and #91). Typically, pipeline construction could potentially be viewed from residences for one to seven days with decreasing levels of visual clarity as the distance to construction activities increases. Given the limited duration that pipeline construction activities would be visible, the resulting visual impact would be less than significant. Views of the two compressor station sites are extremely limited and the compressor station near Winters would be located within an existing facility. The visual impacts of compressor station construction would be less than significant.

OPERATION IMPACTS

An analysis of operation impacts was conducted for the view areas represented by the key viewpoints selected for in-depth visual analysis. The results of the operation impact analysis are discussed below by KOP and presented in the Visual Analysis Summary table included as **Visual Resources Appendix VR-1**. The visual impacts of night lighting are discussed in a separate section of this analysis. For each KOP, an evaluation of visual contrast, project dominance, and view blockage is presented with a concluding assessment of the overall degree of visual change caused by the proposed project.

Impacts of Power Plant Structures

As previously discussed, for Phases 1 and 2, the most prominent power plant structures would be the four 165-foot tall HRSG stacks, the four 107-foot tall HRSGs, the 65-foot tall air inlets to the combustion turbine generators (CTGs), the 40-foot tall steam turbine generator, and the 43-foot tall, 864-foot long cooling tower structure consisting of 18 cells.

The 230 kV electric transmission interconnection and switchyard would also be visible in the immediate power plant vicinity. The transmission interconnection would be located adjacent to the existing PG&E 230 kV transmission line. The existing lattice structures are a maximum of 138 feet tall. The proposed transmission line would be carried on six single-pole tubular structures, which would be a maximum of 125 feet in height (SMUD 2002a, pp. 45-46, Data Response #97).

The proposed switchyard, located immediately west of the power generation facilitates, would be noticeable in the views from KOPs 1-3 but would not be prominent project features within the context of the existing transmission line, Rancho Seco Power Plant, and the proposed power generation facilities that would be prominently visible immediately behind the switchyard.

KOP 1 – Clay East Road

Visual Resources Figure 3B presents a visual simulation of the proposed project as viewed from KOP 1 from the front yard of 14460 Clay East Road. The most obvious change to the landscape would be the introduction of prominent geometric forms with horizontal and vertical lines and complex industrial character. The resulting structural mass would appear similar to that of the adjacent Rancho Seco Power Plant.

The proposed transmission structures and switchyard are also shown in **Visual Resources Figure 3B**. As shown in the simulation, the interconnection's tubular structures and switchyard would be only marginally noticeable within the context of the existing transmission line, Rancho Seco Power Plant, and the proposed power generation facilities.

Visual Contrast

The proposed project would introduce the prominent geometric forms and vertical and horizontal lines of the HRSG structures and stacks and intake air inlet structures and the vertical forms and lines of the electric transmission interconnection and switchyard. These structural characteristics would appear similar to the existing forms and lines established by the adjacent Rancho Seco Power Plant and electric transmission infrastructure converging on the plant. The neutral gray color of the proposed facilities would also be consistent with the color of the existing Rancho Seco Power Plant and electric transmission towers. While the apparent scale of these introduced forms and structural masses would appear similar to the existing power plant, they would be substantially larger than other developed features in the immediate project vicinity including transmission lines, roadside utility infrastructure, and agricultural fences and outbuildings. The resulting visual contrast would be moderate (see the Visual Analysis Summary table presented as **Visual Resources Appendix VR-1**).

Project Dominance

The predominantly rural agricultural landscape visible from KOP 1 is dominated by the flat, horizontal form of the agricultural fields and the prominent complex industrial forms of Rancho Seco Power Plant and electric transmission infrastructure. The proposed power plant facilities would be spatially prominent in the view from KOP 1. The scale of the proposed facilities, without landscaping, would appear co-dominant with the existing power plant and landforms. Also, the height of the vertical HRSG stacks would contribute to the structural prominence of the proposed facilities. Overall project dominance would be co-dominant.

View Blockage

From KOP 1 the vertical HRSG structures and stacks and intake air filters (lower quality landscape features) would block the view to portions of sky (higher quality landscape feature). Portions of the Sierra foothills would also be partially blocked from view on days when they are not obscured by valley haze. The resulting view blockage would be moderate.

Overall Visual Change

From KOP 1, the overall visual change caused by the proposed project would be moderate due to the moderate degree of contrast that would occur from the project's co-dominant structures, combined with the project's moderate degree of view blockage of higher quality landscape features (sky).

Visual Impact Significance

When considered within the context of the overall low-to-moderate visual sensitivity of the existing landscape and viewing characteristics, the moderate visual change that would be perceived from KOP 1 would cause an adverse but not significant visual impact.

KOP 2 –Kirkwood Street

Visual Resources Figure 4B presents a visual simulation of the proposed project as viewed from KOP 2 from the backyard of 11615 Kirkwood Street, near the intersection with Clay East Road. The most obvious change to the landscape would be the introduction of noticeable geometric forms with horizontal and vertical lines and complex industrial character.

Visual Contrast

The proposed project would introduce the noticeable geometric forms and vertical and horizontal lines of the HRSG structures and stacks and intake air inlet structures and the vertical forms and lines of the electric transmission interconnection and switchyard. These structural characteristics would appear similar to the existing forms and lines established by the adjacent Rancho Seco Power Plant and electric transmission infrastructure converging on the plant. The neutral gray color of the proposed facilities would also be consistent with the color of the existing Rancho Seco Power Plant and electric transmission towers. However, the project's structural characteristics would appear dissimilar to the surrounding flat, agricultural landscape. While the apparent scale of these introduced forms and structural masses would appear smaller than the existing power plant, they would be larger than other developed features in the immediate project vicinity including transmission lines, roadside utility infrastructure, and rural residential structures. The resulting visual contrast would be low-to-moderate (see the Visual Analysis Summary table presented as **Visual Resources Appendix VR-1**).

Project Dominance

The predominantly rural agricultural landscape visible from KOP 2 is dominated by the flat, horizontal form of the agricultural fields and the prominent complex industrial forms of Rancho Seco Power Plant. The proposed power plant facilities would be spatially noticeable in the view from KOP 2 but the scale of the proposed facilities, without landscaping, would appear smaller than that of either the surrounding flat landforms or power plant with its two massive hyperbolic cooling towers. Overall project dominance would be subordinate-to-co-dominant.

View Blockage

From KOP 2 the vertical HRSG structures and stacks and intake air filters (lower quality landscape features) would block from view portions of the Sierra Nevada foothills and surrounding agricultural fields (higher quality landscape features). However, compared to KOP 1 which is considerably closer to the proposed project site, the view blockage experienced at KOP 2 would be less apparent in the wider field of view available from this more distant viewpoint (see **Visual Resources Figure 4B**). The resulting view blockage would be low-to-moderate.

Overall Visual Change

From KOP 2, the overall visual change caused by the proposed project would be low-to-moderate due to the low-to-moderate degrees of contrast and view blockage that would occur from the project's subordinate-to-co-dominant structures.

Visual Impact Significance

When considered within the context of the overall moderate visual sensitivity of the existing landscape and viewing characteristics, the low-to-moderate visual change that would be perceived from KOP 2 would cause an adverse but not significant visual impact.

KOP 3 – Clay Station Road

Visual Resources Figure 5B presents a visual simulation of the proposed project as viewed from KOP 3 from the backyard of 11540 Clay Station Road. The most obvious change to the landscape would be the introduction of noticeable geometric forms with horizontal and vertical lines and complex industrial character. However, at this background viewing distance, the structural mass of the proposed project would appear smaller than that of the existing Rancho Seco Power Plant to the north of the project site.

It should be noted that the simulation presented in Figure 5B does not reflect the most recent changes to the project design, which are reflected in the simulations for KOP 1 (**Visual Resources Figure 3B**) and KOP 2 (**Visual Resources Figure 4B**). However, the most substantial visual changes in the new design (slightly different spacing between HRSG structures and stacks and a five-foot increase in the height of the HRSG stacks) would not be readily apparent at this near background viewing distance and would not change the conclusions reached in the KOP 3 analysis.

Visual Contrast

At this near background viewing distance, the most noticeable project elements would be the vertical forms and lines of the HRSG structures and stacks and the vertical forms and lines of the electric transmission interconnection and switchyard. These structure characteristics would appear similar to the existing forms established by the adjacent Rancho Seco Power Plant and electric transmission infrastructure converging on the plant. The neutral gray color of the proposed facilities would also be consistent with the color of the existing Rancho Seco Power Plant and electric transmission towers. Also, the apparent scale of these introduced forms and structural masses would appear substantially smaller than the existing power plant structures. However, the proposed project's linear forms, vertical lines, and industrial character would appear dissimilar to the surrounding flat, horizontal, agricultural landscape. The resulting visual contrast would be low-to-moderate (see the Visual Analysis Summary table presented as **Visual Resources Appendix VR-1**).

Project Dominance

The predominantly rural agricultural landscape visible from KOP 3 is dominated by the flat, horizontal landforms comprised of the foreground to middleground agricultural fields and the prominent and complex industrial forms of Rancho Seco Power Plant. The proposed power plant facilities would be spatially noticeable in the view from KOP 3 but the scale of the proposed facilities, without landscaping, would appear smaller than that of either the foreground to middleground level landforms or the existing power plant with its two massive hyperbolic cooling towers. Overall project dominance would be subordinate.

View Blockage

From KOP 3 the vertical HRSG structures and stacks (lower quality landscape features) would block from view small portions of the Sierra Nevada foothills and distant agricultural fields (higher quality landscape features). The resulting view blockage would be low.

Overall Visual Change

From KOP 3, the overall visual change caused by the proposed project would be low due to the low-to-moderate degree of contrast and low degree of view blockage that would result from the project's visually subordinate structures.

Visual Impact Significance

When considered within the context of the overall moderate visual sensitivity of the existing landscape and viewing characteristics, the low visual change that would be perceived from KOP 3 would cause an adverse but not significant visual impact.

KOP 4 – Rancho Seco Park

Visual Resources Figure 6B presents a visual simulation of the proposed project as viewed from KOP 4 from the swimming and picnic area at Rancho Seco Park. The proposed project would introduce the noticeable linear forms and vertical lines of the HRSG stacks. However, at this distant middleground viewing distance, minimal structural mass would be apparent compared to the massive hyperbolic forms of the Rancho Seco Power Plant cooling towers.

It should be noted that the simulation presented in Figure 6B does not reflect the most recent changes to the project design, which are reflected in the simulations for KOP 1 (**Visual Resources Figure 3B**) and KOP 2 (**Visual Resources Figure 4B**). However, the most substantial visual changes in the new design (slightly different spacing between HRSG structures and stacks and a 5-foot increase in the height of the HRSG stacks) would not be readily apparent at this distant middleground viewing distance and would not change the conclusions reached in the KOP 4 analysis.

Visual Contrast

At this middleground viewing distance, the most noticeable project elements would be the linear forms and vertical lines of the HRSG stacks. The stacks would be minimally visible above Rancho Seco Dam. The neutral gray color of the proposed facilities would also be consistent with the color of the existing Rancho Seco Power Plant and electric transmission towers. The scale of these structural masses would appear substantially smaller than the existing Rancho Seco Power Plant cooling towers. Although the proposed project's linear vertical lines would appear dissimilar to the predominantly horizontal lines created by the dam and water lines, at this distant middleground viewing distance the project's vertical lines would be minimally noticeable (see **Visual Resources Figure 6B**). The resulting visual contrast would be low (see the Visual Analysis Summary table presented as **Visual Resources Appendix VR-1**).

Project Dominance

The view from KOP 4 is dominated by the broad horizontal bands of sky, water, and grass, punctuated only by the prominent hyperbolic forms of the Rancho Seco cooling towers. While the proposed power plant facilities would be spatially noticeable in the center of the view from KOP 4, they would appear subordinate in size compared to the existing natural features in the landscape (sky, water, and grass) and existing power plant structures. Overall project dominance would be subordinate.

View Blockage

From KOP 4 the vertical HRSG stacks (lower quality landscape features) would block from view very small portions sky above the horizon (higher quality landscape feature). The resulting view blockage would be low.

Overall Visual Change

From KOP 4, the overall visual change caused by the proposed project would be low due to the low amounts of contrast and view blockage that would result from the project's visually subordinate structures.

Visual Impact Significance

When considered within the context of the overall moderate visual sensitivity of the existing landscape and viewing characteristics, the low visual change that would be perceived from KOP 4 would cause an adverse but not significant visual impact.

Linear facilities

The electric transmission interconnection and associated switchyard are discussed above under the power plant facilities.

The proposed underground natural gas supply line would not be visible following installation except for an occasional warning marker and would not result in adverse visual impacts. However, the gas pipeline would include two aboveground gas compressor stations, an interconnection station, and three valve stations that would be located in areas with public visual access. Valve Station 3 would be particularly noticeable at the intersection of Valensin and Alta Mesa roads. The above ground valves, elevated valve stems, blow down stacks, and small structure for control equipment would appear industrial in character, and inconsistent with the surrounding landscape features. The valve stems would extend about 3.5 feet above the ground surface while the blow down stacks would be 10 inches in diameter and extend about 8 feet above the ground surface. The remote terminal unit (RTU) would be enclosed in a 5-foot by 8-foot by 8-foot tall structure. At the interconnection station, the pig launcher station would be approximately 10 feet by 10 feet by 5 feet tall. While the resulting visual impacts of these above facilities would not be significant due to their small size relative to other visible features in the landscape, they would be adverse and should be mitigated with appropriate vegetative screening. The other aboveground facilities (measurement station and two compressor stations) would be located within other larger facilities and would not cause adverse visual impacts.

The proposed underground water supply pipeline would be located within SMUD's 2,480-acre property and would not result in adverse visual impacts.

Lighting

The proposed project would be located in an agricultural and rural residential area, which has relatively minimal existing night lighting except for residential lighting. The nearby Rancho Seco Power Plant has only nighttime security lighting, which is visible as a combination of orange-colored and white lights on poles and mounted on structures. A faint glow, from the lighting at the plant, can be seen in the sky above the power plant and there are red flashing lights atop the two 426-foot-tall cooling towers. There are also red, non-flashing lights on the cooling towers at heights of approximately 180 feet and 270 feet (SMUD 2002a, p. 48, Data Response #101).

The proposed project would require nighttime lighting for operational safety and security though the project would not be required to have FAA-style red, flashing warning lights on the HRSG stacks (SMUD 2002a, p. 49, Data Response #104). It is expected that silhouettes of some facilities would be partially visible to nearby residences. Also, because the lights would be directed downward, illumination of visible plumes is expected to be minimal. It is, however expected that project lighting may produce a faint nighttime sky glow during periods of high humidity, and the plumes could be visible in the sky glow (SMUD 2002a, P. 48, Data Response 103). Because the Rancho Seco Power Plant facilities are located approximately 0.5 mile north of the project site, existing power plant lighting is not expected to significantly illuminate proposed project facilities.

To reduce the off-site visibility of night lighting, light bulbs and reflectors would be installed so that they are not visible from public viewing areas and illumination of the vicinity and the nighttime sky would be minimized during project operation (SMUD 2001a, p. 8.11-9). The applicant has also committed to installing light switches on the HRSGs and cooling towers so that they would only be illuminated when needed (SMUD 2001a, p. 8.11-13).

Exterior light fixtures would be hooded, and lights would be directed on-site so that significant light or glare (backscatter to the nighttime sky) would be minimized. Low-pressure sodium lamps and fixtures of a non-glare type would be specified. In addition, the nighttime lighting system would include switches, timers, and sensors to the extent possible. This would minimize the time the lights are on to further reduce the potential for project lighting to be visible off-site (SMUD 2001a, p. 8.11-9).

However, given the lack of existing lighting at the project site and vicinity and the lack of a specific lighting plan for the proposed project, the proposed project lighting has the potential to change the character of the existing landscape at night both during construction and operation of the project. Project night lighting would be most visible from project vicinity residences (KOPs 1, 2, and 3) where views of the site are open and unobstructed with no intervening structures or light sources. Even shielded lighting elements could create significant light and glare impacts as a result of indirect lighting of project structures and backscatter. The resulting visual impacts from night lighting could be adverse and significant.

CONSIDERATION OF IMPACTS IN RELATION TO CEQA SIGNIFICANCE CRITERIA

This analysis considered the potential impacts of the proposed project structures in relation to the four significance criteria for visual resource impacts listed in Appendix G of the CEQA Guidelines, under Aesthetics, specified below.

1. Would the project have a substantial adverse effect on a scenic vista?

There are no scenic vistas in the project region so the proposed project would not result in significant visual impacts under this criterion.

2. Would the project substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?

The proposed project is not located within the viewshed of a state scenic highway nor would it damage the types of resources specified in this criterion. Therefore, project structures would not result in significant visual impacts under this criterion.

3. Would the project substantially degrade the existing visual character or quality of the site and its surroundings?

As discussed in a previous section of this analysis, the proposed project would introduce prominent structures of industrial character into the foreground to middleground of views from nearby residences and roadways. However, the resulting visual change would range from low to moderate, depending on viewpoint location. As a result, viewers of project facilities on adjacent roads and at nearby residences would not experience a high level of visual degradation or a significant visual impact under this criterion.

4. Would the project create a new source of substantial light or glare that would adversely affect daytime or nighttime views in the area?

The project has the potential to create a new source of substantial light that would adversely affect nighttime views in the area and result in a significant visual impact under this criterion.

Mitigation of the visual impacts identified under Criteria 3 and 4 are addressed below in the Mitigation section.

CUMULATIVE IMPACTS

Cumulative impacts to visual resources could occur where project facilities or activities (such as construction) occupy the same field of view as other built facilities or impacted landscapes. It is also possible that a cumulative impact could occur if a viewer's perception is that the general visual quality of an area is diminished by the proliferation of visible structures (or construction effects such as disturbed vegetation), even if the new structures are not within the same field of view as the existing structures. The significance of the cumulative impact would depend on the degree to which (1) the viewshed is altered; (2) visual access to scenic resources is impaired; (3) visual quality is diminished; or (4) the project's visual contrast is increased.

Sacramento County identified one cumulative project within one mile of the proposed power plant site. The project is a proposed biosolids storage facility that would be located on the north side of Twin Cities Road, northwest of the proposed power plant site. Depending on where the biosolids storage facility is located on the candidate parcels, it may be visible in the same field of view of westbound motorists on Twin Cities Road, when approaching the project region east of the proposed power plant site. However, to the extent that both the proposed power plant and biosolids storage facility are visible in the same field of view, it would only be for a very brief viewing period due to the intermittent screening of the power plant site by intervening terrain. The resulting cumulative impact would be adverse but not significant.

Sacramento County has also identified eight recently approved or proposed projects within 500 feet of the proposed gas pipeline route or compressor station including an RV & boat storage facility, a subdivision extension of time, a rezone, two lot splits, two residential accessory buildings, and an apartment development project (SCPCDD 2002). There would be no cumulative visual impacts associated with pipeline construction since construction impacts would be temporary and none of the identified cumulative project locations would be within the same viewshed as the interconnection station or three valve stations. There would also be no cumulative visual impacts associated with operation of the pipeline or the associated aboveground facilities because the pipeline would be buried and not visible and the associated aboveground facilities would be relatively small and not be in the same viewshed as the identified cumulative projects.

The gas compressor station in Yolo County would be located at the back of an existing compressor station and would not be noticeable behind the existing facilities from the one public access road in the project vicinity. Therefore, no cumulative visual impacts would occur as a result of the gas compressor station in Yolo County.

The proposed power plant would result in adverse and significant cumulative visual impacts in conjunction with the existing Rancho Seco Power Plant. Before the construction of Rancho Seco Power Plant, the landscape was rural and pastoral with prominent natural features. The introduction of the Rancho Seco Power Plant introduced a substantial industrial element to the rural setting. The proposed project would continue that process of industrialization with the addition of complex geometric, metallic forms and strong horizontal and vertical lines. These structural characteristics contrast with the natural forms, lines, colors, and textures of the valley floor vegetation and rolling Sierra foothills.

ENVIRONMENTAL JUSTICE

Staff has reviewed Census 2000 information that shows the minority population is less than 50 percent within a six-mile radius of the proposed project (please refer to **Socioeconomics Figure 1** in this Staff Assessment). However, as indicated in **Socioeconomics Figure 1**, there are multiple census blocks with greater than 50 percent minority persons within the six-mile radius; staff considers these to be pockets or clusters. Staff also reviewed Census 1990 information that shows the low-income population is less than fifty percent within the same radius. Based on the visual resources analysis, staff has concluded that project structures would not cause direct significant visual impacts. However, project structures would contribute substantially to adverse and significant cumulative visual impacts. Although some of the impacted residents would be part of the local minority population, the visual impact that they would experience would be similar to that of other dispersed non-minority residents in the project area. Therefore, the minority population located within the project area would not be disproportionately impacted by the proposed project in regard to visual resources.

FACILITY CLOSURE

There are at least three circumstances in which a facility closure can take place, planned closure, unexpected temporary closure and unexpected permanent closure**.**

Planned closure occurs at the end of a project's life, when the facility is closed in an anticipated, orderly manner, at the end of its useful economic or mechanical life, or due to gradual obsolescence. The closure plan that the project owner is required to prepare will address removal of the power plant structures.

Unexpected temporary closure occurs when the facility is closed suddenly and/or unexpectedly, on a short-term basis, due to unforeseen circumstances such as a natural disaster, or an emergency.

Unexpected permanent closure occurs if the project owner closes the facility suddenly and/or unexpectedly, on a permanent basis. This includes unexpected closure where the owner remains accountable for implementing the on-site contingency plan. It can also include unexpected closure where the project owner is unable to implement the contingency plan, and the project is essentially abandoned. The contingency plan that the project owner is required to prepare would address removal of the power plant structures. No special conditions regarding visual resources are expected to be required to address any of the three types of closure.

COMPLIANCE WITH LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

LOCAL

Visual Resources Table 4 provides a listing of the applicable LORS for the County of Sacramento. Twenty-nine LORS were found to pertain to the enhancement and/or maintenance of visual quality and the protection of views. Of the 29 pertinent LORS, 10 are from the Sacramento County Zoning Ordinance. Section 53091 of the Government Code specifically exempts local agency projects involving the production of energy from city or county zoning code and building permit requirements. Table 4 identifies the proposed project's consistency with all local LORS as well as those Zoning Ordinance sections the project is exempt from. Based on staff's preliminary analysis, it appears that the proposed project would be consistent with twenty-five of the local policies referenced in Table 4, partially consistent with one local LORS, and inconsistent with two local LORS. In one case, staff has not received sufficient information to enable a consistency determination. The proposed project would be exempt from one of the Zoning Ordinance sections where an inconsistency was found as well as the instance where consistency has yet to be determined. In all three cases of inconsistency or partial consistency, effective implementation of staff's proposed conditions of certification would ensure that the project complies with these LORS.

Staff is aware that Sacramento County has determined that the project is consistent with local LORS (SCPCDD 2001b). Typically, staff will defer to the local jurisdiction's interpretation of local LORS consistency. However, in this case, staff has not seen or been informed of the basis for that conclusion with respect to the inconsistencies identified here. Therefore, until such time as staff is provided additional information by the County, staff will follow a literal interpretation of the local LORS in the identification of project inconsistencies with local LORS.

Visual Resources Table 4
Proposed Project's Consistency with
Local LORS Applicable to Visual Resources

LORS		Consistency Determination Before Mitigation/ Conditions	Basis for Consistency
Source	**Description of Principles, Objectives, and Policies**		
Sacramento County General Plan Public Facilities Element	Objective: Minimize the health, safety, aesthetic, cultural and biological impacts of energy facilities in Sacramento County.	NO	The lack of vegetative screening along the proposed project's western side increases project visibility and maximizes visual impact to views from the southwest to northwest (KOPs 1 through 3). Effective implementation of staff's Mitigation Measure 3 and Condition of Certification **VIS-3** would bring the proposed project into compliance with this requirement.
Public Facilities Element (cont'd)	Policy PF-71: Locate and design production and distribution facilities so as to minimize visual intrusion problems in urban areas and areas of scenic and/or cultural value including: recreation and historic areas; scenic highways; landscape corridors; state or federal designated wild and scenic rivers; visually prominent locations such as ridges, designated scenic corridors, and open viewsheds; and Native American sacred sites.	YES	The proposed project would not be located in an urban area, an area of identified scenic and/or cultural value, or a visually prominent area.

Visual Resources Table 4
Proposed Project's Consistency with
Local LORS Applicable to Visual Resources

LORS		Consistency Determination Before Mitigation/ Conditions	Basis for Consistency
Source	**Description of Principles, Objectives, and Policies**		
Public Facilities Element (cont'd)	Policy PF-72: Locate and design energy production and distribution facilities in a manner that is compatible with surrounding land uses by employing the following methods when appropriate to the site: (1) visually screen facilities with topography and existing vegetation and install landscaping consistent with surrounding land use zone development standards where appropriate, except where it would adversely affect photovoltaic performance or interfere with power generating capability; (2) provide site-compatible landscaping; (3) minimize glare through siting, facility design, nonreflective coatings, etc., and (4) site facilities in a manner to equitably distribute their visual impacts in the immediate vicinity.	PARTIALLY	The lack of vegetative screening along the proposed project's western side increases project visibility and maximizes visual impact to views from the southwest to northwest (KOPs 1 through 3). As a result, the proposed project would not be consistent with this aspect of the policy. However, effective implementation of staff's Mitigation Measure 3 and Condition of Certification **VIS-3** would bring the proposed project into compliance with this requirement. The applicant has committed to using non-reflective coatings and providing shielded, directional lighting with switches to minimize light emissions off-site. However, the applicant's glare and lighting control measures are not sufficiently specific to conclude that significant glare or night lighting impacts would be avoided. Effective implementation of staff's Mitigation Measures 2, 4, and 5 and Conditions of Certification **VIS-2**, **VIS-4,** and **VIS-5** would bring the proposed project into compliance with this requirement.

Visual Resources Table 4
Proposed Project's Consistency with Local LORS Applicable to Visual Resources

LORS		Consistency Determination Before Mitigation/ Conditions	Basis for Consistency
Source	**Description of Principles, Objectives, and Policies**		
Public Facilities Element (cont'd)	Objective: Ensure the provision of safe, reliable efficient, and economical electric service while minimizing potential land use conflicts, and health, safety, environmental, and aesthetic impacts of transmission facilities.	YES	The proposed project would require only a 0.4-mile transmission interconnection between the project site and the existing Rancho Seco Power Plant switchyard. The proposed interconnection would parallel (to the east) existing double-circuit transmission lines to the switchyard. The short length and location adjacent to similar facilities would minimize aesthetic impacts of the transmission facilities.
Public Facilities Element (cont'd)	Policy PF-85: New transmission corridors should, whenever possible, avoid existing and planned urban areas; specifically those areas designated for residential and commercial uses. When avoidance is not possible, transmission lines should be placed underground.	YES	The proposed project would require only a 0.4-mile transmission interconnection between the project site and the existing Rancho Seco Power Plant switchyard. The proposed interconnection would therefore, avoid existing and planned urban areas.
Public Facilities Element (cont'd)	Policy PF-87: To minimize visual impacts and protect the county's visual and aesthetic resources, new bulk substations should be located in industrial and non-retail commercial areas. To further minimize visual intrusion and potential land use conflicts; substations shall be enclosed with an 8-foot-high security fence in concert with a 25-foot landscaped setback along all public street frontages.	YES	The proposed project's switchyard would be located on-site. The applicant proposes enclosing all facilities with an 8-foot-high fence, and the project would be set back 25 feet from Clay East Road.
Public Facilities Element (cont'd)	Policy PF-88: Proposals to locate all new bulk substations and all other large scale energy distribution facilities shall be submitted to the Planning Department for review and comment in the form of a General Plan Conformity request.	YES	The applicant has committed to submitting proposed plans to Sacramento County and to consult with the County as necessary. Also, staff's Conditions of Certification will require the submittal of plans to Sacramento County for review and comment.
Public Facilities Element (cont'd)	Objective: Plan and design transmission facilities to minimize visual impacts, preserve existing land uses, and avoid biological and cultural resources.	YES	The proposed transmission interconnection would be of minimal length and would be situated adjacent to an existing transmission corridor. The proposed location and length of the interconnection would

Visual Resources Table 4
Proposed Project's Consistency with
Local LORS Applicable to Visual Resources

LORS		Consistency Determination Before Mitigation/ Conditions	Basis for Consistency
Source	Description of Principles, Objectives, and Policies		
			minimize visual impacts.
Public Facilities Element (cont'd)	Policy PF-92: Whenever feasible, utilize existing transmission poles to accommodate new overhead transmission lines. Existing and future transmission corridors should be shared by more than one utility company.	YES	While it would not be feasible to utilize the existing transmission structures for the proposed interconnection, the proposed interconnection would be located immediately adjacent to the existing transmission corridor, thereby avoiding the proliferation of electric transmission and utility rights-of-way.
Public Facilities Element (cont'd)	Policy PF-93: Transmission rights-of-way should avoid bisecting parcels wherever possible.	YES	The proposed electric transmission line is located on the project site and thereby avoids bisecting a parcel.
Public Facilities Element (cont'd)	Policy PF-98: Transmission lines should avoid paralleling recreation areas, historic areas, rural scenic highways, landscaped corridors, and designated federal or state wild and scenic river systems.	YES	The proposed project would not parallel any of the policy's referenced uses or areas.
Public Facilities Element (cont'd)	Policy PF-99: Locate transmission facilities in a manner that maximizes the screening potential of topography and vegetation.	YES	The location of the proposed transmission interconnection takes advantage of the screening potential of the surrounding topography.
Public Facilities Element (cont'd)	Policy PF-100: Utilize monopole construction, where practicable, to reduce the visual impact on a corridor's middle and distant views.	YES	The proposed transmission line would use monopole construction. However, it should be noted that lattice construction is more effective in reducing structure visibility in distant views due to the "transparency" effect achieved by the open lattice structure.
Public Facilities Element (cont'd)	Policy PF-118: Route new high-pressure gas mains within railway and electric transmission corridors, along collector roads, and wherever possible, within existing easements. If not feasible, these gas mains shall be placed as close to the easement as possible.	YES	The proposed natural gas pipeline would follow existing railroad and transmission line easements for a portion of the alignment. It would also be located in or adjacent to road easements where possible.

Visual Resources Table 4
Proposed Project's Consistency with Local LORS Applicable to Visual Resources

LORS		Consistency Determination Before Mitigation/ Conditions	Basis for Consistency
Source	**Description of Principles, Objectives, and Policies**		
Land Use Element	Objective: Use low glare external building surfaces and light fixtures that minimize reflected light and focalize illumination.	YES	The applicant has committed to consult with the CEC regarding surface treatments and staff's proposed Mitigation Measure 2 and Condition of Certification **VIS-2** will require appropriate surface treatments and colors. The applicant has also committed to providing shielded, directional lighting with switches to minimize light emissions off-site. Staff's proposed Mitigation Measures 4 and 5 and Conditions of Certification **VIS-4** and **VIS-5** would require appropriate lighting control measures.
Land Use Element	Policy LU-22: Exterior building materials on nonresidential structures shall be composed of a minimum of 50 percent low-reflectance, non-polished finishes.	YES	The applicant has committed to consult with the CEC regarding surface treatments and staff's proposed Mitigation Measure 2 and Condition of Certification **VIS-2** would require appropriate surface treatments and colors.
Land Use Element	Policy LU-23: Bare metallic surfaces such as pipes, flashing, vents, and light standards on new construction shall be painted to minimize reflectance.	YES	The applicant has committed to consult with the CEC regarding surface treatments and staff's proposed Mitigation Measure 2 and Condition of Certification **VIS-2** would require appropriate surface treatments and colors.
Land Use Element	Policy LU-24: Require overhead light fixtures to be shaded and directed away from adjacent residential areas.	YES	The applicant has committed to providing shielded, directional lighting with switches to minimize light emissions off-site and to use night lighting only where necessary for safety and security purposes. Staff's proposed Mitigation Measures 4 and 5 and Conditions of Certification **VIS-4** and **VIS-5** would require appropriate lighting control measures.
Land Use Element	Policy LU-25: Require exterior lighting to be low-intensity and only used where necessary for safety and security purposes.	YES	The applicant has committed to providing shielded, directional lighting with switches to minimize light emissions off-site and to use night lighting only where necessary for safety and security purposes. Staff's proposed Mitigation Measures 4 and 5 and Conditions of Certification **VIS-4** and **VIS-5** would require appropriate lighting control measures.

Visual Resources Table 4
Proposed Project's Consistency with
Local LORS Applicable to Visual Resources

LORS		Consistency Determination Before Mitigation/ Conditions	Basis for Consistency
Source	**Description of Principles, Objectives, and Policies**		
Zoning Ordinance	Section 301-17: All utilities shall be placed underground unless the Planning Director determines it to be impractical.	YES but **EXEMPT**	The proposed natural gas pipeline would be placed underground. It must be noted that Section 53091 of the Government Code specifically **exempts** local agency projects involving the production of energy from city or county zoning code and building permit requirements.
Zoning Ordinance	Section 301.21: Fences or walls may be required and conditioned to exceed 6 feet in height.	YES but **EXEMPT**	The applicant proposes to install an 8-foot-high cyclone perimeter fence with wood slats and barbed wire atop the fence. See Section 301-17 above regarding project exemption.
Zoning Ordinance	Section 301-62a: Outside storage of materials and equipment shall be located within the buildable portion of the lot and screened from view with solid wood fences, masonry walls, or chain link with slats.	YES but **EXEMPT**	The applicant proposes to install an 8-foot-high cyclone perimeter fence with wood slats and barbed wire atop the fence. See Section 301-17 above regarding project exemption.
Zoning Ordinance	Section 301-63: a) All required fences shall be at least 6 feet in height and may be erected to a maximum height of 8 feet b) Fence height shall be measured from the highest elevation at the property line or at the finished grade of the rear or side yard setback, whichever is higher.	YES but **EXEMPT**	The applicant proposes to install an 8-foot-high cyclone perimeter fence with wood slats and barbed wire atop the fence. See Section 301-17 above regarding project exemption.
Zoning Ordinance	Section 301-70 and 301-71: Require appropriate long-term care and maintenance of all landscaping.	YES but **EXEMPT**	The applicant proposes to install low-maintenance, drought-resistant native tree and shrub species and has committed to maintaining all landscaping plantings. See Section 301-17 above regarding project exemption.
Zoning Ordinance	Section 320-04: No building or structure, nor the enlargement of any building or structure for any of the uses specified in Section 320-01 may be erected to a height exceeding 40 feet.	NO but **EXEMPT**	The proposed project would include buildings and/or structures that would exceed the 40-foot height limitation. See Section 301-17 above regarding project exemption.

Visual Resources Table 4
Proposed Project's Consistency with
Local LORS Applicable to Visual Resources

LORS		Consistency Determination Before Mitigation/ Conditions	Basis for Consistency
Source	**Description of Principles, Objectives, and Policies**		
Zoning Ordinance	<u>Section 320-05</u>: No building or structure may be erected or enlarged for any of the uses specified in Section 320-01 unless the following development requirements are provided and maintained in connection with such buildings or uses: a) A planter or landscaped area at least twenty-five (25) feet wide shall be provided adjacent to all public street rights-of-way, excluding approved driveway entrances. b) A six- (6) foot high perimeter fence of solid wood, masonry or chain link with slats shall be installed along such boundary line. (g) Landscaping provided shall be cared for, maintained and appropriate permits shall be acquired as specified in Title III, Chapter 1, Article 6 of this Code.	NOT DETERMINED but **EXEMPT** YES but **EXEMPT** YES but **EXEMPT**	a) The applicant has not yet submitted a revised site plan with the landscape setback clearly identified. b) The applicant proposes to install an 8-foot-high cyclone perimeter fence with wood slats and barbed wire atop the fence. g) The applicant proposes to install low-maintenance, drought-resistant native tree and shrub species and has committed to maintaining all landscaping plantings. See Section 301-17 above regarding project exemption.
Zoning Ordinance	<u>Section 325-07:</u> Reflectors, spotlight, floodlights, and other sources of illumination may be used to illuminate buildings, landscaping, signs, and parking and loading areas on any site only if they are equipped with lenses or other devices which concentrate the illumination upon such buildings, landscaping, signs, and parking and loading areas. No unshielded lights, reflectors, or spotlights shall be so located and directed that they shine toward or are directly visible from adjacent properties or streets.	YES but **EXEMPT**	The applicant has committed to providing shielded, directional lighting with switches to minimize light emissions off-site and to use night lighting only where necessary for safety and security purposes. Staff's proposed Mitigation Measures 4 and 5 and Conditions of Certification **VIS-4** and **VIS-5** would require appropriate lighting control measures. See Section 301-17 above regarding project exemption.

MITIGATION

APPLICANT'S PROPOSED MITIGATION MEASURES

The proposed project includes a proposal to plant landscaping along the south side of the project, outside of and along the perimeter fence. It would consist of native, drought-resistant trees and shrubs that would require low levels of maintenance (SMUD 2001a, p. 8.11-9). The proposed project also includes some lighting control measures (SMUD 2001a, pp. 8.11-9 and –13). However, beyond the limited screening and general lighting control measures, the applicant proposes no formal mitigation measures.

ADDITIONAL MITIGATION PROPOSED BY STAFF

Energy Commission staff generally agrees with the applicant's mitigation proposals. However, staff's position is that some of these proposals need to be more precisely developed. The following paragraphs discuss additional staff-proposed measures to mitigate project impacts.

Mitigation of Construction Impacts

Construction of the proposed gas pipeline would result in adverse visual impacts. Staff has proposed Mitigation Measure 1 to ensure that visual impacts resulting from pipeline construction do not become significant.

1. The project owner shall ensure that visual impacts of gas pipeline construction are adequately mitigated. The project owner shall require from its contractors that all facility construction sites and staging, material, and equipment storage areas for gas pipeline construction are visually screened from adjacent public roads and nearby residences. All evidence of pipeline construction activities, including ground disturbance due to staging and storage areas, shall be removed and remediated upon completion of construction to its pre-construction condition. Any vegetation removed in the course of construction will be replaced on a 1-to-1 in-kind basis. Such replacement planting shall be monitored for a period of three years to ensure survival. During this period, all dead plant material shall be replaced (see also Condition of Certification **VIS-1**).

Effective implementation of Mitigation Measure 1, through Condition of Certification **VIS-1**, would minimize the intrusiveness of gas pipeline construction and keep construction visual impacts to less than significant levels.

Mitigation of Impacts of Proposed Structures

As presently proposed, the project's structures would result in direct adverse visual impacts and significant cumulative visual impacts when viewed from adjacent roads and nearby residences and recreation areas (as illustrated in views from KOPs 1 through 4). Staff has proposed Mitigation Measure 2 to help blend project structures with the existing landscape.

2. Prior to first turbine roll, the project owner shall treat all project structures and buildings, gas interconnection and measurement stations, aboveground gas valve stations, and fences in appropriate colors or hues that minimize visual intrusion and contrast by blending with the landscape, such that those structures and buildings have surfaces that do not create glare; and such that they are consistent with local laws, ordinances, regulations, and standards. The project owner shall submit for CPM review and approval, a specific treatment plan whose proper implementation will satisfy these requirements (see also Condition of Certification **VIS-2**).

Effective implementation of Mitigation Measure 2, through Condition of Certification **VIS-2**, would minimize structural contrast and keep structural visual impacts to less than significant levels. Effective implementation of Mitigation Measure 2 would also reduce the contribution of project structures to adverse and significant cumulative visual impacts.

Staff has conducted a line-of-sight analysis from KOP 2 and concluded that the planting of screening vegetation along the applicant's (not CPP's) western property boundary could be effective in screening from view a majority of the project facilities. Therefore, staff has proposed Mitigation Measure 3 to mitigate the contribution of project structures to adverse and significant cumulative visual impacts by enhancing the effectiveness of the applicant's proposed landscaping plan for project screening. Effective implementation of Mitigation Measure 3 would also ensure the project's compliance with local LORS.

3. The project owner shall provide landscaping that is effective in screening the proposed project (including the proposed power plant and all aboveground components of the linear facilities including valve stations) from adjacent roads and nearby residences. Trees and other vegetation consisting of informal groupings of fast-growing evergreen trees must be strategically placed and of sufficient density and height to effectively screen the majority of the complex, industrial-appearing structural forms within five years of completion of project construction (see also Condition of Certification **VIS-3**). Landscape screening must include placement of trees on the west side of the project site.

Effective implementation of Mitigation Measure 3, through Condition of Certification **VIS-3**, would reduce project visibility and keep structural visual impacts to less than significant levels.

Mitigation of Project Lighting Impacts

As previously discussed, the proposed project lighting has the potential to change the character of the existing landscape at night both during construction and operation of the project and could result in significant visual impacts to nearby residences in spite of the control measures included in the proposed project. Therefore, staff proposes Mitigation Measures 4 and 5 to mitigate project night lighting impacts.

4. The project owner shall ensure that lighting for construction of the power plant and linear facilities is used in a manner that minimizes potential night lighting impacts (see also Condition of Certification **VIS-4**).

5. The project owner shall design and install all permanent lighting such that light bulbs and reflectors are not visible from public viewing areas, lighting does not cause reflected glare, and illumination of the project, the vicinity, and the nighttime sky is minimized (see also Condition of Certification **VIS-5**).

Effective implementation of Mitigation Measures 4 and 5, through Conditions of Certification **VIS-4** and **VIS-5**, would minimize lighting and keep lighting impacts to less than significant levels.

Mitigation of Impacts in Relation to CEQA Significance Criteria

The proposed project's structures would cause adverse but not significant visual impacts with respect to the four CEQA significance criteria. However, effective implementation of staff's previously discussed Mitigation Measures 2 and 3 (through

Conditions of Certification **VIS-2** and **VIS-3**, respectively) would further reduce the adverse visual impacts of project structures under Criterion 3.

The project's night lighting has the potential to create a new source of substantial light that would adversely affect nighttime views in the area and result in a significant visual impact under this criterion. However, the lighting control measures proposed by the applicant and expanded by staff in Mitigation Measures 4 and 5, (previously discussed) through Conditions of Certification **VIS-4** and **VIS-5**, would ensure that lighting impacts would be less than significant with regard to Criterion 4.

Mitigation of Cumulative Impacts

As previously discussed, the proposed power plant would contribute substantially to significant cumulative visual impacts in conjunction with the existing Rancho Seco Power Plant and cooling towers. Staff has proposed two mitigation measures and two conditions of certification (**VIS-2** and **VIS-3**) to reduce the direct adverse visual impact of project structures and to reduce the contribution of project structures to adverse and significant cumulative visual impacts

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Based on the visual resources analysis, staff has concluded that project structures would not cause direct significant visual impacts but would contribute substantially to adverse and significant cumulative visual impacts in conjunction with the existing Rancho Seco Power Plant. However, effective implementation of Conditions of Certification **VIS-2** and **VIS-3** would reduce the project's contribution to significant cumulative impacts.

The proposed project's night lighting has the potential to cause adverse and significant visual impacts. However, with effective implementation of Conditions of Certification **VIS-4** and **VIS-5**, the project's night lighting visual impacts would be kept to levels that would be less than significant.

In the three cases of inconsistency or partial consistency with applicable laws, ordinances, regulations, and standards, either the inconsistencies would initially not produce a significant visual impact, or with effective implementation of staff's proposed conditions of certification, the impacts causing the inconsistencies would not be significant.

RECOMMENDATIONS

The Energy Commission should adopt the following conditions of certification if it approves the project. Because there is some uncertainty as to the applicant's ability to accomplish the necessary landscape screening within staff's five-year time requirement, the Energy Commission staff should convene a workshop to evaluate the feasibility of Condition of Certification **VIS-3**. The workshop should address vegetation species to be used, specimen size at planting, the need for modification of planting locations to achieve effective screening placement, and the appropriateness of additional measures to enhance screening effectiveness such as the use of berms.

PROPOSED CONDITIONS OF CERTIFICATION

VIS-1 The project owner shall ensure that visual impacts of gas pipeline construction are adequately mitigated. To accomplish this, the project owner shall require the following as a condition of contract with its contractors to construct the gas pipeline:

If visible from nearby residences and roads, aboveground facility construction sites and staging and material and equipment storage areas for gas pipeline construction shall be visually screened with temporary screening fencing. Fencing will be of an appropriate design and color for each specific location, as determined by the CPM. All evidence of construction activities, including ground disturbance due to staging and storage areas, shall be removed and all disturbed areas shall be remediated to an original or improved condition upon completion of construction including the replacement of any vegetation or paving removed during construction.

The project owner shall submit to the CPM for review and approval and to Sacramento County for review and comment a specific screening and restoration plan whose proper implementation will satisfy these requirements.

The project owner shall not implement the screening and restoration plan until receiving written approval from the CPM.

Verification At least 90 days prior to construction of the gas pipeline, the project owner shall submit the plan to the CPM for review and approval and to Sacramento County for review and comment.

If the CPM notifies the project owner that any revisions of the plan are needed before the CPM will approve the plan, within 30 days of receiving that notification, the project owner shall submit to the CPM a revised plan.

The project owner shall notify the CPM within seven days after installing screening at staging and material and equipment storage areas that it is ready for inspection.

The project owner shall notify the CPM within seven days after completing the surface restoration that it is ready for inspection.

VIS-2 Prior to first turbine roll, the project owner shall treat the surfaces of all project structures and buildings visible to the public such that their colors minimize visual intrusion and contrast by blending with the landscape; their surfaces do not create glare; and they are consistent with local laws, ordinances, regulations, and standards. The project owner shall submit for CPM review and approval and Sacramento County review and comment, a specific treatment plan whose proper implementation will satisfy these requirements. The treatment plan shall include:

a) Specification, and 11” x 17” color simulations at life size scale, of the treatment proposed for use on project structures, including structures treated during manufacture;

b) A list of each major project structure, building, tank, transmission line tower and/or pole, and fencing specifying the color(s) and finish proposed for each (colors must be identified by vendor brand or a universal designation);

c) Two sets of brochures and/or color chips for each proposed color;

d) Samples of each proposed treatment and color on each material to which they would be applied that would be visible to the public;

e) A detailed schedule for completion of the treatment; and

f) A procedure to ensure proper treatment maintenance for the life of the project.

The project owner shall not specify to the vendors the treatment of any buildings or structures treated during manufacture, or perform the final treatment on any buildings or structures treated on site until the project owner receives notification of approval of the treatment plan by the CPM.

Verification: The project owner shall submit its proposed treatment plan at least 90 days prior to ordering the first structures that are color treated during manufacture.

If a revision is required, the project owner shall provide the CPM with a revised plan within 30 days of receiving notification that revisions are needed.

Prior to first turbine roll, the project owner shall notify the CPM that all buildings and structures are ready for inspection.

The project owner shall provide a status report regarding treatment maintenance in the Annual Compliance Report.

VIS-3 The project owner shall provide landscaping that is effective in screening the proposed project (including the aboveground gas pipeline interconnection and valve stations) from views from nearby residences. Trees and other vegetation consisting of informal groupings of fast-growing evergreen trees must be strategically placed and of sufficient density and height along the west side of the project to screen the majority of structural forms within five years after first turbine roll of Phase 1 of the project.

The project owner shall submit a landscaping plan to the CPM for review and approval and to Sacramento County for review and comment. The Plan shall include:

a) 11”x17” color simulations of the proposed landscaping at 5 years as viewed from KOPs 1, 2, and 3; and

b) a detailed list of plants to be used and times to maturity given their size and age at planting;.

The project owner shall not implement the plan until the project owner receives approval of the submittal from the CPM. However, the planting must be completed by start of project operation.

Verification: Prior to first turbine roll and at least 90 days prior to installing the landscaping, the project owner shall submit the landscaping plan to the CPM for review and approval and to Sacramento County for review and comment.

If the CPM notifies the project owner that revisions of the submittal are needed before the CPM will approve the submittal, within 30 days of receiving that notification, the project owner shall prepare and submit to the CPM a revised submittal.

The project owner shall notify the CPM within seven days after completing installation of the landscaping, that the landscaping is ready for inspection.

VIS-4 The project owner shall ensure that lighting for construction of the power plant is used in a manner that minimizes potential night lighting impacts, as follows:

a) All lighting shall be of minimum necessary brightness consistent with worker safety.

b) All fixed position lighting shall be shielded, hooded, and directed downward to minimize backscatter to the night sky and direct light trespass (direct lighting extending outside the boundaries of the construction area).

c) Wherever feasible and safe, lighting shall be kept off when not in use and motion detectors shall be employed.

d) A lighting complaint resolution form (following the general format of that in **Visual Resources Appendix VR-2**) shall be maintained by plant construction management, to record all lighting complaints received and to document the resolution of each complaint.

<u>**Verification**</u>: Within seven days after the first use of construction lighting, the project owner shall notify the CPM that the lighting is ready for inspection. If the CPM notifies the project owner that modifications to the lighting are needed to minimize impacts, within 15 days of receiving that notification the project owner shall implement the necessary modifications and notify the CPM that the modifications have been completed.

The project owner shall report any lighting complaints and documentation of resolution in the Monthly Compliance Report, accompanied by any lighting complaint resolution forms for that month.

VIS-5 The project owner shall design and install all permanent lighting such that light bulbs and reflectors are not visible from public viewing areas; lighting does not cause reflected glare; and illumination of the project, the vicinity, and the nighttime sky is minimized. To meet these requirements the project owner shall ensure that:

a) Lighting is designed so exterior light fixtures are hooded, with lights directed downward or toward the area to be illuminated and so that backscatter to the nighttime sky is minimized. The design of the lighting shall be such that the luminescence or light source is shielded to prevent light trespass outside the project boundary;

b) All lighting shall be of minimum necessary brightness consistent with worker safety;

c) High illumination areas not occupied on a continuous basis (such as maintenance platforms) shall have switches or motion detectors to light the area only when occupied; and

A lighting complaint resolution form (following the general format of that in **Visual Resources Appendix VR-2**) shall be used by plant operations to record all lighting complaints received and document the resolution of each complaint. All records of lighting complaints shall be kept in the on-site compliance file.

<u>**Verification:**</u> At least 60 days prior to ordering any permanent exterior lighting, the project owner shall submit to the CPM for review and comment written documentation describing the lighting control measures and fixtures, hoods, shields proposed for use, and incorporate the CPM's comments in lighting equipment orders.

At least 30 days prior to first turbine roll, the project owner shall notify the CPM that the lighting has been completed and is ready for inspection. If the CPM notifies the project owner that modifications to the lighting are needed, within 30 days of receiving that notification the project owner shall implement the modifications and notify the CPM that the modifications have been completed.

The project owner shall report any complaints about permanent lighting and provide documentation of resolution in the Annual Compliance Report, accompanied by any lighting complaint resolution forms for that year.

REFERENCES

Buhyoff, G. J., P.A. Miller, J. W. Roach, D. Zhour, and L. G. Fuller. 1994. An AI Methodology for Landscape Visual Assessments. AI Applications. Vol. 8, No. 1.

California State Department of Transportation (Caltrans) 2002. Office of State Landscape Architect, State Scenic Highway System Web Site: http://www.dot.ca.gov/hq/LandArch/scenic_highways/index.htm.

SCPCDD (Sacramento County Planning and Community Development Department). 2002. Cumulative Projects Map.

SCPCDD (Sacramento County Planning and Community Development Department) 2001b. Report from the to the Board of Supervisors regarding SMUD Cosumnes Power Plant and Gas Pipeline General Plant Consistency. December 5, 2001. Docket date December 14, 2001.

SCPCDD (Sacramento County Planning and Community Development Department). 1997. *County of Sacramento General Plan*.

SMUD (Sacramento Municipal Utility District). 2001a. Application for Certification, Volumes 1 and 2 (01-AFC-19). Submitted to the California Energy Commission on September 13, 2001. Docket date September 13, 2001.

SMUD (Sacramento Municipal Utility District). 2001d. Data Adequacy Supplemental Information for the SMUD Cosumnes Power Plant. November 13, 2001. Docket date November 16, 2001.

SMUD (Sacramento Municipal Utility District). 2001g. Letter from Jane Luckhardt, Downey Brand Seymour & Rohwer, to Kristy Chew, CEC, regarding Notification of Need for Additional Time to Prepare Responses and Objection to California Energy Commission Staff Data Requests. December 10, 2001. Docket date December 20, 2001.

SMUD (Sacramento Municipal Utility District). 2002a. Data Response, Set 1A. January 9, 2002. Docket date January 9, 2002.

SMUD (Sacramento Municipal Utility District). 2002b. Data Response, Set 1B (Responses to Data Requests 9, 83, 84, 94, 134, and 139). January 18, 2002.

SMUD (Sacramento Municipal Utility District). 2002d. Data Response, Set 2A. February 4, 2002. Docket date February 4, 2002.

SMUD (Sacramento Municipal Utility District). 2002e. Data Response, Set 1C. February 4, 2002. Docket date February 5, 2002.

SMUD (Sacramento Municipal Utility District). 2002f. Data Response, Set 2B. February 15, 2002. Docket date February 19, 2002.

SMUD (Sacramento Municipal Utility District). 2002g. Data Response, Set 1D. February 15, 2002. Docket date February 19, 2002.

SMUD (Sacramento Municipal Utility District). 2002h. Data Response, Set 1F – Supplement to Data Response #39. February 27, 2002. Docket date March 11, 2002.

SMUD (Sacramento Municipal Utility District). 2002i. Data Responses, Set 1E – Supplemental Responses to Data Requests: 111, 112, 116, 152, and 161 – Power Plant Cooling Analysis. March 8, 2002. Docket date March 8, 2002.

SMUD (Sacramento Municipal Utility District). 2002j. AFC Supplement A (Revised General Arrangement). March 15, 2002. Docket date March 15, 2002.

SMUD (Sacramento Municipal Utility District). 2002k. Data Response, Set 1G – Responses to Data Requests 16, 22, 29, 30, 31, 50, 51, 56, 87, 88, 143, 144, 145, and 146. March 19, 2002. Docket date March 19, 2002.

SMUD (Sacramento Municipal Utility District). 2002l. Data Response, Set 2C – Responses to Data Requests 181, 182, and 183. March 19, 2002. Docket date March 19, 2002.

SMUD (Sacramento Municipal Utility District). 2002m. Data Response, Set 1H – Responses to Data Requests 19, 20, 25, 29, 30, 31, and 39. March 29, 2002. Docket date March 29, 2002.

SMUD (Sacramento Municipal Utility District). 2002o. Data Response, Set 3A. April 15, 2002. Docket date April 15, 2002.

SMUD (Sacramento Municipal Utility District). 2002p. AFC Supplement B. April 15, 2002. Docket date April 15, 2002.

Smardon, Richard C., James E. Palmer, and John P. Felleman. 1986. *Foundations for Visual Project Analysis.* John Wiley & Sons. New York.

U.S. Department of Agriculture, Forest Service. 1995. *Landscape Aesthetics, A Handbook for Scenery Management.* Agriculture Handbook Number 701. USDA, Forest Service.

U.S. Department of Interior (USDI), Bureau of Land Management (BLM). 1986a. *Visual Resource Inventory Manual*. USDI, BLM.

USDI, BLM. 1986b. *Visual Contrast Rating Manual*. USDI, BLM.

USDI, BLM. 1984. *Visual Resource Management Manual*. USDI, BLM.

Yolo County. 1983. *Yolo County General Plan*. Yolo County.

APPENDIX VR – 1: SUMMARY OF ANALYSIS

APPENDIX VR – 2

LIGHTING COMPLAINT RESOLUTION FORM

Cosumnes Power Plant Project Sacramento County, California
Complainant's name and address: Phone number:
Date complaint received: Time complaint received:
Nature of lighting complaint:
Definition of problem after investigation by plant personnel: Date complainant first contacted:
Description of corrective measures taken: Complainant's signature: ____________________ Date:
Approximate installed cost of corrective measures: $ Date installation completed: Date first letter sent to complainant: ____________(copy attached) Date final letter sent to complainant: ____________(copy attached)
This information is certified to be correct: Plant Manager's Signature:

(Attach additional pages and supporting documentation, as required.)

APPENDIX VR – 3: VISUAL RESOURCES FIGURES

VISUAL RESOURCES FIGURES 1 THROUGH 6B

VISUAL RESOURCES Figure 1

Visual Resources Figure #s	**Applicant Source Figure #s**	***Title* and Additional Graphic Production Guidance**
1	AFC Supplement A Figure 2.2-2R	*Power Plant South Elevation*. Use as is and adjust Title Block

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VISUAL RESOURCES Figure 2

Visual Resources Figure #s	Applicant Source Figure #s	***Title*** **and Additional Graphic Production Guidance**
1	AFC Figure 8.11-1	*Location of Key Observation Points.* Use as is and adjust Title Block

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VISUAL RESOURCES Figure 3A

Visual Resources Figure #s	Applicant Source Figure #s	*Title* and Additional Graphic Production Guidance
3A	AFC Figure 8.11-2a KOP 1: Existing View of Project Site	*KOP 1 – Existing view to the northeast from the front yard of 14460 Clay East Road.*

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VISUAL RESOURCES Figure 3B

Visual Resources Figure #s	**Applicant Source Figure #s**	***Title* and Additional Graphic Production Guidance**
3B	AFC Supplement A Figure 8.11-2bR KOP 1: Simulated View of Project	*KOP 1 – Visual simulation of the proposed project at the start of project operation, as viewed from the front yard of 14460 Clay East Road.*

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VISUAL RESOURCES Figure 4A

Visual Resources Figure #s	Applicant Source Figure #s	*Title* and Additional Graphic Production Guidance
4A	AFC Figure 8.11-3a KOP 2 – Existing View of Project Site	*KOP 2 – Existing view to the northeast from the backyard of 11615 Kirkwood Street, near the intersection with Clay East Road.*

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VISUAL RESOURCES Figure 4B

Visual Resources Figure #s	**Applicant Source Figure #s**	***Title* and Additional Graphic Production Guidance**
4B	AFC Supplement A Figure 8.11-3bR KOP 2: Simulated View of Project	*KOP 2 – Visual simulation of the proposed project at the start of project operation, as viewed from the backyard of 11615 Kirkwood Street near the intersection with Clay East Road.*

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VISUAL RESOURCES Figure 5A

Visual Resources Figure #s	**Applicant Source Figure #s**	***Title* and Additional Graphic Production Guidance**
5A	AFC Figure 8.11-4a KOP 3: Existing View of Project Site	*KOP 3 – Existing view to the southeast from the backyard of 11540 Clay Station Road.*

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VISUAL RESOURCES Figure 5B

Visual Resources Figure #s	Applicant Source Figure #s	*Title* and Additional Graphic Production Guidance
5B	AFC Figure 8.11-4b KOP 3: Simulated view of Project.	*KOP 3 – Visual simulation of the proposed project at the start of project operation, as viewed from the backyard of 11540 Clay Station Road.*

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BEFORE PUBLISHING

VISIBLE PLUMES

Dale Edwards

SUMMARY

Energy Commission staff analyzed the potential visual impacts of the proposed Cosumnes Power Plant (CPP) project’s cooling tower visible water vapor plume and the compliance of the project’s plume with applicable laws, ordinances, regulations, and standards (LORS).

Staff has concluded that the project’s cooling tower water vapor plumes would be frequent and large, but due to the influence of the existing Rancho Seco Power Plant, and the short duration that plumes are predicted to occur on clear days, their direct visual impact would be adverse but less than significant to close-in and more distant viewing locations. The project’s cooling tower water vapor plume would also result in adverse but less than significant cumulative visual impacts, considering the existing Rancho Seco power plant and most notably the parabolic cooling towers, because the plume would be visible only intermittently for a generally short period of the day during approximately half the year.

INTRODUCTION

This analysis focuses on whether water vapor plumes from the proposed CPP would cause significant adverse visual impacts.

ORGANIZATION OF ANALYSIS

This analysis is organized as follows:

- Description of analysis methodology;
- Description of applicable laws, ordinances, regulations and standards;
- Description of the project’s plumes that may have the potential for significant visual impacts;
- Assessment of the visual setting of the proposed power plant site;
- Evaluation of the visual impacts of the proposed project’s plumes on the existing setting;
- Evaluation of compliance of the project with applicable laws, ordinances, regulations, and standards;
- Identification of measures needed to mitigate any potential significant adverse impacts of the proposed project’s plumes and to achieve compliance with applicable laws, ordinances, regulations, and standards;
- Conclusions and Recommendations; and
- Proposed Conditions of Certification.

METHODOLOGY

Visible plumes analysis is inherently subjective. However, the use of generally accepted criteria for determining impact significance and a clearly described analytical approach aid in developing an analysis that can be readily understood.

Significance Criteria

Energy Commission staff considered the following criteria in determining whether a visual impact would be significant. There are no federal significance criteria for visual impacts.

State

The CEQA Guidelines define a "significant effect" on the environment as a "substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project including...objects of historic or aesthetic significance (Cal. Code Regs., tit.14, § 15382).

Appendix G of the Guidelines, under Aesthetics, lists the following questions to be addressed in evaluating whether the potential impacts of a project are significant:

1. Would the project have a substantial adverse effect on a scenic vista?
2. Would the project substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?
3. Would the project substantially degrade the existing visual character or quality of the site and its surroundings?
4. Would the project create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?

Local

Energy Commission staff considers any local goals, policies, or designations regarding visual resources. Conflicts with such laws, ordinances, regulations, and standards may constitute significant visual impacts. See the following Laws, Ordinances, Regulations, and Standards section.

Evaluation Process

The proposed project's plumes would be visible from a number of areas in the project region. Energy Commission staff evaluated the visual impact of the plumes from two key observation points (KOP 2 and KOP 3) which represent the views from areas, in general, at a distance of approximately one-mile and two-miles and beyond. For each KOP, staff considered the existing visual setting and the visual changes that the project's plumes would cause to determine impact significance. Existing condition photographs and plume photo-simulations from each KOP are included in this analysis (see **Visible Plumes Figure 1** through **4**). To assess the existing visual setting, staff considered the following elements:

Overall Visual Sensitivity

The overall level of visual sensitivity is a function of visual quality, viewer expectation, and viewer exposure and can range from low to high.

Visual Quality

Visual quality is an expression of the visual impression or appeal of a given landscape and the associated public value attributed to the visual resource. This analysis evaluates visual quality as ranging from outstanding to low. Outstanding visual quality is a rating reserved for landscapes that would be what a viewer might think of as "picture postcard" landscapes. Low visual quality describes landscapes that are often dominated by visually discordant human alterations, and do not provide views that people would find inviting or interesting (Buhyoff et al. 1994).

Viewer Expectation

Viewer expectation is a measurement of the level of viewer interest regarding the visual resources in an area. Land use is an important indicator of viewer expectation, because it dictates the types of development that may occur. Uses associated with 1) designated parks, monuments, and wilderness areas, 2) scenic highways and corridors, and 3) recreational areas are generally considered to have high viewer expectation. Existing landscape character may temper viewer expectation on some State and locally designated scenic highways and corridors, and on other highways and roads. Residential uses can have a variety of viewer expectation levels based on their surroundings. Commercial uses, including business parks, typically have low-to-moderate viewer expectation, though some commercial developments have specific requirements related to visual quality, with respect to landscaping, building height limitations, building design, and prohibition of above-ground utility lines. Industrial uses typically have the lowest viewer expectation because workers are focused on their work, and generally are working in surroundings with relatively low visual value.

Viewer Exposure

The visibility of a landscape feature, the viewing distance to the landscape feature, the number of viewers, and the duration of the view all affect the exposure of viewers to a given landscape feature. Visibility is highly dependent on screening and angle of view. The smaller the degree of screening and/or the closer the feature is to the center of the view area, the greater its visibility. Increasing distance reduces visibility. Viewer exposure can range from low values for all factors, such as a partially obscured and brief background view for a few motorists, to high values for all factors, such as an unobstructed foreground view from a large number of residences.

Overall Visual Change

To assess the overall visual change that project plumes would cause, staff considered primarily the dominance that the plumes would have to the viewer, but also contrast and view disruption.

Dominance

Dominance is a measure of a feature's apparent size relative to other visible landscape features and the total field of view. A feature's dominance is affected by its relative location in the field of view and the distance between the viewer and the feature. The level of dominance can range from subordinate to dominant.

Contrast

Visual contrast describes the degree to which a project's visual characteristics or elements (consisting of form, line, color, and texture) differ from the same visual elements established in the existing landscape. The degree of contrast can range from low to high.

View Disruption

View disruption includes view blockage, which considers the extent to which any previously visible landscape features are blocked from view by the project, and also the breaking up of a view of large landforms such as mountain ranges. Blockage of higher quality landscape features by lower quality project features causes adverse visual impacts. The degree of view disruption can range from none to high.

LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

The following discussion of federal, state, and local laws, ordinances, regulations, and standards is based on Section 8.11.2 (LORS) of the Application for Certification (SMUD 2001a, pp. 8.11-1 and 8.11-14 through 9.11-21) and an independent review of the Sacramento County General Plan and Zoning Ordinance.

FEDERAL

No federal LORS relating to visual resources apply to the proposed project.

STATE

In the project vicinity, there are no state designated or eligible scenic highways (Caltrans 2002).

LOCAL

The proposed generating facility site is located in Sacramento County and would be subject to any county laws, ordinances, regulations, and standards (LORS) pertaining to the protection and maintenance of visual resources in Sacramento County.

Two applicable LORS from Sacramento County are found in the Public Facilities element of the Sacramento County General Plan. The relevant local LORS and an assessment of the project's LORS consistency are presented in a later section of this analysis.

SETTING

REGIONAL LANDSCAPE

The proposed project would be located in a sparsely developed region of southeast Sacramento County in a landscape characterized by rolling hills, vineyards, cattle grazing land, open space, rural residences, and energy production and transmission infrastructure. The most prominent features in the regional landscape are the Rancho Seco Power Plant's twin 426-foot-high parabolic cooling towers, which will remain standing following the decommissioning of Rancho Seco Power Plant (SMUD 2001a). In the distance to the east are the Sierra Nevada mountains, which are visible on days when they are not obscured by haze. Other noticeable features in the primarily rural landscape are the electric transmission lines that converge on the Rancho Seco substation; and utility lines along Twin Cities Road, the principal east-west roadway in the project vicinity that passes north of the project site. The principal recreation facility in the region is Rancho Seco Park, located approximately 1.6 miles east of the project site. The park offers day use swimming, picnicking, and fishing, and overnight camping.

PLUME VIEWSHED

The distance zones used within this analysis are defined as *foreground* (0 to 1/2 mile), *middleground* (1/2 to 2 miles), and *background* (beyond 2 miles). Within these zones there are many viewing opportunities. Most viewing opportunities are from the west and south of the project site and some available views are unobstructed and panoramic, encompassing broad vistas of agricultural lands and expansive distances of sky. Many views from the south and west are screened by the rolling terrain and/or many mature trees (a substantial number of which are eucalyptus). Views from Twin Cities Road in the immediate project vicinity are partially screened by the intervening rolling terrain. Foreground to middleground views of the proposed project are available from (a) Clay East Road, south of Twin Cities Road (immediately adjacent to the south side of the site), (b) the nearest residences on Clay East Road (0.2 mile southwest of the site), (c) about 50 residences within approximately two miles southwest of the site, and (d) the recreational use areas of Rancho Seco Park approximately 1.6 miles east of the site. A middleground to background view of the site is available from several hilltop residences west of the project site including one on Clay Station Road, approximately 2 miles northwest of the project site.

The cooling tower plumes' dimensions and frequency are described in the **Visual Impacts of Vapor Plumes** section of this analysis. Because the plumes would be similar in height to the existing Rancho Seco cooling towers, the viewshed for the plumes would be similar to that of the existing structures. As noted in the AFC, (SMUD 2001a, pp. 8.11-2 and 3), the 426-foot tall cooling towers of the Rancho Seco Power Plant are visible at least five miles to the west along Twin Cities Road and at least seven miles to the northeast along Twin Cities Road. The towers are intermittently visible from locations extending out more than 12 miles in most directions from the power plant, including from northbound State Route 99. The cooling towers are also visible from elevated vantagepoints at substantially greater distances such as briefly for westbound U.S. Highway 50 motorists as they descend the Sierra Nevada mountains.

IMMEDIATE POWER PLANT VICINITY

Similar to the project region, the immediate power plant vicinity presents a mosaic of uses comprised primarily of rural residential intermixed with vineyards, cattle grazing, undeveloped open space, and energy production. The visual character of the immediate project vicinity, while decidedly rural, is dominated by the industrial character and structural prominence of the Rancho Seco Power Plant and the transmission lines converging on the power plant. The 30-acre project site is characterized by level terrain supporting primarily annual grassland, which is used as pasture. To be consistent with the **Visual Resources** section of this Preliminary Staff Assessment, KOP locations for this analysis are the same as those used in the **Visual Resources** section.

KOP 2 – Clay East Road (Same as Visual Resources KOP 2)

KOP 2 is located at the back yard of 11615 Kirkwood Street, approximately one mile west of the proposed CPP site. This viewpoint was selected to represent residents' views from the foreground to middleground distance to the west and south of the CPP project site. This view is somewhat similar to views experienced by approximately 50 residences to the south and west of the proposed site. **Visible Plumes Figure 1** shows the existing view to the east from KOP 2 toward the project site.

Staff also evaluated the view from Twin Cities Road at an approximate one-mile distance from the proposed CPP site and will use this KOP to describe the impacts from that viewpoint as well. This viewpoint is northwest of the existing parabolic cooling towers.

Visual Quality

KOP 2 and the Twin Cities Road viewpoint afford panoramic views to the north and east and a foreground to middleground agricultural landscape with a prominent presence of energy and electric transmission infrastructure in the middleground. Aside from the foreground agricultural fields, the most prominent features in the landscape are the twin parabolic cooling towers at Rancho Seco Power Plant and the substantial north/south running transmission lines and towers coming out of the Rancho Seco site. Overall visual quality is moderate.

Viewer Expectation

The residential viewers represented by KOP 2 and the eastbound motorists along Twin Cities Road anticipate a foreground to middleground rural agricultural landscape with a prominent energy infrastructure presence in the middleground. Viewers would also expect to see open panoramic vistas across the flat-to-rolling agricultural fields to the north and east. However, looking in the direction of Rancho Seco, viewers would expect to see industrial elements. Therefore, viewer expectation is moderate, consistent with the visual quality.

Viewer Exposure

Visibility is high in that the view of the site and sky from KOP 2 is unobstructed. For residents at this distance, the view duration would potentially be high for a moderate number of home-sites.

At this one-mile distance, a low-to-moderate number of motorists on Twin Cities Road (approximately 20 percent of the 3,800 vehicles per day (SMUD 2001a)) would have brief views of the plumes due to the limited plume hours, rolling terrain that periodically blocks views to the southeast and south, and the approximate 75-degree angle off the direction of travel. Therefore, motorists in the area of this viewpoint would have a low duration of view and low-to-moderate visibility. Overall viewer exposure from these two viewpoints, at an approximate one-mile distance, is moderate.

Overall Visual Sensitivity

The moderate visual quality, moderate viewer expectation, and moderate viewer exposure result in an overall moderate visual sensitivity.

KOP 3 – Clay Station Road (same as Visual Resources KOP 3)

KOP 3 is located at the back yard of 11540 Clay Station Road, approximately two miles west/northwest of the project site. This viewpoint represents the elevated perspective available to approximately two hilltop residences, and other viewpoints at a distance of approximately two miles or more, including several other residences to the south with views toward the proposed project site. **Visible Plumes Figure 3** shows the existing view from KOP 3 to the southeast toward the proposed project site.
Staff also evaluated the view from Twin Cities Road at an approximate two-mile distance west of the proposed CPP site, at the intersection with Clay East Road, and will use this KOP to describe the impacts from that viewpoint as well.

Visual Quality

KOP 3 and the viewpoint on Twin Cities Road, at the intersection with Clay East Road, afford panoramic views of a foreground to background flat agricultural landscape with a prominent presence of energy and electric transmission infrastructure, backdropped by the distant Sierra Nevada mountain range. Aside from the foreground to middleground flat agricultural fields, the most prominent features in the landscape are the twin parabolic cooling towers at Rancho Seco Power Plant with its complex industrial character on the middleground to background margin. Other noticeable features in the middleground landscape include electric transmission lines converging on the power plant. Overall visual quality looking in the direction of the proposed CPP site is moderate.

Viewer Expectation

The residential viewers represented by KOP 3 and the motorists traveling eastbound on Twin Cities Road anticipate a foreground to background rural agricultural landscape with a prominent energy infrastructure presence. However, viewers' expectations also include open panoramic vistas across the flat to rolling agricultural landscape to the distant Sierra Nevada mountains. Viewer expectation is moderate-to-high.

Viewer Exposure

During clear conditions many residential viewers would potentially have uninterrupted sightlines to the plume airspace, however because of the distance of the viewer from the plume, the visibility rating is moderate-to-high. Although the duration of view is potentially high for many residents to the southwest, it is low for many others due to the mature growth of a substantial number of trees that surround or otherwise block views toward the Rancho Seco site. The number of viewers is considered moderate. Overall viewer exposure for residents is moderate-to-high.

From the area represented by the intersection of Twin Cities and Clay East roads, a low-to-moderate number of eastbound motorists would have interrupted sightlines to the plume airspace, resulting in a range of low to moderate-to-high visibility, with a low-to-moderate duration of view. Overall viewer exposure for motorists is low-to-moderate. Therefore, overall viewer exposure considering motorists and residents is moderate.

Overall Visual Sensitivity

The moderate-to-high viewer expectation is somewhat offset by the moderate viewer exposure. When combined with a moderate visual quality rating, the resulting overall sensitivity of the visual setting experienced from KOP 3 is moderate.

Visible Plumes

Vapor Plume Modeling Results

Staff performed an independent psychrometric analysis and dispersion modeling analysis to predict the frequency and dimensions of visible plumes from the project's proposed wet cooling towers and HRSG stacks (CEC/Walters 2002, attached as an appendix to this analysis).

Staff uses a frequency threshold to determine whether to perform a more detailed analysis of plume impacts. That threshold is a 10 percent or greater frequency of plume occurrence during seasonal[1] daylight no rain/no fog (SDNRNF) "clear" hours. Staff typically eliminates from consideration plumes that occur at night or during rain or fog conditions because plume visibility, and overall visual quality, is typically low during those conditions, and also plumes that occur during specific cloudy conditions that result in plumes having less contrast with the background sky.

Staff's analysis determined that HRSG plumes for this project would occur less than 10 percent of SDNRNF hours. Therefore, no further visual analysis of HRSG plumes was conducted. The projects' cooling tower plumes are predicted to occur approximately 18.5 percent of SDNRNF "clear" hours (293 hours per year, or approximately 1.6 hours per day, generally during the early morning hours of November through April), which exceeds staff's 10 percent frequency threshold (see **Visible Plumes Table 1**). Therefore, staff conducted a more detailed analysis of the visual impacts of the proposed project's cooling tower plumes.

Staff has determined that plumes that occur under "clear" meteorological conditions have the greatest potential to cause adverse visual impacts. For projects such as the CPP for which the available meteorological data set categorizes sky cover in 10 percent increments[2], staff includes in the "clear" category a) all hours with total sky cover equal to or less than 10 percent plus b) half of the hours with total sky cover 20-100 percent that have a sky opacity equal to or less than 50 percent. The rationale for including these two components in this category is as follows: a) plumes typically contrast most with sky under clear conditions, and when total sky cover is equal to or less than 10 percent, clouds either do not exist or they make up such a small proportion of the sky

[1] "Seasonal" is defined as the six consecutive months per year when the potential for plume formation is greatest. The months considered for a particular project are determined by the meteorological data used for that project. Usually the months are November through April, as is the case for this project.

[2] These are typically Hourly U.S. Weather Observations (HUSWO) data sets).

that conditions appear to be virtually clear; and b) for a substantial portion of the time when total sky cover is 20-100 percent and the opacity of sky cover is relatively low (equal to or less than 50 percent), clouds do not substantially reduce contrast with plumes; staff estimates this time as approximately half of these hours.

Of all the plumes that are predicted to occur during “clear” SDNRNF hours, staff produces visual simulations based on the smallest plume size for the primary dimension (length in this case) predicted to occur 10 percent of the “clear” SDNRNF hours, and an average of the predicted plume dimensions for the “clear” SDNRNF hours for the other two dimensions (height and width in this case). This “average” secondary dimension is determined by taking the median of the dimensions predicted by the model for 5 to 15 percentile plumes as sorted by the primary dimension. As shown in **Visible Plumes Table 2**, the 10^{th} percentile cooling tower plumes during “clear” SDNRNF hours would achieve substantial size: approximately 380 feet in height, 272 feet in length (not including the length of the cooling tower), and 154 feet in width. The cooling tower would be 43 feet high and 864 feet long. Plume drift would generally follow an up- or down-valley pattern with the north-northwest up-valley direction being more sharply defined than the less defined but more persistent south-southeast down-valley direction.

The modeling results also show that of the 18.5 percent of the “clear” SDNRNF hours that cooling tower water vapor plumes would occur, they would exceed 426 feet in height 9.6 percent of the time (approximately 50 minutes on clear days, generally during the early morning hours, November through April). Plumes would be less than 426 feet tall, the height of the two existing parabolic cooling towers, 8.9 percent of the time (approximately 45 minutes on clear days, generally during the early morning hours, November through April). Overall, “clear” weather plumes are predicted to occur on average approximately 95 minutes on clear days, generally during the early morning hours, throughout the November to April period.

Visible Plumes Table 1
Predicted Cooling Tower Steam Plumes
During Seasonal Daylight No Rain/No Fog Hours
Sacramento 1990-1993 Meteorological Data

Measurement Period	Total SDNRNF Hours	Total SDNRNF Hours with Cooling Tower Plumes		Cooling Tower Plumes During Clear Weather Conditions	
		Hours	Percent	Hours	Percent
Seasonal Daylight No Rain/Fog (SDNRNF) Hours	6,339	2,781	43.9%	1,172	18.5%

Visible Plumes Table 2
Cooling Tower 10th Percentile Visible Plume Dimensions
During Clear Seasonal Daylight No Rain/No Fog Hours
Sacramento 1990-1993 Meteorological Data

Plume Dimensions	Clear Weather Conditions
Length*	272 ft.
Height	380 ft.
Width	154 ft.

* Does not include the length of the tower (864 feet).

Visual Impacts of Vapor Plumes

Due to the openness of the project site and surrounding area, the frequency and large sizes of visible plumes that would occur at the project site would cause a noticeable but intermittent change in the landscape character when viewed from both near and more distant vantagepoints. For approximately one hour per day, during the early morning hours from November through April, the plume's regional viewshed would exceed that of the existing Rancho Seco cooling towers, over 12 miles for some viewers (depending on intervening screening). Viewing locations would include numerous rural residences, Rancho Seco Park, and local roadways. Although few swimming or picnic area users at Rancho Seco Park are likely to be present during the cool morning periods when plumes primarily occur, overnight campers and people fishing would observe early morning plumes. The water vapor plumes would appear as prominent, billowing linear-to-irregular forms with irregular and changing outlines. The plumes would be unique moving forms, originating near ground level and rising vertically and then diagonally across a background consisting of Sierra foothills and/or sky depending on viewing location. The movement of the plume would be noticeable from foreground viewing locations, and less noticeable from middleground to background viewing locations.

Visual Impacts from Nearby Viewing Locations (KOP 2)

KOP 2 was selected to characterize vapor plume impacts on foreground to middleground viewing locations (up to two miles). The plumes would be prominently visible to residents in the project vicinity and travelers on Clay East Road, and intermittently prominent to travelers on Twin Cities Road. It is important to note that plumes, under the "clear" SDNRNF hours staff uses for its analysis, would be taller than the existing 426-foot high parabolic cooling towers only 9.6 percent of that time (approximately 50 minutes a day generally during the early morning hours, November through April). Overall, plumes would only be visible for approximately 1.6 hours a day during clear conditions, generally during the early morning hours, from November through April.

Under clear conditions when viewed from nearby viewing locations such as KOP 2, the white vapor plumes would have high color contrast with the background blue sky. The vertical and diagonal irregular and changing form of the plume, substantial plume mass, and plume motion would distinguish the plume from the broad, horizontal, natural landforms; the generally uniform appearance of sky; and well defined forms of the existing Rancho Seco Power Plant. The resulting visual contrast on clear days would be high.

Under clear conditions, the plumes would be spatially prominent and co-dominant with other built structures and natural landscape features. Therefore, under clear conditions the plume would be co-dominant.

Under clear conditions project plumes as viewed from KOP 2, and other locations at a similar distance, would block from view a low-to-moderate portion of sky and the Sierra Nevada foothills and mountains. The resulting view disruption under clear conditions would be low-to-moderate.

When viewed from KOP 2 (and similar other vantagepoints in the project area), the plumes' high visual contrast, co-dominance, and low-to-moderate view disruption taken together constitute a moderate degree of visual change under clear conditions.

As previously discussed, the overall visual sensitivity for KOP 2 is moderate and is the result of a moderate visual quality of the existing landscape, a moderate viewer expectation, and a moderate degree of viewer exposure. These values are characteristic of many vantagepoints less than two miles from the project. When the anticipated project plumes are considered within the context of the moderate visual sensitivity, the moderate degree of visual change under clear conditions would cause an adverse but less than significant visual impact at KOP 2 and other locations of similar distance. See **Visible Plumes Figure 2** for a simulation of the plume from KOP 2.

Visual Impacts from More Distant Viewing Locations

Project plumes and their resulting visual impacts would also be apparent from more distant regional vantagepoints. **Visible Plumes Figure 4** is a visual simulation of the plume as seen from a distance of approximately two miles (KOP 3). It is representative of the numerous rural residences scattered throughout the landscape at two or more miles northwest to southwest of the project site. These more distant residents in some cases have panoramic views that encompass open, rural, agricultural landscapes dotted with rural residences and farm buildings. For those residents with panoramic views, built features appear very small in the broad pastoral context of the valley floor and few features (with the exception of the Rancho Seco cooling towers) break the low horizontal horizon line, which is uninterrupted in a 360 degree viewing arc from many vantagepoints.

It is important to note that plumes, under the "clear" SDNRNF hours that staff uses for its analysis, would be taller than the existing cooling towers only 9.6 percent of the time (approximately 50 minutes a day generally during the early morning hours, November through April). During the 8.9 percent of the time (approximately 45 minutes a day generally during the early morning hours, November through April) that the plumes are not predicted to exceed the height of the existing parabolic cooling towers, many regional viewers would see a substantial, but less than significant change to their view. The existing parabolic cooling towers would partially block views of the CPP water vapor plumes for the few residences north/northwest of the proposed CPP site. Views of the existing parabolic cooling towers would be partially blocked by water vapor plumes for short periods on clear days between November and April for the few viewers south/southeast of the proposed CPP site.

Under clear conditions, the white color of the plume would exhibit a high degree of color contrast with the darker blue background of the sky and earthtones of the Sierra foothills. Also, the well-defined vertical and curvilinear form of the plume would cause the plume to stand out from the broad, low-horizontal, natural landform of the valley floor; the generally uniform appearance of clear sky and well defined parabolic forms of the existing Rancho Seco cooling towers. The resulting visual contrast under clear conditions would be high.

From the more distant viewing locations represented by KOP 3, under clear conditions, the plume would appear prominent above the low horizon line established by the landform and vegetation of the valley floor. When the Sierra foothills are visible in the distant background, the brighter color of the plume would cause it to stand out from the more subdued earthtones of the foothills. As a result, under clear conditions the plume would be co-dominant in relation to the broad landform of the valley floor (or Sierra foothills) and non-distinct expanse of blue sky.

Under clear conditions, compared to close-in vantagepoints, project plumes would block from view a smaller portion of sky and a smaller portion of the Sierra foothills (when viewed from the northwest to southwest). The resulting view disruption would be low-to-moderate.

From vantagepoints two miles and greater from the proposed CPP site, the plumes' high visual contrast, co-dominance, and low-to-moderate view disruption taken together constitute a moderate degree of visual change under clear conditions.

As previously discussed, the overall visual sensitivity from the more regional vantage point is moderate and is the result of the moderate visual quality of the existing landscape, moderate-to-high viewer expectation, and moderate viewer exposure. When the project plumes are considered within the context of the moderate overall visual sensitivity, the moderate degree of visual change on clear days would cause an adverse but less than significant visual impact for viewers from KOP 3 and other vantagepoints that are more than two miles from the plumes. See **Visible Plumes Figure 4** for a simulation of how the plume will appear from this viewpoint.

CONSIDERATION OF IMPACTS IN RELATION TO CEQA SIGNIFICANCE CRITERIA

This analysis considered the potential impacts of the proposed project vapor plumes in relation to the four significance criteria for visual resource impacts listed in Appendix G of the CEQA Guidelines, under Aesthetics, specified below.

1. Would the project have a substantial adverse effect on a scenic vista?

There are no designated scenic vistas in the project region so the proposed project plumes would not result in significant visual impacts under this criterion.

2. **Would the project substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?**

No scenic highways are in the vicinity of the proposed project. Therefore, the proposed project's cooling tower vapor plumes would not compromise views from a state scenic highway and would not result in significant visual impacts under this criterion.

3. **Would the project substantially degrade the existing visual character or quality of the site and its surroundings?**

The frequency and relatively large sizes of visible cooling tower plumes would cause the plumes, during clear weather conditions, to be prominent features in the views from nearby and more distant roads and residences. However, due to the intermittent, short-duration, changing and seasonal nature of plumes, the resulting visual impact would be adverse but less than significant under this criterion.

4. **Would the project create a new source of substantial light or glare that would adversely affect daytime or nighttime views in the area?**

The project's visible cooling tower plumes have the potential to create a new source of glare for viewers on the eastside of the project site during the early morning hours. There are few residences to the east of the proposed project site, and the number of vehicles that are likely to be traveling from east to west during the short period plumes are of any substantial size would be few. Because of these factors, views of the plumes would result in an adverse but not significant visual impact under this criterion.

CUMULATIVE IMPACTS

Cumulative impacts to visual resources could occur where project facilities or activities (such as construction) occupy the same field of view as other built facilities or impacted landscapes. It is also possible that a cumulative impact could occur if a viewer's perception is that the general visual quality of an area is diminished by the proliferation of visible structures, even if the new structures are not within the same field of view as the existing structures. The significance of the cumulative impact would depend on the degree to which (1) the viewshed is altered; (2) visual access to scenic resources is impaired; (3) visual quality is diminished; or (4) the project's visual contrast is increased.

Sacramento County identified one other approved project that is considered in staff's cumulative analysis. The project is a proposed biosolids storage facility that would be located within one mile northwest of the proposed power plant site, on the north side of Twin Cities Road. Depending on where the biosolids storage facility is located on the candidate parcels, it may be visible in the same field of view of westbound motorists on Twin Cities Road, when approaching the project region east of the proposed power plant site. However, to the extent that both the proposed power plant and biosolids storage facility are visible in the same field of view, it would only be for a very brief viewing period due to the intermittent screening of the power plant site by intervening terrain. The resulting cumulative impact would be adverse but not significant.

The intermittent and generally short-term cooling tower water vapor plumes, would not contribute to an adverse significant cumulative visual impact, considering the proposed

CPP and the existing Rancho Seco Power Plant and associated transmission system. The plumes, under the “clear” SDNRNF hours staff uses for its analysis, would be taller than the existing cooling towers only 9.6 percent of the time (approximately 50 minutes on clear days, generally during the early morning hours, November through April). Staff does not consider such short-term events to result in a significant contribution to a cumulative impact.

ENVIRONMENTAL JUSTICE

Staff has reviewed Census 2000 information that shows the population of people of color is less than 50 percent within a six-mile radius of the proposed project (please refer to **Socioeconomics Figure 1** in this Staff Assessment). However, as indicated in **Figure 1**, there are multiple census blocks with greater than 50 percent people of color within the six-mile radius; staff considers these to be pockets or clusters. Staff also reviewed Census 1990 information that shows the low-income population is less than fifty percent within the same radius.

Based on this visible plume analysis, staff has concluded that project plumes would not cause direct or cumulative significant visual impacts. Therefore, there are no visible plume environmental justice issues.

COMPLIANCE WITH LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

LOCAL

Visible Plumes Table 3 provides a listing of the applicable LORS for the County of Sacramento. Two LORS were found to pertain visible plumes and the enhancement and/or maintenance of visual quality and the protection of views. Of the two pertinent LORS, both are from the Sacramento County General Plan. Based on staff’s preliminary analysis, it appears that the proposed project would be consistent with both of the local policies referenced in **Table 3.**

Visible Plumes Table 3
Proposed Project's Consistency with
Local LORS Applicable to Visible Plumes

LORS		Consistency Determination Before Mitigation/ Conditions	Basis for Consistency
Source	Description of Relevant Principles, Objectives, or Policies		
Sacramento County General Plan Public Facilities Element	Objective: Minimize the health, safety, aesthetic, cultural and biological impacts of energy facilities in Sacramento County.	YES	The unabated cooling tower vapor plume would not result in a direct or cumulative significant visual impact.
Public Facilities Element (SCPCDD 1997)	Policy PF-71: Locate and design production and distribution facilities so as to minimize visual intrusion problems in urban areas and areas of scenic and/or cultural value including: recreation and historic areas; scenic highways; landscape corridors; state or federal designated wild and scenic rivers; visually prominent locations such as ridges, designated scenic corridors, and open viewsheds; and Native American sacred sites.	YES	The proposed project plumes would not be located in an urban area, an area of identified scenic and/or cultural value, or a visually prominent area.

MITIGATION

Mitigation of Impacts of Visible Plumes

The frequent (although of short duration) and large cooling tower plume occurrence during clear weather conditions would cause less than significant direct and cumulative visual impacts when viewed from nearby and regional vantagepoints. The proposed project's vapor plumes would degrade, but not to a substantial level, the existing visual character and quality of the site and its surroundings. Therefore, no mitigation is necessary for CPP cooling tower water vapor plumes.

CONCLUSIONS AND RECOMMENDATIONS

Because of the short duration and intermittent nature of plumes generally limited to the early morning hours of the November through April period, the low number of hours that the plumes would exceed the height of the existing Rancho Seco Plant parabolic cooling towers, the moderate overall visual sensitivity of viewers represented by the two KOPs, and the moderate overall visual change determined for the two KOPs, staff finds that the proposed project's vapor plumes would not cause significant and adverse direct or cumulative visual impacts. To ensure that the cooling tower is designed and operated in a manner that matches the profile evaluated in this analysis, resulting in a less than significant plume impact, staff proposes two conditions of certification.

The CPP project is consistent with the two identified relevant laws, ordinances, regulations, and standards.

PROPOSED CONDITIONS OF CERTIFICATION

PLUME-1 The project owner shall ensure that the CPP cooling tower is designed so that the plume frequency will not increase from the design as identified below.

Exhaust Characteristics for Cooling Tower Cells
(per cell at full turbine load)

	Case 1	Case 2	Case 3
Ambient Temperature	104°F	61°F	34°F
Relative Humidity	17%	59%	90%
Stack Gas Exit Temperature	91°F	79°F	68°F
Stack Gas Mass Flow Rate	106,550 lbs/min	114,417 lbs/min	120,416 lbs/min

This table has been reproduced with the desired operating variables and includes data from the applicant's Attachment VR-109, Table 1 that was included in Data Response Set 1D.

Verification: At least 30 days prior to ordering the cooling tower, the project owner shall provide to the CPM for review and approval the final design specifications of the cooling tower, any associated automated control systems, and related systems and sensors that will be used for compliance with the monitoring requirements of this condition. The project owner shall not order the cooling tower until notified by the CPM that the design has been approved.

The final design parameters of the cooling tower shall include: all parameters as listed in the table above, and the physical size of the cooling tower, the cell exhaust diameter, the fogging frequency curve for the cooling tower, the design L/G (liquid/gas) ratio, and the curve equation to determine the operating exhaust temperature based on the ambient temperature, relative humidity, and heat rejection load condition.

PLUME-2 The project owner shall ensure that the CPP cooling tower is operated so that the plume frequency will not increase from the design and operating characteristics specified in condition **PLUME-1**.

The project owner shall monitor the operation of the cooling tower to ensure that it is operated in a manner consistent with the operating variables specified in condition **PLUME-1**. The project owner shall monitor and record the hourly inlet airflow rates, the hourly operating L/G ratio, the heat rejection load, the hourly ambient temperature and relative humidity, and the corresponding hourly exhaust temperature of the cooling tower. This monitoring shall occur from November through April each year until compliance is demonstrated for three straight years, and may be required again at a later date as determined necessary by the CPM. The cooling tower data shall be provided for each cell unless the project owner can demonstrate that each cell operates identically. Compliance shall be demonstrated if the tower operates within the proposed exhaust temperature vs. operating condition curve equation (i.e., exhaust temperatures at or below the predicted values).

Verification: By May 15th of each year that the cooling tower operations monitoring is required, the project owner shall provide to the CPM the cooling tower operating data for the previous November through April period. The project owner shall include with this operating data an analysis of compliance and shall provide proposed remedial actions if compliance cannot be demonstrated.

REFERENCES

Buhyoff, G. J., P.A. Miller, J. W. Roach, D. Zhour, and L. G. Fuller. 1994. An AI Methodology for Landscape Visual Assessments. AI Applications. Vol. 8, No. 1.

CEC/Walters (California Energy Commission/William Walters). 2002. Visible Plume Analysis. Testimony of William Walters and Lisa Blewitt. September 2002. (Attached as an appendix)

SCPCDD (Sacramento County Planning and Community Development Department). 1997. *County of Sacramento General Plan*.

SMUD (Sacramento Municipal Utility District). 2001a. Application for Certification, Volumes 1 and 2 (01-AFC-19). Submitted to the California Energy Commission on September 13, 2001. Docket date September 13, 2001.

VISIBLE PLUMES APPENDIX

William Walters and Lisa Blewitt

INTRODUCTION

The following provides staff's assessment of the Cosumnes Power Plant (CPP) Project cooling tower and heat recovery steam generator (HRSG) exhaust stack visible plumes. Staff completed a modeling analysis for the applicant's proposed unabated cooling tower and HRSG designs.

PROJECT DESCRIPTION

The applicant has proposed two linear 9-cell conventional mechanical-draft wet cooling towers. These two cooling towers are proposed to be placed in-line creating a virtual linear 18-cell cooling tower. The applicant has not proposed to use any methods to abate visible plumes from the cooling towers.

The project includes four separate turbine/heat recovery steam generator systems, each with separate exhaust stacks. No duct firing will be used. The applicant has not proposed to use any methods to abate visible plumes from the HRSG exhausts.

COOLING TOWER VISIBLE PLUME MODELING ANALYSIS

EXISTING CONDITIONS

The applicant verified in Data Response (DR) #106 (SMUD 2002a, p. 50) that no other plume sources have been identified within the vicinity of the CPP project site.

COOLING TOWER DESIGN PARAMETERS

Staff evaluated the applicant's AFC (SMUD 2001a, AFC Section 8.11.5.3.3), Data Response #108 (SMUD 2002a, p 51), DR #107 and DR #108 (SMUD 2002e, pp. 19-20), and DR #109 (SMUD 2002g, Attachment VR-109), and performed an independent psychrometric analysis and dispersion modeling analysis to predict the frequency and dimensions of visible plumes from the project's proposed unabated wet cooling towers.

The cooling tower design characteristics, presented below in **Table 1**, were determined through a review of the applicant's AFC and Data Request Responses, and through additional engineering calculations.

Table 1 – New Cooling Tower Operating and Exhaust Parameters

Parameter		New Cooling Tower Design Parameters	
Number of Cells		18 (2 @ 1 x 9)	
Stack Height		12.2 meters	
Cell Stack Diameter		10.97 meters	
Equivalent Stack Diameter		43.89 meters (1)	
Maximum Design Inlet Air Flow Rate (kg/s)		**14,400** (2)	
Maximum Heat Rejection Rate (MW)		**671.2** (2)	
Design Liquid to Gas (L/G) Mass Ratio		1.10	
Case (3)	**Ambient Condition**	**Exhaust Flow Rate (lbs/s/cell)**	**Exhaust Temperature (°F)**
1	104 °F, 17% RH	1775.8	91
2	61 °F, 59% RH	1907.0	79
3	34 °F, 90% RH	2006.9	68

Source: AFC (SMUD 2001a) and Data Request Response #107 and DRR #108 (SMUD 2002e, page 19-20), DRR #108 (SMUD 2002a, page 51,Table VR-108), DRR #109 (SMUD 2002g, page VR109-3, Table 1), and AFC Supplement (SMUD 2002j, Figure 2.2-2R).

Notes:

(1) This is based on 8 cells operating (16 cells total) in each 9-cell cooling tower.

(2) Bold numbers reflect having both cooling towers in operation and are the basis for SACTI modeling.

(3) For CSVP modeling, values were extrapolated or interpolated between data points as necessary.

The exhaust temperature and exhaust mass flow rate values were calculated for the hourly ambient conditions modeled through linear interpolation and extrapolation of the data provided by the applicant for the three cases presented in **Table 1**. The exhaust moisture content was determined by assuming saturated conditions at the calculated exhaust temperature.

COOLING TOWER VISIBLE PLUME MODELING ANALYSIS

Staff modeled the cooling tower plumes using both the Combustion Stack Visible Plume (CSVP) model and the Seasonal/Annual Cooling Tower Impact (SACTI) model. The SACTI model is designed to model multiple cell cooling towers, and for the CSVP modeling analysis uses the USEPA recommended multiple adjacent stack approach in order to model the entire exhaust water emissions of the tower. **Table 2** provides the CSVP model visible plume frequency results using a four-year (1990-1993) meteorological data set, obtained from the National Climatic Data Center, from Sacramento.

Table 2 – Staff Predicted Hours with Cooling Tower Steam Plumes Sacramento 1990-1993 Meteorological Data

	Available (hr)	Plume (hr)	Percent
All Hours	34,980	19,595	56.0%
Daylight Hours	17,865	5,871	32.9%
Nighttime Hours	17,115	13,724	80.2%
Daylight No Rain/Fog Hours	16,028	4,070	25.4%
Seasonal Daylight No Rain/Fog Hours*	6,339	2,781	43.9%

*Seasonal conditions occur anytime from November through April.

These modeling results indicate that the visible plume formation would mainly occur during the cold weather months, with the majority of plume formation occurring at night or early morning. For the proposed cooling tower, the maximum temperature where a visible plume is predicted is 74.7°F when the relative humidity is 90%. Visible plumes could occur at higher temperatures if the relative humidity were above 90%; however, the four years of meteorological data did not show those conditions to exist.

Staff's SACTI modeling analysis visible plume dimension results, using the same four-year (1990-1993) meteorological data set from Sacramento are provided in **Table 3**.

Table 3 – Staff Results of Cooling Tower Visible Plume Dimensions

Sacramento 1990-1993 Meteorological Data

All Hours	Percentile	SACTI Model	CSVP Model
Length (m)	50%	60-70	42
	10%	700-800	2,888
	Maximum	>10,000	>5,000
Height (m)*	50%	30-40	62
	10%	100-200	336
	Maximum	>1,000	4,513
Width (m)	50%	60-80	29
	10%	140-160	201
	Maximum	1000-1200	1,690
Daytime No Rain/Fog Hours			
Length (m)	50%	50-60	No Plume
	10%	200-300	150
	Maximum	>10,000	>5,000
Height (m)*	50%	20-30	No Plume
	10%	50-60	171
	Maximum	>1,000	4,283
Width (m)	50%	40-60	No Plume
	10%	80-100	56
	Maximum	800-1,000	1,475
Seasonal Daytime No Rain/Fog Hours			
Length (m)	50%	50-60	No Plume
	10%	300-400	200
	Maximum	>10,000	>5,000
Height (m)*	50%	20-30	No Plume
	10%	80-90	214
	Maximum	>1,000	4,283
Width (m)	50%	40-60	No Plume
	10%	100-120	64
	Maximum	800-1,000	1,475

Seasonal = November through April (day 120-304).
*SACTI Plume height does not include the height (12.2 meters) of the cooling tower (release point).

As **Table 3** shows, for a plume frequency of 10 percent, the CSVP model generally predicts similar but taller plume dimensions than the SACTI model. While the CSVP model does have certain limitations, such as no specified mixing height to limit maximum plume heights, it uses actual hourly meteorological data and can model "calm" hours assuming a minimum wind speed; while the SACTI model groups the meteorological data and does not process "calm" hours. Therefore, staff concludes that the CSVP modeling results, which also includes the variable load characteristics of the cooling tower with respect to variable ambient conditions, should provide more realistic visible plume characteristics.

The applicant modeled the cooling tower visible plume dimensions using a program called MISTVUE (SMUD 2001g, DR #109, page VR109-2). MISTVUE uses a linear interpolation of water vapor pressure, between the stack exit and ambient conditions, together with the Goff-Gratch formulation of the Clausius-Clapeyron equation for water vapor pressure, to determine the amount of dilution required for the visible plume to not be visible. These calculations are performed for each hour. MISTVUE performs calculations for various sources including cooling towers and combustion sources. MISTVUE determines the distance along the centerline of the plume where sufficient dilution has occurred such that the plume is no longer visible.

The MISTVUE modeling analysis visible plume frequency results provided by the applicant using a three year (1990-1992) meteorological data set from the monitoring station at Sacramento Executive Airport are provided in **Table 4** along with staff's CSVP results using a four year (1990-1993) meteorological data set from Sacramento.

Table 4 – Comparison of Predicted Hours with Cooling Tower Steam Plumes

	Staff CSVP	Applicant MISTVUE			
	Percent 1990-1993	Percent 1990-1992	Percent 1990	Percent 1991	Percent 1992
All Hours	56.0%	50.4%	48.1%	51.0%	51.9%
Daylight Hours	32.9%	30.5%	28.3%	30.8%	32.6%
Nighttime Hours	80.2%	70.3%	68.0%	71.3%	71.5%
Daylight No Rain/Fog Hours	25.4%	23.1%	22.0%	23.5%	23.6%
Seasonal Daylight No Rain/Fog Hours*	43.9%	N/A	N/A	N/A	N/A

*Seasonal conditions occur anytime from November through April.

Table 4 shows that the plume frequency determinations are very similar.

The applicant models a single cooling tower cell, which staff believes causes the applicant's modeling analysis to underestimate the plume dimensions of the cooling tower by not accounting for the total water emissions from the contiguous cooling tower cell exhausts and not accounting for the interaction of the adjacent exhausts. The plume dimension (height and length) underestimation should be most pronounced when the wind direction is aligned along the length of the tower.

A plume frequency of 10% of seasonal (November through April) daylight no rain/fog high visual contrast hours analysis is used to determine potential plume impact significance. The high visual contrast hours analysis methodology is provided below:

> The Energy Commission has identified a "clear" sky category during which plumes have the greatest potential to cause adverse visual impacts. For this project the meteorological data set[1] used in the analysis categorizes total sky cover and opaque sky cover in 10% increments. Staff has included in the "Clear" category a) all hours with total sky cover equal to or less than 10% plus b) half of the hours with total sky cover 20-100% that have a sky opacity equal to or less than 50%. The rationale for including these two components in this category is as follows: a) plumes typically contrast most with sky under clear conditions and, when total sky cover is equal to or less than 10%, clouds either do not exist or they make up such a small proportion of the sky that conditions appear to be virtually clear; and b) for a substantial portion of the time when total sky cover is 20-100% and the opacity of sky cover is relatively low (equal to or less than 50%), clouds do not substantially reduce contrast with plumes; staff has

[1] This analysis uses an Hourly US Weather Observations (HUSWO) data set.

estimated that approximately half of the hours meeting the latter sky cover and sky opacity criteria can be considered high visual contrast hours and are included in the "clear" sky definition.

The results of the high visual contrast hours analysis is provided in **Table 5**.

Table 5 – Staff Predicted Cooling Tower Plume Hours Cloud Cover

Plume Hours by Cloud Cover Type					
All		Clear		Scattered/Broken/Overcast	
Hours	%	Hrs	%	Hours	%
2,781	43.9	1,172	18.5	1,609	25.4

* - Percentiles are calculated by dividing the number of plume hours by the reference number of seasonal daylight no rain no fog hours (6,339).

The 10th percentile "clear" sky plume dimensions are estimated by the CSVP model are as follows:

Length – 83 meters (272 feet)
Height – 116 meters (380 feet)
Width – 47 meters (154 feet)

These dimensions include the height of the tower (12.2 meters) but do not include the length of the tower, which is approximately 263 meters (864 feet) long. Therefore, the actual visible plume length is 263 meters plus a portion of the 83 meter plume length, which depends on the angle of the wind relative to the long axis of the cooling tower.

The CSVP model predicts plume frequencies greater then 10% of seasonal daylight no rain/fog high visual contrast hours, which would trigger a study of the visual impacts of the plume from the cooling tower. The visual impact analysis for the cooling tower plumes is provided in the Visual Resources section of the Staff Assessment.

HRSG VISIBLE PLUME MODELING ANALYSIS

Staff evaluated the applicant's AFC (SMUD 2001a, AFC Section 8.11.5.3.3) and Data Request Response #109 (SMUD 2001g, Attachment VR-109) and performed an independent psychrometric analysis and dispersion modeling analysis. The Combustion Stack Visible Plume (CSVP) model was used to estimate the worst-case potential plume frequency, and provide data on predicted plume length, width, and height for each HRSG stack.

HRSG DESIGN PARAMETERS

Based on the stack exhaust parameters anticipated by the applicant for each HRSG stack, the frequency and size of visual plumes can be estimated. The operating data for these stacks are provided in **Table 6**.

Table 6 – HRSG Exhaust Parameters

Parameter	HRSG Exhaust Parameters		
Stack Height	50.3 meters (165 feet)		
Stack Diameter	5.64 meters (18.5 feet)		
	Case 1	**Case 2**	**Case 3**
Ambient Temp	104°F	61°F	34°F
Ambient Relative Humidity	17%	59%	90%
Turbine Load	100%	100%	100%
Inlet Fogging	On	Off	Off
Exhaust Temperature	189°F	185°F	182°F
Exit Velocity	Calculated for each hour modeled		
Exhaust mass flow rate	3,469,410 lbs/hr	3,604,224 lbs/hr	3,750,308 lbs/hr
Exhaust Molecular Weight	28.5 lbs/lb-mol		
Moisture Content (% by wt.)	6.26%	5.29%	5.01%

Source: AFC (SMUD 2001a), Data Request Response #109 (SMUD 2002a, Table VR-109, page 53) and DRR #109 (SMUD 2002g, Table 2, page VR109-4), and AFC Supplement (SMUD 2002j, Figure 2.2-2R).
Notes:
1. For CSVP the analysis, values were extrapolated or interpolated between data points as necessary.

HRSG VISIBLE PLUME MODELING ANALYSIS

Staff modeled the HRSG plumes using the CSVP model with a four-year meteorological data set, obtained from the National Climatic Data Center, for Sacramento. **Table 7** provides the CSVP model visible plume frequency results.

Table 7 – Staff Predicted Hours with HRSG Steam Plumes Sacramento 1990-1993 Meteorological Data

	Available (hr)	Plume (hr)	Percent
All Hours	34,980	4,262	12.2%
Daylight Hours	17,865	948	5.3%
Nighttime Hours	17,115	3,314	19.4%
Daylight No Rain/Fog Hours	16,028	197	1.2%
Seasonal Daylight No Rain/Fog Hours*	6,339	192	3.0%

*Seasonal conditions occur anytime from November through April.

These results confirm that the visible plume formation would mainly occur during the cold weather months, with the majority of plume formation occurring at night or early morning. For the proposed HRSG, the maximum temperature where a visible plume is predicted is 50°F when the relative humidity is 100%.

The MISTVUE modeling analysis visible plume frequency results provided by the applicant using a three year meteorological data set from the monitoring station at Sacramento Executive Airport are provided, compared to staff's results, in **Table 8**.

Table 8 – Comparison of Predicted Hours with HRSG Steam Plumes

	Staff CSVP	Applicant MISTVUE			
	Percent 1990-1993	Percent 1990-1992	Percent 1990	Percent 1991	Percent 1992
All Hours	12.2%	10.8%	9.8%	10.5%	12.0%
Daylight Hours	5.3%	5.1%	4.1%	4.7%	6.5%
Nighttime Hours	19.4%	16.4%	15.5%	16.3%	17.4%
Daylight No Rain/Fog Hours	1.2%	1.3%	1.6%	1.3%	1.1%
Seasonal Daylight No Rain/Fog Hours*	3.0%	N/A	N/A	N/A	N/A

*Seasonal conditions occur anytime from November through April.

As shown in **Table 8**, the applicant's MISTVUE plume frequency results are very similar to staff's CSVP plume frequency results.

A plume frequency of 10% of seasonal (November through April) daylight no rain/fog high contrast hours is used as an initial plume impact study threshold trigger. The CSVP model predicts plume frequencies less then 10% of seasonal daylight no rain/fog hours high contrast hours, which would not trigger additional study of the visual impacts of the plumes from the HRSGs.

PLUME ABATEMENT

The cooling tower plumes can be abated through the use of an air-cooled condenser (dry cooling) or through the use of plume abated cooling towers. A separate cooling alternatives study is being prepared to address these two alternative cooling options. An air-cooled condenser would completely eliminate water vapor plumes. A plume abated cooling tower would need to be designed to an appropriate abatement point. A comparison of an estimate of plume frequencies for the unabated cooling tower and three plume abated cooling towers is provided in **Table 9**. The three plume abated towers are assumed to be wet/dry cooling towers with the following plume mitigation design points: 52°F and 73% relative humidity; 45°F and 80% relative humidity; and 38°F and 80% relative humidity.

Table 9 – Unabated/Abated Cooling Tower Plume Frequency Comparison

	Seasonal Daylight No Rain/No Fog Frequency	
Cooling Tower Design	Plume Hours	Plume Frequency
Applicant Proposed Unabated Design[a]	2,781	43.9%
Abated with 52°F and 73% RH Design Point[b]	1,446	22.8%
Abated with 45°F and 80% RH Design Point[b]	421	6.6%
Abated with 38°F and 80% RH Design Point[a]	149	2.4%

a – The plume frequencies were modeled using design data provided for these two designs by the applicant
b – The plume frequencies were estimated using frequency fogging curves provided by Marley Cooling Tower (Marley 2002).

Staff's initial screening analysis indicates that a wet/dry cooling tower with a design point somewhere between 52°F and 73% relative humidity and 45°F and 80% relative humidity would reduce the frequency of visible plumes to under 10% of seasonal daylight no fog no rain high visual contrast hours, which is roughly equivalent to plume frequency somewhere between 15% and 20% of all seasonal daylight no rain no fog hours. Abated cooling tower designs that might be proposed to mitigate significant visual impacts would need to be verified through cooling tower performance curves from a qualified cooling tower vendor.

REFERENCES

Marley (Marley Cooling Tower) 2002. Fogging Frequency Curves for 45°F/80% RH and 52°F/73% RH Design Points. May 13, 2002.

SMUD (Sacramento Municipal Utility District) 2001a. Application for Certification, Volumes 1 and 2 (01-AFC-19). Submitted to the California Energy Commission on September 13, 2001. Docket date September 13, 2001.

SMUD (Sacramento Municipal Utility District) 2002a. Data Response, Set 1A. January 9, 2002. Docket date January 9, 2002.

SMUD (Sacramento Municipal Utility District) 2002e. Data Response, Set 1C. February 4, 2002. Docket date February 5, 2002.

SMUD (Sacramento Municipal Utility District) 2002g. Data Response, Set 1D. February 15, 2002. Docket date February 19, 2002.

SMUD (Sacramento Municipal Utility District) 2002j. AFC Supplement A (Revised General Arrangement). March 15, 2002. Docket date March 15, 2002.

ALTERNATIVES

Negar Vahidi

INTRODUCTION

In this section, staff considered potential alternatives to the construction and operation of the proposed Cosumnes Power Plant (CPP). The purpose of this alternatives analysis is to describe a reasonable range of feasible alternatives that could substantially reduce or avoid any potentially significant adverse impacts of the proposed project (Cal. Code Regs., tit. 14, §15126.6; Cal. Code Regs., tit. 20, § 1765). Staff analyzed different technologies and alternative sites that may reduce or avoid the potentially significant impacts associated with the CPP. Staff also analyzed the impacts that may be created by locating the project at alternative sites.

LAWS, ORDINANCES, REGULATIONS, AND STANDARDS (LORS)

CALIFORNIA ENVIRONMENTAL QUALITY ACT

The "Guidelines for Implementation of the California Environmental Quality Act" require an evaluation of the comparative merits of "a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project." In addition, the analysis must address the "no project" alternative (Cal. Code Regs., tit. 14, §15126.6(e)).

The range of alternatives is governed by the "rule of reason" which requires consideration only of those alternatives necessary to permit informed decision-making and public participation. The California Environmental Quality Act (CEQA) states that an environmental document does not have to consider an alternative of which the effect cannot be reasonably ascertained and of which the implementation is remote and speculative (Cal. Code Regs., tit. 14, §15125(d)(5)). However, if the range of alternatives is defined too narrowly, the analysis may be inadequate (City of Santee v. County of San Diego (1989) 214 Cal. App. 3d 1438).

SCOPE AND METHODOLOGY OF THE ALTERNATIVES ANALYSIS

The purpose of staff's alternatives analysis is to identify a reasonable range of feasible alternatives that could substantially reduce or avoid any potentially significant adverse impacts of the proposed project. To accomplish this, staff must determine the appropriate scope of analysis. Consequently, it is necessary to identify and determine the potentially significant impacts of the proposed project and then focus on alternatives that are capable of reducing or avoiding the significant impacts of the proposed project.

To prepare this alternatives analysis, staff used the following methodology:

- Identify the basic objectives of the project, provide an overview of the project, and describe its potentially significant adverse impacts.

- Identify and evaluate alternative locations or sites.
- Identify and evaluate technology alternatives to the project, including conservation and renewable sources.
- Evaluate the impacts of not constructing the project, known as the “no project” alternative under CEQA.

PROJECT OBJECTIVES

According to the AFC, the applicant chose the proposed site for the following reasons:

- The site is close to the existing transmission substation at the Rancho Seco Nuclear Plant (currently being decommissioned), with access to PG&E, and through PG&E, the ISO electrical markets (SMUD 2001a, p. 5-1). The proposed project site will allow power delivery without constructing significant new transmission lines, thereby reducing potential impacts on the environment.
- Sufficient land (in excess of 35 acres plus a construction laydown area) is available (SMUD 2001a, p. 2-1).
- The site is close to an existing water supply requiring minimal impact on the environment for purposes of constructing additional water supply infrastructure (SMUD 2001a, p. 8.4-6). Water quality is excellent, allowing a high level of cycling before disposal (SMUD 2002a, p. 7-4).
- The site is proximate to present and future gas supplies (Lodi) for future reliability (SMUD 2001a, p. 8.4-6).
- Development of the site would not cause loss of significant environmental resources (SMUD 2001a, p. 1-5).
- The site is located in a rural area with few residences nearby (SMUD 2001a, p. 8.4-11).
- The project uses would be consistent with neighboring utility uses, and would be consistent with the original intended (and zoned) use of the site (i.e., power generation (SMUD 2001a, p. 8.4-15).
- The site’s General Plan designation is for Public/Quasi-Public, consistent with a generating facility (SMUD 2001a, p. 8.4-6).

Based on analysis of SMUD’s Application for Certification (AFC), the Energy Commission staff has determined the project’s objectives as:

- Generation of approximately 1,000 MW of electricity in a location that can serve SMUD’s service area, particularly during peak demand periods;
- Commercial operation of 500 MW by the first quarter of 2005, and an additional 500 MW by the first quarter of 2008; and
- Location where sufficient land (a minimum of 30 acres) and infrastructure are available.

POTENTIAL SIGNIFICANT ENVIRONMENTAL IMPACTS

In this document, staff has identified the potential for significant environmental effects of the proposed project in the technical areas of air quality, biological resources, noise, and cultural resources.

Air Quality: There are four major air quality issues that could affect the licensing of the project:

1. The project may not meet the federal BACT requirements for NO_x, NH3, and CO emissions.
2. The project emissions have the potential to contribute to violations of the state and the federal 1-hour ozone air quality standards.
3. The project emissions have the potential to contribute to violations of the state 24-hour PM_{10} and the federal 24-hour $PM_{2.5}$ air quality standards.
4. The proposed emission reduction credits are not adequate to mitigate the project's potential significant ozone and PM_{10} impacts.

Additionally, the applicant needs written correspondence from the EPA and SMAQMD confirming the acceptability of the use inter-pollutant credits and compliance with regional and Federal standards and limits. An agreement from the applicant is also required to limit ammonia slips and sulfur compounds, provide NO_x, SO_x, and PM_{10} ERCs, and abide to additional construction mitigation measures identified in the staff assessment report. Staff will work with the EPA staff to resolve these issues prior to the issuance of the staff FSA (see the following Conclusions and Recommendations sections).

Biological Resources: The CPP has the potential to affect state- and federally- listed species and sensitive habitats at the power plant site, the construction laydown area, and along the project linears. Additionally, until coordination and review of biological project impacts are completed and approved by USFWS, NMFS, CDFG, and the County of Sacramento, the CPP will not be in compliance with LORS. Staff is particularly concerned over impacts to:

1. Vernal pool plants and invertebrates;
2. Fish and aquatic species in waterways;
3. Heritage trees;
4. Valley elderberry longhorn beetle;
5. Western spadefoot toad;
6. California tiger salamander;
7. Northwestern pond turtle;
8. Giant garter snake;
9. Swainson’s hawk;
10. Western burrowing owl; and

11. Migratory birds.

Noise: Most noise impacts can be mitigated to less than significant levels, with the exception of impacts on a residence approximately 800 feet from the proposed CPP site. The applicant is currently negotiating with the landowner to relocate the residence, but at this time, negotiations have not been finalized.

Cultural Resources: The proposed project linear facilities have the potential to impact two archaeological sites, two historic sites, and one newly discovered site that appears to have both a prehistoric and a historic component.

OUTSTANDING UNRESOLVED ISSUES

There are issues in a number of technical sections wherein staff needs additional information from the applicant to finalize impact conclusions. These issues are not considered to be significant environmental effects at this time. Although these issues are not fully resolved at this writing, staff expects that resolution will be reached by FSA publication. These issues are as follows:

Transmission System Engineering: Staff's preliminary analysis indicates that there are no significant system reliability criteria violations. However, due to the uncertainties associated with the status of other generation projects in the area, staff has not fully evaluated downstream impacts, transmission facilities, and/or mitigation measures required for the reliable operation of the electrical transmission system. Staff is concerned that SMUD's system impact study does not provide sufficient information to address contribution of the Cosumnes project to potential cumulative impacts in the Sacramento/Northern California areas. As such, staff is recommending the approval of only 500 MW of the proposed 1,000 MW CPP at this time. The impacts of the remaining 500 MW will be reviewed at a later time.

Water Resources: SMUD proposes to use a Zero Liquid Discharge (ZLD) system for the CPP. ZLD avoids a wastewater discharge to surface water and results in significant water savings over the original CPP proposal. The applicant has stated they will propose an alternative that additionally conserves or avoids the use of fresh water for the Phase 2 portion of the CPP. In addition, SMUD must provide a flood encroachment analysis, a flood analysis that includes the switchyard, and maps/drawings that clearly depict the designs of proposed conveyance features so that staff can complete the CPP project Final Staff Assessment.

SITE ALTERNATIVES

The applicant presented three sites (the Carson Ice-Gen Facility, the Procter & Gamble Site, and the Campbell Soup Site) in the AFC's Alternatives section (9.0). However, based on field reconnaissance of the sites and preliminary analysis of the comparative merits of these sites to the proposed CPP site, Energy Commission staff determined that two of the sites would have environmental impacts that are equal or greater than the CPP site. Therefore, these two sites have been eliminated from this analysis. For a discussion of the impact associated with these applicant proposed alternative sites, refer to the section entitled "Alternatives Eliminated From Detailed Analysis" (below). Energy Commission staff have identified two additional alternative sites (the Lodi Site and the Woodland Site). The following discussion includes an analysis of potential alternative sites as well as a discussion of the alternative sites eliminated from detailed evaluation.

SCREENING CRITERIA USED TO SELECT ALTERNATIVE SITES

The following criteria were used to identify potential alternative sites:

1. The site should avoid or substantially lessen one or more of the potential significant effects of the project;
2. The site should meet most of the project objectives;
3. The site should be vacant or have a reasonable potential to become vacant;
4. The site should not be located adjacent to moderate or high density residential areas, sensitive receptors (such as schools and hospitals), or recreation areas;
5. The site should not create significant impacts of its own.

Three alternative sites are evaluated in detail: Carson Ice-Generation Site, Lodi Site, and Woodland Site. Please see **Alternatives Figures 1, 2, and 3** for maps of these three sites. Following is a description of each site and a discussion of its potential environmental impacts.

CARSON ICE-GENERATION SITE

The Carson Ice-Generation site (recommended as an alternative in the AFC) is a 55-acre site that is currently managed in accordance with the policies of the Sacramento Regional Wastewater Treatment Plant's (SRWTP) Bufferlands. The Sacramento Regional County Sanitation District (SRCSD) set aside 2,500 acres in the 1970s to serve as a buffer between the SRWTP and surrounding neighborhoods in southern Sacramento County. The site is located at 8521 Laguna Station Road in Elk Grove (refer to **Alternatives Figure 1**), approximately 20 miles northwest of the CPP site. The SRWTP evaporation ponds are to the west of the alternative site, the Carson Ice-Generation facility is adjacent to the site to the north, and the Bufferlands are to the south and to the east of the site, beyond the Union Pacific Railroad. A majority of the parcel is currently used for agriculture (SRCSD 2002a).

Although there are no current plans, the SRCSD would like to reserve a 55-acre area for part of its planned expansion zone (SRCSD 2002a). If the SRWTP does not expand on to the site, the parcel would become a permanent part of the Bufferlands. Since the parcel is currently being managed as part of the Bufferlands, construction of a power plant is not consistent with the County's management policy for the Bufferlands, which discourages the conversion of agricultural land or open space to permanent structures (SRCSD 2002a).

The parcel is potential habitat for Swainson's hawk (State-listed threatened species) and burrowing owl (federal and State-listed species of concern) (SRCSD 2002a). There are known Swainson's hawk nests within one-quarter mile of the site; therefore, the site is likely to be within their foraging area (SRCSD 2002a). Along the southern boundary of the parcel there is a perennially wet drainage ditch, which is potential habitat for giant garter snake, a federally-listed endangered species.

The nearest residences are found in large housing developments located less than one mile to the east, north, and south of the site (SMUD 2001a). The homes closest to the SRWTP property would likely have views of the power plant (in addition to existing views of the SRWTP, the Carson Ice-Generation facility, and other existing infrastructure).

In summer 2002, the SRWTP expects to begin operation of a five million gallon-per-day (gpd) water recycling facility (SMUD 2002n). An EIR was approved to allow the facility to produce an additional 5 million gpd, although a construction date has not been set.

With the expanded recycled water facility, sufficient recycled water would be available to operate a power plant at this site (SRCSD 2002b). Since the SRWTP is adjacent to the site, installation of a short water pipeline would be required.

The site is adjacent to SMUD's existing natural gas line that terminates at the Carson Ice-Generation facility and connects to PG&E's Line 400 and 401 near Winters, California. Construction of a natural gas pipeline less than one-quarter mile in length would be required to connect to the existing line.

Since the existing transmission lines that connect to the Carson Ice-Generation facility are 69 kV, a new transmission line would have to be constructed to connect to SMUD's existing 230 kV lines that run north to south, east of the City of Elk Grove and parallel to Waterman Road, approximately 6.5 miles from the site. Due to the significant amount of residential development in the area, the new transmission line connection would likely be significantly longer than 6.5 miles in length. Although staff believes that it is feasible to build transmission facilities from the Carson Ice-Generation site to connect to the SMUD 230 kV system corridor, significant problems routing a 230 kV transmission line through the City of Elk Grove are anticipated. A 230 kV switching station to connect to multiple 230 kV lines at the interconnection point would be required. A system impact study would need to be performed to confirm the technical and economic feasibility of such a connection. However, transmission costs to inject 1,000 MW into the SMUD system from the Carson Ice-Generation site appear significantly greater than from the proposed CPP site.

The advantages and disadvantages of the Carson Ice-Generation site in comparison to the CPP are listed below.

Advantages

- **Infrastructure and Construction Access**: Natural gas and recycled water are available on the Carson Ice-Generation site. Since there are existing industrial facilities adjacent to the site and it is bounded by major roads, there is adequate access for heavy load trucks during power plant construction. Therefore, this site would eliminate the construction of a 26-mile natural gas pipeline and construction of a construction access road.

- **Cultural Resources**: Elimination of the 26-mile natural gas pipeline would reduce the potential for impacts on cultural resource sites.
- **Biological Resources**: Elimination of the 26-mile natural gas pipeline would also reduce the degree of impacts to Laguna Stone Lake Preserve, wetland features, aquatic species in waterways, valley elderberry longhorn beetle, burrowing owls, Swainson's hawks, giant garter snakes, heritage trees, and a wide variety of other species and habitats.
- **Water Resources**: The project would use available recycled water from the Sacramento Regional Wastewater Treatment Plant. Therefore, this site would eliminate the proposed use of fresh inland water from the Folsom-South Canal at the CPP.

Disadvantages

- **Biological Resources**: Even though the site would eliminate the need for a 26-mile natural gas pipeline, the site is still potential habitat for Swainson's hawk (State-listed threatened), burrowing owl (CDFG species of special concern), and giant garter snake (State and federal-listed threatened). In addition, there are known Swainson's hawk nests within close proximity to the site.
- **Visual Resources**: Even though the Carson Ice-Generation site is adjacent to existing industrial facilities, a power plant at the site would be within the viewshed of large residential developments to the south of the site where there is limited vegetative screening.
- **Land Use**: The parcel is reserved for future SRWTP expansion, and in the interim is being managed in accordance with the County's management policy for the Bufferlands. Therefore, construction of the power plant would conflict with future plans as well of as the Bufferlands' management policy. The Carson-Ice Generation's site proximity to the City of Elk Grove could create potential future impacts with the city's growth and expansion.
- **Transmission Access**: Construction of at least 6.5 miles of 230 kV transmission lines traversing the City of Elk Grove would be necessary. However, due to significant amounts of residential development in the area, this new transmission line connection could be very difficult, necessitating the determination of an alternate, and likely longer, route. A system impact study would need to be performed to confirm the technical and economic feasibility of such a connection. Additionally, a 230 kV switching station would need to be constructed to accommodate multiple 230 kV lines at the interconnection point.

LODI SITE

The Lodi Site was identified by staff and is a 32-acre site just west of Interstate 5 (I-5) and adjacent to the City of Lodi's White Slough Water Pollution Control Facility (WSWPCF) and the Northern California Power Authority's (NCPA) 50 MW Combustion Turbine No. 2 project. The City of Lodi owns approximately 1,000 acres in the area, 30 acres of which are used by the WSWPCF and 900 acres of which are leased to local farmers for agricultural uses. The WSWPCF is currently screened from views from I-5 and other roadways to the east by a row of mature trees along the plant's eastern boundary. These trees would also provide some screening for a power plant.

The site is located off of North Thornton Road, southwest of the City of Lodi, in San Joaquin County (refer to **Alternatives Figure 2**), approximately 30 miles southwest of the proposed CPP site. The site is zoned Public and currently used for agriculture. However, the City of Lodi is willing to negotiate other uses for the land (WSWPCF 2002).

This alternative site is just east of the NCPA plant and is accessible via existing paved roads. However, upgrades or reinforcement of the existing roads would likely be required to support heavy load trucks during construction. The site has very shallow groundwater and is at approximately zero feet of elevation. Therefore, it would require a substantial amount of dirt fill to raise the site above the 100-year floodplain (WSWPCF 2002).

A 20-acre parcel used for agriculture exists between the alternative site and the White Slough Wildlife Area (WSWA). The WSWA is under the jurisdiction of the California Department of Water Resources but is managed by the California Department of Fish Game. The WSWA land adjacent to the City of Lodi property line contains unconnected canal ponds that are frequented by recreational fishermen. In addition, the WSWPCF evaporation ponds are located just east of the site and are frequented by birdwatchers throughout the year because the ponds are heavily used by migratory waterfowl (WSWPCF 2002). The nearest residential receptors are more than a mile away, beyond the agricultural fields. As such, the nearest residential receptors likely would not be able to see or hear a new facility at this site, as its view would be screened by the existing industrial facilities, existing vegetation, and I-5.

Two existing 230 kV transmission lines running in a northwest to southeast direction cross the northeast corner of the Lodi Site. Both lines would be easily accessible to the power plant. The eastern-most line is a double-circuit transmission line owned by PG&E. The western-most line is a single-circuit transmission line owned by the Western Area Power Administration (WAPA). The plant could connect to either the PG&E or WAPA lines and transfer power to the SMUD system at the Elk Grove Substation, approximately 20 miles north of the Lodi Site.

There could be significant transmission constraints or other issues in dealing with PG&E, the ISO, and possibly WAPA in order to deliver power to the SMUD system. A system impact study would need to be performed to confirm technical and economic feasibility.

The existing natural gas pipeline that serves the NCPA facility and the WSWPCF does not have sufficient capacity to feed a 1,000 MW power plant. However, Lodi Gas Storage, LLC constructed a 30-inch natural gas pipeline as part of the Lodi Gas Storage Project approximately 2.5 miles north of the alternative site. Although Lodi Gas Storage, LLC is not a merchant, they do have available space in the pipeline for lease to transport natural gas to the site (LGS, 2002). A 24-inch pipeline would be installed from the site to the existing line under I-5 near Highway 12. PG&E Line 108 is approximately three and one-half miles east of the alternative site; however, the line would likely need to be reinforced to the serve a 1,000 MW power plant (PG&E 2002). Ground disturbance for construction of a natural gas transmission line to connect with Line 108 would increase the potential for impacts to archaeological and biological resources.

The WSWPCF could supply enough un-disinfected secondary-treated recycled water to meet CPP's needs. Currently, during summer months, recycled water is committed to agricultural use, but plant management indicated that this commitment of water could be changed to allow a power plant to use reclaimed water year-round. Water provision terms would need to be defined in agreements between the City of Lodi and a power plant developer (WSWPCF 2002).

The advantages and disadvantages of the Lodi Site in comparison to the CPP are listed below.

Advantages

- **Infrastructure:** Whether the Lodi Site utilized the Lodi Gas Storage, LLC or the PG&E pipeline options, available natural gas would be in close proximity to the Lodi Site, eliminating the need for a 26-mile natural gas pipeline. The WSWPCF has available reclaimed water.
- **Cultural Resources**: Elimination of the 26-mile natural gas pipeline would reduce the potential for impacts on cultural resource sites.
- **Biological Resources**: Elimination of the 26-mile natural gas pipeline would also reduce the degree of impacts to Laguna Stone Lake Preserve, wetland features, aquatic species in waterways, valley elderberry longhorn beetle, burrowing owls, Swainson's hawks, giant garter snakes, heritage trees, and a wide variety of other species and habitats.
- **Water Resources**: The project at this site would use recycled water from the City of Lodi's WSWPCF. Therefore, this site would eliminate the proposed use of fresh inland water from the Folsom-South Canal at the CPP.

Disadvantages

- **Construction Impacts:** The site has shallow groundwater and a high flooding potential; therefore, construction would require a substantial amount of fill to raise the site above the 100-year floodplain.
- **Visual Resources**: A power plant at this location would not likely be within the viewshed of residential receptors; however, a power plant may be potentially visible to motorists traveling on I-5 and recreationists (e.g., hunters, fishermen, birdwatchers) that frequent the WSWA and WSWPCF evaporation ponds. Therefore, visual resources is considered a slight disadvantage at the Lodi Site in comparison to the CPP site.
- **Transmission Access**: While there is enough transmission capacity to handle 1,000 MW, a 230 kV switching station would need to be constructed to accommodate multiple transmission lines and there could be transmission constraints and significant issues with PG&E, the ISO, and WAPA in order to deliver

power to the SMUD system. In addition, a system impact study would need to be performed to confirm technical and economic feasibility.

WOODLAND SITE

The Woodland Site was also identified by staff, and is located on a 40-acre site approximately one-half mile south of I-5 and approximately one mile east of County Road 102 (refer to **Alternatives Figure 3**). The site is over 50 miles northwest of the CPP site located off of Gibson Road, outside of the City of Woodland, in Yolo County. The Woodland Site is an unused parcel within the 2,500 acres owned by the City of Woodland, adjacent to the Water Pollution Control Facility (WPCF).

Although the site is located within the boundary of the WPCF and is accessible via existing paved roads, upgrades or reinforcement of the existing roads would likely be required to support heavy load trucks during construction. There is a high water table at the site, within a few feet of the surface (City of Woodland, 2001). The applicant would need to import fill to raise the site above the FEMA designated 100-year floodplain.

The site is zoned Open Space and is currently vacant. Agricultural land lies to the north, south, and east of the site. The land to the west is used for industrial treatment processing (City of Woodland, 2002).

The nearest residential sensitive receptor is a large residential development (Gibson Ranch) located approximately one mile west of the site, west of County Road 102.

There are 115 kV and 60 kV wood pole power lines along County Road 102, approximately one mile west of the site. There are also two 115 kV steel tower transmission lines at County Road 101, approximately 2.5 miles to the northwest. However, staff believes that none of these lines have the capacity to serve a 1,000 MW power plant nor are they connected to the SMUD transmission system. Therefore, a 230 kV transmission line would need to be constructed from the site directly east over the Sacramento River to the existing SMUD transmission system. The new transmission line would be approximately 14 miles in length and would connect to SMUD's 230 kV transmission lines that run in a north to south direction across Elkhorn Boulevard just west of the East Main Drainage, outside the community of Rio Linda.

PG&E's gas transmission Line 172 is located approximately one mile west of the Woodland Site at the intersection of County Road 102 and Gibson Road. There is sufficient available natural gas to support a 1,000 MW power plant (PG&E 2002). The applicant would need to construct a pipeline approximately one mile in length to connect with PG&E's Line 127.

The CPP requires approximately 9.6 million gpd for its proposed operation and the WPCF could meet these needs. The WPCF can provide 7 million gpd of recycled water and the City of Woodland is currently planning for expansion of the facility in the future (City of Woodland 2002).

The advantages and disadvantages of the Woodland Site in comparison to the CPP are listed below.

Advantages

- **Infrastructure**: Available natural gas is within one mile of the Woodland Site. The WPCF has available recycled water.
- **Cultural Resources**: Elimination of the 26-mile natural gas pipeline would reduce the potential for impacts on cultural resource sites.
- **Biological Resources**: Elimination of the 26-mile natural gas pipeline would also reduce the degree of impacts to Laguna Stone Lake Preserve, wetland features, aquatic species in waterways, valley elderberry longhorn beetle, burrowing owls, Swainson's hawks, giant garter snakes, heritage trees, and a wide variety of other species and habitats.
- **Water Resources**: The project would use recycled water from the City of Woodland's WPCF. Therefore, this site would eliminate the proposed use of fresh inland water from the Folsom-South Canal at the CPP.

Disadvantages

- **Visual Resources**: Even though the Woodland Site is adjacent to existing industrial facilities, a power plant at the site would be within and would alter the viewshed of a large residential development.
- **Transmission Access**: Construction of approximately 14 miles of 230 kV transmission lines could pose significant problems as the route would take the transmission line near the Sacramento Airport, across the Sacramento River, across an existing 500 kV line, and around several new residential developments. A new switching station would need to be constructed to accommodate the line. Additionally, the existing 230 kV line would need to be improved or the new transmission line would need to extend to the Elverta substation.
- **Construction Impacts**: The site has very shallow groundwater and a high flooding potential; therefore, construction would require a substantial amount of fill to raise the site above the 100-year floodplain.
- **Biological and Cultural Resources:** Since biological and cultural resources surveys have not been conducted for this alternative, there could be potentially significant impacts to these resources.

NO PROJECT ALTERNATIVE

CEQA Guidelines state that "the purpose of describing and analyzing a No Project Alternative is to allow decision makers to compare the impacts of approving the proposed project with the impacts of not approving the proposed project" (Cal. Code Regs., tit. §15126.6(i)). Toward that end, the No Project analysis considers "existing conditions" and "what would be reasonably expected to occur in the foreseeable future if the project were not approved…" (§15126.6(e)(2)).

The No Project Alternative assumes that the power plant will not be constructed. As a result, the proposed site would remain, at least temporarily, as annual grassland pasture, and the construction and operational impacts of the CPP would not occur.

However, SMUD would not be able to make use of land and infrastructure that was originally set aside for the purpose of generating the Sacramento area's energy needs. The applicant would not meet the objectives of the project, mainly to provide energy to the Sacramento area. Consequently, SMUD customers would have less total generating capacity and a less reliable and competitive electric system. SMUD may need to rely on outside sources of power, which could include the use of existing or other proposed power generation facilities that may have greater negative impacts on the environment.

ALTERNATIVES ELIMINATED FROM DETAILED ANALYSIS

This section describes alternatives that did not satisfy the screening criteria for inclusion in the more detailed analysis presented above, and include the following:

- Two alternative sites proposed by the applicant in the AFC (the Procter & Gamble Site and the Campbell Soup Site)
- Demand side management
- Distributed generation
- Renewable resources

Each of these alternatives, and the reasons for their not being considered in detail in this analysis, is addressed below.

SITE ALTERNATIVES ELIMINATED FROM THIS ANALYSIS

CEQA guidelines state that the alternatives discussion need not consider alternatives that are either infeasible or do not avoid significant environmental impacts. The following sections define other sites that were considered as alternatives to the CPP project and the reasons for their elimination from further consideration.

Proctor & Gamble Site

The Proctor & Gamble Site is located in the City of Sacramento, approximately 20 miles north of the proposed site. The site is bordered by the Procter & Gamble manufacturing plant to the south, the existing SMUD Ice-Generation facility to the east, and the Union Pacific Railroad to the west. The applicant identified the Proctor & Gamble Site (Site 2) in the Alternatives section of the AFC (SMUD 2001a, p. 9-1). The site is vacant land, less than five acres in size, and zoned for industrial use. Both transmission capacity and gas supply are available; however, substantial upgrades to increase the capacity of these utilities would likely be required (SMUD 2001a, p. 9-4). This site was eliminated because less than five acres is not sufficient land area to support a 1,000 MW facility.

Campbell Soup Site

The Campbell Soup Site is located in the City of Sacramento, approximately 15 miles north of the proposed site. The alternative site is adjacent to the SMUD cogeneration facility on Franklin Boulevard and 47th Avenue. The applicant identified the Campbell Soup Site (Site 3) in the Alternatives section of the AFC (SMUD 2001, p. 9-1). The site is less than 10 acres in size and the vacant land is zoned for industrial use. Both transmission capacity and gas supply are available; however, substantial upgrades to increase the capacity of these utilities would likely be required (SMUD 2001a, p. 9-4).

This site was eliminated because less than 10 acres is not sufficient land area to support a 1,000 MW facility.

TECHNOLOGY ALTERNATIVES

Conservation and Demand Side Management

One alternative to a power generation project could consist of a program or programs to reduce energy consumption; the Warren-Alquist Act specifically prohibits the Energy Commission from considering conservation programs as alternatives to a proposed generation project (Pub. Resources Code, Section 25305(c)). This section was adopted because at the time, the approximate effect of such programs was accounted for in the Energy Commission's "integrated assessment of need," with which all projects licensed by the Energy Commission were required to be consistent with. The Warren-Alquist Act was amended in 1999 to delete the requirement that the Energy Commission find that power plant licensing projects be in conformity with the integrated assessment of need.

In spite of the state's success in reducing demand in 2001, California continues to grow and overall demand is increasing. The 2002-2012 Electricity Outlook Report (CEC 2002a) concludes that, despite exceptional conservation efforts in 2001, voluntary demand reduction will likely decrease over time.

While conservation and demand reduction programs are not considered as alternatives to a proposed project, the Energy Commission is responsible for several such programs, most notably the energy efficiency standards for new buildings and for major appliances. These programs are typically called "energy efficiency," "conservation," or "demand side management" programs. One goal of these programs is to reduce overall electricity use; some programs also aim to shift such energy use to off-peak periods.

The Energy Commission's Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24, Part 6) were established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow consideration and possible incorporation of new energy efficiency technologies and methods. The Energy Commission adopted new standards in 2001, as mandated by Assembly Bill 970 to reduce California's electricity demand. The new standards went into effect on June 1, 2001. Since 1975, the displaced peak demand from these conservation efforts has amounted to roughly the equivalent of eighteen 500 MW power plants. The annual impact of building and appliance standards has increased steadily, from 600 MW in 1980 to 5,400 MW in 2000, as more buildings and homes are built under increasingly efficient standards (CEC 2002a).

After the California Independent System Operator (Cal-ISO) ordered rolling blackouts in January 2001 as a result of statewide electricity shortages, conservation efforts initially resulted in dramatic reductions in electricity use. Electricity use for each month in 2001 ranged from 5 percent to 12 percent less than it was in 2000. However, in 2002 demand has been increasing as the memories of rolling blackouts fade.

The California Public Utilities Commission supervises various demand side management programs administered by the regulated utilities, and many municipal electric utilities have their own demand side management programs. The combination of these programs constitutes the most ambitious overall approach to reducing electricity demand administered by any state in the nation.

The Energy Commission is also responsible for determining what the state's energy needs are in the future, using five and 12 year forecasts of both energy supply and demand. The Energy Commission calculates the energy use reduction measures discussed above into these forecasts when determining what future electricity needs are, and how much additional generation will be necessary to satisfy the state's needs.

Having considered all of the demand side management that is "reasonably expected to occur" in its forecasts, the Energy Commission then determines how much electricity is needed. The most recent estimation of electricity needs is found in the 2002-2012 Electricity Outlook Report (available on the Energy Commission's website).

GENERATION TECHNOLOGY ALTERNATIVES

Staff considered several alternative generation technologies that do not burn fossil fuels: solar, wind, biomass, geothermal, and hydropower.

Solar Generation

Currently, there are two types of solar generation available: solar thermal power and photovoltaic (PV) power generation.

Solar thermal power generation uses high temperature solar collectors to convert the sun's radiation into heat energy, which is then used to run steam power systems. Solar thermal is suitable for distributed or centralized generation, but requires far more area than conventional plants. Solar parabolic trough systems, for instance, use approximately five acres to generate one MW.

Photovoltaic (PV) power generation uses special semiconductor panels to directly convert sunlight into electricity. Arrays built from the panels can be mounted on the ground or on buildings, where they can also serve as roofing material. Unless PV systems are constructed as integral parts of buildings, the most efficient PV systems require about four acres of ground area per MW of generation.

SMUD began installing solar PV plants at the Rancho Seco Site in the 1980s (SMUD 2002o). The first one MW plant was installed in 1984 and a second one MW plant was installed in 1986. Each plant occupies approximately 10 acres. Two smaller units that generate 218 kW and 128 kW were installed in 1995, and an additional 750 kW unit was installed in 2001 and will be online shortly. The two smaller units occupy between one and two acres total, and the 750 kW unit occupies approximately 15 acres.

In addition to the solar PV plants at the Rancho Seco Site, SMUD supports the installation of PV systems at other SMUD-owned property, and on residential and commercial buildings through its Solar Program. In total, SMUD has installed approximately 10 MW in solar facilities (SMUD 2002o).

Solar resources would require large land areas in order to meet the project objective of generating 1,000 MW of electricity (or 500 MW for Phase 1 of the CPP). For example, assuming that a parabolic trough system was located in a maximum solar exposure area, such as in a desert region, generation of 1,000 MW would require 5,000 acres, or over 165 times the amount of land area required by the proposed plant and linear facilities. For 500 MW of output, these numbers would be reduced to 2,500 acres of land area, or about 83 times the land area required for the proposed CPP. For a PV plant, depending on the efficiency of the system, generation of 1,000 MW would require between 4,000 and 10,000 acres, or between 133 and 333 times the amount of land area required by the proposed plant and linear facilities. Land area for 500 MW of output would be between approximately 2,000 and 4,000 acres, or between 67 and 133 times the amount of land required by the proposed CPP.

While solar generation facilities do not generate problematic air emissions and have relatively low water requirements, there are other potential impacts associated with their use. Construction of solar thermal plants lead to potential habitat destruction. PV systems can have negative visual impacts, especially if ground-mounted. Furthermore, the manufacturing of PV panels generates some hazardous wastes.

Both solar thermal and PV facilities generate power during peak usage periods since they collect the sun's radiation during daylight hours. However, even though the use of solar technology may be appropriate for some peaker plants, their failure to provide reliably available power due to the intermittent nature of the power makes solar technology unsuitable for peak demand applications. Therefore, solar thermal power and photovoltaic power generation would not successfully meet the project objectives of providing electricity during peak demand.

Wind Generation

Wind carries kinetic energy that can be utilized to spin the blades of a wind turbine rotor and an electrical generator, which then feeds alternating current (AC) into the utility grid. Most state-of-the-art wind turbines operating today convert 35 to 40 percent of the wind's kinetic energy into electricity. Modern wind turbines represent viable alternatives to large power fossil power plants as well as to small-scale distributed systems. The range of capacity for an individual wind turbine today ranges from 400 watts up to 3.6 MW. California's 1,700 MW of wind power represents 1.5 percent of the state's electrical capacity.

Although air emissions are significantly reduced or eliminated with wind facilities, they can have significant visual effects and wind turbines also cause bird mortality (especially for raptors) resulting from collision with rotating blades.

Wind resources would require large land areas in order to generate 1,000 MW of electricity. Depending on the size of the wind turbines, wind generation "farms" generally can require between five and 17 acres to generate one megawatt (resulting in the need for between 5,000 and 17,000 acres to generate 1,000 MW, or 2,500 and 8,500 acres to generate 500 MW) (CEC 2001b). Although 7,000 MW of new power wind capacity could cost-effectively be added to California's power supply, the lack of available transmission access is an important barrier to wind power development (Beck

2001). California has a diversity of existing and potential wind resource regions that are near load centers such as San Francisco, Los Angeles, San Diego, and Sacramento (CEC 2001c). However, wind energy technologies cannot provide reliably available power for peak demand due to the natural intermittent availability of wind resources, and therefore would not successfully meet the project objectives of providing electricity during peak demand.

Biomass Generation

Biomass generation uses a waste vegetation fuel source such as wood chips (the preferred source) or agricultural waste. The fuel is burned to generate steam. Biomass facilities generate substantially greater quantities of air pollutant emissions than natural gas burning facilities. In addition, biomass plants are typically sized to generate less than 20 MW, which is substantially less than the capacity of the proposed 1,000 MW CPP project. Although at the peak of biomass industry, 66 biomass plants were in operation in California. Currently, there are about 30 direct-combustion biomass facilities in operation (CEC 2001d).

In order to generate 1,000 MW, which is proposed for the CPP, fifty 20 MW biomass facilities would be required or twenty-five 20 MW biomass facilities to generate 500 MW. However, these power plants would have potentially significant environmental impacts of their own, such as the emission of harmful by-products from combustion and secondary chemical reactions.

Geothermal

Geothermal technologies use steam or high-temperature water (HTW) obtained from naturally occurring geothermal reservoirs to drive steam turbine/generators. There are vapor-dominated resources (dry, super-heated steam) and liquid-dominated resources where various techniques are utilized to extract energy from the HTW. Geothermal is a commercially available technology, but it is limited to areas where geologic conditions result in high subsurface temperatures. Although geothermal resources do exist in California, there are no viable geothermal resources in the Sacramento County region (CEC 2001e).

Hydropower

While hydropower does not require burning fossil fuels and may be available to the Sacramento region, this power source can cause significant environmental impacts primarily due to the inundation of many acres of potentially valuable habitat and the interference with fish movements during their life cycles. As a result of these impacts, it is extremely unlikely that new hydropower facilities could be developed and permitted in the Sacramento region within the next several years.

Conclusion Regarding Alternative Technologies

Alternative generation typically provides lower efficiencies, has specific resource needs, environmental impacts, permitting difficulties, and intermittent availability. Therefore, they do not fulfill a basic objective of this plant: which is to provide reliable baseload and peaking power in order to ensure reliability for electricity in the Sacramento area and throughout California. Consequently, staff does not believe that these renewable technologies present feasible alternatives to the proposed project.

CONCLUSIONS

Staff does not believe that alternative technologies (geothermal, solar, wind, biomass, and hydroelectric) present feasible alternatives to a 1,000 MW power plant. While the No Project Alternative would eliminate all impacts of this project, the objective of increasing SMUD baseload and peaking generation in the Sacramento region would not be achieved.

All three alternative sites are located adjacent to wastewater treatment facilities that can provide recycled water to the plant. The use of recycled water eliminates the use of fresh inland water from the Folsom-South Canal. In addition, the sites are located within close proximity to existing and accessible natural gas pipelines. Easy access to nearby pipelines eliminate the need to construct the new, 26-mile natural gas pipeline associated with the CCP site, which in turn would reduce the biological and cultural resource impacts. The Lodi Site is the most isolated, followed by the Woodland Site, and the Carson Ice-Generation Site. Both the Woodland and Carson Ice-Generation sites have sensitive receptors within one mile of the sites, which could create potential visual, air quality, and public health impacts. In addition, the Woodland and Carson Ice-Generation Sites would require the construction of 230 kV transmission lines and switching stations to connect with the SMUD system and the Woodland Site would possibly need to upgrade its existing transmission lines. The Lodi Site would also require the construction of a new switching station. The Carson Ice-Generation Site is within the Bufferlands of the SRCSD, which consists of 2,500 acres of wetlands, grasslands, and riparian forest habitats. The Bufferlands offers habitat for a variety of threatened- and special-status species, some of which have potential habitat on the Carson Ice-Generation Site.

Overall, the three site alternatives considered in this section offer some advantages and disadvantages in comparison to the proposed project. However, none of the alternative sites appear to reduce the potentially significant adverse impacts of the project without causing additional potentially significant impacts themselves.

REFERENCES

CEC (California Energy Commission). 2001a. Peaking Unit Site Investigation for the California Energy Commission: Site #48, Pleasant Valley State Prison.

____. 2001b. Internet Website at http://www.energy.ca.gov/wind/overview.html.

____. 2001c. Internet Website at http://www.energy.ca.gov/maps/windmap.html

____. 2001d. Internet Website at http://38.144.192.166/development/biomass/biomass.html.

____. 2001e. Internet Website at http://www.energy.ca.gov/maps/geothermal_map.html.

____. 2002a. Internet Website at http://www.energy.ca.gov/electricity_outlook/index.html.

City of Woodland. 2001. Personal communication with Larry Harrison and Chris Stabenfeldt (North State Resources) with Sherri Martin, Management Analyst for the Department of Public Works, Gary Wegener, Engineer for the Department of Public Works, and Roy Wilson, Water Pollution Control Facility Manager, May 31, 2001.

____. 2002. Personal communication by Valerie L. Starr (Aspen Environmental Group) with Sherri Martin, Management Analyst for the Department of Public Works, April 24, 2002.

LGS (Lodi Gas & Storage, LLC). 2002. Personal communication by Valerie L. Starr (Aspen Environmental Group) with Kevin O'Toole, Vice President of Hub Services, April 16.

PG&E (Pacific Gas & Electric Company). 2002. Personal communication by Valerie L. Starr (Aspen Environmental Group) with Darren Jones, PG&E, Consulting Gas Transmission Engineer, April 23, 2002.

SMUD (Sacramento Municipal Utility District) 2001a. Application for Certification, Volumes 1 and 2 (01-AFC-19). Submitted to the California Energy Commission on September 13, 2001. Docket date September 13, 2001.

____. 2002a. Data Response, Set 1A. January 9, 2002. Docket date January 9, 2002.

____. 2002o. Personal communication by Valerie L. Starr (Aspen Environmental Group) with Dave Collier, SMUD PV Program, April 4, 2002.

SRCSD (Sacramento Regional County Sanitation District) 2002a. Personal communication by Valerie L. Starr (Aspen Environmental Group) with Bryan

Young, Sacramento Regional Wastewater Treatment Plan Bufferlands, Natural Resource Supervisor, April 16.

____. 2002b. Personal communication by Greg Peterson with Ruben Robles, Water Recycling Program Manager, April 11.

WSWPCF (White Slough Water Pollution Control Facility). 2002. Personal communication by Valerie L. Starr (Aspen Environmental Group) with Del Kerlin, Site Manager, City of Lodi White Slough Water Pollution Control Facility. April 10, 2002.

APPENDIX A TO WATER AND SOIL RESOURCES
SMUD COSUMNES POWER PLANT
WATER SUPPLY AND COOLING OPTIONS

Susan V. Lee, James Schoonmaker, and Greg Peterson

1. INTRODUCTION

PURPOSE OF REPORT

As originally proposed, the Cosumnes Power Plant (CPP; 01-AFC-19) would use large quantities of fresh inland water from the American River (delivered through the Folsom South Canal) for cooling. Approximately 8,000 acre-feet of water per year (AFY) or 5,158 gallons per minute (gpm) would be used for the proposed 1,000 megawatt (MW) facility. That water would be concentrated through evaporation, then mixed with process wastewater and discharged into surface waters at Clay Creek on the SMUD property. Shortly before publication of this Staff Assessment, SMUD submitted to the Energy Commission a proposal in which a zero liquid discharge (ZLD) system would be used (SMUD, 2002a). This system would reduce water demand to approximately 5,300 AFY per year and eliminate the surface water discharge. However, this report was prepared before staff had an opportunity to evaluate the details of the ZLD proposal. Therefore, this Appendix still evaluates ZLD options and presumes discharge of process water into Clay Creek.

This analysis of cooling options for the CPP was undertaken for the following reasons: to consider alternate cooling processes, to evaluate other sources of cooling water, to consider elimination of effluent discharge to surface waters, and to discuss the feasibility of these options. Each of these issues is summarized below.

Combined-cycle plants require less cooling than traditional fossil or nuclear steam power plants because only about 45 percent (instead of 100 percent) of the electricity is generated from the steam cycle. Limited water availability in some locations and potential environmental impacts associated with the use of seawater, river water, and inland surface water for power plant cooling have led power plant designers to develop a range of alternate cooling systems that use less water. Alternate cooling processes have seen a steady increase in use and are now well proven processes. This report evaluates the use of hybrid cooling and dry cooling at the CPP.

APPLICANT'S COOLING OPTIONS ANALYSIS

In Data Response Set 1E (SMUD, 2002i), SMUD submitted a 30-page report considering the following options in comparison to the proposed project's wet cooling tower system with discharge of treated wastewater into Clay Creek:

- Dry Cooling: two separate air-cooled condensers (ACCs) are proposed, one adjacent to each of the steam turbines.

- Hybrid Cooling: a parallel condensing system is analyzed, which would require both a wet cooling tower and a smaller ACC than that used in dry cooling alone.
- Reclaimed Water: reclaimed water from the Sacramento Regional Wastewater Treatment Plant (Sac Reg) or Galt is considered.
- Brackish Water: cooling water from the Delta (near Antioch) is considered.
- Groundwater: pumping of groundwater for cooling is briefly considered but eliminated due to regional groundwater overdraft situation
- Wastewater Zero-Liquid Discharge

The analysis concludes that a recirculating wet cooling system is "by far, the least expensive cooling system analyzed, yet it still preserves balance among all natural resources." Therefore, it concludes that the proposed system "is the best choice for the environment, the region, SMUD's customer-owners, and CPP." Staff's assessment f the applicant's cooling analysis is presented in later sections of this report.

OPTIONS CONSIDERED IN THIS REPORT

This report provides information for the Energy Commission's impact analysis This analysis evaluates two different cooling options: dry cooling and hybrid (wet/dry) cooling. It also considers three potential sources of recycled water: the Sacramento Regional Wastewater Treatment Plant, the City of Galt, and the City of Lodi. In addition, this report evaluates two zero liquid discharge (ZLD) processes that would eliminate surface discharge by concentrating cooling tower blowdown and other wastestreams into dry crystalline solids, suitable for offsite disposal.

Appendix A Table 1 is a summary of the cooling process, water supply, and discharge options that are addressed. Since each option in one column can be combined with an option in any other column, there is a wide range of possible combinations.[1]

Appendix A Table 1
Summary of Cooling Process, Water Supply, and Discharge Options

Cooling Process Options	Water Supply Options	Discharge Options
Wet cooling (proposed)	Folsom South Canal (inland surface water – proposed)	Surface discharge (Clay Creek – originally proposed)
Dry cooling		
Hybrid (wet/dry) cooling	Recycled water (3 alternate sources)	Zero liquid discharge (2 process options)

[1] This report does not consider the cumulative impacts resulting from implementation of more than one of the options described here. Such impacts might be most likely to occur in the areas of biological and water resources; these would be evaluated in the event that any of these options are formally proposed by the applicant.

ROLES OF THE ENERGY COMMISSION AND THE REGIONAL WATER QUALITY CONTROL BOARD

The Energy Commission is the Lead Agency for the proposed CPP project under CEQA. As part of the licensing process, the Energy Commission evaluates the potential environmental impacts of the proposed project and considers feasible mitigation including project alternatives if significant impacts are identified. The Warren-Alquist Act, the Energy Commission's enabling legislation, also requires an assessment of compliance with laws, ordinances, regulations, and standards (LORS).

The CPP requires a National Pollutant Discharge Elimination System (NPDES) Permit for wastewater discharge from the RWQCB. The RWQCB has requested that during the licensing process for CPP, the Energy Commission consider feasible cooling and discharge alternatives that reduce the use of high-quality inland surface water and reduce or eliminate wastewater discharge (RWQCB, 2002). This information will be considered by the RWQCB as it develops its draft NPDES Permit.

REPORT CONTENTS

This report consists of seven sections, followed by a list of references.

1. Introduction

Section 1 describes the purpose of the report, the cooling options reviewed and other report contents, the roles of the Energy Commission, the SWRCB, and the RWQCB.

2. Overview of Water Supply and Cooling Options Considered

Section 2 provides an overview of the proposed water supply and cooling technology for the CPP and the cooling technologies considered in this report: dry cooling, wet cooling, hybrid cooling, and the use of recycled water for power plant cooling. It describes the basic cooling technologies and how they work, where the technologies are currently used, and the advantages and disadvantages of each.

3. Conceptual Design of Cooling Options for the CPP

Section 3 describes potential designs for dry and hybrid cooling systems at the CPP, and the approximate costs for each.

4. Municipal and Industrial Wastewater Sources for CPP Cooling

Section 4 describes availability of wastewater from nearby water treatment plants and from industrial sources including Aerojet's groundwater treatment system and water now used at the Rancho Seco nuclear plant. Potential water transport routes are defined and approximate costs are presented.

5. Conceptual Design of Zero Liquid Discharge Systems at CPP

Section 5 presents a description of how two different ZLD systems would work at the SMUD site and illustrates potential site designs. This section also describes the ZLD process, the process for the disposal of solids, and the approximate cost of the systems described.

6. Environmental and Engineering Analysis

Section 6 analyzes the environmental and engineering effects of the cooling, water supply, and ZLD system options for each of the technical issue areas that would be substantially affected (e.g., air quality, aquatic biology, visual, etc.).

7. Conclusions

This section presents overall conclusions about the options evaluated in this Appendix.

2. BACKGROUND ON WATER SUPPLY AND COOLING OPTIONS

2.1 POWER PLANT OPERATION AND COOLING

The proposed CPP would consist of a nominal 1,000-megawatt combined-cycle natural gas facility. The CPP would be constructed in two phases, each phase consisting of 500 MW. At this time, it is uncertain when Phase 2 would be constructed. The SMUD Board of Directors is expected to decide in 2003 if and when Phase 2 will be required or pursued. Each phase would consist of two combustion turbines, two heat recovery steam generators, and one condensing steam turbine.

Thermal power plants convert fuel (such as natural gas) to electrical power and waste heat. In combustion turbines, or Brayton cycles, almost all the waste heat is rejected in the exhaust gases. In steam turbines, or Rankine cycles, waste heat is rejected in the flue gases and in the condenser/cooling system. The steam turbines require cooling for efficient power generation. Operation of a cooling system for steam turbines serves three purposes: (1) condensing steam into water to allow pumping of a liquid instead of compressing a gas; (2) recycling of the water back to the boiler to optimize water use; and (3) minimizing the steam turbine exhaust temperature to maximize the output of the steam turbine. The temperature of the heat sink and the heat transfer efficiency of the cooling system affect the overall plant performance. In the case of the CPP, the proposed cooling medium (or heat sink) is fresh inland water.

Combined-cycle plants require less cooling than traditional fossil fuel or nuclear steam power plants because only part of the electricity is generated from the steam cycle. In the case of the proposed CPP, of the 1,000 MW produced, about 450 MW would be produced by the steam cycles of Phases 1 and 2. Combustion (gas) turbines in a combined-cycle plant generate the remaining 550 MW and do not need water for cooling.

Environmental impacts associated with the use of coastal and inland surface water for power plant cooling and wastewater discharge to surface waters have led power plant designers to develop cooling systems that reduce or eliminate the need for cooling water. This section describes three general cooling technologies: dry cooling, hybrid cooling, and wet cooling systems. For each of the cooling technologies, this section provides general background information, conceptual design information, and discusses possible environmental effects of the cooling technologies. In addition, this section describes using recycled water instead of fresh water for cooling and the ZLD system.

2.2 DRY COOLING SYSTEMS

Description of the Process and Equipment Required

There are two types of dry cooling systems: direct dry cooling and the lesser used indirect dry cooling. In both systems, fans blow air over a radiator system to remove heat from the system. In the direct dry cooling system, also known as an air-cooled condenser (ACC), steam from the steam turbine exhausts directly to a manifold radiator system that rejects heat to the atmosphere, condensing the steam inside the radiator. This process is illustrated in **Appendix A Figure 1** (at the end of this Appendix). Direct dry cooling is the option considered for CPP in this report.

Indirect dry cooling uses a secondary working fluid (in a closed cycle with no fluid loss) to help remove the heat from the steam. The secondary working fluid extracts heat from the surface condenser and is transported to a radiator system that is dry cooled (fans blow air through the radiator to remove heat from the working fluid). Because indirect dry cooling is not very common and does not appear to have any strategic advantages at the CPP, it was not analyzed in this report.

Historic, Current, and Proposed Use of Dry Cooling

Dry cooling was first used in 1938 for a vacuum steam turbine installed in a power plant in Germany (Guyer, 1991). By 1971, 14 power plants worldwide had been equipped with condensers for direct dry cooling. The largest installation at that time was a roof-mounted unit for a 160 MW power plant in Utrillas, Spain. By 1991, dry cooling was being used at approximately 40 power plants worldwide with generating capacities greater than 100 MW. Since that time, use of dry cooling has increased significantly around the world and in the United States (Guyer, 1991; EPA, 2001; Maulbetsch, 2001).

The largest dry-cooled system in the world today is the Matimba plant in South Africa, which began operating in 1991. It represented a major scale-up of dry-cooled technology, using direct dry cooling for six 660 MW units, totaling 3,960 MW.

The Sutter Power Plant, one of the newest power plants in California (on-line in 2001) was constructed as a dry-cooled facility. This plant was constructed by Calpine Corporation and is a 540 MW, natural gas-fired, combined-cycle facility. The Sutter combined-cycle design consists of two combustion turbine generators (CTGs), two heat recovery steam generators (HRSGs) with duct burners, and a steam turbine generator (STG). The Sutter Power Plant uses a 100 percent dry cooling design that reduces groundwater use by over 95 percent from the original proposal of 3,000 gallons per minute (gpm) to a revised annual average of less than 140 gpm. The five percent of the water that is used represents the makeup for the steam cycle, which is not used for cooling. The dry cooled plant is also a zero effluent discharge facility and does not discharge any process fluids.

The Energy Commission also permitted the Crockett Cogeneration Plant, a 240 MW facility with dry cooling in Crockett, which went on-line in 1995. The plant uses 12 fans to cool the steam output from the 80 MW steam turbine. Energy Commission staff visited the facility in June 2000 and found the dry cooling to be operating as expected, with no major problems. The Energy Commission also permitted the Otay Mesa facility in 2001, a 510 MW combined-cycle facility in San Diego County.

Dry cooling is also becoming a common technology for power plants in Nevada, such as the El Dorado Energy Project, which is an air-cooled 480 MW combined-cycle facility located in Boulder City, Nevada. Two other combined-cycle air-cooled power plants are currently under construction in Nevada: the Duke Energy 1,200 MW Moapa Energy Facility (approximately 20 miles northeast of Las Vegas in Apex Industrial Park) and the 575 MW Big Horn Power Plant (in Primm, approximately 55 miles southwest of Las Vegas). In addition, there are four combined-cycle dry-cooled power plants proposed to be constructed in Nevada. These facilities include: Apex Generating Station (1,100 MW), Arrow Canyon (575 MW), and Silver Hawk (570 MW) facilities at the Apex Industrial Park, and the Copper Mountain Power Facility (600 MW) in Boulder City.

Dry cooling is also considered to be a feasible technology by the New York Department of Environmental Conservation, which has recently required dry cooling to replace cooling systems with higher water demand.[2]

Energy Commission staff research indicates that the use of dry cooling technology is expanding rapidly, and the size of the plants using dry cooling is also increasing. It is estimated that 15 to 20 gigawatts (GW) of power generated worldwide use dry cooling.

Photos 1 and 2 (at the end of this Appendix following the figures) show examples of dry cooling installations.

Advantages and Disadvantages of Dry Cooling

Dry cooling conserves water and minimizes wastewater. However, this technology can raise environmental and economic issues, depending on the location and specific situation (these are reviewed specifically for the CPP site in Section 6 of this report). The following is a general list of the advantages and disadvantages of dry cooling.

Advantages of Dry Cooling Systems

- Dry cooling is not water dependent. (Non-cooling water demand is about three percent of total water demand for a wet cooling facility, so plant location is less dependent on a water source. While dry cooling has minimal water intake and wastewater discharge requirements, a small amount of water for non-cooling purposes is still required.
- Dry cooling minimizes the use of water treatment chemicals.
- Dry cooling minimizes the generation of liquid and solid wastes.
- Dry cooling does not generate visible plumes that are commonly associated with wet cooling towers.

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[2] Once-through cooling has been used at coastal power plant sites where seawater is used once for cooling and then returned at higher temperatures to the ocean. Inland power plants using closed loop wet or hybrid cooling systems recirculate cooling water, using it several times prior to discharge.

- Dry cooling can eliminate the need for discharge permits and impacts to aquatic biological resources, and disturbance of wetland/aquatic substrate habitat associated with surface water discharge.

Disadvantages of Dry Cooling Systems

- Dry cooling requires air-cooled condensers, whose physical structures can have slightly greater visual effect than wet cooling structures. However, since there is no visible exhaust plume, the overall visual effect can be less.
- Dry cooling typically requires the disturbance of a larger surface area than is required for wet cooling towers due to the area required by the air-cooled condensers.
- Dry cooling can have greater noise impacts than wet cooling systems because of the number of fans and the considerably greater total airflow rate. Although quieter fans and other mitigation measures are available to mitigate these impacts.
- Dry cooling steam cycle efficiency and output can be slightly less than wet cooling, depending on site ambient climate conditions and seasonal variation. Extra power is needed to operate the additional cooling fans.
- Capital cost of air-cooled condensers is generally higher than wet cooling.

2.3 WET COOLING

Description of the Process and Equipment Required

Wet closed-loop cooling is the proposed cooling method for the CPP. Water would be used to remove waste heat from the system through cooling towers, and is then recirculated. In wet cooling systems, process heat is removed by evaporation each time the water is cycled through the system. **Appendix A Figure 2** shows how a typical wet cooling system operates (see end of this Appendix).

The cooling system must be replenished with "makeup water" to replace water "lost" (or consumed) to evaporation, blowdown[3], and drift. The cooling system takes advantage of evaporation to remove heat, but cooling system water is consumed through evaporation, and evaporation increases the concentration of impurities. Blowdown volumes are dependent on the quality of the makeup water, and the accumulation of impurities in the cooling water loop. **Photo 3** (see end of this Appendix) shows two mechanical draft wet cooling towers.

Current Uses of Wet Cooling

Wet cooling is one of the most common cooling technologies used in the world. Wet cooling towers used by U.S. industries remove heat from approximately 500 billion gallons of water per day (Burger, 1994).

[3] Blowdown is the bleeding off of a small percentage of the total circulating water flow, while replacing it with new makeup water to maintain water quality. In this way, system water quality stays within specifications.

Advantages and Disadvantages of Wet Cooling

The following is a general list of the advantages and disadvantages of wet cooling.

Advantages of Wet Cooling Systems

- Capital costs for a wet cooling system are less than those of dry cooling.
- Wet cooling approaches "wet bulb"[4] temperatures, which equal or are lower than "dry bulb"[5] temperatures, thus improving cooling efficiency in comparison to dry cooling systems.
- Wet cooling can use low-quality recycled water, (e.g., from wastewater treatment plants), thereby avoiding the use of fresh water.

Disadvantages of Wet Cooling Systems

- Wet cooling requires a dependable source of water.
- Wet cooling requires more water than dry or hybrid cooling.
- Wet cooling requires raw water treatment to control concentrations of impurities in the cooling loop and wastewater discharge stream.
- Wet cooling can produce water vapor plumes that have negative aesthetic effects and which can increase the occurrence of ground fog during cool, calm, humid weather. Plume abatement technologies are available, although they are more expensive than systems without these features (but less expensive than dry cooling).

2.4 HYBRID (WET/DRY) COOLING

Description of the Process and Equipment Required

Hybrid cooling systems combine wet and dry cooling technologies to further reduce cooling water demand from that needed for closed-loop wet cooling. The two primary hybrid systems are water conservation and plume abatement designs. These hybrid systems can vary depending upon the unique situation and objectives (Burns and Micheletti, 2000).

Water conservation designs reduce water usage for plant cooling. Water is primarily used during the hottest periods of the year to reduce the losses in steam cycle capacity and plant efficiency that occur with all-dry systems. The hybrid water conservation systems can limit water use to only one to five percent of that required for all-wet systems while achieving substantial efficiency and capacity advantages during the peak load periods of hot weather. If additional water is available, it can be used to further increase plant efficiency.

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4 Wet bulb temperature accounts for the relative humidity in the air (the largest differences between wet and dry bulb temperatures would occur in very dry conditions).

5 Dry bulb temperature is the temperature indicated by an ordinary thermometer, that does not account for moisture in the air.

The most common type of hybrid system is the hybrid plume abatement system. Plume abatement towers are very similar to all-wet systems, but they also add a small amount of dry cooling to heat the saturated exhaust air from a wet cooling tower, thereby decreasing relative humidity and the visible tower exhaust vapor plume during cold, high-humidity days. **Appendix A Figure 3** (see end of this Appendix) shows the similarities between wet towers and hybrid plume abatement towers. On an annual basis, hybrid plume abatement towers use about five percent less water than wet cooling. Plume abatement towers achieve high plant efficiency similar to the wet towers, but with reduced visible plume and ground fog.

Current Use of Hybrid Cooling

Plume abatement hybrid towers have been used since the 1970s with proven reliability. The parallel condensing cooling systems (with both a wet tower and a dry cooling tower) have been used since at least the late 1980s. The Energy Commission recently approved the 500 MW Three Mountain Power facility with hybrid cooling, and other hybrid-cooled facilities are under consideration.

Advantages and Disadvantages of Hybrid Cooling

The following is a general list of the advantages and disadvantages of hybrid cooling.

Advantages of Hybrid Cooling Systems

- Hybrid systems can conserve 20 to 80 percent of the water consumed by wet towers.
- Parallel condensing hybrid cooling approach "wet bulb" temperatures in the wet portion of the system. Wet bulb temperatures are lower than "dry bulb" temperatures, thus improving cooling efficiency in comparison to an all-dry cooling system.
- Hybrid cooling reduces the volume of cooling tower blowdown that would have to be discharged or concentrated in ZLD processes.

Disadvantages of Hybrid Cooling Systems

- Requires a dependable source of water.
- Capital and maintenance costs for hybrid systems are generally higher than wet closed loop systems.
- Plume-abated hybrid cooling systems can have greater noise than wet cooling systems because of the fans. Quieter fans are available to mitigate these impacts, but add capital cost.

2.5 RECYCLED WATER IN POWER PLANT COOLING

Alternate Water Sources

SWRCB Policy 75-58 requires consideration of alternate water sources in lieu of the use of fresh inland water for power plant cooling. Policy 75-58 requires consideration of the following water supply options in the following order: (1) wastewater discharged to the ocean; (2) ocean water; (3) brackish water from natural sources or irrigation return flow; (4) inland wastewaters of low total dissolved solids (TDS); and (5) other inland waters.

The CPP site is not in reasonable proximity to wastewater being discharged to the ocean or to ocean water. Some brackish groundwater may be available at the CPP site, but availability of adequate supplies has not been established. No other sources of brackish water are within a reasonable distance of the CPP. There are several sources of inland wastewater available to the proposed CPP project. These wastewater sources are analyzed in more detail later in this report.

Recycled Water

California currently has hundreds of recycled water programs throughout the State. These recycled water programs enable fresh water to be conserved.

The past decade has seen significant improvements in water reclamation treatment technology. Today, the technology exists to treat recycled water to virtually any desired quality. **Appendix A Table 2** provides some examples of California recycled water programs.

In most parts of California, industrial and agricultural customers are encouraged to use recycled wastewater by pricing it at a fraction of the cost of inland surface water. Recycled water for unrestricted use is commonly discounted 10 to 35 percent below potable water rates to provide customer incentives. Greater discounts are given for recycled water treated to a lower standard, such as water to be used for industrial cooling.

SWRCB Resolution 77-1 (January 6, 1977) encourages and promotes reclaimed water use for non-potable purposes. The California Legislature's Water Recycling Act of 1991 (Water Code §13575 et seq.) makes the following findings and declarations:

a. The State is subject to periodic drought conditions.

b. The development of traditional water resources in California has not kept pace with the State's population, which is growing at the rate of over 700,000 per year and which is anticipated to reach 36 million by the year 2010.

c. There is a need for a reliable source of water for uses not related to the supply of potable water to protect investments in agriculture, green belts, and recreation, and to replenish groundwater basins, and protect and enhance fisheries, wildlife habitat, and riparian areas.

d. The environmental benefits of recycled water include a reduced demand for water in the Sacramento–San Joaquin Delta, which is otherwise needed to maintain water quality, reduced discharge of waste into the ocean, and the enhancement of groundwater basins, recreation, fisheries, and wetlands.

e. The use of recycled water has proven to be safe from a public health standpoint, and the State DHS is updating regulations for the use of recycled water

f. The use of recycled water is a cost-effective, reliable method of helping to meet California's water supply needs.

Appendix A Table 2
Examples of California Recycled Water Programs

Program	Use	Capacity
Sacramento Regional Wastewater Treatment Plant	Landscape irrigation, industrial cooling	5 mgd, to expand to 10 mgd
South Bay Water Recycling	Landscape irrigation, industrial	15 mgd by 2003
Laguna Subregional Water Reclamation System, Santa Rosa	Agriculture, environmental enhancement	19.7 mgd
Monterey County Water Recycling	Agriculture irrigation	12.5 mgd
North City, San Diego	Landscape irrigation, industrial	8 mgd
Irvine Ranch Water District	Agriculture & landscape Irrigation, industrial	Started in '63, now 9 mgd
West Basin Water Recycling	Industrial, saline intrusion barrier, landscape	14.8 mgd to refinery cooling towers, 6 mgd to groundwater
County Sanitation Districts of Los Angeles County	Aquifer recharge, landscape Irrigation, industrial cooling, wildlife habitat	187 mgd reclaimed water, 74 mgd beneficially reused
Los Angeles DWP, Westside	Landscape irrigation	30 mgd
Los Angeles DWP, Greenbelt	Landscape irrigation	17.7 mgd
Orange County Water District, Green Acres	Landscape irrigation, industrial	6.1 mgd
Eastern Municipal Water District	Landscape & agriculture irrigation, environmental enhancement	29.3 mgd

g. The development of the infrastructure to distribute recycled water will provide jobs and enhance the economy of the state.

h. Retail water suppliers and recycled water producers and wholesalers should promote the substitution of recycled water for potable water and imported water in order to maximize the appropriate cost-effective use of recycled water in California.

i. Recycled water producers, retail water suppliers, and entities responsible for groundwater replenishment should cooperate in joint technical, economic, and environmental studies, as appropriate, to determine the feasibility of providing recycled water service.

j. Retail water suppliers and recycled water producers and wholesalers should be encouraged to enter into contracts to facilitate the service of recycled and potable water by the retail water suppliers in their service areas in the most efficient and cost-effective manner.

k. Recycled water producers and wholesalers and entities responsible for groundwater replenishment should be encouraged to enter into contracts to facilitate the use of recycled water for groundwater replenishment if recycled water is available and the authorities having jurisdiction approve its use.

l. Wholesale prices set by recycled water producers and recycled water wholesalers, and rates that retail water suppliers are authorized to charge for recycled water, should reflect an equitable sharing of the costs and benefits associated with the development and use of recycled water.

The Act established a statewide recycled water goal of 700,000 AFY by the year 2000 and 1,000,000 AFY by the year 2010 (Water Code §13577).

Current Use of Recycled Water for Power Plant Cooling

The use of recycled water for non-potable processes and cooling tower makeup has been practiced for over half a century and is well established in California as an integral part of most long-range water plans. In California, recycled water is primarily used for irrigation, therefore requiring seasonal storage or another means of disposal of effluent discharge during the non-irrigation season. Cooling tower makeup constitutes the next greatest use of California recycled water and its year around demand enables more consistent utilization.

The Sacramento Regional Wastewater Treatment Plant (Sac Reg) currently provides secondary effluent to SMUD for its Carson-Ice Cogeneration facility cooling. The City of Lodi's treatment plant also provides secondary effluent to a power plant adjacent to the treatment plant.

The Energy Commission approved the Delta Energy Center in 2000, an 880 MW combined-cycle power plant in Pittsburg, California. The Delta Energy Center uses secondary-treated wastewater from the Delta Diablo Sanitation District for the cooling towers. In 1999, the Energy Commission also approved the Los Medanos Power Plant, a combined-cycle 555 MW power plant that uses tertiary treated recycled water. The Delta Diablo Wastewater Treatment Facility located in the City of Antioch supplies recycled water for wet cooling. The Energy Commission is currently reviewing several plants that are proposing to use recycled water: the Los Esteros Critical Energy Facility, Palomar Energy Project, Inland Empire Energy Center, and the Russell City Energy Center.

Public Health Concerns Related to Use of Reclaimed Water

The California Department of Health Services governs use of reclaimed water by implementing requirements found in Title 22, Cal. Code Regs., Section 60306. These regulations address the potential for a mist or spray created by the process to carry disease or bacteria to the public or to project workers. Section 60306 states that if a mist is created, tertiary treatment is required and if there is no mist, secondary treatment is acceptable. If the mist could contact members of the public or employees, the Section (in part [c]) adds requirements for chlorination and installation of a drift eliminator. The DHS would evaluate a proposed system that would use reclaimed water to see whether it is completely enclosed, if people could be exposed, or other conditions.

Advantages and Disadvantages of Use of Recycled Water for Power Plant Cooling

The advantages and disadvantages of using recycled water for cooling makeup include the following:

Advantages of Cooling Using Recycled Water

- Recycled water is beneficially used.
- The provider of the recycled water (most likely a government entity) would receive income to offset treatment costs.
- Fresh water is conserved for the highest priority need (drinking water).
- The impact from the discharge of effluent pollutants is reduced.
- Recycled water is a reliable water source even if a drought occurs.
- Use of recycled water has strong public acceptance.

Disadvantages of Cooling Using Recycled Water

- Recycled water may not always be readily available in the large quantities needed for power plant cooling.
- An additional pipeline (connecting the power plant with the wastewater treatment plant) must be constructed.
- There are revenue risks inherent to developing a supply system to serve a single customer or a small number of customers.
- Water quality needs of users can require additional treatment.

2.6 ZERO LIQUID DISCHARGE (ZLD) SYSTEMS

Description of the Process and Equipment Required

Zero liquid discharge (ZLD) systems enable complete closure of water systems and are used where there are restrictions to water supply or effluent discharge. Generally, a ZLD system is a multiple process system, which concentrates the blowdown in one or two stages to form a saline brine, which is then concentrated into crystalline solids for disposal. Usually, the distillate (distilled water) is reused in the process as makeup water for the steam cycle. There are two process groups used to concentrate blowdown streams: membrane processes and thermo-mechanical. Following concentration, crystallizers or solar processes are used to convert concentrated brines into a solid cake, which can be disposed of in an appropriately licensed landfill.

Membrane Processes

Membrane processes can remove a wide range of water constituents including turbidity, coliforms, trace organics, dissolved solids, and specific ions. Membrane processes include microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), reverse osmosis

(RO), electrodialysis reversal (EDR), and direct osmosis (DO). MF and RO remove submicron particles and oil, and are effective pretreatment for processes that remove dissolved solids and can concentrate cooling tower blowdown to 25 percent of the original liquid volume.

EDR employs electric current and specially prepared membranes that are semi-permeable to ions based on their charge and ability to reduce the ionic content of the water. RO uses a cross-flow semi-permeable membrane to remove both dissolved organics and salts. Both processes produce a concentrated reject brine stream that requires further concentration before disposal. RO is generally preceded by MF and can achieve higher recovery and produce a more concentrated reject stream than EDR, and since it is more widely used in the power generation industry, will be analyzed in this study.

DO further concentrates brine streams and is equivalent to thermo-mechanical evaporators in performance and capital cost. A DO process commonly requires less energy than thermo-mechanical evaporators and can have lower O&M cost. However it is still considered to be experimental in the power industry and is not yet widely used.

Thermo-Mechanical Evaporation

There are two types of thermo-mechanical evaporators: multiple-effect evaporators (MEE) and vapor compression evaporators (VCE). In MEE systems, low-pressure steam is used as a primary evaporation heat source, with the resulting vapor used to evaporate water at a lower temperature and pressure in a subsequent stage. In VCE systems, the vapor produced from evaporating the wastewater is compressed to elevate its temperature and is then used as the heat source in the same evaporator. The amount of energy required to compress the vapor is much less than that required to evaporate water, thus less energy is consumed than if external steam were used as a heat source. The vapor can be compressed mechanically or thermally with steam in a jet ejector. VCE evaporators have slightly higher capital costs than MEE evaporators; however, VCE evaporators require less energy and are more commonly employed for power plant ZLD applications. Both the crystallizer and solar processes are evaluated in this report.

Crystallizer Process

A crystallizer is a forced circulation process commonly used to concentrate salt brines and is often preceded by an evaporator to increase thermal efficiency. Crystallizers function similar to VCE evaporators except they circulate a solids-laden stream instead of a concentrated brine. The process continuously circulates the solids-laden stream through a heat exchanger and collects flashed vapor in a flash chamber, thereby evaporating sufficient water to increase the solids concentration to the point where salts crystallize and can be subsequently removed in a centrifuge or filter press. Crystallizers are constructed of corrosion resistant alloys.

Solar Processes

The pan evaporation rate is a relative standard that gauges evaporation, which is about a third higher for Sacramento in comparison to the United States average. Solar processes are the oldest ZLD process and can include either open pond and/or engineered solar structures. Open ponds with concentrated saline brine can evaporate about 40 percent of the theoretical pan evaporation rate of clean water, or approximately 18 to 22 inches per year in Sacramento. The reduction is due to saline impairment and collection of rainfall on pond interior slopes. Solar ponds are usually divided into four or more cells so that brine concentration and drying can occur in three or more drying cells, and individual cells can be taken off line for final cake drying and removal as needed.

Outfitting dilute waste brine ponds with a pumped spray system can increase evaporation. To reduce seepage, open evaporation ponds are usually built with black plastic liners, such as high-density polyethylene (HDPE), polypropylene, or hypalon. When coupled with an MF + RO membrane process, and an evaporator, solar drying may be a cost effective alternative to a mechanical crystallizer.

Solar process design has improved over the past decade, increasing efficiency and reducing heat loss.

Current Use of ZLD Processes

Six recently approved California power plants will use ZLD processes. Two are operational (Sunrise Combined Cycle [320 MW] and Sutter Power Project [540 MW], and four are under construction (Blythe Energy [520 MW), High Desert [720 MW], Three Mountain [500 MW], and Western Midway Sunset [500 MW]). As noted above, SMUD has recently proposed to use ZLD at the CPP.

Advantages and Disadvantages of ZLD

Following is a list of the general advantages and disadvantages of ZLD.

Advantages of ZLD

- Eliminates surface water discharge-related environmental impacts for wet and hybrid cooling tower blowdown, thereby eliminating or expediting NPDES approval.
- Recovers membrane process permeate, and evaporator and crystallizer condensate, thus reducing makeup water demand.
- The Central Valley RWQCB has stated that it considers ZLD to be the best practical treatment (BPT), which is considered to be a standard of reasonableness and economic feasibility (Carlson, 2002).
- Enables use of either wet or hybrid wet-dry cooling as alternatives to dry cooling at sites where blowdown discharge is constrained.

Disadvantages of ZLD

- Requires additional capital investment.
- Requires additional on-site operation and maintenance, although this would be partially offset by the value of the reduced makeup water.
- Can create potential environmental impacts, such as visual impacts and the increased use of land area. The evaporators would be about 65 feet high, which is consistent with height of typical cooling towers and HRSG units.
- Requires offsite disposal of solids.
- Adds a parasitic power and low-grade steam load.
- May require additional chemicals to manage scaling and biofouling.

3. CONCEPTUAL DESIGN OF COOLING OPTIONS FOR THE CPP

3.1 DESCRIPTION OF THE PROPOSED PROJECT

SMUD seeks approval from the Energy Commission to construct and operate the Cosumnes Power Plant (CPP), a natural gas-fired power plant adjacent to the Rancho Seco Nuclear Plant (currently being decommissioned), 25 miles southeast of the City of Sacramento, in Sacramento County, California. The project would be located on a 30-acre portion of an overall 2,480-acre site owned by SMUD.

CPP is proposed to consist of a nominal 1,000 MW combined-cycle natural gas facility. The plant would be constructed in two phases, each consisting of 500 MW. Each phase would have two combustion turbines, one condensing steam turbine, and two heat recovery steam generators. The transmission line would consist of 0.4 miles of new 230-kV line from the on-site switchyard to the existing switchyard at the Rancho Seco Plant. Natural gas could be supplied by a new 26-mile gas line. A new 0.4-mile water pipeline connecting to the existing 66-inch-diameter water line at the Rancho Seco Plant would convey cooling water to the CPP site. The water would come from the Folsom South Canal.

As originally proposed, the CPP would use Folsom South Canal water for cooling. The average water needed would be 7,953 AFY (5,128 gpm), with peak demand as high as 11,948 AFY (7,703 gpm). Water demands are approximately three percent for non-cooling and 97 percent for evaporative cooling. Non-cooling water is used for potable water uses within the plant, such as drinking water, fire suppression, and safety showers, as well as for steam cycle makeup and CTG inlet foggers. As water is circulated through the proposed wet cooling towers, a portion would be lost to evaporation and drift, with a portion “blown down” (purged) to maintain constituents in the cooling loop at a desired equilibrium concentration. The cooling water was proposed to be concentrated an estimated three cycles, which is well below the cycles possible for the proposed water source.

The applicant's proposal to use ZLD at the CPP was received by Energy Commission staff immediately prior to issuance of this Staff Assessment, so the original discharge to Clay Creek is still addressed herein.

As described in the Introduction to this Appendix, the applicant submitted its Power Plant Cooling Analysis in March 2002. This report also considers dry and hybrid cooling options, though in different configurations than those evaluated herein.

3.2 DRY COOLING

This section describes the conceptual design of a dry cooling system for the CPP. One air cooled condenser (ACC) would be required for each phase. For simplicity, subsequent discussion here is based on one single unit of 500 MW nominal output, essentially covering Phase 1 only.

As described in Section 2, an ACC is essentially a heat exchanger like an automobile radiator: steam and hot water on the inside of tubular finned coils is condensed and cooled by passing ambient air over the outside of the finned coils. The heat transfer is accomplished by using air, rather than water evaporation. Therefore performance is driven by the ambient temperature rather than the lower "wet bulb" temperature associated with evaporative cooling.

Dry Cooling Design Basis

The most important variables in design of an ACC system are assumptions regarding site weather conditions. Weather data from the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) is typically used in studies such as these. For this evaluation, an ambient temperature of 94°F dry bulb and 70°F wet bulb was used as the maximum design basis for the ACC. This temperature was selected because it represents a temperature that would be exceeded during only five percent of summer hours, based on ASHRAE data. This is a typical design factor for a power plant's cooling system. The Steam Turbine Generator (STG) would exhaust its spent low pressure exhaust steam into the ACC, where it would be condensed and returned to condensate pumps and eventually the HRSG's and returned to the steam cycle of the plant. The design basis used a 40°F "approach", which means that the temperature difference between the ambient air and the steam/water being condensed would be 40°F at design conditions of 94°F ambient temperature. This assumption is also consistent with the applicant's cooling options study. Use of these temperatures results in a condensing temperature of 134°F. This temperature uniquely defines the pressure of the exhaust of the STG, which would be 2.47 psia (pounds per square inch absolute) or 5 inches mercury ("5 in. Hg"). The conceptual design result is an array of 35 cells (each fin-fan unit is called a cell) for each unit.

Optimally, the distance of the piping from ACC to STG exhaust should be as short as possible. This piping is very large and expensive. The applicant plans to locate the CTGs on the inside of the plant and the STGs on the outside, closer to the facility boundaries. There appears to be no significant disadvantage to arranging the plant in this manner. Another potential arrangement could place each STG between a set of CTGs.

Dry Cooling Size and Location

An ACC would be required for each steam generating unit. Each ACC would be located at one end of the power plant, closest to the STG that it serves. (See **Appendix A Plate 1** at the end of this Appendix; a photo simulation of this arrangement is presented in Figure 2 in the applicant's Power Plant Cooling Analysis; SMUD, 2002i.) Each cell would consist of a supporting frame, a 32-foot diameter fan, and cooling coils. The diameter of each cell would be approximately 38.5 feet. The ACC would be constructed with a 7-by-5 array of cells. Cells would be butted adjacent to each other, seven cells long and five cells wide, resulting in 35 total cells in a rectangular footprint. Unlike wet cooling towers, where closely adjacent cells add moisture to the air and potentially affect the performance of adjacent cells, the dry cells have no effect on each other so can be arranged in this grid array without substantially affecting thermal performance. The total area of each ACC would be 220 by 350 feet (or about 1.8 acres for each ACC).

From the ground surface, there would be a space of approximately 30 feet in height to allow for air to enter the underside of the cells. The cell fins/siding start at this point in elevation (30 feet) and extend to the fan deck at 58 feet above grade. The top of the fans would be at 58 feet, and the 32-foot diameter fan discharge shrouds (which exhaust vertically) would extend approximately another 12 feet in height for a total height of 70 feet. Over that, there would be a series of large diameter pipes (ranging in diameter from about 12 feet to 2 feet) that distribute the STG exhaust to the ACC.

Dry Cooling Noise and Fan Configuration

Noise from the ACC is generated by the fans, so fan type and configuration determines the noise of the ACC. The fans used for this analysis are of a lower power than the most efficient available, and were selected in order to reduce noise. The resulting noise would be 58 dBA at 400 feet. Two other options were considered:

- A lower cost but noisier option would generate 64 dBA at 400 feet from the ACC using a 6-by-5 array of cells. The equipment in that design would cost approximately $1.75 million less than the selected design.
- An even quieter option is available for a cost premium of approximately $1.75 million above the selected option. That option would yield 51 dBA at 400 feet. The quieter option uses more heat exchange surface and smaller fans to achieve the cooling results, and would require a slightly larger array (283 by 205 feet).

These higher and lower noise and cost options can be further explored if needed, but the middle option was selected for analysis. All three of these options have essentially identical thermal performance.

Dry Cooling Water Consumption

The average annual water balance indicates that the project as proposed in the AFC would consume an average of 4,930 gpm (7,953 AFY) of water from the Folsom South Canal. Of this amount, 4,783 gpm or 97 percent is lost in cooling tower evaporation. Using an ACC cooling system would reduce water use by 97 percent, or 4,783 gpm.

Dry Cooling Cost

The estimated capital cost for the ACC configuration presented here would be approximately \$34.6 million for each unit (\$69.2 million for both ACCs). The applicant estimated the cost to be \$31.2 million (or \$62.4 million for both ACCs), very similar to staff's estimate.

The cost of maintaining the ACC is expected to be on the order of \$100,000 per year.

Dry Cooling Efficiency

Dry cooling is slightly less efficient than wet cooling towers. The average temperature of Sacramento is 67.5°F according to ASHRAE data. At this temperature, the efficiency loss would be about one percent, or 5 MW. At the higher design temperature (94°F), the reduced efficiency is expected to be approximately 13.6 MW (i.e., generation would be 511 MW with wet cooling and 498 per MW with dry cooling). The 94°F temperature is expected to be exceeded 150 hours per year.

This capacity loss could be reduced by the use of other engineering options. For example, use of spray water cooling at the inlets to ACC or STG exhaust for the very short time durations where peaking is needed are typical. This is sometimes called "spray enhanced dry cooling".

Comments on Applicant's Cooling Option Study

As previously described, the applicant has submitted a study of cooling options, and this has been reviewed by staff. The study assumed a maximum design basis of 104°F. According to the ASHRAE data, a temperature of 101°F would be exceeded on only one percent of summer days, so a value of 104°F would be experienced very infrequently. The effect of selecting this high temperature is relatively small in terms of size and design of the ACC. However, the effect on the resulting economic evaluations is large. The loss quoted in the applicant's study (a loss of approximately 20 MW at 104°F air temperature) is correct, but that air temperature would be experienced very infrequently and staff does not consider it to be an appropriate design basis. As stated above, a design temperature that occurs during 95 percent of summer hours (94°F) is considered to be more reasonable.

The applicant presented an ACC design similar to that considered in this study, except that the applicant has presented an 8-by-5-cell array rather than the 7-by-5-cell arrangement used here.

3.3 HYBRID (WET/DRY) COOLING

There is a wide range of cooling options that are "hybrid" in nature, in that they use some dry cooling combined with some evaporative (wet) cooling. At the driest end of the spectrum is "spray enhanced dry cooling," a system that augments the ACC with water spray cooling for very high temperature days, thus achieving about a five percent wet/95 percent dry hybrid system. At the other end of the hybrid spectrum is the "plume abatement" cooling tower. This design looks much like a standard wet cooling tower but achieves reduction of visible plume by installing dry cooling air-cooled coils of approximately five percent capacity above the evaporative surface of a wet cooling tower. Since this design is common, it is a practical means of achieving a five percent reduction of evaporated water for a moderate cost.

It is possible to design a "hybrid" system at any point on the wet/dry spectrum whose wet and dry ends are described above. The applicant's cooling study (Data Response Set 1E) reviews a hybrid option of 50 percent wet and 50 percent dry. That option would use a half-size conventional cooling tower and a half-size dry condensing system. This effectively reduces evaporated water by about half of the wet cooling system, with no effect on the non-cooling water uses.

The second hybrid system would be a 50/50 hybrid process in which Phase 1 would be a 100 percent dry cooled and Phase 2 would use a plume-abated wet cooling tower. The Phase 2 water supply could be provided by fresh water or by recycled water.

Hybrid Design

For purposes of this analysis, two different hybrid designs are considered. The first would be essentially a plume-abated wet cooling system resulting in cooling that would be five percent dry and 95 percent wet. Both phases of the CPP project would use this 95/5 system. Consideration of these two options gives two useful "points" in investigating the practicality of the hybrid cooling option.

In the power plant design process, the normal practice is to carry out economic studies for various options and conditions. While economic factors and other characteristics are examined, the most important variable is the weather assumptions. Based on ASHRAE data, the average temperature for Sacramento is in the 60s and the lowest temperature is approximately 34°F. There are approximately 30 hours per year during which air temperature exceeds 101°F (ASHRAE one percent of summer hours) and 150 hours that it exceeds 94°F (ASHRAE five percent of summer hours). Economic optimization is a complex process and is not presented here, but experience indicates that the final result for equipment sizing would typically fall in a range between the "average" temperature and the five percent of summer high value. Analysis for a municipal utility would tend to favor the more capital-intensive side of the typical,[6] so for purposes of this analysis the upper "five percent" value of 94°F was selected. This value is used to make a conceptual design for purpose of this evaluation.

With the 94°F ambient temperature design basis, the corresponding wet bulb temperature would be 70°F. Using these assumptions, a hybrid plume-abated cooling tower consisting of eight cells was selected. Dimensions are provided below.

Hybrid Size and Location

Each 95/5 unit's cooling tower would be made up of eight cooling cells, each with a footprint of 50 feet square and a height of 55 feet. Centered on each cell at the top would be a fan. The fan would be 32 feet in diameter and would include a discharge flue about 15 feet high and 32 feet in diameter. The total cooling tower footprint would

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6 Because a municipal utility can issue tax-exempt bonds, its "cost of money" is lower. Therefore, optimization would result in generally higher capital costs and lower operating costs for a public entity.

be approximately 50 feet by 400 feet (**Appendix A Plate 2** illustrates tower size and location). The location of the tower would be the same as shown in the AFC for the wet towers, i.e., on the eastern portion of the plant. It is desirable to locate cooling towers away from the high voltage electrical gear – switchyard and electrical get-away towers – in order to minimize the effects of airborne water and contaminants on the high voltage electrical insulators. There is little difference in external appearance between a conventional wet tower as shown in the AFC and a plume abatement tower as postulated here, except for a slightly taller fan deck.

The 50/50 hybrid system would use one of the two sets of ACCs (as illustrated in **Appendix A Plate 1**) for cooling the Phase 1 unit, and one 8-cell cooling tower, as illustrated in **Appendix A Plate 2**, for cooling the Phase 2 unit.

Cooling for the 50/50 hybrid option at CPP would be provided in Phase 1 by dry cooling and by a plume-abated wet cooling tower in Phase 2. Sac Reg and Lodi could provide adequate recycled water for this option. Also, this sequence would provide sufficient time for the City of Galt's treated wastewater volume to satisfy the makeup water demand for a plume-abated wet cooling tower.

Hybrid Water Use

The plume-abated tower identified for the 95/5 option would reduce water consumption from the proposed wet tower option by approximately five percent. On a year-round basis, this number would vary based on changes in humidify and other weather conditions. In fact, water consumption should be reduced more than five percent since the dry portion of the tower is somewhat more effective in the colder part of the year. A thorough evaluation would require specific weather information and detailed cycle analysis that was not used in this analysis. Other consumption numbers would not be substantially affected.

Cooling water consumption for 50/50 hybrid cooling system would be about 47 percent of the proposed wet cooling system.

Hybrid Noise

A hybrid cooling system can be designed to control fan noise so that the plume abatement would not cause an overall increase in noise levels. Noise levels for the 50/50 hybrid would be the same as those of the dry cooling option in Phase 1, and similar to the proposed project in Phase 2.

Hybrid Cost

Compared to a conventional wet cooling tower, the 95/5 plume abatement tower would cost approximately $2.5 million more per unit (installed capital cost). Operation and maintenance costs would be essentially the same as those of a wet tower.

The 50/50 hybrid cooling installed for Phase 1 (dry cooling) would cost approximately $28 million and a Phase 2 (plume-abated wet cooling) installed cost would be $2.5 million (all in 2002 dollars), for a total of approximately $30.5 million for both phases.

Hybrid Efficiency

The 95/5 hybrid tower can be sized to any performance value that is accomplished by a wet tower. For this analysis, a wet tower and a wet/dry tower were conceptually sized, using a difference in STG exhaust pressure of 0.3 inches of mercury. This exhaust pressure increase results in the loss of approximately 1.2 MW of generation. This value should be considered approximate, as actual optimization could result in more or less. The heat rate impact of 1.2 MW loss on 511 MW nominal full load is 0.25 percent or 16 Btu/kWh.

Comment on Applicant's Cooling Option Study

The applicant's study shows a 9-cell hybrid cooling tower, resulting in a 450-foot length for each unit, whereas this study uses an 8-cell tower. For the 95/5 wet/dry plume abatement tower, the 8-cell configuration is considered appropriate based on the design criteria defined above.

4. MUNICIPAL AND INDUSTRIAL WASTEWATER SOURCES FOR CPP COOLING

Three municipal wastewater sources are considered as potential water sources for the CPP's wet cooling makeup demand of 4.54 mgd (4,890 AFY) average, 6.67 mgd (7,184 AFY) maximum with ZLD. These sources are the municipal wastewater plants at Galt and Lodi, and the Sacramento Regional Wastewater Treatment Plant (Sac Reg) in Elk Grove. The use of industrial wastewater from Aerojet or Rancho Seco is also considered in this section.

Appendix A Table 3 shows that water supply sufficient for use in either hybrid cooling option for Phases 1 and 2 is now available from Sac Reg, Folsom South Canal (proposed source), and Lodi. Galt is a rapidly growing community and it is estimated that it will be able to provide 2.7 mgd by 2008 (Griffin, 2002), which could serve the 50/50 hybrid, which would use wet cooling in Phase 2. On-site storage tanks are assumed to be sized to provide sufficient short-term storage, and it is assumed that up to 400 AFY of backup water would be available from Rancho Seco Reservoir or the groundwater well.

RWQCB has noted several concerns about the surface discharges of the Sac Reg, Lodi, and Galt plants: body contact, pathogens, organo-pesticides, metals, mercury, chlorine by-products, and effluent-dominated discharge with little assimilative capacity (Carlson, 2002; Leary, 2002). The use of tertiary treatment or membrane filtration may be needed to meet the plants' renewed permit conditions unless they can find other uses for their treated water. This situation may provide an incentive to export water to the CPP.

Appendix A Table 3 summarizes water demand and availability for various water sources and cooling options.

Appendix A Table 3
Summary of Candidate Water Sources and Cooling Processes

Parameter	Wet Cooling Fresh Water		Recycled Water for Wet Cooling			50/50 Hybrid[1]	Dry Cooling
Cooling Water Source	**Folsom South Canal**		**Sac Reg**	**Galt + Sac Reg**	**Lodi**	**Galt**	N/A
Sufficient Phase 2 cooling water available	Now		Now	2008	Now	2008	N/A
Approx. TDS (mg/L)	200	200	400	488	410	575	575
Dissolved silica (mg/L)	12	12	16	16	16	16	16
Cycles of concentration	3	12	9	9	9	9	N/A
Wastewater discharge	Surface	ZLD	ZLD	ZLD	ZLD	ZLD	ZLD
Ave. non-cooling makeup (gpm)	147	147	147	147	147	147	147[3]
Average cooling makeup (gpm)	4,783	3,155	3,155	3,155	3,155	1,499	0
Ave. total makeup flow (gpm)	4,930	3,302	3,302	3,302	3,302	1,646	147
Max. non-cooling makeup (gpm)	365	365	365	365	365	365	365
Maximum cooling makeup (gpm)	7,041	4,633	4,633	4,633	4,633	2,201	0
Max. total makeup flow (gpm)	7,406	4,998	4,998	4,998	4,998	2,566	365
Pipe diameter, ID & OD (inches)	29" ID 34" OD	22" ID 26" OD	22" ID 26" OD	22" ID 26" OD	22" ID 26" OD	15.2" ID 18" OD	8.7" ID 10" OD
HDPE pipe est. weight, #/ft (SDR 11 or 13.5)	109	64	64	64	64	31	13
Pipeline route (miles)	0.3	0.3	26	12 + 14[2]	26	12	12

[1] "50/50 Hybrid Cooling" assumes Phase 1 dry cooling and Phase 2 wet cooling with plume abatement tower.
[2] If both Galt and Sac Reg provided recycled water, the assumed pipeline route would be 12 miles to Galt + 14 miles to Sac Reg.
[3] Non-cooling water for a dry-cooled plant could be taken from the Folsom South Canal.

Notes:

- Since ZLD avoids the surface discharge issues noted above and avoids the dependence on a NPDES permit, ZLD would be used for both fresh water and recycled water sources. Sac Reg and Galt are assumed to be the most viable sources of recycled water, with Sac Reg or Sac Reg + Galt assumed to provide wet or 95/5 hybrid cooling requirements and Galt is assumed to provide the Phase 2 water for 50/50 hybrid cooling.
- The cycles of concentration were assumed to be controlled by dissolved silica, using a target concentration of 150 mg/L in the cooling loop, although this target has been able to be increased in other applications with the use of appropriate scale inhibitor and dispersant chemicals. Sidestream softening and/or filtration processes have also been shown to help manage silica levels
- Emergency backup water supply in Rancho Seco Reservoir of 800 AFY is assumed for wet and 95/5 hybrid cooling options, and 400 AFY for 50/50 Hybrid cooling.

The following sections describe the three municipal and two industrial wastewater sources, and present information on the pipeline that would be required to transport water to the CPP site.

4.1 SACRAMENTO REGIONAL WASTEWATER TREATMENT PLANT

Sac Reg is located approximately 26 miles northwest of the CPP at 8521 Laguna Station Road near the intersection of Franklin and Laguna Boulevards in the City of Elk Grove. Sac Reg treats wastewater from most of Sacramento County and currently handles 182 mgd dry weather flow, which is over 20 times the amount needed by CPP. Sac Reg will soon begin negotiating a 40 mgd facility expansion with RWQCB. It now has 2 mgd of uncommitted summer capacity and can expand to 10 mgd in the future. SMUD's 126 MW Carson Ice-Gen cogeneration facility is adjacent to Sac Reg and uses about 1 mgd of secondary effluent for cooling.

Treated wastewater discharge from Sac Reg currently discharges into the Sacramento River about one mile below the community of Freeport in Sacramento County, and impacts the San Joaquin–Sacramento Delta. Current constituents of concern include: mercury, lindane, and increased temperature. The CVRWQCB may also limit total dissolved solids (TDS) mass load. From a wastewater treatment perspective, development of recycled water could help Sac Reg meet future mass limits for effluent mercury, lindane, thermal limits, and any future TDS mass limits. A TDS mass limit would prevent acceptance of saline streams, such as cooling tower blowdown. Therefore, cooling water blowdown would likely not be returned to Sac Reg for additional treatment and discharge, but would be concentrated into a solid and hauled offsite.

Pipeline Route to the CPP

Recycled water is assumed to be supplied to the CPP through a buried 26-inch high-density polyethylene (HDPE) pipe routed parallel to the proposed welded steel natural gas supply line. Refer to AFC Figures 2.1-1 and 6.1-2 through 6.1-7 for pipeline routing maps. A 5- to 10-foot separation from the gas line is recommended to minimize the chance that repair work on one pipeline would damage the other line. Therefore, the pipeline easement width would be increased by 7 to 12 feet. The construction easement would be about 15 feet wider than the applicant proposed gas pipeline alone. HDPE is assumed as the pipe material because of its low biofouling, low friction loss, durability, long life, water hammer tolerance, and lack of cathodic effect on buried steel lines. A detailed engineering analysis would be required before final selection of pipe rating and materials.

It is assumed that three pump stations would be required along the 26-mile pipeline route. Each station would have a footprint of about 1,000 square feet.

The pipeline from Sac Reg to CPP could also provide water for future enhancement of the Stone Lakes National Wildlife Refuge, provided that disinfected secondary effluent-23 is an applicable quality standard for that use. If other wastewater users were identified along the pipeline route, the pipeline could serve them as well as the CPP.

4.2 CITY OF GALT WASTEWATER TREATMENT PLANT

The City of Galt Wastewater Treatment Plant is located approximately 12 miles southwest of CPP at 10059 Twin Cities Road, west of the Union Pacific Railroad (UPRR) tracks and State Route 99. Galt currently produces an average of 2 mgd of secondary effluent, which will increase to 3 mgd upon reaching their urban growth plan of 30,000 (up from the current 20,000) (Griffin, 2002). The treatment plant currently discharges into Skunk Creek (which flows to Laguna Creek, then to the Cosumnes River) in winter and to land application (agricultural irrigation) in summer. The City is now in the process of expanding its 165-acre land application site. TDS is 550 to 600 mg/L. The plant is also in the process of preparing its NPDES permit renewal application, which may require tertiary filtration due to body contact and other issues during winter surface discharge. It may also seek to expand capacity by up to 50 percent (to an average of 3 mgd) to accommodate future growth. Galt does not currently produce enough water for use in wet or hybrid cooling, so it is assumed that Galt water could not be used for Phase 1 of the proposed project or for the 95/5 hybrid option evaluated in this report. An average flow of 3 mgd would provide cooling water for the 50/50 hybrid option and up to 64 percent of the CPP average demand for wet cooling with ZLD. Additional water would have to be supplied from the Folsom South Canal or another wastewater source (e.g., Sac Reg) to provide the entire CPP demand.

The City of Galt has expressed interest in discussing the possible export of effluent to the CPP (Griffin, 2002). Use of Galt recycled water would result in the most direct pipeline route to the CPP and would avoid directional drilling under the Cosumnes River. The City's land application site would have to be irrigated with other water.

Because of the limited treated water supply available at Galt, Galt water supply could be used in two scenarios:

1. Galt could supply half of the water needed for Phase 1 and Sac Reg could provide the other half. An 18-inch-diameter line could be constructed from Sac Reg to the junction with a similar branch from Galt. The cost for such a split system is expected to be about 10 percent less than the conveyance cost to Sac Reg alone, because even though the total length of pipe would be greater, the majority of it would be the smaller-diameter (and cheaper) 18-inch pipe.
2. A 50/50 hybrid option would have less than half the demand of wet cooling. In this scenario, Phase 1 would use dry cooling and Galt would provide recycled water for Phase 2.

Pipeline Route to the CPP

Galt has the most direct route to CPP and would not require directional drilling under the Cosumnes River. The water pipeline from Galt to CPP would follow the route described below and illustrated in **Appendix A Figure 4** at the end of this Appendix.

The pipeline from CPP would initially parallel the proposed natural gas pipeline to the west side of State Route Highway 99 and the UPRR tracks. If the 50/50 hybrid option were used and Galt were the only water provider, the pipeline would then turn south along the UPRR right-of-way to the Galt Wastewater Treatment Plant. If wet cooling were used, this route could join a pipeline from Sac Reg.

One pump station would be needed between Galt and the CPP; about 1,000 square feet of land would be required.

4.3 CITY OF LODI WHITE SLOUGH WATER POLLUTION CONTROL FACILITY

The City of Lodi's White Slough Water Pollution Control Facility (WSWPCF) is located approximately 30 miles southwest of CPP at 12751 North Thornton Road, west of I-5 and approximately 1.5 miles south of Highway 12, in San Joaquin County. Its wastewater production averages 6.2 to 6.5 mgd (8.5 mgd max) and its renewed NPDES permit calls for 6.4 mgd of tertiary capacity by 2005. At this time, the City is waiting for a decision on siting a proposed sports complex, which could use one-third of the City's dry weather effluent flow, with the remainder going to agricultural land application during dry weather and surface discharge for the remainder of the year (Kerlin, 2002). Its tertiary process will likely be a membrane or mixed media filter.

The City currently provides 0.2 to 0.3 mgd of secondary effluent to each of two small turbine generator facilities that generate about 50 MW each. The City recognizes that power plants have a year-round water demand and this use is advantageous over seasonal uses, such as seasonal irrigation. The existing power generating facilities now send their cooling tower blowdown back to the City, as the City currently does not have any salt mass load cap. The remaining City's effluent is provided for corn and alfalfa irrigation on City-owned land and could potentially be available for export. The City now owns sufficient land for its foreseeable land application needs, but this land could presumably be irrigated with groundwater if the effluent were used for industrial purposes. Treated effluent averages about 390 to 440 mg/L TDS. In winter, the City discharges to an adjacent tidal-influenced slough that is effluent-dominated and has minimal assimilative capacity, thereby creating body contact issues.

Pipeline Route to the CPP

The pipeline route from Lodi to the CPP could follow the route described below and illustrated in **Appendix A Figure 4** (end of this Appendix):

- East on Eight Mile Road under Interstate 5
- North on DeVries Road
- East of Armstrong Road, cross Highway 99 and remain on Armstrong Road
- North on North Curry Road
- East on Hogan Lane
- North on North Curry Avenue
- East on Harney Lane
- North on Jack Tone Road
- Cross Highway 12/88 to Elliot Road, continue north on Elliot Road which turns into Clay Station Road, east on Clay East Road to south side of the CPP site.

4.4 POTENTIAL INDUSTRIAL WASTEWATERS

Two industrial facilities, Aerojet and Rancho Seco power plant, have high-quality "wastewaters" that should be of sufficient quality for cooling at CPP.

Aerojet Water

Aerojet's past industrial activities created a large groundwater contamination plume. Aerojet has been required to implement a series of remedial actions over the past 20 years. Originally, the treated effluent was re-injected to groundwater. Subsequently it was land applied, and the next phase calls for 13 mgd to be discharged to Alder Creek, which flows into the American River above Nimbus Dam immediately upstream of the Folsom South Canal diversion point.

The two largest Aerojet groundwater treatment systems are:

- The 2,000-gpm American River Groundwater Extraction and Treatment (ARGET) project, utilizing UV-oxidation and air stripping, discharging to the American River, near the Sunset Boulevard bridge.
- The 4,000-gpm (increasing to 6,000 gpm in three months) Groundwater Extraction and Treatment (GET) fluidized bioreactor to enhance the removal of PCE and nitrate.

Groundwater is drawn from the 100 to 300 feet deep Mehrten formation that underlies much of the Sacramento area. The groundwater is of good quality (150-200 mg/L TDS, 10-20 mg/L SO_4, 10-20 mg/L Cl, and 1-20 mg/L nitrate) with 2 ppm TCE/PCE, which is removed to non-detectable levels. Up to 10 mgd (11,201 AFY) would be available for CPP cooling (Swanick, 2002).

The assumed route for water transfer from Aerojet to the CPP would be via the Folsom South Canal. **Appendix A Figure 5** shows the route from the Aerojet plant to the CPP via the Folsom South Canal. Currently, the Arden Cordova Water Service Company uses Folsom South Canal water for its potable supply, and would need to address the potential impact of the use of Folsom South Canal water at CPP on its water quality and quantity. If this option were implemented, and there were such concerns, it might be possible to route Aerojet's treated discharge into the Folsom South Canal downstream of the Arden Cordova intake. This could be accomplished with the installation of a dedicated pipeline parallel to the Folsom South Canal, but this would negate potential pipeline cost savings. Use of this "wastewater" as a CPP water source would reduce lower American River flow by diverting high-quality effluent that would otherwise go to the lower American River via Alder Creek, and would have the same effect as direct use of American River water. Therefore, there appears to be no benefit to further evaluation of this option.

Rancho Seco Water

The Rancho Seco pump station on the Folsom South Canal has drawn an average of 14,100 AFY during the past three years, reportedly for dilution of miscellaneous decommissioning washdown water and for nuclear fuel rod cooling. A discharge of 8,900 cfs was reported, with the difference being described as miscellaneous leakage and supplemental discharge. Following the planned placement of Rancho Seco fuel rods into dry storage during the fall of 2002, there is no identified need to continue this water use, although SMUD has stated that they plan to continue the current rate of "wastewater" discharge indefinitely (continuation of Rancho Seco's "wastewater" discharge is an issue independent of the CPP).

There is no reason to expect that Rancho Seco's "wastewater" quality would differ from that of Folsom South Canal water. While reuse of the Rancho Seco "wastewater" is technically possible, use of this water for CPP cooling would have essentially the same water supply effect as the proposed use of Folsom South Canal water. Therefore, there appears to be no reason to further pursue this option.

5. CONCEPTUAL DESIGN OF ZERO LIQUID DISCHARGE SYSTEMS AT CPP

This section presents examples of two ZLD systems that could be used at CPP (the system that the applicant has recently proposed is similar to ZLD Option 1). ZLD could be used with any of the cooling options considered: wet cooling (as proposed), hybrid cooling, or dry cooling. **Appendix A Table 1** summarizes the potential combinations of control, water supply, and discharge options.

Cooling tower blowdown would comprise the majority of CPP wastewater, and because of its concentration during cooling, it would have elevated levels of water constituents and treatment chemicals. The applicant originally proposed that CPP wastewater be treated with end-of-pipe treatment processes and then discharged to surface waters. Discharge would be up to a maximum of 3.5 mgd (3,886 AFY) and average of 2,628 AFY, at 3 cycles of concentration for Phase 1. If quality did not meet NPDES discharge criteria, additional fresh water was proposed to dilute the wastewater.

Cooling makeup water is assumed to be either fresh inland surface water from Folsom South Canal or recycled water. In either case, this ZLD analysis assumes that groundwater and/or the water held in the Rancho Seco Reservoir would be available as a backup water supply. On-site water storage tanks would be sized to dampen diurnal cycles and short-term water needs during maintenance work. In this analysis, two ZLD options are considered.

ZLD OPTION 1: CRYSTALLIZER PROCESS

ZLD Option 1 would use a membrane process to concentrate the blowdown stream, followed by a Vapor Compression Evaporator (VCE) evaporator and a crystallizer. The membrane process would consist of 800 gpm microfiltration (MF) pretreatment followed by reverse osmosis (RO). Each process would have two arrays arranged in a pre-engineered metal building with dimensions 60 feet wide by 100 feet long by 20 feet high. This building would contain all membrane systems, chemical storage, and control room. Average power demand would be 850 Horsepower. All pump motors would be inside the building.

In addition to the membrane processes defined above, an adjacent 100 x 100 feet unenclosed area would hold a 200 gpm VCE and 15 gpm crystallizer unit processes. The VCE evaporator would have a diameter of 6 to 8 feet and a height of 65 to 70 feet. The crystallizer would have an overall height of approximately 55 feet, with a 12- to 14-foot diameter at mid-height, with the top mist eliminator section being less than 6-feet diameter. A common access stair tower would be constructed to a height of 60 feet between the two units. Pump and compressor motors would be located outside on grade. Pump noise could be minimized by the use of lower speed motors and if necessary, by the use of sound attenuation barriers, where noise is not already obstructed by tankage and equipment located on grade.

These two areas would be located immediately west of the cooling towers for Phase 2, in the location now shown in Attachment C as the "Maintenance Building and Warehouse." Because it is important that the ZLD equipment be centrally located, it is assumed that the ZLD would be in this location and that the warehouse could be moved to the south or relocated elsewhere. The approximate costs for this option would be:

- $4.8 million with the proposed wet cooling system
- $4.6 million with the 95/5 hybrid cooling system
- $2.9 million with the 50/50 hybrid cooling system
- $0.5 million with dry cooling.

ZLD Option 1 would have the system components listed below. The components would include:

- MF + RO concentration of cooling tower blowdown, with MF filtrate storage tank and filter press to remove solids.
- VCE of RO reject stream
- Crystallizer for final concentration of solids cake
- Final disposal of solids cake at Keifer Landfill.

ZLD OPTION 2: SOLAR PROCESS

ZLD Option 2 has MR + RO membrane processes followed by a VCE evaporator, similar to ZLD Option 1. The primary difference is that the crystallizer is replaced with solar evaporation ponds covering 6 to 10 acres. The evaporation ponds would be placed at the site recycled from the currently proposed 20-acre staging area after this area is no longer required for plant construction (the staging area is located due south of the proposed turbines, across Clay East Road). While the solar process requires more land than the crystallizer process described above, the principal advantage of solar drying over the crystallizer is that it would have lower power and steam requirements. The solar ponds could be covered with a plastic greenhouse structure about 8 to 10 feet tall to increase the evaporation rate and thus reduce the pond area.

ZLD Option 2 would have four solar evaporation ponds instead of a crystallizer, and the remaining system components would be the same as listed above for Option 1.

6. ENVIRONMENTAL AND ENGINEERING ANALYSIS

This section presents environmental and engineering analysis in 13 disciplines. Each discipline considers the potential for impacts from the recycled water supply options, dry cooling, hybrid cooling, and the two ZLD options.

6.1 AIR QUALITY

Matt Layton

Introduction

Potential air pollutant emissions and impacts from project-related air emissions are associated with both facility construction and operation. Construction emissions of concern are diesel exhaust and fugitive dust, while operational impacts include particulate matter (PM10 and PM2.5) and the combustion air pollutants. The potential operational air pollutant emissions include combustion byproducts, fugitive dust, and cooling tower drift. This section identifies the potential air pollutant emissions and air quality impacts of using recycled water, and air-cooled or hybrid cooling tower systems.

Recycled Water Supply Options

The major air quality concerns related to use of recycled water are (a) emissions from construction of the water pipeline, (b) the potential for increased cooling tower drift, and (c) potential hazardous contents of drift emissions. It is likely that construction emissions from the recycled water pipeline would be similar to those from construction of the proposed gas pipeline, though emissions would be increased with the additional pipeline. With use of recycled water in cooling towers, California Title 22 requires the use of high efficiency cooling tower drift eliminators (as have been proposed by the applicant) and a biocide program tailored for managing the risk of Legionnaires' disease. Impacts from the construction of recycled water pipelines would likely be less than significant if mitigation for construction emissions were implemented. Potential impacts from use of reclaimed water in cooling towers would be reduced to less than significant levels through compliance with DHS requirements.

Air Emissions and Impacts of Dry Cooling

Construction Emissions

The magnitude of emissions from the construction of the air-cooled condenser (ACC) would be greater than from the construction of the proposed wet cooling system because a larger area would be disturbed. Grading and construction to install the ACC cooling equipment would disturb an additional 2-1/2 acres. The additional soil disturbance and construction activity could increase fugitive dust and vehicle exhaust emissions. Each of the two ACCs would occupy about 1.8 acres, whereas the proposed wet cooling towers would occupy less than a half-acre. Dry cooling would not evaporate water and thus ambient air humidity and area ground fog would not be impacted.

Air impact modeling for construction of the proposed project calculated project construction contributions to existing violations of the State 24-hour PM10 standard. The increased construction activity for a dry cooling system would increase the project's contribution to local PM10 levels relative to the proposed project, increasing the short-term construction air impacts. With the implementation of the Sacramento Metropolitan Air Quality Management District (District) and staff proposed construction mitigation, staff believes that, as with the proposed project construction, this contribution would be less than significant.

Operational Emissions

A dry cooling system would result in fewer direct PM10 emissions compared to a wet or hybrid cooling system. However, it is frequently argued that the power plant performance penalties associated with ACCs, compared to other types of cooling that use water, would result in additional, albeit indirect, air pollutant emissions from additional fuel firing. The performance penalties include increased heat rates (approximate annual average of about one percent) and parasitic loads. However, these potential increases in air emissions at the project are highly speculative since California has a competitive electricity market. The project owner could choose to generate the “lost” capacity at another company plant, or buy capacity on the open market rather then generating it at the CPP project.

The displaced capacity could be provided from an emissionless hydro or nuclear plant, from an out of state coal-fired power plant, or from numerous, already permitted plants throughout the western region. As a result, the emission changes due to power plant performance degradation resulting from the dry cooling technology cannot be tied to the proposed project. Furthermore, if the applicant opted to fire more fuel at CPP to overcome reduced capacity due to ACCs, any emission increases would need to be modeled for potential impacts, and offsets would likely have to be provided for the increases. Therefore, impacts would be less than significant with the operation of a dry cooling (ACC) system.

Air Emissions and Impacts of Hybrid Cooling

Construction Emissions

Construction of a hybrid cooling system would likely produce both diesel and fugitive dust emissions very similar to those of the proposed wet cooling towers. Impacts can be reduced to less than significant levels with implementation of standard mitigation measures for construction.

Operational Emissions

During operation of a hybrid cooling system, there would be PM emissions from cooling tower drift, but drift emissions from a plume abatement cooling tower are expected to be less than those of the proposed project. The amount of PM is proportional to the amount of wet cooling in a hybrid or plume abatement tower and the amount of drift and the total dissolved solids (TDS) in the circulating water. The proposed hybrid cooling systems are either 5 or 53 percent dry. The cooling loop TDS should be approximately the same with either Folsom South Canal or recycled water as makeup water, thus air emissions should not be affected by water source.

The annual PM10 emissions from a hybrid cooling tower would be in approximate proportion to the wet cooling fraction, and can vary slightly with drift eliminator efficiency and the amount of solids (TDS) in the water used. The PM10 emissions from cooling tower drift would cause less than significant impacts, as the emissions would be fully mitigated by emission reduction credits. As with the ACC system, any potential or actual power plant performance penalties compared to the proposed project would not result in air emissions that must be tied to the project. Therefore, impacts would be less than significant with the operation of a hybrid cooling system.

Zero Liquid Discharge

Installation of a ZLD system, whether with a crystallizer or solar drying, would result in additional short-term construction impacts. A solar-based system would require construction of 6 to 10 acres of evaporation ponds, which would require additional earth moving, which would have greater construction PM10 and equipment emissions than the crystallizer system.

ZLD membrane, evaporator, and crystallizer processes are fully closed systems that do not vent significant water or air emissions to the air. In fact, evaporators and crystallizers recover the majority of evaporated water in the form of condensates. However, solar ponds do evaporate water and do not recover condensates, but are relatively slow-rate benign unit processes that will not have PM10 emissions during normal operation. To minimize the release of dust during the removal of dried salt cake from solar drying ponds, various crystal enhancement chemicals are available that encourage the creation of large crystalline solids and minimize the generation of fine dust. The use of solar evaporation structures would further reduce the risk of dust generation during salt cake loading.

Impacts of the construction and operation of both types of systems can be reduced to less than significant through implementation of construction mitigation measures and measures that would minimize dust during transport of salt cake.

Mitigation for all Cooling Options

Construction

The implementation of the District and staff Conditions of Certification (as presented in the **Air Quality** section of the PSA) regarding construction emissions would address and mitigate to less than significant levels any potential impacts from increases in emissions from the construction of either of the cooling technologies, the recycled water pipeline, or the ZLD system.

Operation

If the applicant decided to implement hybrid or dry cooling, use reclaimed water, or install a ZLD system, the potential operational air emissions changes at CPP would be modeled for impacts and mitigated or offset, as appropriate.

Conclusion for Air Quality

The potential construction emission increases could increase the short-term impacts; however, these impacts are expected to be small, as equipment associated with the dry cooling fraction is largely manufactured in large components offsite and assembled on-site. Staff and the District have proposed Conditions of Certification that would minimize construction emissions, and mitigate the impacts to less than significant levels.

Furthermore, if PM10 violations were measured, construction activities could be modified to reduce emissions sufficiently to ensure that standards are not violated.

Any potential or actual power plant performance penalties associated with the cooling technologies, as compared to the existing or proposed project, would not result in air emissions that must be tied to the project. In addition, any air emissions changes at CPP would be modeled for impacts and mitigated or offset, as appropriate. Therefore, air emissions and impacts would be less than significant with the operation of either of the cooling system technologies, and with reclaimed water.

6.2 BIOLOGICAL RESOURCES

Melinda Dorin

Introduction

The CPP as proposed by SMUD may have significant impacts on biological resources. Staff is still waiting for information from SMUD, and has been unable to make a recommendation in the Preliminary Staff Assessment (see **Biological Resources** section). Two of the outstanding issues that are relevant to this cooling options analysis, are potential impacts to fisheries in the Lower American River, due to the proposed water use, and the location of sensitive biological resources along the proposed gas pipeline route.

While the reclaimed water pipelines would be long for either of the proposed alternatives, the routes generally are either along existing disturbed rights-of-way or along existing paved roads. This decreases the likelihood of additional significant impacts being caused by pipeline construction. However, staff has not had the opportunity to conduct either a wetland delineation, or biological surveys along the proposed water pipelines, so a definitive impact determination cannot be made at this time.

Since the applicant has not performed biological surveys, staff conducted a search in both the California Department of Fish and Game (CDFG) California Natural Diversity Database (CNDDB), and in the U.S. Fish and Wildlife, Sacramento Office's database to gather existing biological resources information. The following is a general list of the species most likely to be impacted from the proposed water use and additional linear facilities. This list does not constitute a complete list of sensitive species and habitats that are addressed in staff's Preliminary Staff Assessment for the CPP (see **Biological Resources** section):

- Invertebrates, associated with wetland and vernal pool habitats (i.e., fairy shrimp)
- Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus*
- Delta smelt, *Hypomesus transpacificus*
- Central Valley steelhead, *Oncorhynchus mykiss*
- Winter-run chinook salmon, *Oncorhynchus tshawytscha*
- Central Valley fall/late fall-run chinook, *Oncorhynchus tshawytscha*
- Central Valley spring-run chinook salmon, *Oncorhynchus tshawytscha*.
- California tiger salamander, *Ambystoma californiense*

- Giant garter snake, *Thamnophis gigas*
- Western burrowing owl, *Athese cunicularia hypugaea*
- Swainson's hawk, *Buteo swainsoni*
- Greater sandhill crane, *Grus canadensis tabida*
- Several species of rare plants, associated with wetlands and vernal pool habitats
- As well as habitats such as claypan vernal pools, wetlands, and riparian corridors.

The following is a list of species that have been proposed for, or are designated as having, critical habitat in the project area:

- Delta smelt
- Valley elderberry longhorn beetle
- Central Valley fall/late fall-run chinook
- Central Valley spring-run chinook salmon.

Recycled Water Supply Options

Sacramento Regional Wastewater Treatment Plant

The existing route for the gas pipeline may have significant impacts on biological resources. Biology staff will be exploring options for rerouting segments of the alignment in order to decrease impacts to less than significant levels. Widening the existing proposed easements to accommodate a water pipeline next to the gas pipeline would have potentially significant cumulative impacts to areas that have high densities of wetlands.

Staff supports the idea of using the same easement for the gas pipeline and a reclaimed water pipeline, in order to reduce impacts to biological resources to the smallest corridor possible. The width of the impacted corridor would be smaller than having two separate easements and the restoration and revegetation could be completed at one time. This would reduce any long-term impacts. However, if the applicant adopted this option, biological surveys would be required in order that any sensitive species or wetland areas could be avoided, and habitat compensation would be recommended to mitigate unavoidable impacts. This mitigation appears feasible.

Staff proposes that if this alternative is selected then the water pipeline follow the final gas pipeline route.

City of Lodi White Slough Water Pollution Control Facility

The proposed pipeline route would have minimal impacts to sensitive species habitat as it is proposed to follow paved roads. Impacts to California tiger salamander may occur at the northern end of the proposed pipeline. These impacts would also occur from construction of the proposed gas line. The same measures taken to protect and mitigate for the gas pipeline construction activity would be applied to construction of the water pipeline. Once the pipeline heads south from the project site the route is defined as being entirely within existing roads and no new habitat loss from construction would occur.

Surveys would have to be completed along the proposed route in order to assess potential for injury or mortality to individuals such as burrowing owls. There is also the potential for wetlands, ditches, and vernal pools that have rare plants, or invertebrates present, to be located along the road. Impacts to these habitats would be mitigated using the same measures as for the gas pipeline. If this alternative were selected, then surveys would be required, and avoidance or habitat compensation would be recommended for sensitive species or habitats to ensure that all impacts are mitigated to less than significant levels. This mitigation appears feasible.

City of Galt Wastewater Treatment Plant

This is the shortest proposed water pipeline, so it is likely that this route would have the fewest impacts to sensitive species and habitats. The proposed reclaimed water pipeline would be parallel to that of the proposed gas pipeline for a majority of its route.

Surveys would have to be completed along the new portion of the proposed route in order to assess potential for injury or mortality to individuals such as burrowing owls. There is also the potential for wetlands, ditches, and vernal pools that have rare plants, or invertebrates present, to be located along the railroad tracks. Impacts to these species and habitats would be mitigated using the same measures as for the gas pipeline. If this alternative is selected, then surveys would be required to assess the biological resources present along the route and avoidance or habitat compensation would be recommended for sensitive species or habitats to ensure that all impacts can be mitigated to less than significant levels. This mitigation appears feasible.

Hybrid Cooling

There is not a major difference in noise, height, or appearance between a plume abatement tower (such as that suggested for both the 95/5 hybrid and Phase 2 of the 50/50 hybrid) and the SMUD proposed cooling tower. Therefore, there would be no substantial increase in impacts to biological resources at the site from either of these hybrid cooling facilities, as compared to the proposed project. As for the proposed cooling towers, there is a potential for collision with the towers by birds or bats that forage or migrate at night or in inclement weather, but this impact would be the same as for the proposed project. The plume abatement tower would not create a significant new collision impact to biological resources. For discussion of the impacts of the dry cooling structure that would be used in Phase 1 of the 50/50 hybrid, see the “Dry Cooling” section below.

A hybrid cooling system would result in a net benefit to biological resources within the Lower American and Sacramento Rivers by reducing the amount of cooling water necessary at the proposed CPP. A hybrid cooling system would lessen the amount of water that was drawn out of Folsom South Canal. This would result in a decrease of water being diverted from the Lower American River. Although SMUD has a contract and a water right for the use of Lower American River water, any water that SMUD did not use would be available for the benefit of existing biological resources. Additional water that moves through the Sacramento–San Joaquin Delta improves habitat for federally- and/or state listed endangered species such as winter-run chinook salmon, delta smelt, Central Valley steelhead, and Sacramento splittail.

Water that would be made available through the Water Forum, or the Environmental Water Account, especially in dry years for environmental uses would result in a benefit to fish species in the American River and the Sacramento–San Joaquin Delta. The Central Valley Regional Water Quality Control Board Basin Plan for the Sacramento and San Joaquin River Basins lists a multitude of beneficial uses for the Lower American River. Among those are: municipal and domestic supply, irrigation, industry, power, recreation, warm and cold freshwater habitat, migration, spawning, and wildlife habitat. The basin plan implements objectives in order to maintain all of the above beneficial uses. An alternative cooling system would help make water available for environmental use (CVRWQCB, 1998).

Clay Creek has changed from historically being an ephemeral creek that carries water only in the rainy months and dries completely in the summer, to one that carries water all year, due to SMUD water discharges from the decommissioned Rancho Seco Nuclear Facility. The water released to Clay Creek from Rancho Seco is used downstream for irrigation of vineyards and other uses. Clay Creek becomes channeled in the vicinity of the vineyards. Use of either hybrid cooling would reduce discharge from that of the originally proposed project.

Dry Cooling

The dry cooling towers would be shorter then the SMUD proposed cooling towers, so there would be no significant impacts to biological resources due to collision. Any potential impacts to plant or animals from the cooling tower drift would also be avoided with a dry cooled facility. However, the ACCs would require disturbance of a larger land surface area than either the proposed project or hybrid cooling towers. Biological surveys would be required, with mitigation in the form of avoidance or habitat compensation if sensitive species or habitats were identified. This mitigation appears feasible.

The reduction in the amount of surface water that would be needed at the proposed CPP would benefit resources in the Lower American River, and the Sacramento River (see above discussion).

Zero Liquid Discharge (ZLD Options 1 and 2)

Biological resources staff supports the ZLD alternative, which would result in Clay Creek flow remaining the same as it would be without the CPP project. Although Clay Creek has water in it all year due to discharges at Rancho Seco, historically Clay Creek was ephemeral in nature. The habitat at the site now consists of seasonal swales and vernal pools that hold water in the wet season and then dry out in the spring. The plants and animals associated with this type of habitat have adapted their life cycles in order to survive. Sensitive species such as California tiger salamander, western spadefoot toad, vernal pool invertebrates, and vernal pool plants either aestivate or are dormant in the summer months. These special status species would not be adversely affected if there were less, or no flow in Clay Creek during the summer. Clay Creek is tributary to Hadselville Creek, which is tributary to Laguna Creek, which in turn is tributary to the Cosumnes River. Laguna Creek as well as the Cosumnes River dry up in the summer months. Therefore, a decrease in flows to the Cosumnes River would not adversely affect the aquatic resources in the Cosumnes River.

Biology staff would prefer the use of ZLD Option 1 (crystallizer) to ZLD Option 2 (solar). The crystallizer would have a smaller footprint, and therefore lessen habitat impacts. There are drainages and vernal pools located south of Clay East Road, that staff would prefer that the project avoid. Impacts from the proposed laydown area would result in a temporary loss of habitat (for two years), but ZLD facilities on the site would remove habitat for foraging and nesting habitat for the life of the project. Staff would need to evaluate the permanent loss of this habitat for its significance and recommend appropriate mitigation. Although mitigation appears feasible, staff prefers to avoid the impact altogether.

Conclusion for Biological Resources

In conclusion, Energy Commission biology staff supports the use of reclaimed water and a ZLD system. The 50/50 hybrid system with reclaimed water from Galt would minimize pipeline construction impacts. Although the appropriate biological resources surveys have not been completed for the proposed pipeline routes, staff prefers that the pipeline routes be located along existing roads where possible in order to minimize habitat loss and the potential to impact sensitive species.

Biology staff prefers that ZLD Option 1 be implemented in order to keep the permanent project footprint on the north side of Clay East Road and to limit the amount of long-term habitat disturbance that would be necessary.

Using a smaller amount of surface water for cooling the proposed CPP would benefit habitat and fisheries resources in the Lower American River, and the Sacramento–San Joaquin Delta. If SMUD did not consume its full entitlement of water, it would be available to benefit the uses outlined in the Basin Plan, as well as benefit additional sensitive fisheries.

6.3 CULTURAL RESOURCES

Dorothy Torres

Introduction

This section addresses the potential for recycled water pipelines, dry or hybrid cooling, and ZLD systems, to affect cultural resources.

Recycled Water Supply Options

Sacramento Regional Wastewater Treatment Plant

The water pipeline from the Sacramento Regional Wastewater Treatment Plant to the CPP would follow the proposed gas line route. Both previously recorded and newly identified cultural resources are present along the currently proposed gas line route. Expanding the width of the trench to accommodate an additional water line would increase the potential for damage to cultural resources in the path of the gas line and adjacent to it. Cultural resources evaluated as eligible to the National Register of Historic Places (NRHP) or the California Register of Historic Resources (CRHR) would require mitigation. Some presence/absence testing has been performed by SMUD and more is planned. If necessary, SMUD will also evaluate several sites in the near future. If this option were selected, SMUD would need to perform additional cultural resources surveys and research along this wastewater pipeline alignment, and appropriate mitigation (avoidance or recovery) would be developed. This mitigation appears feasible.

City of Lodi White Slough Water Pollution Control Facility

The addition of another long linear to the project increases the potential for impacts to previously undiscovered and unidentified cultural resources. Staff's background research for this linear is incomplete, however a review of the portion of the proposed line in Sacramento County revealed that there have been very few cultural resources surveys in the area proposed for the line. Although there were few surveys, one revealed that the proposed linear would run through an identified site that is now bisected by a road. If this option were selected, SMUD would need to perform additional cultural resources surveys and research along this wastewater pipeline alignment, and appropriate mitigation (avoidance or recovery) is likely to be feasible and would be developed.

City of Galt Wastewater Treatment Plant

If 50/50 hybrid cooling was implemented and Galt supplied all cooling water, this proposed alternate route would impact the same cultural resources that the portion of the gas line on Arno Road would impact. A records search identified two areas in which the line from the City of Galt Wastewater Treatment Plant has the potential to impact historic transmission lines, identified during a 1999 survey of the area. Apart from the historic transmission lines, the area between Arno Road and the Galt Wastewater Treatment Plant does not appear sensitive for cultural resources. However, although previous surveys have not identified many cultural resources in the vicinity of the proposed line, there is still a potential for subsurface ground disturbance to impact previously unidentified cultural resources. If this option were selected, SMUD would need to perform additional cultural resources surveys and research along this wastewater pipeline alignment, and appropriate mitigation (avoidance, recovery, or recordation) is likely to be feasible and would be developed.

Hybrid Cooling

No potential historic resources have been identified in the vicinity of the plant that would be adversely affected by the proposed plant or the hybrid cooling towers. Although there is a potential to discover archaeological resources, since it does not appear that the plant footprint would affect any archaeological resources and the hybrid cooling apparatus would be built within the proposed footprint, there do not appear to be any additional impacts. It does not appear that the hybrid cooling option would adversely affect any identified cultural resources.

Dry Cooling

There are no historic resources, identified within the vicinity of the proposed plant that would be adversely affected by the plant. There is a potential to discover buried archaeological resources; however, the project footprint and area adjacent to the plant were also surveyed for the proposed project and no cultural resources were identified. Therefore, it does not appear that there would be any additional impacts to cultural resources from dry cooling.

Zero Liquid Discharge

Option 1: Crystallizer System

Zero Liquid Discharge (ZLD) Option 1 (Crystallizer System) would be located within the proposed plant boundaries and would not impact any currently identified cultural resources. As with the proposed project, there is a potential to impact previously undiscovered archaeological resources due to ground disturbance. These impacts could be reduced to less than significant levels with implementation of mitigation measures (avoidance or recovery) which are likely to be feasible.

Option 2: Solar System

Potential cultural resources have been identified in the vicinity of the proposed parking and laydown areas, which is the same location as for the solar evaporation ponds. Pursuant to Confidential Attachment CR-41, avoidance of these resources would be easily accomplished due to the design of the planned uses of parking and laydown (SMUD, 2002g). The resources are clustered in one area. Mitigation using flagging or fencing to avoid the resources appears feasible. The area that includes the resources would not be graded or paved. If ground disturbance necessary for construction of the evaporation ponds were greater than that for the proposed laydown area, and the identified resources could not be avoided, the potential cultural resources would need to be evaluated for eligibility to the NRHP or CRHR. If they are eligible for either register, mitigation would be necessary and at this time appears feasible. Recordation is the most logical mitigation because the resource appears to be historic, but data recovery may also be appropriate. The **Cultural Resources** PSA Section presents mitigation measures that could also be used to mitigate impacts of the ZLD solar system.

Conclusion for Cultural Resources

Much of the proposed reclaimed water pipeline route from Arno Road to the City of Galt Wastewater Treatment Plant has been surveyed within the past five years for cultural resources. Those surveys did not identify many cultural resources in the vicinity of that proposed linear and it may be possible to avoid those that were identified. There is still a potential to impact subsurface cultural resources during ground disturbance. However, from the information available it appears than impacts to cultural resources on this proposed route are not likely. Regardless, if this or any other new pipeline route were selected, surveys and research would be required, and appropriate mitigation would be recommended to reduce impacts to less than significant levels.

A review of the portion of the reclaimed water line proposed from the City of Lodi White Slough Water Pollution Control Facility, located in San Joaquin County, demonstrated that there have been very few cultural resources surveys in the vicinity of the proposed linear beginning near the City of Lodi Pollution Control Facility. A thorough cultural resource assessment of this route would include a cultural resources survey.

The line from the Sacramento Regional Wastewater Treatment Plant, to be routed next to the gas line, has the potential to have additional impacts to several previously identified cultural resources. Mitigation for those resources may be necessary. The possibility of discovering new cultural resources is increased by additional ground disturbance, so surveys and appropriate mitigation would be required.

Hybrid cooling, dry cooling, and ZLD Option 1 would not cause impacts to any previously identified cultural resources. The potential for impacts to undiscovered cultural resources would be the same as for the proposed project, and could be mitigated by avoidance or data recovery as defined in the Conditions of Certification in the **Cultural Resources** PSA section.

ZLD Option 2, like the proposed laydown area, has the potential to impact previously identified resources. However, the resources are clustered in a specific location in the proposed laydown area. The area can be easily staked or fenced to ensure avoidance by ground disturbing equipment. The location of the potential resources will not be graded or paved for the laydown areas. If avoidance by ZLD Option 2 is not possible, eligibility to the NRHP or CRHR would need to be determined and if eligible, mitigation (probably recordation or data recovery) would need to be developed. The possibility of discovering additional cultural resources would be increased by additional ground disturbance, so the potential for impacts to cultural resources would be greater with this option. It is not clear whether the potential cultural resources could be avoided by the solar evaporation ponds. Depending on the size and configuration of the ponds, it may be possible to ensure avoidance by staking or fencing off the resources in a manner similar to that proposed for the laydown areas.

6.4 HAZARDOUS MATERIALS MANAGEMENT

Alvin Greenberg, Ph.D.

Introduction

The CPP is currently proposing to use potable water from the Folsom South Canal for cooling. The purpose of this analysis is to determine if there would be any additional impacts due to use of hazardous materials for the different water supply and cooling options.

Recycled Water Supply Options

With all three recycled water options, there are minor amounts of hazardous materials (fuels, solvents, lubricants, etc.) used in the construction of pumping facilities and pipelines. Because of the small amounts, low potential for off-site migration, and/or solid form, the use of hazardous materials during the construction of any wastewater pipeline and pump stations would not result in a significant risk to the public.

The municipal secondary treated effluent from the treatment plant would need to be processed and pretreated before it can be used as a cooling medium in the CPP project. Manufacturers of cooling equipment typically specify that the cooling medium to be used meet certain criteria in order to be acceptable for use with their equipment. This is necessary to alleviate the general water quality problems of scaling, corrosion, biological growth and fouling. The pretreatment involves chemical conditioning, but the type, level, frequency and intensity of the pretreatment would depend on three factors: the quality of the reclaimed water, the ability of the treatment plant to consistently maintain the quality of the effluent without violating regulatory discharge standards, and the technical specifications for the cooling medium as required by the cooling equipment manufacturers. The CPP's design engineer would need to specify the type and amount of each chemical that would be required under the reclaimed water-cooling scenario. Then, compliance with LORS and implementation of specific recommended Conditions of Certification would ensure that impacts would not be significant.

Hybrid Cooling

Hybrid cooling systems combine wet and dry cooling technologies, and reduce cooling water quantities in comparison to wet cooling systems. The 95/5 hybrid cooling system proposed for the CPP would include a plume abatement cooling tower consisting of eight cells. The 95/5 hybrid cooling alternative would use less water volume than the proposed wet cooling system, and the water could be either from the Folsom South Canal or treated wastewater. If this hybrid cooling option were implemented, the specific components of the recycled water would need to be identified. Then, appropriate Conditions of Certification would be developed to ensure that impacts from potentially hazardous components would be less than significant.

The 50/50 hybrid option would not use water in Phase 1 (which would use dry cooling), but would use a plume-abated hybrid tower with recycled or fresh water for Phase 2. Impacts after both phases would be midway between the dry and 95/5 hybrid cooling options.

Dry cooling would not use the large volumes of water used in wet or hybrid cooling systems and hence would reduce the volume of chemicals (e.g., sodium hypochlorite) needed to control algae growth within the system (particularly in the condenser tubes). Thus, hazardous materials usage would decrease. On the other hand, the larger volume of piping including seals, flanges, and valves, may result in oxygen entry into the system and therefore require an increase use in oxygen scavengers to prevent corrosion and scaling. The CPP project is proposing to use carbohydrazide, a material of very low toxicity, as an oxygen scavenger. There could be a substantial increased use of carbohydrazide for a dry cooling system, but this would still not result in a significantly increased risk or hazard. Thus, the overall use of hazardous materials with dry cooling would be the same or less than as with wet cooling.

Zero Liquid Discharge

Neither ZLD system would use the large volumes of water used in wet or hybrid cooling systems and hence would reduce the volume of chemicals (e.g., sodium hypochlorite) needed to control algae growth within the system (particularly in the condenser tubes).

Thus, hazardous materials usage would decrease. On the other hand, the use of larger amounts of oxygen scavengers to prevent corrosion and scaling would be required. The CPP project, in its preliminary ZLD proposal, is proposing to use carbohydrazide, a material of very low toxicity, as an oxygen scavenger. The substantially increased use of carbohydrazide in either ZLD option would still not result in an increased risk or hazard. Thus, the overall use of hazardous materials with either ZLD system would not be expected to create a significant impact with implementation of standard Conditions of Certification.

Conclusion for Hazardous Materials Management

The construction of any of the cooling or discharge options would require very small amounts of hazardous materials. The impacts are expected to be no different from those identified for the construction of the proposed CPP as described in the **Hazardous Materials Management** PSA Section and can be addressed by adherence to the LORS and proposed Conditions of Certification found in the Staff Assessment.

The use of water from either the Folsom South Canal or reclaimed water in the cooling process would require the storage and use of hazardous chemicals. As a minimum, the quality of the reclaimed water, cooling medium specification requirements, and applicable waste discharge standards would all influence the types of chemicals needed and their quantities for treating reclaimed water used in cooling.

Staff does not consider the impacts from any of the water sources, cooling, or discharge options discussed to be significantly different, since rather minor differences in hazardous materials use would exist with any of the options. Any risks associated with chemical usage in cooling water should be adequately mitigated through compliance with the appropriate federal, state, and local requirements for hazardous materials use and adherence to the applicant’s and staff’s proposed Conditions of Certification. These proposed mitigation methods are standard for power plants licensed by the Energy Commission and thus the overall risk due to hazardous materials is approximately the same for all proposed water sources and cooling methods. However, because staff does not know at this time the identity and amounts of the chemicals needed to use secondary treated reclaimed water in any of the cooling options assessed, the potential risk or hazard cannot be definitively determined at this time.

6.5 LAND USE

Jim Adams

Introduction

A variety of water supply and cooling options have been analyzed regarding the operation of the CPP. The discussion below relates to the potential land use impacts of the particular options.

Recycled Water Supply Options

Sacramento Regional Wastewater Treatment Plant

Given the proposed use of the CPP gas line easement, from a land use perspective there are no significant differences between this option and the use of water from the Folsom South Canal.

City of Lodi White Slough Water Pollution Control Facility

The applicant would need to comply with all applicable LORS for San Joaquin County and the City of Lodi. In terms of land use impacts, the Sacramento Regional Wastewater Treatment Plant is preferred over the Lodi water source because the Lodi facility would require the establishment of an entirely new pipeline route, contacts with two new jurisdictions, and potential effects on more landowners.

City of Galt Wastewater Treatment Plant

This alternative would require compliance with the applicable LORS for Sacramento County and the City of Galt. Public rights-of-way should be utilized whenever possible, however directional boring may be required. This option is not as advantageous as the option in which Sac Reg wastewater would be used, because this option would require disturbance in a new right-of-way (where the Sac Reg route would be disturbed for the gas pipeline for the proposed project). This option would require one new jurisdiction's (City of Galt) involvement, and would also have potential effects on more landowners.

Hybrid Cooling

Hybrid cooling towers would occupy the same footprint as the proposed wet cooling towers. The hybrid tower facility would be consistent with Sacramento County's land use LORS.

Dry Cooling

The land use issue for this option revolves around an adequate area to accommodate air-cooled condensers and related structures. SMUD owns enough land on which to construct and operate a dry cooling system, but a dry cooling system would require disturbance of more land than the proposed project. The dry cooling facility, as part of a public-quasipublic use, would be consistent with Sacramento County's LORS.

Zero Liquid Discharge (ZLD Options 1 and 2)

If either zero liquid discharge option were utilized, it would have to be consistent with the applicable LORS for Sacramento County.

Conclusion for Land Use

Staff has concluded that the various water supply and cooling options would have no significant impacts with respect to land use when compared with the proposed use of Folsom South Canal water, as long as the applicable LORS are complied with, which appears feasible. Sac Reg and Galt are preferred to other recycled water sources for reasons stated above.

6.6 NOISE

Introduction

The use of either dry or hybrid cooling systems would change the number and locations of noise sources in the overall plant design. The most significant noise sources in these systems are the fans, which are located relatively high on the system structures. Dry and hybrid cooling tower fans may be slightly higher than wet cooling fans. All cooling systems would have circulating water pumps, with motors typically located near ground level, and which may be shielded by other system components. The sides of the wet cooling tower structure may significantly shield noise from cascading water.

The array of structures for both dry and hybrid systems may provide shielding of some units for receptors, depending on the receptor position. That is, one of the cooling towers or ACC units may block line of sight to some or all of the others, which would reduce the noise received from the shielded units. For receptors parallel to the array, each unit would contribute noise to the total noise exposure, with little or no shielding. The power plant may also provide shielding for some receptors.

Any type of combined-cycle power plant introduces the possibility of high startup noise levels due to the need to bypass HRSG-produced high-pressure steam to the condenser until it is of adequate quantity and quality to send to the steam turbine. For dry cooling systems, the high-pressure startup steam would be ducted into the manifolds leading to the air-cooled condensers. Silencers or other acoustical treatment may be required in the steam lines to ensure that noise due to the steam bypass during startup does not exceed acceptable levels.

Noise level data used for this analysis were obtained for two low-noise fan and equipment system options from a supplier of cooling equipment for power plants and similar industrial installations. The actual noise emissions of a given cooling system installation may vary from these values, depending on final system configuration, but the values presented here are expected to be reasonably representative of typical installations.

The Energy Commission staff has concluded that a potential for a significant noise impact exists where the noise of the project plus the background exceeds the background by 5 dBA L_{90} or more at the nearest noise sensitive receptor. Staff considers it reasonable to assume that an increase in background noise levels up to 5 dBA in a rural setting is insignificant; an increase of more than 10 dBA is clearly significant. An increase between 5 and 10 dBA should be considered adverse, but may be either significant or insignificant, depending on the particular circumstances of a case.

Factors to be considered in determining the significance of an adverse impact as defined above include:

1. The resulting noise level[7]
2. The duration and frequency of the noise
3. The number of people affected
4. The land use designation of the affected receptor sites
5. Public reactions or controversy as demonstrated at workshops or hearings, or by correspondence
6. Prior CEQA determinations by other agencies specific to the project.

Noise Impacts of Recycled Water Options

The primary noise from recycled water options would be short-term disturbance from construction equipment during pipeline construction. Proposed Conditions of Certification would ensure that these impacts were minimal.

Pump stations located along the recycled water pipeline routes could result in noise during operation. However, the pumps could operate within masonry block or concrete enclosures or buildings if necessary, and where practical, these stations would be located remote from nearby residences, so no noise impacts are expected.

Noise Impacts of Dry Cooling

In the dry cooling option, the array of air-cooled condensers would be placed either on the south and north ends of the power plant site, or on the east side of the site, in the approximate location of the proposed wet cooling towers. Two banks of 35 cells are proposed for Phase 1. Because specific fan types were not specified in Section 3.3, two options are evaluated here: Noise Option 1, with 150 horsepower (HP) fans, and Noise Option 2, with 125 HP fans. In the lower-noise configuration (Option 2), the same number of cells would be used, though each fan would be slightly larger. The reference noise levels and operational assumptions are presented in **Appendix A Table 4.**

Appendix A Table 4
Cooling Fan Installation Operational Assumptions
Dry Cooling Alternatives

Noise Option	No. of Fans	Motor Ratings	Sound Level, dBA at 400 feet	Layout
1	35 x 2	150 HP	58	195' x 275' x 2
2	35 x 2	125 HP	51	195' x 275' x 2

7 For example, a noise level of 40 dBA would be considered quiet in many locations. A noise limit of 40 dBA would be consistent with the recommendations of the California Model Community Noise Control Ordinance for rural environments, and with the data supporting the noise guidelines of the World Health Organization. If the project would create an increase in ambient noise no greater than 10 dBA at nearby sensitive receptors, and the resulting noise level would be 40 dBA or less, the project noise level would likely be insignificant.

Given the assumptions listed above, the noise levels due to the fan installations were predicted at the nearest receptors described in the AFC. The calculations accounted for hemispherical spreading, shielding by the combined-cycle units, and for ambient and predicted project operational noise levels. (Project noise levels were adjusted to eliminate the sound contribution of the proposed wet cooling system.)

The predicted noise levels at the nearest affected receptors are given in **Appendix A Table 5.**

Appendix A Table 5
Predicted Cooling System Noise Levels
Dry Cooling Alternatives

	Sound Levels at Receivers, dBA			
	Noise Option 1		Noise Option 2	
Condition	**R1 (Clay East)**	**R2 (Kirkwood St)**	**R1 (Clay East)**	**R2 (Kirkwood St)**
Cooling option	48	39	41	32
Ambient	32	31	32	31
Power plant (w/o cooling)	56	41	56	41
Cooling option cumulative*	56	43	56	42
LORS standard	45	45	45	45
Proposed project cumulative	56	42	56	42
Change from proposed project	0	+1	0	0
Change from ambient conditions	+24	+12	+24	+11

*Configuration plus ambient noise level.

The predicted values indicate that, for each dry cooling configuration, the cumulative noise levels at Receptor R1 would exceed the noise standards of the Sacramento County Noise Element, and the change in cumulative noise levels at that location would exceed the 5 dBA L_{90} noise level increase that staff uses as a threshold for determining whether there is the potential for a significant noise impact. However, the dry cooling system would not of itself cause the noise standards to be exceeded, as other elements of the project design dominate the noise exposure at R1.

At Receptor R2, the cumulative noise levels would not exceed the noise standards of the Sacramento County Noise Element, but the change in cumulative noise levels at that location would exceed the 5 dBA L_{90} noise level increase that staff uses as a threshold for determining whether there is the potential for a significant noise impact. However, the dry cooling system would not of itself cause the noise standards to be exceeded, as other elements of the project design contribute to the noise exposure at R2. The change in noise levels due to Dry Cooling Noise Option 1, as compared to the proposed wet cooling system, is one decibel, which is undetectable outside of laboratory conditions.

Energy Commission staff has recommended a Condition of Certification (**NOISE-6**) in the **Noise Section** of the PSA that would require that the power plant noise level not exceed 39 dBA at any residence. Compliance would ensure that the cumulative noise level due to the power plant operation and the background noise level would not exceed 40 dBA. This condition would permit an increase over ambient noise levels of up to 9 dBA. Staff would recommend compliance with this noise standard for the power plant using either of the cooling options.

Conclusion for Dry Cooling

The predicted noise levels associated with the project using either dry cooling option at Receptor R1 may create noncompliance with LORS, and would exceed the noise standard recommended by Condition of Certification NOISE-6. At Receptor R2, the predicted noise levels associated with both dry cooling options appear to comply with LORS, but would exceed the noise standard recommended by Condition of Certification NOISE-6. The changes in noise levels due to the dry cooling options, as compared to the proposed wet cooling system, are insignificant.

Noise Impacts of Hybrid Cooling

Noise Impacts of 95/5 Hybrid Cooling

A 95/5 hybrid cooling system would occupy approximately the same location as the proposed wet cooling system. The predicted noise levels for the hybrid system are the same as for the wet cooling system. **Appendix A Table 6** shows the predicted noise levels for the 95/5 hybrid cooling system.

Appendix A Table 6
Predicted Cooling System Noise Levels
95/5 Hybrid Cooling System

Condition	Sound Levels at Receivers, dBA R1 (Clay East)	Sound Levels at Receivers, dBA R2 (Kirkwood Street)
Hybrid cooling	36	30
Ambient	32	31
Power plant (w/o cooling)	56	41
Hybrid cumulative[1]	56	42
LORS standard	45	45
Proposed project cumulative	56	42
Change from proposed project	0	0
Change from ambient conditions	+24	+11

The predicted values indicate that, for a project using a 95/5 hybrid cooling system, the cumulative noise levels at Receptor R1 would exceed the noise standards of the Sacramento County Noise Element, and the change in cumulative noise levels at that location would exceed the 5 dBA L_{90} increase that staff uses as a threshold for determining whether there is the potential for a significant noise impact. However, the 95/5 hybrid cooling system would not of itself cause the noise standards to be exceeded, as other elements of the project design dominate the noise exposure at R1.

At Receptor R2, the cumulative noise levels would not exceed the noise standards of the Sacramento County Noise Element. However, the change in cumulative noise levels at that location would exceed the 5 dBA L_{90} increase that staff uses as a threshold for determining whether there is the potential for a significant noise impact. However, the cooling system would not of itself cause the noise standards to be exceeded, as other elements of the project design contribute to the noise exposure at R2.

There would be no change in noise levels due to the 95/5 hybrid cooling system, as compared to the proposed wet cooling system.

Noise Impacts of 50/50 Hybrid Cooling

The 50/50 hybrid cooling system is envisioned as a Phase I dry cooling system with Phase II plume abatement wet cooling. As a result, impacts would fall approximately midway between the impacts described above for dry cooling and for 95/5 hybrid cooling.

Conclusion for Hybrid Cooling

The predicted noise levels associated with 95/5 hybrid cooling at R1 would not comply with applicable LORS, and would exceed the noise standard recommended by Condition of Certification NOISE-6. At R2, the predicted noise levels associated with 95/5 hybrid cooling would comply with applicable LORS, but would exceed the noise standard recommended by Condition of Certification NOISE-6. The changes in noise levels due to 95/5 hybrid cooling, as compared to the proposed wet cooling system, would be insignificant. The impacts of the 50/50 hybrid cooling system would be slightly more than 95/5 hybrid cooling, and also insignificant.

Zero Liquid Discharge Systems

Two options are proposed: a crystallizer system (ZLD Option 1) and a solar system (ZLD Option 2). Both would require construction, resulting in short-term construction noise. The crystallizer system would have some operational noise (estimated by the applicant to result in an increase of 0.5 dB); this will be analyzed in the Final Staff Assessment. The solar option is preferred at this time because it would not create operational noise.

Construction Noise for All Options

Of the three cooling options (wet, hybrid and dry), construction of the hybrid and wet systems would produce generally lower noise levels, as the construction would occur farther away from the most sensitive receptors. If the dry cooling ACC condensers were located closer to the residences, this would result in higher levels of construction noise. Construction noise would also occur along the recycled water pipelines and during construction of a ZLD system. The allowable noise levels for construction activities would be the same for all alternatives, so the proposed Conditions of Certification would ensure that construction noise would be insignificant for all options with implementation of mitigation, which is believed to be feasible.

Conclusion for Noise

None of the cooling options would cause a perceptible change in noise levels at the nearest receptors as compared to the proposed wet cooling system. With all of the cooling options, there is a significant noise impact at R1, and a potentially significant impact at R2. At R1, it is anticipated that the applicant would arrange to have the mobile home relocated or otherwise converted into a compatible land use. At R2, it is anticipated that additional noise abatement can be provided for the most significant noise sources of the power plant so that the noise impacts may be mitigated to an acceptable level. However, the cooling system (whether wet or dry) may be a significant contributor to noise in the overall plant design, so it may be necessary to further reduce cooling system noise, regardless of the cooling system employed. If it is necessary to further reduce fan noise beyond that described for this analysis, the control of fan speed (via two-speed or variable speed motors), super-quiet fans, and related noise-mitigated equipment could be required, which could require additional cells and additional area.

6.7 PUBLIC HEALTH

Alvin Greenberg, Ph.D.

Introduction

Cosumnes Power Plant (CPP) is currently proposing to use potable water from the American River for cooling. Staff is evaluating sources of recycled water for the CPP facility and cooling and discharge technologies that would allow the volume of cooling water to be dramatically reduced. Any public health impacts from cooling-related use of reclaimed water would result from public exposure to any toxic constituents in the water posing cancer and non-cancer risks. The potential for such impacts would depend on the concentrations of such toxicants in the treated water or from construction equipment used to build conveyance and treatment facilities. There is no such exposure to these constituents that would result from the use of a ZLD system.

Recycled Water Supply Options

Impacts for the construction of pumping stations and a water pipeline of any length would be minimal and short-term. It is doubtful that air emissions from construction equipment, such as diesel exhaust, would be significant with respect to public health, as the emissions would be spread over the entire length of the pipeline and not emitted at any one location for any significant duration. For operations, three pumping stations would be needed. These pumps would most likely be electric and thus would have no emissions of toxic air contaminants from the stations themselves, although there would be minor criteria and non-criteria emissions from their source of electricity (which would most likely be at a distant location).

Hybrid Cooling

Department of Health Services' (DHS) regulations (CCR Title 22 §60306) govern the use of reclaimed water in cooling towers. Recycled water would be used in this cooling option and drift from cooling towers would occur. Residual substances (metals and organics) in the treated wastewater would be released to the atmosphere. The treated wastewater could contain more or fewer metals and organics than Folsom South Canal water, depending upon the method and the effectiveness of treatment. If treated to tertiary standards, biologicals (bacteria, viruses, or prions) are not expected to be present in concentration sufficient to pose a significant risk to the public. However, if treated to secondary standards, as proposed in the conceptual design of the hybrid cooling option using reclaimed water, effective drift eliminators (as currently proposed by the applicant for its wet cooling system) would be required. Chlorination may also be required to reduce health risks. Depending on the specific engineering and site location factors of the system, and the risk of public or worker exposure at the site, additional treatment may be required by the DHS. If this treatment is not applied effectively, pathogenic organisms including Coliform bacteria, viruses, and perhaps Legionella could be released into the air, thus posing a risk to the nearby public. Mitigation would require analysis of this possibility, and may result in a requirement for tertiary or other specified treatment of cooling water.

Also, as with the proposed project, the water used in a hybrid system (both 95/5 Hybrid with wet tower and plume abatement and the 50/50 Hybrid) must be treated with chemical additives to guard against system corrosion and biofouling (bacterial growth). These chemicals must be utilized at levels not posing a health hazard to humans at discharge to the air or wastewater collection system. This can be accomplished through Conditions of Certification.

Dry Cooling

Only minimal air emissions from the construction of the dry cooling system would occur under this option. It is doubtful that emissions of toxic air contaminants (TACs) would be significant. And, because no water is used for cooling under this option, no cooling tower drift would exist. Therefore, no public health impacts would occur.

Zero Liquid Discharge

Only minimal emissions from the construction or operation of the ZLD system would occur under ZLD Option 1 or 2. Some emissions would be associated with hauling residual salt cake offsite, but these would be minor, as only a few truck trips per day (or less) would be required. Therefore, no public impacts would occur.

Conclusion for Public Health

Use of secondary reclaimed wastewater could present a risk to public health from the operation of any system unless specific and extensive preventive measures as outlined in CCR Title 22 as noted above are implemented. No significant impacts would occur from implementing a ZLD system or dry cooling.

6.8 TRAFFIC AND TRANSPORTATION

James Fore

Introduction

A number of alternatives for water supply and cooling technologies for SMUD's CPP have been proposed for analysis. The water supply alternatives include alternate water supplies from the Sacramento Regional Wastewater Treatment Plant, the City of Lodi White Slough Water Pollution Control Facility, and the City of Galt Wastewater Treatment Plant. The cooling alternatives under consideration are a hybrid cooling system and dry cooling. Two ZLD systems were also considered. The traffic and transportation effects of using one of more of these alternatives for the CPP are analyzed below.

Recycled Water Supply Options

Sacramento Regional Wastewater Treatment Plant

The Sacramento Regional Sanitation District Regional Wastewater Treatment Plant is located in the vicinity of SMUD's Carson Ice-Gen Plant, where the natural gas fuel pipeline for the CPP would originate. The proposed water pipeline from the wastewater treatment plant would parallel the proposed natural gas pipeline route. This would require that the construction easement for the two pipelines be approximately 15 feet wider than the natural gas pipeline construction easement alone.

The construction of the wastewater pipeline would require an additional workforce and trucks for the delivery of equipment and supplies. The natural gas pipeline would require an average of 50 workers per month with a peak workforce of 53. Using a worst-case assumption that the construction of the wastewater pipeline would not require a workforce greater than that associated with the natural gas pipeline, the workforce for both pipelines (i.e., gas and wastewater) would require an average of less than 100 workers. The associated truck traffic would also increase due to the delivery of pipe for the water line and some additional equipment and supplies.

If CPP follows a traffic control plan that requires off road parking and laydown areas, then the additional construction activity should not result in significant effects for traffic. This is a result of the proposed pipeline route being located adjacent to railroad rights of way, through open fields, and parallel to existing roads that do not have heavy traffic flows.

When the pipeline is located in roadways, the project traffic control plan (required in Conditions of Certification) would have to ensure that:

- Construction signs are posted in advance of the start of construction activity to inform the public,
- One lane of traffic remains open during construction, and
- Flaggers are posted along these portions of the route to direct traffic.

City of Lodi White Slough Water Pollution Control Facility

The City of Lodi White Slough Water Pollution Control Facility (WSWPCF) is located approximately 30 miles southwest of the CPP site. This facility is located in Lodi, within San Joaquin County. CPP would be required to comply with applicable LORS for these jurisdictions.

Since the construction activity associated with this pipeline is comparable to the natural gas fuel pipeline, the level of truck traffic and workforce associated with its construction was used in the evaluation. Although the proposed pipeline route is located in open areas along rural roadways, it would require the crossing of Interstate 5 and State Route 99.

These crossings can be executed with minimal traffic effects through the use of directional boring. The impact on traffic can be maintained at an insignificant level because the route is located mainly along rural roadways with low traffic volumes and good levels of service (LOS). Only a portion of the pipeline route would be under construction for a short period of time and through the use of a traffic control program as required under **Standard Condition Trans-5** in the **Traffic and Transportation** section of the PSA.

City of Galt Wastewater Treatment Plant

The City of Galt Wastewater Treatment Plant is located approximately 12 miles southwest of the CPP. The proposed route for the pipeline would follow the Santa Fe and Union Pacific Railroad right of way until it intersects the CPP proposed natural gas fuel pipeline route. It would then share the natural gas fuel pipeline route. This portion of the route would be the same as the Sacramento Regional Wastewater Treatment Option. The pipeline route from the Galt wastewater treatment facility would not have a significant impact on the area roadways as long as the construction activity would be confined to the railroad right of way and the project requires off roadway workforce parking and laydown areas.

Hybrid Cooling

The hybrid cooling system combines wet and dry cooling technologies. This system requires less water and would have levels of construction activity and related traffic similar to those of the proposed project's wet cooling system. However, it would require workers for the construction and installation of the hybrid cooling system. Truck traffic would also be required for the delivery of hybrid cooling and plume abatement towers. If the delivery of additional equipment results in heavy loads, SMUD has agreed to deliver this equipment by rail. Therefore, there would be no additional traffic impact due to heavy loads.

If the additional construction activity associated with the increased workforce and truck traffic can be scheduled so that the maximum traffic identified in the PSA is not exceeded, then the construction of the hybrid cooling system would not change the results of the original traffic analysis. The LOS for Twin Cities Road and Clay East Road during construction stays well within acceptable traffic levels. Therefore, the project would not create significant traffic problems even if construction activity resulted in a slight increase in traffic.

Dry Cooling

The impact for dry cooling would be the same as the hybrid cooling if maximum traffic levels during construction do not change.

Zero Liquid Discharge (ZLD Options 1 and 2)

Construction of either ZLD option would require additional construction traffic above that of the proposed project.

Conclusion for Traffic and Transportation

Staff concludes that the various water supply and cooling options would not have significant effects on traffic and transportation, provided that these options do not result in increased traffic above the maximum traffic levels evaluated in the original proposal. Staff believes the original traffic levels can be maintained through construction scheduling for the required workforce and truck deliveries.

Of the recycled water options reviewed, traffic disruptions would be fewest if the recycled water line parallels the natural gas pipeline route. Since the major portion of the workforce and truck traffic associated with this option would be away from the CPP site, it would not result in a significant increase of construction traffic at the site.

6.9 VISUAL RESOURCES

Michael Clayton

Introduction

This section presents a visual analysis of the various water supply and cooling options. The primary issue of concern with respect to visual resources is the introduction of additional visible structures and plumes into the existing rural landscape. Three recycled water supply options were evaluated: (1) Sacramento Regional Wastewater Treatment Plant, (2) City of Lodi White Slough Water Pollution Control Facility, and (3) City of Galt Wastewater Treatment Plant. Hybrid and dry cooling options were also evaluated. Two zero liquid discharge options were also evaluated.

Recycled Water Supply Options

Sacramento Regional Wastewater Treatment Plant

Under the Sacramento Regional Wastewater Treatment Plant option, cooling water would be transported to the site by an underground pipeline to the CPP. The water pipeline would parallel the proposed gas pipeline with a five-foot separation distance. As discussed under the visual analysis of the gas pipeline, the pipeline route would pass through areas that are characterized as urban residential, rural residential, light industry, agriculture, and open space. The pipeline route would generally follow a railroad alignment and roadways, and would cross some agricultural fields. Since the pipeline would be underground, there would be no long-term visual impacts from project operation. Therefore, only temporary visual impacts associated with pipeline construction would occur.

There are approximately 530 residences located along the 26-mile pipeline route that are within 500 feet of the pipeline alignment (SMUD 2002a, Data Response #90). However, it is likely that not all of these residences would have a view of the pipeline construction because of the elevation of residences relative to the pipeline, the orientation of the residence relative to the pipeline, and the presence of vegetation, fencing, or other structures that would obstruct views from the residence.

A typical pipeline construction spread would include a bulldozer, backhoe, and boom trucks, excavators, material delivery trucks, welding trucks, and inspection vehicles. In traffic areas, the construction spread would be less than 500 feet in length. In rural or agricultural areas, the size of the construction spread would depend on safety and construction efficiency. As discussed in the visual analysis of the proposed gas pipeline, the speed of construction for the gas pipeline would be 100 feet to 500 feet per day and could potentially be viewed from residences for one to seven days with decreasing levels of visual clarity as the distance to construction activities increases. With the addition of the water pipeline to the pipeline construction spread, more construction crews would be used and the pipeline construction spread would be visible for a longer period of time from any point along the route. However, the duration that a construction spread would be visible from nearby residences would still be relatively short and the resulting adverse visual impacts would be less than significant. Furthermore, implementation of staff's Conditions of Certification **VIS-1** (screening of staging areas and right of way restoration) and **VIS-4** (construction lighting) would ensure that pipeline construction impacts do not become significant.

City of Lodi White Slough Water Pollution Control Facility

Under the Lodi White Slough Water Pollution Control Facility option, cooling water would be transported to the site by a 30-mile underground pipeline to the CPP. The pipeline route would follow existing road right-of-ways through rural residential and agricultural areas. The route would also pass through the more urban setting of Lockeford. Since the pipeline would be underground, there would be no long-term visual impacts from project operation.

The layout, components, and pace of a typical pipeline construction spread are described in the previous section. Although adverse visual impacts would result from the visibility of pipeline construction, the length of time that the pipeline spread would be visible from any residence along the route would be relatively short, and the resulting visual impacts would be less than significant. As described above, implementation of staff's Conditions of Certification **VIS-1** and **VIS-4** would ensure that pipeline construction impacts do not become significant.

City of Galt Wastewater Treatment Plant

The City of Galt Wastewater Treatment Plant could provide all required cooling water for the 50/50 Hybrid Cooling option, or about half of the cooling water for wet cooling or the 95/5 Hybrid cooling options. In either case, the pipeline route would follow existing railroad and road right-of-ways and pass through some open fields. The pipeline landscape is primarily characterized by rural residential and agricultural uses. Since the pipeline would be underground, there would be no long-term visual impacts from project operation.

The layout, components, and pace of a typical pipeline construction spread are described above. Although adverse visual impacts would result from the visibility of pipeline construction, the length of time that the pipeline spread would be visible from any residence along the route would be relatively short, and the resulting visual impacts would be less than significant. Implementation of staff's Conditions of Certification **VIS-1** and **VIS-4** would ensure that pipeline construction impacts do not become significant.

Hybrid Cooling

Under the 95/5 hybrid cooling option, two plume abatement towers (one for each project phase) would be utilized instead of two conventional wet cooling towers as proposed. The 95/5 hybrid cooling towers would be in the same location as the proposed cooling towers though they would be somewhat larger. Each of the two 95/5 hybrid cooling towers (consisting of eight cells) would be 70 feet tall by 50 feet wide by 400 feet long. By comparison, the two proposed cooling towers (consisting of nine cells) would be 43 feet tall by 66 feet wide by 432 feet long. Thus, the 95/5 hybrid cooling towers would be 17 feet taller than the proposed towers though they would have similar visual character.

Compared to existing views, the resulting visual impacts from 95/5 hybrid cooling would be similar to the proposed project except for a slight increase in view blockage caused by the slightly larger cooling structure. When viewed from nearby residences and roads, the greater height of the hybrid cooling towers would cause slightly more view blockage of one or more of the primary three background landscape features consisting of sky, nearby agricultural fields, and Sierra Nevada foothills. However, even though there would be a slight increase in view blockage, the resulting visual change would not cause a significant visual impact in the context of the overall low-to-moderate to moderate visual sensitivities of the existing landscape (given the presence of the large natural draft cooling towers of the decommissioned nuclear facility) and viewing characteristics.

Plume abatement towers would be specifically designed to minimize the visible vapor plumes, although insufficient design details have been developed for the 95/5 hybrid cooling option to enable accurate characterization of the resulting vapor plumes. However, for the purposes of this analysis, it is assumed that the 95/5 hybrid vapor plumes that would be significantly less than those resulting from the mitigated proposed project.

The 50/50 hybrid configuration would have dry cooling for the first phase and a plume abatement tower for the second phase. Visual impacts are therefore expected to be midway between the 95/5 hybrid and dry cooling.

Dry Cooling

Under the dry cooling option, two air-cooled condensers (ACCs) would be necessary (one for each steam turbine generator). Each ACC would consist of 35 cells in a seven by five array resulting in overall dimensions of 70 feet tall by 198 feet wide by 275 feet in length. With the STG located outboard of each set of CTGs, one ACC could be located at each end (north and south) of the plant. A less intrusive arrangement would be possible by locating each STG between the two CTGs in each phase, which would enable the ACCs to be located in the approximate location of the proposed wet cooling towers.

When viewed from the west (KOPs 1 through 3), the two ACCs would be more visible at each end (north and south) of the proposed power plant compared to the proposed wet cooling tower location, which would be behind (to the east) the power generation facilities. Views of the ACCs from Rancho Seco Park (KOP 4) east of the site would be substantially screened by the reservoir dam/access road. However, from the west, the more highly visible ACCs would appear similar in visual character to the proposed cooling towers but the new structural configuration on the project site would result in a slight increase in visual contrast and view blockage.

Compared to existing views, the resulting visual impacts from dry cooling would be similar to the proposed project except for a slight increase in visual contrast and view blockage. When viewed from nearby residences and roads, the ACCs would block from view additional areas of sky, nearby agricultural fields, and Sierra Nevada foothills. However, even with the slight increase in visual contrast and view blockage, the resulting visual change would not cause a significant visual impact in the context of the overall low-to-moderate to moderate visual sensitivities of the existing landscape and viewing characteristics.

Furthermore, this cooling option would eliminate the production of cooling tower vapor plumes or any contribution to area ground fog and the attendant significant visual impact that would result with the proposed project.

Zero Liquid Discharge (ZLD Options 1 and 2)

Crystallizer System

Either ZLD option would require the addition of a 20 feet tall by 60 feet wide by 100 feet long building to house the membrane processes. The VCE evaporator would be 65 to 70 feet tall and have a diameter of 6 to 8 feet. The crystallizer for ZLD Option 1 would be 55 feet tall and have a mid-height diameter of 12 to 14 feet and top diameter of 6 feet.

The addition of these structures would increase the proposed site's structural complexity but would not alter the project's visual character or substantially increase visual contrast, project dominance, or view blockage. In the context of the other existing and proposed facilities, the resulting visual change attributable to this ZLD option would not cause a significant visual impact, regardless of the cooling technology selected for the project.

Solar System

The solar system ponds covering 6 to 10 acres (ZLD Option 2) are used with membrane processes and VCE evaporator similar to those required for ZLD Option 1. The evaporation ponds would be located on the south side of Clay East Road and could be open pond with spray system or covered with an 8- to 10-foot-tall greenhouse structure with polyethylene film skin.

The addition of evaporation ponds would result in visible landform and vegetation modifications that would be noticeable from some viewing locations. The addition of greenhouse structures could potentially increase the proposed site's structural complexity and cause additional view blockage. However, the area on the south side of Clay East Road where the evaporation ponds and greenhouse structures would be located is partially screened from public and residential views by the intervening rolling terrain.

Therefore, in the context of the other existing and proposed facilities and site modifications, and the limited visibility of the solar facilities to the south of the project site, the resulting visual change attributable to this zero liquid discharge option would not cause a significant visual impact, regardless of the selected cooling technology.

Conclusion for Visual Resources

Staff concludes that each of the three recycled water supply options would result in similar visual impacts during construction. However, the incremental increase in visual impact caused by adding the water supply pipeline to the gas pipeline route would be substantially less than the visual impacts of constructing the gas pipeline and a separate Lodi water supply pipeline. The visual impacts of constructing the Galt water supply pipeline would be only marginally greater than the Sacramento Regional option due to the overlap of those two routes. Therefore, from a visual impact perspective, the preferred water supply option is the Sacramento Regional Wastewater Treatment Plant, followed by the City of Galt Wastewater Treatment Plant, with City of Lodi White Slough Water Pollution Control Facility being least preferred. However, none of the three would have significant visual impacts.

Dry cooling is preferred over the proposed project because it eliminates visible vapor plumes. Both hybrid cooling options use plume abatement towers, which should eliminate most of the visible vapor plume associated with the mitigated proposed project. As previously discussed, there is insufficient design information available to enable the modeling and characterization of visible hybrid cooling vapor plumes. Either hybrid cooling option would have significantly less visible plume than the mitigated proposed project, and thus is preferred.

The ZLD solar system is lower in height, but covers more area than the crystallizer, which is located near the center of the project and near the cooling tower or ACC. Relative to the proposed project, either option should add minimal visual impact to public roads and private residences, and neither would create a significant impact.

6.10 WASTE MANAGEMENT

Alvin Greenberg, Ph.D.

Introduction

The CPP is currently proposing to use potable water from the American River for cooling. The purpose of this analysis is to evaluate the alternate sources of water, alternate cooling technologies, and ZLD systems. Please refer to the **Waste Management** section of the SA for discussions on contaminated soils and groundwater that specify appropriate mitigation measures and Conditions of Certification to ensure less than significant impacts for the project as proposed.

Recycled Water Supply Options

In providing recycled wastewater from any of the three sources mentions, there would be certain wastes associated with the construction and operations of the pumping facilities and the water pipelines.

Excavation personnel may encounter potentially contaminated soils and/or groundwater. Therefore, proper handling procedures may be necessary. A Phase I Environmental Site Assessment would be needed for any pumping station site and the pipeline route prior to site preparation. A Phase II Environmental Site Assessment may also be needed depending upon the findings and recommendations of the Phase I ESA. Once proper environmental site assessments have been conducted, the potential waste management impacts would be known. Please also refer to the **Waste Management** section of the PSA for discussions on contaminated soils and worker safety standards that specify appropriate mitigation measures and Conditions of Certification to ensure impacts on workers are less than significant for the project as proposed. The same types of conditions would likely ensure that any impacts from contaminated soils or groundwater encountered during construction of the water lines would also be insignificant.

Additionally, there would be minor amounts of hazardous and non-hazardous wastes generated during construction and operation of the pipeline. These consist of routine construction/operations wastes such as building materials, gasoline and diesel fuel leaks, lubricants (oil and grease), oily rags, paper, wood, scrap pipe, etc. These amounts would be minor and if handled in the same manner as that described for the project site, would present an insignificant risk to workers and the public.

Hybrid Cooling

Construction of the 95/5 or 50/50 hybrid cooling alternative would generate types of wastes similar to those from the other alternatives. The amount of soil from excavation activities could be larger, if pilings were required to support the towers.

During operation of a wet or hybrid cooling tower, relatively minor amounts of sludge collects in the basin of the cooling tower and would require removal every few years. The sludge would require testing to determine its classification as hazardous or non-hazardous. Conditions of Certification should be developed to ensure that the sludge is tested and disposed of in an appropriate manner and that impacts would not be significant.

Dry Cooling

Wastes generated during construction of the air-cooled condenser would consist of relatively minor amounts of hazardous and non-hazardous wastes such as excess paint, packing materials, concrete, lumber, spent solvent, clean up materials, and the like. The amount of soil that would have to be excavated would depend on the final design chosen, but may not be significant particularly if the condenser is built on pilings. Classification of the excavated material would take place after it is stockpiled. It would then be sampled and analyzed to determine on-site reuse or off-site disposal options in accordance with the project waste management plan. Standard Conditions of Certification would ensure that impacts of storage or disposal would be less than significant.

Dry cooling does not generate any wastes during operation.

Zero Liquid Discharge

Wastes generated during construction of the ZLD system would be similar to those of other project facilities and would consist of relatively minor amounts of hazardous and non-hazardous wastes. The amount of soil that would have to be excavated would depend on the final design chosen, but may not be significant. Conditions of Certification would ensure that classification of the excavated material would take place after it is stockpiled. It would then be sampled and analyzed to determine on-site reuse or off-site disposal options in accordance with the project waste management plan.

ZLD processes will generate up to 10 TPD of dry solids for offsite disposal at Keifer Landfill, which has adequate capacity to accept the solids. This is equivalent to less than one half truck per day, which should not have an appreciable traffic impact. Average ZLD generated solids are shown in **Appendix A Table 7.**

Appendix A Table 7
Solids Disposal Quantities (Dry Tons/day)

Cooling Process	Folsom South Canal	Recycled Water
Wet Cooling	6.8 Tpd	16.2 Tpd
95/5 Hybrid	6.4 Tpd	15.4 Tpd
50/50 Hybrid	3.3 Tpd	8.5 Tpd
Dry	0.2 Tpd	N/A

As shown in **Appendix A Table 7**, The operation of the ZLD system in either option could result in the generation of up to ten tons per day of salt cake waste. This waste might be considered hazardous depending on the levels of certain metals in the salt, or might be considered a California designated waste due to its high salt content. The category of designated waste includes non-hazardous waste that contains pollutants which, under ambient environmental conditions at a waste management unit, could be released in concentrations that could exceed applicable water quality objectives or affect the beneficial uses of waters of the state (Cal. Code Regs., tit. 27, §20210). Designated wastes are required to be disposed of at Class I or Class II disposal sites. Testing of the salt cake would be required in order to ensure proper disposal. If the salt cake is non-hazardous it would be disposed in a Class III landfill. CPP has listed in its application a few Class III landfills that would accept its solid non-hazardous waste. Adequate capacity exists in these landfills to properly dispose of the salt cake generated by the ZLD without significantly impacting the capacity or remaining life of any of these facilities. Specific Conditions of Certification would be developed to ensure appropriate testing and disposal of salt cake. Such requirements would prevent the occurrence of significant impacts.

Construction and operation of the zero liquid discharge system would not have any significant effects on any of the other waste streams generated at CPP.

Conclusion for Waste Management

Staff does not consider the waste management impacts from the recycled water supply and cooling system options discussed to be significantly different, since rather minor amounts of wastes would be generated from any of the options. All waste management impacts from these cooling and water supply options could be reduced to less than significant levels.

However, the ZLD system would generate much larger amounts of waste in the form of salt cake (on the order of several tons per day) that would require testing and disposal. Staff believes that adequate capacity exists at the landfills proposed for use by CPP to handle any additional waste generated from the ZLD system, and that Conditions of Certification could ensure that impacts would be less than significant.

Waste Management Impacts of Zero Liquid Discharge

It is assumed that makeup water for non-cooling processes would be treated onsite with membrane processes and the waste brine treated onsite in a ZLD system. In the case of dry cooling, the relative small waste stream is assumed to be sent to a small onsite ZLD system. (While this could be replaced with the use of a demineralizer resin exchange service, but this would not eliminate the waste stream, but only cause it to be generated offsite.)

6.11 WATER AND SOIL RESOURCES

Philip Lowe, Greg Peterson

Introduction

This section evaluates the potential impacts of the hybrid and dry cooling systems, water supply sources, and ZLD on surface waters, and soils/sedimentation.

Recycled Water Supply Options

The use of recycled water from any source would greatly benefit the Sacramento region because it would reduce or eliminate the proposed use of inland fresh surface water for power plant cooling. However, each option has the potential to create impacts to surface waters and soils, as described in the following paragraphs.

Sacramento Regional Wastewater Treatment Plant

The Sacramento Regional Sanitation District's Regional Wastewater Treatment Plant is located approximately 26 miles northwest of the CPP. The water pipeline would parallel the proposed gas pipeline route to the CPP site. This alternative would eliminate the Clay Creek crossing of the proposed water supply line from the Rancho Seco Plant to the CPP, but increase the width of the trenched water crossings for the proposed gas pipeline. Overall soil and surface water impacts would be slightly greater than those of the proposed project, due to the larger trench, but still less than significant assuming implementation of appropriate Best Management Practices (BMPs) and recommended mitigation.

City of Lodi White Slough Water Pollution Control Facility

The City of Lodi's White Slough Water Pollution Control Facility (WSWPCF) is located approximately 30 miles southwest of the CPP. This alternative would add approximately

30 miles of pipeline, crossing many additional watercourses including Paddy Creek (three branches), the Mokelumne River, Dry Creek, and Skunk Creek. As a result, soil and surface water impacts would be greater than for the proposed project. However, with implementation of appropriate BMPs and standard mitigation, impacts would still be less than significant.

City of Galt Wastewater Treatment Plant

The City of Galt Wastewater Treatment Plant is located approximately 12 miles south-west of the CPP. This alternative would add at least three new water crossings: Laguna Creek, Wouldow Creek, and a tributary to Laguna Creek, as well as add approximately 15 feet to the width of excavation for a portion of the proposed gas pipeline between the CPP and the Sac Reg plant. Soil and surface water impacts would be greater than for the proposed project. With implementation of appropriate BMPs and standard mitigation, impacts would be less than significant.

Hybrid Cooling

Hybrid cooling at 95 percent wet cooling would employ plume abatement cooling towers at the same location as the proposed cooling tower. Hybrid cooling at 50/50 wet/dry would involve use of dry cooling for Phase 1 and a wet cooling tower for Phase 2. These alternatives would use 5 and 50 percent less water, respectively, than the proposed project, but other soil and surface water impacts would be similar to those of the proposed project. No significant impacts are expected with the implementation of appropriate BMPs and standard mitigation measures.

Dry Cooling

The ACCs would be located either on the south and north ends, or on the east side of the proposed site. The north ACC would involve a substantially greater encroachment into the south braid of Clay Creek than would the proposed project. This tower would be located approximately in the location of the proposed detention basin, making construction of the basin impractical or subject to significant design modification. The south tower would be located in the path of the eastern Clay Creek tributary crossing the CPP site. This tributary could be diverted around the ACC as is proposed for the proposed project, but this would involve creating a new stream crossing on Clay East Road. If both ACCs were located on the east side of the site, the impacts to surface waters could be minimized.

The soil and surface water impacts of dry cooling would be substantially greater than for the proposed project, but mitigable to less than significant levels. One mitigation approach would be to locate the ACCs on the east side of the CPP property rather than on the north and south. Use of dry cooling technology would eliminate nearly all of the proposed project’s demand for cooling water. Eliminating the use of fresh inland surface water from the Folsom South Canal for power plant cooling would be beneficial to area surface water users and is preferred by staff.

Zero Liquid Discharge (ZLD Options 1 and 2)

Both ZLD options would eliminate the proposed discharge of cooling water to Clay Creek, which would have significant advantages over the proposed project.

ZLD Option 1: Crystallizer System

ZLD Option 1 would involve modifications to the site plan without changing the project footprint. Soil and surface water impacts would be similar to those of the proposed project. No significant impacts would be expected.

ZLD Option 2: Solar System

ZLD Option 2 would involve installation of solar evaporation ponds (that may be covered with a plastic greenhouse structure) covering 6 to 10 acres and located due south of the proposed turbines, across Clay East Road. The evaporation ponds would be located in the proposed CPP laydown area. Clay Creek tributaries that are located within SMUD's proposed laydown area could be diverted around the ponds, but this may involve creating a new stream crossing for Clay East Road. Soil and surface water impacts would be greater than those of the proposed project.

Conclusion for Surface Water and Soils

Dry cooling and ZLD are both preferred technologies for the CPP project. The use of recycled water would create additional short-term soil and surface water impacts due to pipeline construction, but these impacts could be minimized through mitigation so they would remain less than significant. All water supply options would be beneficial due to a reduced demand for surface water. These alternatives can all comply with LORS and are not expected to cause significant impacts.

6.12 GEOLOGY, PALEONTOLOGY, AND MINERAL RESOURCES

Janine Band

Introduction

This section evaluates the potential impacts of the dry and hybrid cooling systems, recycled water sources, and ZLD systems in the areas of geology and paleontology.

Recycled Water Supply Options

Faults and Seismicity for All Options

The pipeline alignments for all options are located within Seismic Zone 3 as delineated on Figure 16-2 of the 1998 edition of the California Building Code (CBC). No active or potentially active faults are known to cross the pipeline alignment (CDMG, 1994). The closest known faults are those of the Foothills Fault System, located more than 11 miles east and north of the eastern end of the proposed CPP facility. East of the CPP site, these faults are considered to be inactive, though about 40 miles north, in Auburn, more recent fault activity has been noted (Maulchin, 1996). The nearest known active faults are those associated with the San Andreas Fault system, approximately 40 miles west of the Sacramento Regional Wastewater Treatment Plant and the blind thrust faults along the Coast Range-Central Valley margin approximately 22 miles west of the treatment plant. These faults are somewhat closer to the Lodi treatment plant and further from Galt.

The California Division of Mines and Geology (CDMG) Map Sheet 48 (CDMG, 1999) predicts peak ground acceleration with a 10 percent chance of exceedance in 50 years of between 0.10 and 0.20g for the project area.

Geological, Mineralogical, and Paleontological Resources for All Options

Since all pipeline alignments overlie Quaternary alluvial deposits, potential sand and gravel resources may be impacted. However, many other equivalent deposits that are not currently mined surround the site.

The Tertiary and Quaternary formations that underlie the pipeline alignments are known to contain land mammal fossils in other locations. Land mammal fossils are deemed scientifically and paleontologically important. Proposed mitigation measures are defined in the **Geology and Paleontology** section of the PSA and would reduce any impacts to a level that is not significant.

Slope Failures for All Options

The potential for slope failures along all pipeline alignments is considered low. The alignments are generally located on well-drained alluvium that has a slope of between one and two percent.

Sacramento Regional Wastewater Treatment Plant

The recycled water pipeline from the Sacramento Regional Wastewater Treatment Plant to the CPP facility would be underlain by recent alluvium in the Cosumnes River flood plain, unconsolidated alluvial sediments of the Modesto and Riverbank Formations and consolidated alluvial sediments of the Laguna Formation.

The potential for liquefaction along this pipeline route is expected to be low. Further investigation of potential subsidence should be included in the engineering geology report required for final design. The project area includes soils containing a high percentage of expansive clay minerals and hardpan soils. However, these conditions would not affect pipeline construction and operation.

City of Lodi White Slough Water Pollution Control Facility

The recycled water pipeline from the White Slough Water Pollution Control Facility to the CPP facility would be underlain by recent alluvium at the Mokelumne River and Dry Creek crossings unconsolidated alluvial sediments of the Modesto and Riverbank Formations and consolidated alluvial sediments of the Laguna Formation. Potential impacts from faults and seismicity would be the same as those defined for Sac Reg above.

The potential for liquefaction is generally expected to be low along this pipeline route, with liquefaction potential increasing near the Lodi Water Pollution Control Facility. Investigation of the potential for subsidence should be included in the engineering geology report required for final design.

City of Galt Wastewater Treatment Plant

The recycled water pipeline from the Galt Wastewater Treatment Plant to the CPP facility would be underlain by unconsolidated alluvial sediments of the Modesto and Riverbank Formations and consolidated alluvial sediments of the Laguna Formation. Potential impacts from faults and seismicity and for liquefaction, subsidence, and expansive soils, would be the same as those defined for Sac Reg above.

Hybrid Cooling

The hybrid plume abatement towers would be located immediately east of the CPP facility in the same location as the proposed wet cooling towers. The site is underlain by consolidated alluvial deposits of the Laguna Formation, and is blanketed by arkosic alluvium of the Modesto-Riverbank Formation that occupies the broad, shallow valley of Clay Creek (Wagner, et al., 1981). Clay Creek is an ephemeral stream that crosses several hundred feet north of the CPP site.

Liquefaction, Subsidence, and Expansive Soils

The soils and sediments that cover the CPP site are generally well drained and consolidated and the depth to groundwater is expected to be greater than 150 feet (EGC, 1993). Therefore, the potential for liquefaction is expected to be low.

Soils that contain a high percentage of expansive clay minerals are prone to expansion if subjected to an increase in water content. Based on descriptions of two borings (EGC, 1993), the CPP site is believed to be underlain by sands, silts, and clays, with minor amounts of gravel to depths of 75 feet below the ground surface. Clay expansivity was not measured or discussed in the EGC report. Further investigation of the location, depth and thickness of expansive soils should be included in the engineering geology report required for final design.

Seiche

Earthquakes are known to cause seiches, oscillating waves in a lake or bay that can cause damage to nearby low-lying development. The small reservoir upstream from the CPP site is not likely to produce seiche waves due to the small size and to the distance from major seismic sources.

Slope Failures

The potential for slope failures at the power plant site is considered to be low. The project is located on well-drained alluvium that has a slope of between one and two percent, and there are no significant slopes adjacent to the site.

Geological and Paleontological Resources

There would be no difference in impact to geological and mineral resources between the project as proposed and the project with hybrid cooling.

Dry Cooling

While the facilities for the dry cooling alternative would have a slightly larger foot print than the facilities for the hybrid cooling alternative, the proposed cooling alternatives would both be located immediately adjacent to the proposed CPP site and the impacts associated with geology and paleontology would be virtually identical.

Zero Liquid Discharge (ZLD Options 1 and 2)

The facilities for ZLD Option 1 are located within the CPP site and the impacts associated with Geology and Paleontology are virtually identical to the impacts identified for the proposed project. The solar evaporation pond associated with Option 2 would be reclaimed from the proposed 20-acre staging area. The geologic conditions in the staging area are essentially the same as the conditions at the CPP site. As a result the geologic impacts associated with ZLD Option 2 would are be similar to those of the proposed project.

Conclusion for Geology and Paleontology

The applicant would likely be able to comply with applicable LORS. The LORS require preparation of an Engineering Geology Report that addresses geologic conditions and provides design recommendations to mitigate any potential impacts. The adoption and implementation of the proposed Conditions of Certification for paleontology should mitigate any potential adverse impacts to paleontological resources, should such resources be encountered during construction of the project. As a result, the cooling alternatives should have no adverse impact with respect to geologic hazards or geological and paleontological resources and the project should comply with LORS, provided that the project complies with the **Conditions of Certification** for Geology, Paleontology, and Mineral Resources.

6.13 POWER PLANT RELIABILITY AND EFFICIENCY

Kevin Robinson and Steve Baker

Introduction

The cooling system of a combined-cycle power plant such as the Cosumnes Power Plant is fundamental to safe and efficient power output, and if it functions below the intended performance, the power output may be curtailed (reduced), or the plant may be shut down. Safeguards such as raw water storage and redundant pumps enable a high degree of cooling system reliability and adequate advance warning of any mechanical problems.

Recycled Water Supply Options

The water produced by the three reclaimed water sources (Sacramento Regional Wastewater Treatment Plant, City of Lodi White Slough Water Pollution Control Facility, and City of Galt Wastewater Treatment Plant) are required by CCR Title 22 (Section 60306) to have redundant unit processes, power supplies, or effluent storage on-site and thus are considered to be highly reliable. However, use of recycled water could impact the reliability of the Cosumnes Power Plant due to its high dependence on cooling water. Any interruption of water supply would cause the plant's power to be reduced, or the plant to be shut down completely. Therefore, it is critical that the source of water for the power plant be reliable and provide a continuous and adequate amount of water for the project. The reliable production of recycled water by each of the three treatment plants would need to be evaluated.

Reliability Impacts of Dry Cooling

Dry cooling relies on the dry bulb temperature of the ambient air to provide the needed cooling effect. In hot climates, extremely hot weather may degrade cooling system performance, causing partial curtailment of power output or, in the worst case, total shutdown of the power plant. In the Central Valley climate in which the CPP is located, such extremely hot days do occur, but the plant would be designed to perform in a high percentage of these days (as defined in Section 3.2). In a year with unusually high temperatures, adverse impacts on plant reliability from use of dry cooling could occur. However, the Energy Commission has previously concluded (at the Sutter Power Project, 97-AFC-2) that the reduced water consumption justified the reduced reliability.

Efficiency Impacts of Dry Cooling

Dry cooling would have a one percent higher heat duty (i.e., one percent lower electricity output for the same amount of input fuel) than a comparable facility with wet cooling. The analysis of the Sutter Power Project showed that annual average fuel efficiency would be reduced 1.5 percent compared to a wet cooling system. The Energy Commission concluded that the reduced water consumption and wastewater production justified dry cooling and the reduced efficiency at Sutter Power Project, and this situation is considered to be very similar.

Reliability Impacts of Hybrid Cooling

A hybrid cooling system can be expected to yield reliability in between an all wet or dry cooling system. Significant adverse impacts on plant reliability from use of hybrid cooling are therefore unlikely.

Efficiency Impacts of Hybrid Cooling

A hybrid cooling system can be expected to provide cooling more effectively than a dry cooling system, especially on hot days when dry cooling system performance would have the most degradation. While still less effective on an annual average basis than wet cooling, a hybrid system would have a power output between all-wet and all-dry cooling systems. Incorporation of a hybrid cooling would thus present less of an adverse impact on fuel consumption than dry cooling, but would be less efficient than wet cooling.

Conclusion for Reliability

Wet cooling is the most reliable method for cooling the CPP Project. Hybrid cooling employs more equipment components and thus may have slightly less reliability, but it is not expected that these impacts would be significant, and they could be mitigated through prudent design and the use of redundant equipment at essential unit processes. Dry cooling would show the most adverse impacts to plant reliability due to the extremely hot summer days in the Central Valley, which will lead to a less reliable power source due to the possibility of curtailment.

Conclusion for Efficiency

Wet cooling should yield maximum fuel efficiency. Dry cooling would likely provide an average 1 to 1.5 percent reduction in fuel efficiency, and the reduced efficiency of hybrid cooling would lie in between wet and dry cooling, in approximate proportion to the dry cooling fraction. Therefore, wet cooling is preferred to maximize efficiency, but the options considered would not result in significant decreases.

7. CONCLUSIONS

Sections 3 through 5 of this report present conceptual designs for cooling, water supply, and discharge options at the CPP: three different sources of recycled water, the use of hybrid or dry cooling, and the use of two types of ZLD systems. Any of the recycled water options could be used with hybrid cooling and/or ZLD, and dry cooling would need no new major water supply. Section 6 describes the potential environmental and engineering impacts of each option.

Appendix A Tables 8a and 8b presents a summary of water use and cost for each cooling option and several water supply options. The cooling options could reduce total water demand for the CPP project by a minimum of five percent (with the 95/5 hybrid) up to 95 percent (with dry cooling).

The total capital cost for CPP (Phases 1 and 2) would be $595 million (CEC, 2002b). Therefore, as illustrated in **Appendix A Table 8a**, the additional capital cost for the cooling options alone would range from a one percent increase (for the 95/5 hybrid) to approximately a 12 percent increase (for dry cooling). With costs for ZLD and the recycled water pipeline included, capital costs would increase by about ten percent with 50/50 hybrid cooling. Also, as stated in Section 6.13, power plant efficiency would be reduced by up to 1.5 percent with use of dry cooling.

It is especially notable that some of these options would have the potential to save over nearly 3300 gpm (over 5,000 AFY) of fresh water, as illustrated in **Appendix A Tables 8a and 8b**. Given the high value of water in California, this reduction in water use is considered to be substantial, providing a benefit to the region and the SMUD customers. The additional cost of the alternative cooling systems is very small when compared to the cost of the proposed plant and the amount of water that could be saved.

Appendix A Table 8a
Water Demand and Cost Summary for Cooling Options

Water Demand (in AFY) (assuming implementation of ZLD)	Cooling Options (assuming use of fresh water)			
	Wet Cooling	95/5 Hybrid	50/50 Hybrid	Dry Cooling
Average non-cooling makeup (gpm)	147	147	147	147
Average cooling makeup (gpm)	3155	2997	1499	0
Total water demand (gpm)	3302	3144	1646	147
Fresh water savings (gpm)	base	164	1723	3281
Capital Cost ($M) of Cooling Systems				
Phase 1	base	+ $2.5	+ $14.9	+ $14.9
Phase 2	base	+ $2.5	base	+ $14.9

Notes:
Flow numbers for Phase 1 and Phase 2 combined. Cost information as shown is per phase.
Cost of base case wet cooling is assumed to be $19.7 million (Applicant's cooling option study).

Appendix A Table 8b
Water Demand and Cost Summary for Recycled Water Sources

Water Demand (assuming implementation of ZLD)	Recycled Municipal Wastewater Options*		
	Wet Cooling: Sac Reg + Galt	95/5 Hybrid: Sac Reg + Galt	50/50 Hybrid: Galt
Average non-cooling makeup (gpm)	147	147	147
Average cooling makeup (gpm)	3155	2997	1499
Total water demand (gpm)	3302	3144	1646
Fresh water savings (gpm)	3281	3281	3281
Capital Cost ($M)			
Recycled water pipelines	$21.0	$21.0	$5.9

Notes:
All information is for both phases combined (i.e.; total plant).
The costs for use of recycled wastewater include savings because some proposed project components would be reduced in size.

The following sections summarize the conclusions of each analysis, and present an overall recommendation for combining cooling and water supply options.

ZERO LIQUID DISCHARGE

It is noted that the applicant submitted a ZLD proposal immediately prior to issuance of this Preliminary Staff Assessment, and that proposal has not yet been reviewed in detail. Two ZLD systems are considered: a crystallizer system and a solar drying system. No unmitigable significant impacts were identified for either ZLD system. The differences between the two with respect to environmental impact relate primarily to the large land area required for a solar system. Disturbance of this land can create long-term impacts to cultural or biological resources and additional short-term construction air emissions from dust and equipment exhaust. Crystallizer systems require larger and more visible structures, but substantially less ground disturbance. Staff's preliminary analysis indicates that these impacts can be mitigated to less than significant levels, but these analyses will be presented in more detail in the Final Staff Assessment.

RECYCLED WATER SOURCES

Three sources of treated wastewater were considered for cooling at CPP: City of Lodi, City of Galt, and the Sacramento Regional plant. Lodi and Sac Reg currently appear to have adequate supplies of treated water, but each is located about 25 miles from CPP, requiring construction of longer pipelines. Galt is about 12 miles away, and while it does not yet have an adequate supply of recycled water to serve all of CPP's cooling needs, it could supply adequate water for a 50/50 hybrid cooling system if Phase 1 were constructed with dry cooling and Phase 2 were constructed with a plume-abated wet cooling system. Water from both Sac Reg and Lodi could also be used to fully serve the cooling requirements of Phases 1 and 2 with either wet cooling (as proposed) or any hybrid option.

Environmental impacts associated with the use of recycled water at CPP are primarily the short-term impacts resulting from pipeline construction. These impacts would require more detailed analysis, especially for biological and cultural resources, but if the new pipelines followed existing roads and standard construction mitigation were applied, impacts could likely be reduced to less than significant levels.

Construction of recycled water pipelines and required treatment systems could cost over $20 million more than the proposed CPP, depending on the water volume needed and water source. In addition, there would be slightly greater operating costs due to the required water purchase and additional pumping and maintenance. However, these costs are balanced by a significant regional benefit in an area where fresh water is becoming valuable and scarce. Any reduction in the proposed use of 5,090 AFY of fresh inland water for power plant cooling would be beneficial. Using less water from the Folsom South Canal would also reduce indirect impacts to biological and aquatic resources.

COOLING TECHNOLOGIES: WET, HYBRID, OR DRY COOLING

This report considers two potential hybrid cooling designs, a 95/5 wet/dry design (essentially a plume-abated wet cooling tower) and a 50/50 option in which dry cooling would be used for one phase and plume-abated wet cooling for the second phase. A dry cooling system has also been described and analyzed. The applicant is proposing to use a wet cooling system.

Cooling technologies have qualitative, as well as quantifiable differences. **Appendix A Table 9** presents a qualitative comparison of wet cooling (as proposed), 95/5 hybrid, 50/50 hybrid, and dry cooling. For each alternative, it is assumed that Folsom South Canal or shallow groundwater would be used for non-cooling water demands. Cooling water makeup water would be either Folsom South Canal or recycled water.

The only significant impact identified for the cooling options is the potential for construction and operational noise to exceed LORS at the nearest sensitive receptors, but the proposed facility would also create that same impact.

Appendix A Table 9
Qualitative Comparison of Cooling Technologies

Environmental Impact	Wet Cooling	95/5 Hybrid Cooling	50/50 Hybrid Cooling	Dry Cooling
Cooling water supply rate*	Highest	< 95% of wet cooling	< 47.5% of wet cooling	None
Wastewater volume	Highest	< 95% of wet cooling flow	< 47.5% of wet cooling flow	Approx. 3% of wet cooling flow
Discharge treatment requirement	Very stringent	Same as wet cooling	Same as wet cooling	Same as wet cooling
Plant efficiency/heat rate	Baseline, approx. 7,000 Btu/kWh	0.25% max/0.1% average higher heat rate per kW	1.4% max/0.5% average higher heat rate per kW	2.7% max/1% average higher heat rate per kW
Plant emissions	Baseline	Proportional to heat rate, or less	Proportional to heat rate, or less	Proportional to heat rate, or less
Auxiliary power requirements	Baseline	More than wet cooling	Midway between wet and dry cooling	Most compared to wet cooling
Secondary emissions	Salt deposition from cooling tower drift	Less salt deposition from cooling tower drift	Midway between wet and dry cooling	No secondary emissions
Land requirements	Baseline	Similar	Midway between wet and dry cooling	Up to 2-1/2 acres more
Visual impact: Structural	Least obtrusive structure	Approx. 17 ft taller struc-ture compared to wet	One plume abatement tower + one dry ACC	Approx. 17 ft taller structure compared to wet
Visible Plume	Some occurrence of visible plume, function of ambient humidity, could increase ground fog	Plume occurrence can be reduced to almost zero	Plume occurrence can be reduced to almost zero	No visible plume
Noise	Lowest	Comparable to wet cooling	Halfway between wet and dry	58 dBA at 400 ft

8. REFERENCES

ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers). 1985. Volume 1, Fundamentals, 1985 Edition.

ATC. 2001. Application For Certification (AFC), 2001. Application for Certification Cosumnes Power Plant, submitted by Sacramento Municipal Utility District.

Burger, Robert. 1994. Cooling Tower Technology, Maintenance, Upgrading and Rebuilding. Third Edition.

Burns, J.M., and Wayne C. Micheletti. 2000. Comparison of Wet and Dry Cooling Systems for Combined Cycle Power Plants, Final Report (Version 2.1). Prepared for Hunton & Williams Legal Counsel for Utility Water Act Group.

Carlson, David. 2002. Letter from Central Valley RWQCB, NPDES Section Chief, to Paul Richins, Energy Commission. January 31.

CDMG (California Division of Mines and Geology). 1994. Fault Activity Map of California and Adjacent Areas with Locations and Ages of Recent Volcanic Eruptions, Scale: 1:750,000.

CDMG. 1999. CDMG (California Division of Mines and Geology). 1999. Seismic Shaking Hazard Maps of California, CDMG Map Sheet 48.

CEC (California Energy Commission). 2002. Internet website describing CPP project: http://www.energy.ca.gov/sitingcases/smud/description.html. August 7.

CVRWQCB. 1998. Central Valley Regional Water Quality Control Board. Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin River Basins. pp. 80.

Environmental Geotechnical Consultants, Inc. (EGC). 1993. Geotechnical Study for Proposed Independent Spent Fuel Storage Installation, Rancho Seco Nuclear Generating Station, Sacramento County, California.

Griffin, John. 2002. City of Galt Public Works Engineer, personal communication with Greg Peterson (Energy Commission staff).

Guyer, E.C. 1991. Dry Cooling: Perspectives on Future Needs, Prepared for Electric Power Research Institute.

Kerlin, Del. 2002. Superintendent of Lodi's White Slough Water Pollution Control Facility, personal communication with Greg Peterson.

Leary, Pat. 2002. Sacramento Regional Water Quality Control Board, personal communication with Greg Peterson. March 18.

Mantovani, et al. 2001. Management Practices for Nonpotable Water Reuse, Water Environment Research Foundation.

Maulbetsch, John S. 2001. Water Supply Issues Workshop. Present to the California Energy Commission February 8, 2001.

Maulchin, L. 1996. A Technical Report to Accompany the CALTRANS California Seismic Hazard Map. Prepared for CALTRANS by the Office of Earthquake Engineering.

Riess, et al. 2001. Evaluation of the Aqua-Aerobic Systems Cloth-Media Disk Filter (CMDF) for Wastewater Recycling Applications in California, Center for Environmental and Water Resources Engineering, University of California, Davis.

RWQCB (California Regional Water Quality Control Board). 2002. Review of Application for Certification, Cosumnes Power Plant, Sacramento County. January 29.

Swanick, Gerry. 2002. Aerojet Corporation, personal communication with Greg Peterson. March 22.

SMUD (Sacramento Municipal Utility District). 2002i. Data Responses, Set 1E — Supplemental Responses to Data Requests: 111, 112, 116, 152, and 161 — Power Plant Cooling Analysis. March 8. Docket date March 8, 2002.

USBOR (U.S. Bureau of Reclamation). 2002. U.S. Bureau of Reclamation and Sacramento Regional Sanitation District, January 2002, Phase I, Title XVI Feasibility Analysis for Countywide Water Recycling Program, Tetra Tech, in association with Easton Water Resources, Inc.

USEPA (U.S. Environmental Protection Agency). 1992. Guidelines for Water Reuse. September 1992.

Water Environment Federation. 2000. Membrane Technologies for Industrial and Municipal Wastewater Treatment and Reuse.

Wagner, D. L., C. W. Jennings, T. L. Bedrossian, and E. J. Bortugno. 1981. Geologic Map of the Sacramento Quadrangle, California, 1:250,000. California Division of Mines and Geology Regional Geologic Map Series Map No. 1A.

PLACEHOLDER FOR FIGURE 1 (DIRECT DRY COOLING SYSTEM)

PLACEHOLDER FOR FIGURE 2 (WET COOLING SYSTEM OPERATION)

PLACEHOLDER FOR FIGURE 3 (WET COOLING TOWER AND HYBRID PLUME ABATEMENT TOWERS)

PLACEHOLDER FOR FIGURE 4 (PIPELINE ROUTES FROM GALT AND LODI TO COSUMNES POWER PLANT)

PLACEHOLDER FOR FIGURE 5 (PIPELINE ROUTE FROM AEROJET PLANT TO COSUMNES POWER PLANT)

PLACEHOLDER FOR PHOTO 1 (DRY COOLING INSTALLATION EXAMPLE)

PLACEHOLDER FOR PHOTO 2 (DRY COOLING INSTALLATION EXAMPLE)

PLACEHOLDER FOR PHOTO 3 (MECHANICAL DRAFT WET COOLING TOWERS)

PLACEHOLDER FOR PLATE 1 (AIR COOLED CONDENSER SIZE AND LOCATION)

PLACEHOLDER FOR PLATE 2 (HYBRID COOLING TOWERS SIZE AND LOCATION)

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