MASTER CALIFORNIA ENERGY COMMISSION

TRANSPORTATION STUDY

for the

Geysers Geothermal Resource Area

CONTRACT NO. 700-80-040

PREPARED BY:

CALIFORNIA DEPARTMENT OF TRANSPORTATION

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ABSTRACT

Transportation Study for the Geysers

Geothermal Resource Area

Contract No. 700-80-040

The primary objective of the study is to assess potential cumulative impacts on the transportation system and to make recommendations as to options for handling future transportation development. This area is currently under active development in Lake and Sonoma Counties.

The area is served by state highways, county roads, and an internal network of private roads. Access into the area is limited, and the roads must handle a variety of traffic including an unusually high percentage of heavy trucks transporting construction equipment and materials, hazardous chemicals, and toxic wastes.

In conducting the transportation study public documents on geothermal power plant developments were researched and field trips to inspect the transportation facilities were made. People who have a special interest in the transportation system were also interviewed. In addition, traffic, accident, and road data were analyzed. Traffic forecasts based on projected geothermal resource development were made.

All access roads are of substandard design and deficient in structural adequacy. With projected traffic at 40% above the current level for most of the next six years, it is expected that cumulative impacts will cause accelerated degradation of the existing roads.

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I. INTRODUCTION

The Geysers Geothermal field is currently under active development in Lake and Sonoma Counties. There are 15 power generation units (980 megawatts) in operation and another 19 units (1534 megawatts) either under construction, in licensing or planned by 1990 for a total of 2442 megawatts. The area is served by State highways, County roads, and an internal network of private roads. Access into the area is limited, and the roads must handle a variety of traffic including an unusually high percentage of heavy trucks transporting construction equipment and materials, hazardous chemicals, and toxic wastes. With each additional power generation unit, an increasing strain is placed on the existing transportation system. Faced with this situation, the California Energy Commission engaged the California Department of Transportation to prepare a transportation study for the Geysers Geothermal Resource Area. The primary objective of the study is to assess potential cumulative impacts on the transportation system and to make recommendations as to options for handling future transportation development. The emphasis in this study is on access roads into the Geysers Area with consideration for demands on the internal network.

II. SUMMARY

In conducting the Transportation Study for the Geysers Geothermal Area, public documents, such as EIR's, AFC's, and NOI's on geothermal power plant developments were researched and field trips to inspect the transportation facilities were made. People who have a special interest in the transportation system serving the Geysers Area were also interviewed. In addition, traffic accident, and road data were analyzed. Traffic forecasts based on projected geothermal resource development were made.

Socrates Mine Road, Cloverdale Geysers Road, and Healdsburg Geysers Road are the primary public access roads into the Geysers Resource Area, (See Figure 1). All three access roads are of substandard design and structurally deficient. With projected traffic at 40% above the current level for most of the next six years, cumulative impacts will cause accelerated degradation of the existing roads and potential for increased accidents. As traffic increases, the attendant increase in the movement of hazardous chemicals and toxic waste removal presents a potential danger to local residents from accidental spills.

After examining the different alternatives for transportation development, the following actions are recommended:

- o Improve Healdsburg Geysers Road to Sonoma County standards. A Traffic Index of 8 is recommended for the structural section.
- o Prohibit heavy truck traffic on Cloverdale Geysers Road until it is properly improved and maintained. In the meantime, direct heavy truck traffic to use Healdsburg Geysers Road.
- o Although the Construction contract to upgrade Socrates Mine Road is already underway, the structural section design and construction should be based on a Traffic Index of 8.
- o A large hot water resource area is located northeasterly of the Geysers Geothermal Area. A separate transportation study for this area is recommended.

FIGURE 1

III. STUDY AREA

Location

The Geysers steam field is part of the Geysers-Calistoga Geothermal Resource Area, which is one of five Known Geothermal Resource Areas, (KGRA)s, in Northern California, (Figure 2). The Geysers-Calistoga KGRA consists of approximately 380,000 acres laying in both Sonoma and Lake Counties. The larger percentage of this resource area lies in Lake County.

The Geysers Geothermal Resource Area, (Figure 1), is situated on the Mayacmas Mountain along the Lake/Sonoma County boundary. The area is estimated to be approximately 10,500 acres in size. The dry steam reservoir is anticipated to extend outward from the proven field currently under active or proposed development. The actual extent of the reservoir has not been determined.

Geothermal Resource Area Access

Regional access to the steam field is by way of Interstate 5 and U.S. 101, which interface with State Highways 128, 175, 29 and 20 (Figure 3). From these links a series of local county roads, in various operational conditions, furnished the final leg. From these points the steam field is served by an intricate network of private roads operated and maintained by the steam field developers, the largest of which is Union Oil who maintains approximately 35 miles of roads within the Geysers.

Sonoma County (Figure 1 and Figure 4)

From Sonoma County the main route to the Geysers Area from the south is U.S. 101 to State Route 128 to Healdsburg Geysers Road to Pine Flat Road. The Healdsburg Geysers route is the primary route used by geothermal related traffic headed for the Geysers. Pine Flat Road is used by Patchett Bus Company to transport construction workers to PG&E Unit 18 located in the Sonoma County side of the GRA, (Geysers Resource Area, see Figure 4). The main route from the north is U.S. 101 to Cloverdale Geysers Road. Beyond these points, the internal network of private roads serving development within the Geysers Resource Area begins.

FIGURE 2

Known Geothermal Resources Area

REGIONAL MAP

FIGURE 4

LEGEND

- POWER PLANT
- 380 1981 ADT
- (20.8 %) TRUCK %

The predominate land uses along these access routes are agricultural and natural resource extraction. Slight local traffic is generated east of the Cloverdale, Geyserville, and Healdsburg communities. Sonoma County traffic count records for 1975 indicate an average of 36 ADT (average daily traffic), eastbound on Cloverdale Geysers Road east of Pine Mountain Road. These trips represent the local residential trip making pattern. Directional split traffic counts for the Healdsburg Geysers road were not available, however, population density in this area is low and land use is mainly agricultural. Therefore, local traffic use of the Healdsburg Geysers Road would also be minimal. All vehicles permitted to enter the private roads beyond the county roads are related to geothermal development. (See Figure 4-A Traffic Count Locations).

Lake County Figure 1 and Figure 4)

From Lake County the main access to the Geysers Area, is by way of State Highway 175 northward to Socrates Mine Road. Ford Flat Road, off of State Highway 175, is occasionally used by workers to commute from Cobb Village to Socrates Mine Road. Saw Mill Flat Road, (also known as Geyser Rock Road), also provides steam field access for geothermal traffic. This is a private road off Bottle Rock Road north of Cobb. Further north, High Valley Road (another private road), intersects Bottle Rock Road and provides access to the MCR Geothermal Corporation Leasehold. This is the site of the Department of Water Resource's Bottle Rock Plant currently in the initial phase of development. Guard gates at High Valley Road, Saw Mill Road, and Socrates Mine Road ensure traffic entrance to the steam field by authorized vehicles only (Figure 4).

Most of the surrounding land uses in the Cobb Mountain area are residential with commercially developed areas. Neighboring communities and recreation areas are Anderson Springs, Harbin Springs, Whispering Pines, Pine Grove, Cobb, Hobergs, Lock Lomond, and Middletown.

Waste Disposal Routes

There are two commercial solid waste disposal sites in southern Lake County. One is near Kelseyville and the other is located near Middletown. Both sites are approved for disposal of geothermal wastes and are rated Class II-1.*

* This is a classification system used by the California Water Resources Control Board. The class is determined by the geology and hydrology of the disposal site. The number designates the type of wastes.

Solid wastes collected in the cooling tower basins or the drilling sumps may be disposed of at either of these two sites.

Highway 175 provides access to the Kelseyville dump site, while Butts Canyon Road provides access to the dump site near Middletown. Currently, most of the geothermal waste is disposed of at the Middletown site by way of Socrates Mine Road, Highway 175, and then to Butts Canyon Road.

The number of truck trips for toxic waste removal is basically governed by the amount of drilling. At present with 15 geothermal operating plants and eight drilling rigs in operation 16 daily round trips are made by two trucking firms to the Geysers to remove toxic waste. GII Trucking in Middletown averages 10 trips and IT Corporation in Lakeport averages 6.

These trips are made 365 days a year. It is not anticipated that the number of truck traffic for waste removal purposes will decline when all geothermal construction is complete because some drilling is required to maintain continued steam pressure once units become operational. Present estimates are that it takes one well per year per power plant to replenish steam supply (K. Stellings, Division of Oil and Gas). Considering that the maximum time to drill a well is about 3 months it is apparent that drilling will be on-going after all 34 units are complete and therefore, toxic waste removal truck traffic will also be constant.*

* See following sections on "Exploration Drilling", and "Production of Steam and Electricity", for further discussion on drilling needs and implications.

Geothermal Development Activities

Geothermal activity is occurring in the Mayacmas Mountains near the Lake/Sonoma County boundary side. Only one of the 15 operating geothermal plants, PG&E's Unit 13, is located in Lake County. The remaining 14 operating power plants are located in Sonoma County.

Other electrical power companies are planning to develop geothermal power plants at the Geysers. Considering planned geothermal development potential cumulative capacity could reach 2,442 MW (megawatts) by 1990. In addition to the 15 plants already in operation, five new plants are planned to be in operation in Lake County by 1985, two others, along the Sonoma/Lake County boundary by 1987, and 12 in Sonoma County by 1989 for a total of 34 units. (Table 1, Geothermal Power Plant Development at the Geysers by County, California Energy Commission, 1981).

TABLE 1
GEOHERMAL POWER PLANT DEVELOPMENT
AT THE GEYSERS BY COUNTY

<u>COUNTY</u>	<u>UTILITY</u>	<u>ON-LINE DATE</u>	<u>CAPACITY(MW)</u>	<u>STATUS</u>
Lake	PG&E Unit 13	1980	135	On-Line
Lake	PG&E Unit 16	1983	110	AFC
Lake	Department of Water Resources, Bottle Rock	1984	55	Under Construction
Lake	Occidental #1	1984	80	AFC
Lake	Northern California Power Agency #1	1985	66	AFC
Lake	DWR NewField		55	Planned
Lake	Sacramento Municipal Utility District #2	1987	55	Planned

TOTAL UNITS FOR LAKE COUNTY = 6

<u>COUNTY</u>	<u>UTILITY</u>	<u>ON-LINE DATE</u>	<u>CAPACITY(MW)</u>	<u>STATUS</u>
Sonoma	PG&E Unit 1	1960	11	On-Line
Sonoma	PG&E Unit 2	1963	13	On-Line
Sonoma	PG&E Unit 3	1967	27	On-Line
Sonoma	PG&E Unit 4	1968	25	On-Line
Sonoma	PG&E Unit 5	1971	53	On-Line
Sonoma	PG&E Unit 6	1971	53	On-Line
Sonoma	PG&E Unit 7	1972	53	On-Line
Sonoma	PG&E Unit 8	1972	53	On-Line
Sonoma	PG&E Unit 9	1973	53	On-Line
Sonoma	PG&E Unit 10	1973	53	On-Line
Sonoma	PG&E Unit 11	1974	106	On-Line
Sonoma	PG&E Unit 12	1979	105	On-Line
Sonoma	PG&E Unit 15	1979	55	On-Line
Sonoma	PG&E Unit 14	1980	110	On-Line
Sonoma	Northern California Power Agency #2	1982	110	Under Construction
Sonoma	PG&E Unit 17	1982	110	Under Construction
Sonoma	PG&E Unit 18	1983	110	Under Construction
Sonoma	Sacramento Municipal Utility District #1	1983	65	Under Construction
Sonoma	Department of Water Resources, So. Geysers	1984	55	AFC
Sonoma	Northern California Power Agency #3	1985	55	AFC
Sonoma	Union Thermal Maga Wild Well	1985	5	Planned
Sonoma	PG&E Unit 20*	1985	110	Planned
Sonoma	PG&E Unit 19*	1988	55	Planned
Sonoma	PG&E Unit 21*	1988	110	Planned
Sonoma	PG&E Unit 22*	1988	110	Planned
Sonoma	PG&E Unit 23*	1989	110	Planned

TOTAL UNITS FOR SONOMA COUNTY = 26

Sonoma/Lake	Modesto ID	1985	110	Planned
Sonoma/Lake	Occidental #2	1987	55	Planned

TOTAL UNITS ON SONOMA/LAKE COUNTY BOUNDARY = 2

TOTAL UNITS AT THE GEYSERS = 34

SOURCE: California Energy Commission, 1981

* According to PG&E's 12/5/80 Resource Plan, geothermal resources are proven through Unit 18 only, for a total of 1348 MW. The schedule of units after 18 is dependent upon successful exploratory drilling.

General Impact of Geothermal Development on Road Network

The type of vehicular traffic (passenger or truck), to a site depends upon the stage of geothermal development. Geothermal development is divided into five general stages.*

STAGE I: Preliminary Exploration

Exploration prior to leasing for geothermal development includes non-intensive use of the road system consisting of geologic and land mapping, geochemical and geophysical surveys, water analysis and temperature studies, and possible drilling of shallow (300'-500') temperature gradient holes.

Vehicular traffic generated during this stage is minimal; most of the vehicles would be two-axle autos and trucks or truck-mounted drilling equipment.

STAGE II: Exploration Drilling

Exploration drilling is the drilling of the first full-scale wells intended to prove the existence and limits of the geothermal resource. This phase generates traffic consisting of large drilling rigs and associated large trucks.

MCR Geothermal, one of the main steam developers in Lake County, estimates that 35 semi-trailer loads are required to move the equipment necessary to establish one drill rig. A typical drilling crew consists of 24 people spread out over a 24-hour period. Drilling crews make approximately 30-vehicle trips per day to the drill site. Drilling normally takes 45 to 90 days per well. In Lake County, 130 geothermal wells have been drilled or are under County permit. Approximately 38 additional wells are in the planning or review process.

Associated with the drilling process is waste disposal. During the winter months, large amounts of rain water seep into the drilling sumps. These sumps contain toxic materials and must be pumped out and disposed of properly.

* Reference: Application for Certification; Geysers, Unit 16, Volume 1, Pacific Gas & Electric Company, December 1979.

There are currently two firms that transport the waste material to two Class II-1 dump sites. GII Trucking in Middletown averages 10 trips per day, 365 days a year, to the Geysers to remove toxic waste material. IT Corporation in Lakeport averages 6 trips per day, 365 days a year. Both companies own five trucks; two three-axle trucks and three truck and trailer combinations. The trips per day vary with the seasons. Winter months tend to be the most active months while trips drop off during the summer months.

STAGE III: Field Development

Field development is the continued drilling in order to provide enough reserves to supply a power generation facility. Approximately 16 wells are necessary to support one 110-megawatt power plant. The drilling processes are the same as exploration drilling but much more intensive.

During field development and construction of the power plant unit, both the amount of equipment and manpower needed reaches a peak. These are two separate but often are simultaneous activities. This stage is the most labor intensive and peak traffic activity period (see Figure 4-B). The power plant construction process has three sub-categories as follows:

A. Site Preparation

This includes the use of graders and earth moving equipment to clear a site. The average number of workers required for this phase is 20 craftsmen, mostly heavy equipment operators.

A large number of water trucks are needed. During the 32-month construction period approximately 3,600,000 gallons of water could be used. This translates into 1,000 to 1,500 round trips of 3 to 4 axle trucks for water delivery purposes for each site.

B. Excavation

Excavation for the foundations of the plant facilities begin after the general site is prepared. Drill rigs, backhoes, bulldozers, and more earth moving equipment are needed. Labor force numbers can vary from 20 to 50 per site.

During this phase truck traffic can average 5 round-trips per day. Water trucks make a couple of trips and the others are usually 2-3 axle standard size truck loads for delivery of materials. However, when the concrete foundation is laid 16 cubic yard size, trailer trucks at the rate of 10-20 round-trips daily are required.

C. Plant Construction

Plant construction is the most labor intensive of all the construction processes. During plant construction, the number of employees may increase to 70 or 80 and peak at 100.

A sampling of traffic entering the Geysers indicates that on the average five heavy trucks and 65 automobiles/light trucks will approach a site each day during construction of the facility.* This sampling was taken during the spring months and the number of vehicle trips may not be representative of peak summer construction activity when vehicle trips would most likely increase.

Heavy trucks include 10-15 ton cranes, dump trucks, transit mixers, and various tractor-trailer rigs. These vehicles do not substantially increase the amount of traffic in the area, but they may cause congestion and safety problems where these vehicles must cross the center-line to negotiate turns.

Transportation to the work sites for construction workers is provided by Patchett Bus Company in Santa Rosa. Patchett, under contract to Swinerton and Walberg, a labor relations firm hired by the major utilities, has various pick-up points around Lake, Sonoma, and on occasions, in Mendocino Counties. the major utilities provide monetary incentives to any employee who chooses to take a bus. Most of the workers who ride the buses are from Lake and Sonoma Counties, however, some workers drive into these counties from the San Francisco-Oakland Bay Area, and from some northern and central California Counties (see note below**).

* Data Source: Saw Mill Flat Road guard gate log records, Spring 1981.

** Other Counties include: Sacramento, Contra Costa, Trinity, Yuba, Butte, Sutter, Glenn, Humboldt, Placer, San Joaquin, Alameda and Marin

Buses run two basic routes to the Geysers geothermal work sites. All buses are routed out of Santa Rosa. One route goes through Calistoga to Middletown. The other route travels north along U.S. 101 to the Cloverdale Geysers Road. Passenger pick-up points are scheduled along these two basic routes based on demand locations. In more remote areas a minimum of eight people justifies the need for a bus pick-up stop.

Bus ridership fluctuates according to the construction cycle at a work site and enclosure of the building shell (turbine housing). Bus passenger records indicate a high of 452 construction workers since March 1981 to a current low of 138 (November 13, 1981). However, when the electrical-mechanical phase (a labor intensive cycle), is begun at the NCPA Unit, which is now enclosed, buses and related traffic will increase and continue through the winter months.*

To facilitate safe parking for commuters, Caltrans constructed a Park-and-Ride lot in Middletown which Patchett uses as a pick-up point. Other pick-up points in Lake County are the Letrianon Resort in Blue Lake, Highway Grocery near Upper Lake, Highway 29 and Live Oak Drive in Kelseyville, Bottle Rock Road and Geyser Rock Road, County Kitchen Coffee Shop in Cobb, Foods Etc. in Clearlake, 1/8 of a mile up Socrates Mine Road and the junction of Highway 29 and Highway 175. Pick up points in Sonoma County are in Santa Rosa, on Airway Drive between Industrial Drive and Center Drive and at the Veterans Memorial Building, by the Christian Science Life Center off of Mark West Springs Road, and in Healdsburg, off of Dry Creek Road and Healdsburg Avenue.

Caltrans is designing a Park-and-Ride lot at the junction of Highway 175 and 29 near Lakeport, an area currently being used by commuters. The proposed Park-n-Ride lot will improve the attractiveness of ridersharing and access onto the highways from the parking area.

* These numbers only represent construction workers riding buses. Records show, that an additional 69 construction workers drove their own vehicles since March 1981 and 42 others are currently driving in.

These numbers only reflect union represented craft workers. The actual number of workers at the Geysers is higher.

The plant construction phase also includes the installation of steam pipelines and electric transmission lines. Most of the construction materials are transported from the valley via Williams on Highway 20. The number of vehicles for this purpose is negligible. The plant construction phase of development has the greatest impact on the transportation network. Steam turbines weighing up to 100 tons or more are transported to the geothermal sites during this phase. Overload permits are required for these loads. The volume of tractor trailer rigs hauling heavy equipment to the site increases during this phase. As previously indicated, construction personnel is at its peak during the construction phase.

STAGE IV: Production of Steam and Electricity

When construction is completed, work trips can be expected to diminish to 20 round trips per day. Most of these trips involve the transportation of personnel to the work sites to perform routine operation and maintenance of the plant. A minimum of make-up drilling is necessary to provide replacement wells. It is estimated that it takes one make-up well per year per power plant to replenish the steam supply. (K. Stellings, California Division of Oil and Gas).

STAGE V: Total Closeout of Operations

Closeout takes place after geothermal resources can no longer be economically extracted from the reservoir. Estimated life of an active well is 30 years. At closeout the wells are abandoned and all surface equipment is removed. Surface reclamation and restoration are also required. To date, there have been no closeouts.

This phase of development would have minimal impact on traffic volumes (see Figure 4-B).

SOURCES: Field Data, Traffic Counts
and Observed Vehicle Occupancy

FIGURE 4-B

IV. EXISTING TRANSPORTATION CHARACTERISTICS

Data on current road conditions, traffic volumes, accident historic and operating conditions was gathered, organized and analyzed. Data gathering efforts included; taking field trips to review the access facilities, making traffic counts at critical locations, (see Figure 4-A) and researching accident data from Caltrans' Traffic Accident Surveillance and Analysis System and from local jurisdictions. Staff members from Lake and Sonoma Counties, the California Highway Patrol, at Santa Rosa and Lakeport, and the California Division of Forestry, at Middletown, were interviewed for their input. Efforts were made to acquire current trip making data and access problem concerns from PG&E. However, this data was not received.

State Highway 128 (at Healdsburg Geysers Road

This is a 2-lane conventional, rural highway. Current average daily traffic is 2,100 vehicles per day at the Alexander Valley Road junction, 1,400 at the Geysers Road junction and 850 at the River Road junction. Peak month, average daily traffic (ADT) is 3,000, 2,000 and 1,200 respectively (Caltrans 1980 Traffic Volumes on California State Highways).

Accident records show a decline in accident from 9 in 1979 to 7 in 1980 and 2 in the first 6 months of 1981 (see Table 2).

The calculated accident rate for this roadway for 1979 is 2.93 as compared to the State average of 1.96 for similar roadways for the same year. The 1980 accident rate is 2.28 as compared to the State average of 1.84.*

* The accuracy of traffic data is subject to reporting levels of the law enforcement agencies supplying the collision reports. Caltrans estimates that it receives collision reports for approximately 100 percent of all fatal accidents, 90 percent of all injury accidents and 40 percent of all property-damage-only accidents occurring on State highways.

Accident rates of road segments are used to predict rates to be expected on new roads, or to compare rates on an existing road with rates on other roads of the same type. Accident rates represent total accidents per million vehicle miles.

U. S. 101 (Cloverdale)

U.S. 101 is a 2-lane conventional, primary highway. The current average daily traffic is approximately 9000 vehicles per day. The peak month average daily traffic is approximately 13,000 (Caltrans, 1980 Traffic Volumes on California State Highways). This increase in traffic volume is attributed to seasonal variations in the type and amount of vehicle traffic.

The seasonal pattern of traffic on any highway is closely related to economic and social demands for transportation. The traffic variation on rural highways influenced by summer recreational traffic is quite pronounced. Typically, the highest months for rural highways are June to September with the peak occurring in August (Highway Capacity Manual, 1965). This section of U.S. 101 is a rural highway and closely reflects this pattern. During the summer months between June to September, the volume increases reaching a peak in August. The lowest volumes occur in January (Caltrans District 04, Monthly Average Daily Traffic). This route has high recreational travel and is highly congested on three-day weekends, such as Memorial Day, Fourth of July, and Labor Day. Occasionally, it is congested on other summer weekends too.

The current accident rate is below that of the last two years and is steadily declining (see Table 2). A total of 16 accidents were reported for 1979, 10 for 1980 and 4 for the first 6 months of 1981. The 1969 accident rate was .79 as compared to a State average of 1.96. The 1980 rate decreased to .49 as compared to the State average of 1.84.

Pine Flat Road

Pine Flat Road is a narrow, winding Sonoma County Road. It is poorly maintained with a deteriorating road surface, only the last portion of the road is graded. The road as a whole is inadequate for heavy truck traffic, (CEC Staff "Occidental AFC, EIR Transportation", May 1981). This road ends at the entrance to the Union Oil leasehold and is separated from the internal private road network by a locked gate. Other than the Patchett buses, which carry workers to the PG&E Unit 18, there is no public traffic on this road.

ACCIDENT HISTORY

LOCATION	1978	1979	1980	1981*
State Route 175 (Lake Co.) (Cobb to Middletown)	--	17	21	9
Socrates Mine Road	--	Ø	3	3
Bottle Rock Road	--	Ø	Ø	2
Butts Canyon Road	--	4	4	Ø
State Route 101 (Sonoma Co.) (Route 128 to Mendocino C. Line)	--	16	10	4
State Route 128 (Sonoma Co.) (River Rd. to Alexander Valley Rd.)	--	9	7	2
Cloverdale-Geysers Road	7	7	7	2
Healdsburg-Geysers Road	10	6	10	9

NOTES:

All State route accident data from California Traffic Accident Surveillance & Analysis System
 Accident data for both Geysers Roads from Sonoma County
 Accident data for Socrates Mine, Bottle Rock, & Butts Canyon Roads from California Highway Patrol

*For first 6-months of 1981.

TABLE 2

Healdsburg-Geysers Road

This 2-lane county road runs from State Highway 128 northerly to Geysers Resort Road. Various sections of this road have sharp curves and short sight distances and steep grades. The roadway varies between 18 and 28 feet wide (Sonoma County Public Works Department, 1981). Actually, in some places it is even narrower. At some locations the pavement is damaged and is in need of repairs. Visual inspection of the roadway indicates extensive signs of road failure in the form of alligator cracks.* It appears that this road is being subjected to loading beyond its capacity.

Traffic counts taken during the week of August 7-14, 1981 indicate current average daily traffic at approximately 600 vehicles per day with 20% trucks.** An unusually high percentage (50%) of the trucks are 5-axle trucks. A 5-axle truck causes 10 times the damage inflicted by a 2-axle truck to a pavement (Caltrans Highway Design Manual).

The current accident rate is running at about double the average rate of the last three years (Table 2). The calculated 1979 accident rate, per million vehicle miles of travel for comparable roads, of 2.30 was higher than the State average of 2.21. The 1980 rate of 3.61 again surpassed the State average of 2.39. The accident rate for the first 6 months of 1981 reached a high of 5.85.*** Accident analysis for the last three years indicate that 62% of the accidents involved trucks, 70% occurred at curves, and 46% involved a vehicle on the wrong side of the roadway. This describes a condition where the curves are so sharp that it is difficult for big trucks to make the curves without encroaching on the wrong side of the pavement.

* Alligator Cracking - Interconnected or interlaced fatigue cracks, forming a series of small polygons. Alligator cracks are always load associated. Initially, a single longitudinal crack or a series of parallel cracks appear in the wheel paths. Upon further loading, the cracks interconnect forming the typical pattern resembling an alligator's skin.

** Traffic counts may vary from other sources because of the construction cycle, intensity of development activities, and seasonal variation at the time counts were taken.

*** The Statewide accident rate for 1981 was not available for comparison when these calculations were made.

Cloverdale-Geysers Road

This narrow 2-lane county road runs from U.S. 101 north of Cloverdale to the Geysers Resort Road. Most of this road is in mountainous terrain which has contributed to erosion of the roadway. In some places, the roadway has slipped away leaving an effective width of about eight feet. There is also a one lane bridge over Little Sulphur Creek, which is inadequate for heavy trucks. This is a truss bridge which will take normal truck traffic but not maximum loading of the larger heavy geothermal truck traffic. Overload permits are required. The maximum weight limit for this bridge, at present, is 18,000 lbs. per axle (Sonoma County Public Works Department). In addition to being poorly maintained, this road has inadequate sight distances and sharp curves.*

The current average daily traffic is about 380 vehicles per day with 20% trucks.** This road is in exceedingly poor condition, nevertheless, some heavy, multi-axle trucks still use it.

The accident rate in the past three years has been fairly constant (see Table 2). Thirty-five percent of the accidents involved trucks, 55% occurred at curves, and 35% involved a vehicle being on the wrong side of the road. The accident rate per million vehicle miles of travel stood at 3.60 for 1979 and 1980. This rate was considerably higher than the State average of 2.51 for 1979 and 2.39 for 1980. This means that the Statewide accident rates for similar roads are declining whereas, the accident rate for this road has been consistently higher.

* The State legal maximum axel loading permitted is 20,000 lbs. per axel or 34,000 lbs. per tandem axel group, the gross not to exceed 80,000 lbs. provided the proper axel space is maintained.

** Counts may vary from other sources due to construction phase, intensity of activities and seasonal variations.

Socrates Mine Road

With the exception of the initial one and one half miles, the road is a narrow winding unpaved road. The roadway through the Aminoil leasehold is steep and has apparently been a source of increased erosion because it was unpaved and the road itself was the cause for erosion which resulted in increased turbidity and other water quality problems in Anderson and Gunning Creeks. Heavy truck traffic on the road has caused increased deterioration of the road surface and excessive dust.

The road generally has poor horizontal alignment, sharp curves and short sight distances. The grade exceeds maximum county standards in many places. (CEC Staff, Geysers 16, Final EIR", March 1981). The road is too narrow in most parts, and is without adequate shoulders or guardrails where needed. There are two bridge structures located on short radius curves and these bridges are in poor condition. However, both bridges are to be reconstructed. Currently, Socrates Mine Road is below Lake County's Mountain Standards for collective roads with erosion control (Lake County standard specification resolution number 70-222).

The current average daily traffic is 690 vehicles per day, an increase of 50% over that of 1977. About 20% of the traffic are trucks, 56% of which, are 5-axle trucks.*

Reported accidents for the first 6 months of 1981 equalled the total number of accidents for 1980 (see Table 2). The accident rate per million vehicle miles for 1980 was 2.64 as compared to the Statewide average of 2.39 and the accident rate for the first 6 months of 1981 was 5.27 which is a significant increase.

A construction contract to upgrade Socrates Mine Road has been executed. Aminoil, representing a group of primary users of this road, is the administrator of this contract which is for approximately 2.8 miles of roadway improvements. Upgrading will include roadway and bridge reconstruction and widening some sections of the road to 22 feet minimum or 28 feet maximum.

* Counts taken by Caltrans, District 1, week of May 4, 1981.

State Highway 175 (Between Middletown and Cobb)

This is a 2-lane conventional highway with an average daily traffic of 580 at Highway 29 and varying between 2440 and 1750 vehicles per day between Cobb and the Socrates Mine Road junction. The heaviest traffic is near Cobb where the average daily traffic is 2440. At Socrates Mine Road the ADT is about 1750. The level of traffic has increased sharply in the last few years.

The total number of accidents increased between January 1979 and December 1980. The 1979 accident rate per million vehicle miles in the vicinity of Cobb was 4.87 and 6.65 in the vicinity of the Socrates Mine Road junction. The State average was 2.21 for the same year. The 1980 rates increased to 5.89 at Cobb, and 8.21 at Socrates Mine Road, whereas the overall State average decreased in 1980 to 2.04.

Bottle Rock Road

Bottle Rock Road is a ten mile-long county arterial road which intersects Highway 175 at Cobb and Highway 29 about three miles south of Kelseyville. The Circulation Element of the Lake County General Plan designates Bottle Rock Road as a county arterial road which serves as a "low level bypass of the Cobb Mountain route (State Highway 175)", (Gennis and Associates, Engineers, "Initial Environmental Study Bottle Rock Road Reconstruction Project").

This is a paved 2-lane county road. Some sections of this road are narrow and other sections have short or restricted sight distances. There are also signs of pavement failures. This is an old prescriptive road originally built for logging purposes. No design standards were followed and only sections have been improved.

The current average daily traffic varies from 780 at Highway 29 to 1250 at Cobb (see Figure 4).

Approximately 10% of the traffic are trucks, about 27 of which are 5-axle trucks.

According to the California Highway Patrol in Lakeport, there were no recorded accidents in 1979 and 1980. However, in the first 6 months of 1981 there were two recorded accidents.

Bottle Rock Road is an access road to the Department of Water Resource's proposed Bottle Rock Power Plant. The Department of Water Resources has signed an agreement with Lake County to upgrade this road through a series of three construction contracts starting in the latter part of 1981. Improvements will include three passing lanes, widening shoulders and realignment of all curve radius to a minimum of 300 feet.

Ford Flat Road

This is a three-mile long, narrow, winding, dirt, mountain road. It connects Socrates Mine Road to the Whispering Pines and Cobb area in Lake County. It can also be used as a short-cut to Highway 175 and Bottle Rock Road leading to the Kelseyville waste disposal site. Lake County emphasizes the fact that commute traffic on this road causes excessive dust and noise problems at the residences along the road and its use must be limited to local residents. (CEC Staff, Occidental, AFC, EIR Transportation, May 1981). The average daily traffic is about 45. No accidents have been recorded within the last two and a half years.

Butts Canyon Road

This Lake County Road is 10 miles long and gives access to the Middletown waste disposal site owned by Geothermal Incorporated.

Excessive use by heavy truck traffic has caused the failure of the road surface. Visual inspection indicated that the structural section and drainage of this road is not adequate for heavy truck traffic. Lake County has appropriated funds to upgrade 1.2 miles of this road. The elevation will be raised in problem areas prone to poor drainage and soil saturation. It is not known at this time if other funds will be made available for improvements to the remainder of the road.

The current average daily traffic is 485 vehicles per day (FEIR, Unit 16). It is estimated that currently about 20 heavy truck trips are made on this road daily.

Internal Road System

Although the primary concerns of this study are the public access roads into the Geysers area, the internal road system, although private, is an integral part of the Geysers Geothermal Area transportation system.

Access is controlled by Union Oil Geothermal Division. Only traffic directly related to geothermal operations is permitted access. Other geothermal vehicles are permitted but only by permit. Vehicle permits by weight categories are required. These are issued in three categories at set annual fees. The first category covers small vehicles to one ton, the second category includes light and bobtail trucks up to two and one half tons, the third category is for heavy trucks greater than two and one half tons. The movement of drilling rigs has a set fee which is assessed per move.

East-west access from Lake County to Sonoma County can be obtained by way of Socrates Mine Road or Saw Mill Flat Road, via the internal road network to Geysers Resort Road to either Healdsburg Geysers Road (southbound) or Cloverdale Geysers Road (northbound).

Guards stationed at the Geysers steam field entrances at Socrates Mine Road, Saw Mill Flat Road and Geysers Resort Road control traffic access (see Figure 4). There is also a locked gate at the end of Pine Flat Road. (This gate is not normally open and is not shown on the map.) The use of guards and the building of gates was initiated to prevent vandalism (Union Oil Geothermal Division Staff).

Because geothermal activity is constant during a 24-hour period 7-days a week, the presence of slow moving heavy trucks, the mountainous terrain, and the frequent presence of steam carrying pipes interlaced along and across roads, could potentially pose a safety hazard for non-geothermal traffic unfamiliar with the area.

V. TRAFFIC PROJECTIONS

Traffic projections for the Geysers Geothermal Resource Area are done by isolating the area with its four primary access roads. Cloverdale Geysers Road, Healdsburg Geysers Road, Saw Mill Flat Road and Socrates Mine Roads (Figure 5). A generation factor was developed by relating current vehicle traffic, which includes all vehicle classifications on these four roads to the number of workers in the area. Horizon year traffic is projected by using this generation factor and future work force data furnished by the California Energy Commission.

Methodology

- Generation Rate

Total Daily Vehicle Trips in and out of area
(Figure 5) = 1920.*

Total Workers in the area (from CEC Staff, Average for
6/81 and 9/81) = 615.

Generation rate = $\frac{1920}{615} = 3.12$ Vehicle Trips/Worker

- Workers (Horizon year work force) see Figure 6
- Projected Total Vehicle Trips = Generation Rate x Workers
- Trip Assignment - See Assumption #3

Cloverdale Geysers Road	20%
Healdsburg Geysers Road	31%
Saw Mill Flat Road	13%
Socrates Mine Road	36%

Assumptions

1. Because geothermal materials are a highly specialized technology, it is assumed that materials locations will not change within the time limit of the projections.

* All traffic significant to the design and operation of the access road is related to geothermal development.

EXISTING TRAFFIC PATTERN

Cloverdale Geysers Rd.	380 = 20%	} 51% use western access
Healdsburg Geysers Rd.	600 = 31%	
Saw Mill Flat Rd.	250 = 13%	} 49% use eastern access
Socrates Mine Rd.	690 = 36%	
	<u>1920</u>	

WORK FORCE NEEDS FOR GEYSERS GEOTHERMAL DEVELOPMENT

SCENARIO 2

2387 MW

FIGURE 6

Assumptions (Continued)

2. Between now and 1990 development in this area will primarily be for geothermal resource. Other development such as residential and recreational will be minimal and insignificant.
3. The number of workers for future years is based on data furnished by the California Energy Commission for Scenario 2 (2387 megawatts), to which workers for exploratory drilling and drilling for make-up wells, to replace lowering field pressure and steam volume, were added. The estimate of additional workers is based on information furnished by companies that are drilling now, the State Division of Oil and Gas, and the U.S. Department of Labor, plus the assumption that one make-up well is required per plant, per year, (California Division of Oil and Gas). Work forces for Bottle Rock and NCPA #1 are not included here because they would not be using any of the four primary access roads.
4. The existing vehicle trip pattern shows that 51% of the geothermal traffic use the western approach and 49% use the eastern approach. The distribution between the primary access roads is 28% on Cloverdale Geysers Road, 31% on Healdsburg Geysers Road, 13% on Saw Mill Flat Road and 36% on Socrates Mine Road (traffic counts, 1981). It is assumed that the future pattern will be about the same because it closely parallels socio-economic data developed by the California Energy Commission which indicates that at present there is an approximate 50/50 split between Sonoma and Lake County as a place of residence for geothermal workers, and future projections indicate a future split of 50% for Sonoma County, 40% for Lake County, 5% for Mendocino County and 5% for Napa County. Traffic from Lake, Napa and some from Mendocino would continue to use the eastern approach.
5. Because development at the Geysers is limited to geothermal activities and only geothermal related traffic is attracted, free access would not change the present trip distribution as those wishing to make these trips are already doing so.
6. Vehicle trips generated by geothermal resource development in the study area are strongly related to the number of full time workers in the area.

Alternate Methodology

A test of the component generation method was made by estimating the current total vehicle trips. For example, the traffic generated by the construction of power plants was estimated by multiplying the trip rates given in geothermal development EIR's, (65 light vehicle round-trips and 5 heavy vehicle round-trips per day), by the number of power plants under construction. Similarly, the traffic generated by the operation and maintenance of power plants and that generated by drilling activities were also estimated. The total traffic estimated using this method was 33% below what was actually counted. For this reason this method was considered not acceptable. It appears that these trip rates are in error.

Results (See: Projected Average Daily Traffic, Figure 7)

The resultant projections show that the traffic will rise, reflecting the strong influence of construction activities, to a point approximately 40% above the current level in the end of 1982. With the exception of a dip in 1983-84, traffic is anticipated to stay at that level until after 1987. All construction activities are expected to be completed by the end of 1989, at which time traffic is expected to drop down to a point approximately 35% below the current level. Some minor activity will continue through 1993.

PROJECTED AVERAGE DAILY TRAFFIC

FIGURE 7

VI. PROJECTED TRANSPORTATION IMPACTS

Traffic generation, due to continued development at the Geysers, is expected to increase by approximately 40% above the current level by the end of 1982. Except for a dip in 1983-84 this level of traffic will be maintained until the end of 1987, at which time it will start decreasing to 35% below the current level in 1989, as plant construction activities are winding down. The main access routes are expected to be impacted as follows:

State Highways, Sonoma and Lake Counties

This increase in generated traffic is not anticipated to create any serious traffic problems on these State Highways.

Socrates Mine Road

This road, which is being upgraded with a \$4 million construction project, should have no problem handling projected traffic except for the structural section.

Cloverdale Geysers Road

Overall, this road is in an exceedingly deteriorated state which adversely affects the level of service, particularly in terms of speed, comfort and safety. The general alignment and mountainous profile inhibit meeting minimum standards for carrying capacity and speed with the present traffic volumes. County standards require the existing road to accommodate at least a design speed flow of 20 miles per hour.* However, because of twisting alignment and roadway deterioration, this minimum cannot safely be accommodated.

Of major concern is the continued use of the road by multi-axle trucks and the higher than average accident rate for comparable roads.

It is expected that if this road remains open without major improvements, it will continue to be used by multi-axle and smaller vehicles. Projected traffic increases will aggravate present unsafe operating conditions.

* Sonoma County recommendations

Healdsburg Geysers Road

As indicated in Section IV, this road has substandard widths, severe horizontal curves resulting in short sight distance, and inadequate pavement stretch. The severity of these deficiencies will be accelerated by the continued use by heavy trucks. Also, as Cloverdale Geysers Road deteriorates further, some or all of the heavy trucks may shift to this road.

It is expected that safety is the element which will be most impacted by the projected traffic increases. Deterioration of the road surface will also increase in proportion to increases in use in numbers of trucks.

Residents in this area should also be exposed to a higher potential of hazardous chemical and toxic waste spills.

VII. TRANSPORTATION DEVELOPMENT ALTERNATIVES

Projected traffic volumes do not indicate a need for additional access routes. Present routes have enough capacity to handle anticipated increases. Problems indentified are those of safety implications relative to geometric and structural deficiencies on Cloverdale Geysers Road and Healdsburg Geysers Road. To mitigate these problems four possible alternatives can be considered:

1. Do Nothing

If nothing is done to correct the deficiencies, potential liabilities may force Sonoma County to prohibit truck usage of these roads. This would not be a solution to the problem as it simply avoids the issues and would create new problems for users.

2. Construct a New Road of Proper Standards

A new road of proper standard can be designed and constructed to safely handle the combined traffic volumes of Healdsburg Geysers Road and Cloverdale Geysers Road. However, there are three drawbacks against this alternative.

- o First, it is not economically justifiable as there is a cheaper alternative. The construction and right of way acquisition cost per mile for a new road could be between \$3 million to \$7 million.* Assuming an average length of 14 miles for a new road the total cost could be between \$42-\$98 million. The cheaper alternative would be to improve Healdsburg Geysers Road. A cost estimate for basic safety improvements for Healdsburg Geysers Road, developed by the Sonoma County Public Works Department, estimates a cost of \$3.18 million. However, because of funding constraints, safety improvements would have to be made in stages and phased over a period of time.
- o Secondly, the detrimental effects to the environmental impacts due to construction of a new road are probably not justified. Earthwork disturbance due to cuts and fills would very likely create long term adverse visual impacts affecting native vegetative growth and topography. The value of removed vegetation to the wildlife habitat would be irretrievably lost. The loss of habitate would in turn reduce the wildlife population. Water quality could also be affected by increased turbidity and erosion due to construction near streams. Construction would also require expansion of large amounts of energy.

*Figures calculated from a current Caltrans project to build 1.3 miles of road in a similar topographica location.

- o Finally, the lead time of approximately ten years required to construct a new road, including public hearings and the environmental review process, is far too long to consider this an effective mitigation measure.

3. Improved Healdsburg Geysers Road

As indicated in Section IV, both Cloverdale Geysers Road and Healdsburg Geysers Road are in need of improvements if they are to continue serving geothermal development traffic. However, financing both improvements now may not be financially feasible as it would cost \$10 million to improve Cloverdale Geysers Road and \$7.6 million to improve Healdsburg Geysers Road (Department of Public Works, Sonoma County). An alternative would be to improve Healdsburg Geysers Road now and divert to it the truck traffic from Cloverdale Geysers Road until such time when the latter is properly improved.

Sonoma County has already indicated that it does not have the large sum necessary to improve Healdsburg Geysers Road. Following are three possible alternatives for financing this improvement:

- o Have the primary users pay for the improvement. This approach seems equitable since the primary users would receive most of the benefits from improved operating conditions and cause most of the damages to the road. A precedent for this approach has been established at Socrates Mine Road and reaffirmed at Bottle Rock Road.
- o Under current Law (AB 1905), Sonoma County receives about \$400,000 per year as royalties from geothermal development. This amount could be allocated directly to finance improvements. Unfortunately, this amount would not be enough to complete improvements in the near future, nor should it be construed to be a definite and continuous source of funds as the law could change.
- o Divide improvement costs between primary users and Sonoma County. Primary users would pay 90% and Sonoma County would pay 10%, because about 90% of the traffic currently using this road is geothermal related. The County's share would be financed with the royalties from geothermal development.

4. Induce Alternate Mode of Transportation

Approximately 60% of the construction workers are currently taking Patchett buses to the job sites and some are using carpools. It is assumed that this ratio will remain constant throughout the period of development. More could be accommodated through the use of more buses, however, there is no indication that this percentage will change in the future. Although a more aggressive effort in this area may be beneficial, the biggest problem is the transport of materials, equipment, and wastes, for which there is really no feasible alternative mode to trucks. For instance, the biggest construction helicopter can lift a maximum load of ten tons. Various components of a power generating plant weigh from 20 to 200 tons.

VIII. RECOMMENDATIONS

1. Improve Healdsburg Geysers Road to a minimum design width of 22 feet of paving plus 8-foot wide shoulders. This would meet the design width criteria for this facility as recommended by the American Association of State Highway Officials and utilized by Sonoma County. The structural section should be designed for a Traffic Index of 8.* The existing structural section was designed for a Traffic Index of 6 and has been subjected to many years of wear and tear. In most areas the structural section can be strengthened by placing asphalt concrete over the existing pavement. However, where there are signs of structural failures, digouts may be necesasry.

Safety improvements should include flattening sharp curves, improving sight distances where they are now inadequate, widening pavements and providing shoulders, constructing passing lanes and pullouts, and providing safety measures such as guardrails and warning signs. Because safety concerns are relative to facility deficiencies and road failures and because there is no pronounced peak traffic period, traffic control devices and transportation systems management approaches are not viable mitigation measures.

Projections indicate that traffic will hit the first peak in late 1982 then dip downward in 1983 and 1984 before peaking again in 1985. If the whole project cannot be completed by midyear 1982, consideration should be given to staging this project; make the safety improvements in the first half of 1982, before traffic peaks, and complete the remaining work in 1983-1984, when traffic will be lighter. The Public Works Department for Sonoma County has identified 23 separate safety priority improvement projects which include widening 4.54 miles of roadway, widening 8 curves and 1/2 mile of passing lanes. The total cost of these would be \$3.18 million.

2. Prohibit heavy trucks on Cloverdale Geysers Road until it is properly improved and maintained. In the meantime, the heavy truck traffic can be directed to use Healdsburg Geysers Road. An improved Healdsburg Geysers Road should be able to accommodate this additional truck traffic.

*Appendix A

Considering the amount of traffic and the long lead time involved the expenditure of funds to fully improve this road does not seem justified. As Cloverdale Geysers Road continues to deteriorate, heavy truck traffic normally using this road may shift to Healdsburg Geysers Road. If funds for major improvements for the Cloverdale Geysers Road are not available, it could be restricted to light traffic only. The Public Works Department for Sonoma County estimate a cost of approximately \$10 million to make basic priority spot improvements.

3. A construction contract to upgrade Socrates Mine Road is currently underway. The new structural section is being constructed for a Traffic Index of 7 (Bill Cain, Veizades and Associates Bill McVicker, Aminoil USA, Inc.).

Traffic index calculations using classification count data taken during July 1980, indicate that the structural section should be constructed for a Traffic Index of 8, which could prove to be more cost effective by keeping long-range maintenance costs down.*

4. Northeasterly of the Geysers Steam Field Area, liquid-dominated resources (hot water) are believed to be present over a very large area. It is felt by some experts that up to 5000 megawatts may be produced from this area. Considering the magnitude of the potential hot water resource development and the geographic size of the area that would be affected, a separate transportation study to assess the potential transportation impacts and to develop mitigation measures is recommended.
5. Presently only construction workers are bused. It would be desirable if this service is expanded to steamfield development and operations and management when they can be scheduled together.

*Appendix B

IX. PERSONS CONTACTED AND BIBLIOGRAPHY

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- BERG, Vincent - Energy Analysis Program, Lawrence Berkeley Laboratory, University of California, Berkeley, California.
- BOTZ, James - County Council, County of Sonoma, Santa Rosa, California.
- BLANK, Bill - Construction Manager, The Geysers NCPA geothermal site.
- CALE, Michael - Sonoma County Planning Department, Santa Rosa, California
- CHAPPELL, Ron - Supervisor, Civil Engineer, Union Oil, Santa Rosa, California.
- COLLINS, Eugene - Public Works Director, Lake County, Lakeport, California.
- DEGUCHI, Roy - Sacramento Municipal Utility District, Sacramento, California.
- EMSLIE, Mr. - Aminoil USA Inc., Santa Rosa, California.
- FLYNN, Jay J. - Commander, California Highway Patrol, Lakeport, Lake County, California.
- FURGUSON, Don - State Forest Ranger, State Forestry Department, Middletown, California.
- GARDNER, Mr. - Officer, California Highway Patrol, Santa Rosa, California.
- HEAD, Donald - Sonoma County Public Works Director, Santa Rosa, California.
- HOWE, Harry - Chief Siting Engineer, PG&E, San Francisco, California.
- HUDSON, Ted - Supervisor, Department of Interior, Conservation Division, District Geothermal Office, Santa Rosa, California.
- KIMSEY, Doug - Transportation Planner, Caltrans, District 1, Eureka, California.

MARKFIELD, Dale - Construction Manager, DWR, Division of design and Construction, Sacramento, California.

MARRS, Mr. - Construction Superintendent, #1 construction site, The Geysers SMUDGE #1.

McVICKER, Mr. - Aminoil USA Inc., Santa Rosa, California.

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APPENDIX A

EAL CONSTANTS AND CALCULATIONS OF
TRAFFIC INDEX FOR HEALDSBURG GEYSERS ROAD

APPENDIX A
EAL CONSTANTS AND CALCULATIONS OF TRAFFIC INDEX
FOR HEALDSBURG GEYSERS ROAD

(1)	(2)	(3)	(4)
Vehicle Type	EAL 10 Year Constants	Average Daily Trucks	Total 10 Year EAL (Col. 2 X Col. 3)
2-axle trucks	690	24	16,560
3-axle trucks	1840	12	22,080
4-axle trucks	2940	2	5,880
5-axle trucks	<u>6890</u>	<u>29</u>	<u>199,810</u>
Totals	--	67**	244,330*

Traffic Index (TI) From Table 7-651.2B
CalTrans Highway Design Manual

*244,330 equals TI of 7.5

**Data source: Classification counts taken 7-30-81

APPENDIX B

EAL CONSTANTS AND CALCULATIONS OF
TRAFFIC INDEX FOR SOCRATES MINE ROAD

APPENDIX B
EAL CONSTANTS AND CALCULATIONS OF TRAFFIC INDEX
FOR SOCRATES MINE ROAD

(1)	(2)	(3)	(4)
<u>Vehicle Type</u>	<u>EAL 10 Year Constants</u>	<u>Average Daily Trucks</u>	<u>Total 10 Year EAL (Col. 2 X Col. 3)</u>
2-axle trucks	690	24	16,560
3-axle trucks	1840	10	18,400
4-axle trucks	2940	1	2,940
5-axle trucks	<u>6890</u>	<u>43</u>	<u>296,270</u>
Totals	--	78**	334,170*

Traffic Index (TI) From Table 7-651.2B
CalTrans Highway Design Manual

*334,170 equals TI of 8.0

**Data source: Classification counts taken 5-7-81

GLOSSARY

ADT:	(Average Daily Traffic) - The average 24 hour volume, being the total number during a period of one year divided by the number of days in that year.
ACCIDENT RATE:	Expressed in million vehicle miles for road segments and used to predict rates to be expected on new roads, or to compare rates on an existing road with rates on other roads of the same type.
AFC:	Application for Certification.
CONVENTIONAL HIGHWAY:	A highway with no control of access which may or may not be divided or have grade separations at intersections.
CURB:	A vertical or sloping member along the edge of a pavement or shoulder forming part of a gutter, strengthening or protecting the edge, and clearly defining the edge to vehicle operators.
EA:	Environmental Assessment: Under NEPA used to determine if EIS is required. Also Expenditure Authorization: Cost accounting number issued for each project prior to undertaking any work.
EAL:	Equivalent Axle Load, see California Highway Design Manual.
EIR:	Environmental Impact Report: A detailed statement setting forth the environmental effects and considerations pertaining to a project as specified in the California Environmental Quality Act of 1970, and may mean either a Draft or a Final EIR:
EIS:	Environmental Impact Statement: An environmental impact document prepared pursuant to the National Environmental Policy Act (NEPA) of 1969. The federal government uses the term EIS in the place of the term EIR, which is used in CEQA.
ENVIRONMENTAL DOCUMENTS:	Draft and Final EIRs, Initial Studies, Negative Declarations, Notices of Completion and Notices of Determination.

ENVIRONMENT:

The physical conditions which exist within the area which will be affected by a proposed project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance.

GRA:

Geysers Resource Area.

HIGHWAY,
STREET, OR
ROAD:

These are general terms denoting a public way for purposes of vehicular and pedestrian travel, including the entire area within the right-of-way. In rural areas, or in urban areas where there is comparatively little access and egress, a way between prominent termini is usually called a highway or a road. A way in an urban area, with or without provision made for curbs, and sidewalks.

KGRA:

Known Geothermal Resource Area.

LEVEL OF
SERVICE:

Is a qualitative measure of the effect of a number of factors, which include speed and travel time, traffic interruptions, freedom to maneuver, safety, driving comfort and convenience, and operating costs. A given lane or roadway may provide a wide range of levels of service. The various levels for any specific roadway are functions of the volume and composition of traffic and of the speed attained. A lane or roadway designed for a certain level of service at a specified volume will actually operate at many different levels of service as the flow varies during an hour, and as the volume varies during different hours of the day, days of the week, periods of the year, and during different years with traffic growth.

Characteristics

- A. Free flow; low volumes and high speeds; most drivers can select own speed
- B. Stable flow; speeds restricted slightly by traffic; service volume used for design of rural highways
- C. Stable flow; speed controlled by traffic; service volume used for design of urban highways
- D. Approaching unstable flow; low speed

- E. Unstable flow; low, varying speeds; volumes at or near capacity
- F. Forced flow; low speed; volume below capacity; stoppages.

MVM: Million vehicle miles.

MW: Megawatts, one million watts of power.

NOI: Notice of Intent.

OPERATINOAL IMPROVEMENTS: Lane or shoulder widening, reconstruction or other width modifications, construction of shoulders or additional lanes (thru or turn), median barriers and guardrails, replacement parking, landscaping, channelization, pavement markings, signing and signals for capaicty and/or safety. Grade separations (for railroad pedestrians, bicycles, or vehicles). Reconstruct restrictive segments which prevent full utilizatin of existing capacity along a route. Removing, reconstructing, or replacing structures which restrict traffic flow.

PAVEMENT: That part of a roadway having a constructed surface for the facilitation of vehicular movement.

PEAK MONTH ADT: The peak month ADT is the average daily traffic for the month of heaviest traffic flow. This data is obtained because of many routes, high traffic volumes which occur during a certain season of the year are more representative of traffic conditions than the annual ADT.

PEAK-HOUR TRAFFIC: The highest number of vehicles found to be passing over a section of a lane or a roadway during 60 consecutive minutes.

PRIVATE ACCESS: Entrance to or exit from a road is restricted.

PUBLIC ACCESS: Entrance to or exit from a road is opened to public.

ROADWAY: That portion of a road which is improved, designed, or ordinarily intended for vehicular use. Divided roads, and roads with frontage roads, have more than one roadway. On undivided roads without frontage roadways, the roadway width normally lies between the regularly established curb lines or between the outer extremities of the shoulders, whichever is appropriate.

- SHOULDER:** The portion of the roadway contiguous with the traveled way for accommodations of stopped vehicles, for emergency use, and for lateral support of base and surface courses.
- SIGHT DISTANCE:** The continuous length of highway ahead visible to the driver.
- SPEED:** The rate of movement of vehicular traffic or of specified components of traffic, expressed in miles per hour.
- DESIGN SPEED:** A speed selected for purposes of design and correlation of those features of a highway, such as curvature, superelevation, and sight distance, upon which the safe operation of vehicles is dependent.
- STRUCTURAL SECTION:** The planned layers of specified materials, normally consisting of subbase, base, and pavement placed over basement soil.
- TERRAIN:** The topography of the profile of a highway, road, or street. The term generally has one of three modifiers: level, rolling, or mountainous. These three modifiers represent combinations of geometric features in varying degrees which related primarily to gradients and horizontal and vertical alinement. They reflect the effect on capacity of the operating characteristics of trucks in terms of their passenger car equivalent under the different geometric conditions.
- a. Level Terrain - Any combination of gradients, length of grade, or horizontal or vertical alinement that permits trucks to maintain speeds that equal or approach the speeds of passenger cars.
 - b. Rolling Terrain - Any combination of gradients, length of grade, or horizontal or vertical alinement that causes trucks to reduce their speeds substantially below that of passenger cars on some sections of the highway, but which does not involve sustained crawl speed by trucks for any substantial distance.

- c. Mountainous Terrain - Any combination of gradients, length of grade, or horizontal or vertical alinement that will cause trucks to operate at crawl speed for considerable distances or at frequent intervals.

T. I.: (Traffic Index) - A design criteria for selecting the structural thickness of a roadway. It is a number which ranges from 3 to 15.5. The higher number requires a stronger structural section.

TRUCK: A free-wheeled vehicle having dual tires on one or more axles, or having more than two axles, designed for the transportation of cargo rather than passengers. Includes tractor-trucks, trailers and semitrailers when used in combination.

VOLUME: The number of vehicles that pass over a given section of a lane or a roadway during a time period of one hour or more. Volume can be expressed in terms of daily traffic or annual traffic, as well as on an hourly basis.

- a. Average annual daily traffic - The total yearly volume divided by the number of days in the year, commonly abbreviated as AADT.
- b. Average daily traffic - The total volume during a given time period in whole days greater than one day and less than one year divided by the number of days in that time period, commonly abbreviated as ADT.