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16. ABSTRACT

The purpose of this report is to present the operational problems experienced by septic tank- leach field disposal systems at safety road-side rest areas (SRRAs) and to identify the factors that lead to the malfunction of these systems. Thirteen SRRAs were evaluated. A brief literature search was conducted.

Nine of the thirteen SRRAs were evaluated in the field. Problems with the systems reported to the investigators or observed directly in the field were documented.

Wastewater production rates (for rest room flows only) and detention times were calculated for each SRRA. The resulting values were applied in determining the amount of wastewater produced each day and how much detention time is provided in order to identify the causes of malfunctions.

An inventory of 91 SRRAs in the State of California with general information on the type of sewage disposal system used and its characteristics included as part of this report.

Some causes of malfunctions in septic tank systems identified in this report are overloading, poor site conditions, poor traffic prediction methods and undersizing of septic tanks and/or leach fields.

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STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF FACILITIES CONSTRUCTION

IDENTIFICATION OF THE CAUSES CONTRIBUTING TO THE MALFUNCTION OF SEPTIC TANK SYSTEMS AT SAFETY ROADSIDE REST AREAS

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The State of California does not endorse products or manufacturers. Trade or manufacturers' names appear herein only because they are considered essential to the object of this document.

CONVERSION FACTORS

English to Metric System (SI) of Measurement

Quality	English unit	Multiply by	To get metric equivalent
Length	inches (in)or(")	25.40 .02540	millimetres (mm) metres (m)
	feet (ft)or(')	.3048	metres (m)
	miles (mi)	1.609	kilometres (km)
Area	square inches (in^2) square feet (ft^2) acres	6.432×10^{-4} .09290 .4047	square metres (m^2) square metres (m^2) hectares (ha)
Volume	gallons (gal) cubic feet (ft^3) cubic years (yd^3)	3.785 .02832 .7646	litre (l) cubic metres (m^3) cubic metres (m^3)
Volume/Time (Flow)	cubic feet per second (ft^3/s	28.317	litres per second l/s)
	gallons per minute (gal/min)	.06309	litres per second (l/s)
Mass	pounds (lb)	.4536	kilograms (kg)
Velocity	miles per hour (mph) feet per second (fps)	.4470 .3048	metres per second (m/s) metres per second (m/s)
Acceleration	feet per second squared (ft/s^2)	.3048	metres per second squared (m/s^2)
	acceleration due to force of gravity (G) (ft/s^2)	9.807	metres per second squared (m/s^2)
Density	(lb/ft^3)	16.02	kilograms per cubic metre (kg/m^3)
Force	pounds (lbs) (1000 lbs) kips	4.448 4448	newtons (N) newtons (N)
Thermal Energy	British termal unit (BTU)	1055	joules (J)
Mechanical Energy	foot-pounds (ft-lb) foot-kips (ft-k)	1.356 1356	joules (J) joules (J)
Bending Moment or Torque	inch-pounds (in-lbs) foot-pounds (ft-lbs)	.1130 1.356	newton-metres (Nm) newton-metres (Nm)
Pressure	pounds per square inch (psi)	6895	pascals (Pa)
	pounds per square foot (psf)	47.88	pascals (Pa)
Stress Intensity	kips per square inch square root inch ($ksi\sqrt{in}$)	1.0988	mega pascals$\sqrt{metre}$ ($MPa\sqrt{m}$)
	pounds per square inch square root inch ($psi\sqrt{in}$)	1.0988	kilo pascals$\sqrt{metre}$ ($KPa\sqrt{m}$)
Plane Angle	degrees (°)	0.0175	radians (rad)
Temperature	degrees fahrenheit (F)	$\frac{+F - 32}{1.8} = +C$	degrees celsius (°C)

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INTRODUCTION

General Overview of Roadside Rest Areas

There are 91 Safety Roadside Rest Areas (SRRAs) throughout the State of California. Septic tank systems are used for wastewater treatment at a majority of these. A limited number of national and local studies have indicated that septic tank systems experience a significant rate of failure.

This research study was undertaken to analyze and provide recommendations for solving wastewater disposal problems and related factors for septic tank - leach field systems at SRRAs. This report identifies the causes of the malfunctions at 13 SRRAs in California.

An inventory which lists the locations, the type of sewage disposal system used, the system characteristics, main line traffic count data, and the types of facilities that are offered to the motoring public for each of the 91 SRRAs was developed. This inventory is included in Appendix A.

On site visits were made to nine SRRAs where the existing systems were observed. Data are presented concerning rest area problems as reported or observed by the investigators during field visits. A study was made of current documents and reports where the causes of failure in septic systems were discussed. Calculations were made, using current traffic data to estimate the average and peak rest room flow rates for each SRRA. Detention times were calculated based on these flow rates.

The primary reason for providing rest areas on federal and state highways is safety. They are generally intended and designed for short term occupancy and to provide a few minutes of relaxation for the motoring public. The estimated annual usage of the Safety Roadside Rest Area (SRRA) system in California in 1981 was 47,380,817 persons. An important service provided for the convenience and comfort of the motorists at these SRRAs is the rest rooms. A water supply that meets health regulations must also be supplied(1). Additional facilities may include picnic areas, drinking fountains, tourist information, public telephones and facilities for disposing of the wastewater from camping trailers and recreational vehicles (RVs).

These SRRAs are frequently in locations remote from municipalities and do not have adequate public water supply and sewage systems available. Therefore, it is necessary to provide these utilities that will serve the rest areas.

Roadside Rest Area Wastewater Disposal

Wastewater disposal at SRRAs has been complicated by several factors. The conventional treatment and disposal systems have proven inadequate in many cases. This is attributed, in part, to the quantity of wastewater to be processed and the daily and seasonal variation in wastewater flow(2).

Septic tank systems are widely used for wastewater disposal at SRRAs. Of 422 SRRAs wastewater disposal facilities surveyed nationwide, 50% were septic tank systems(3). California currently has 91 SRRAs on its highways; approximately 75% of these utilize septic tank systems. Figure 1 shows the distribution of rest area disposal methods in each Federal Highway Administration (FHWA) region and also nationwide. Table 1 presents the nationwide distribution in more detail together with the maximum design flow used in FHWA regions for each disposal method(3).

Survey results suggest that septic tank systems are considered by FHWA to be suitable for design up to 15,000 gpd, while conventional aerobic treatment in extended aeration plants or lagoons is judged capable of handling higher flows. Although disposal of rest area wastewater to municipal sewers is commonly regarded as the most desirable method, few rest areas are able to use this approach(3). Because of the special characteristics of effluent flow and differences in character of rest area wastes from normal municipal waste flows, the well-developed technology for municipal effluents cannot be employed for on site treatment at rest areas(4).

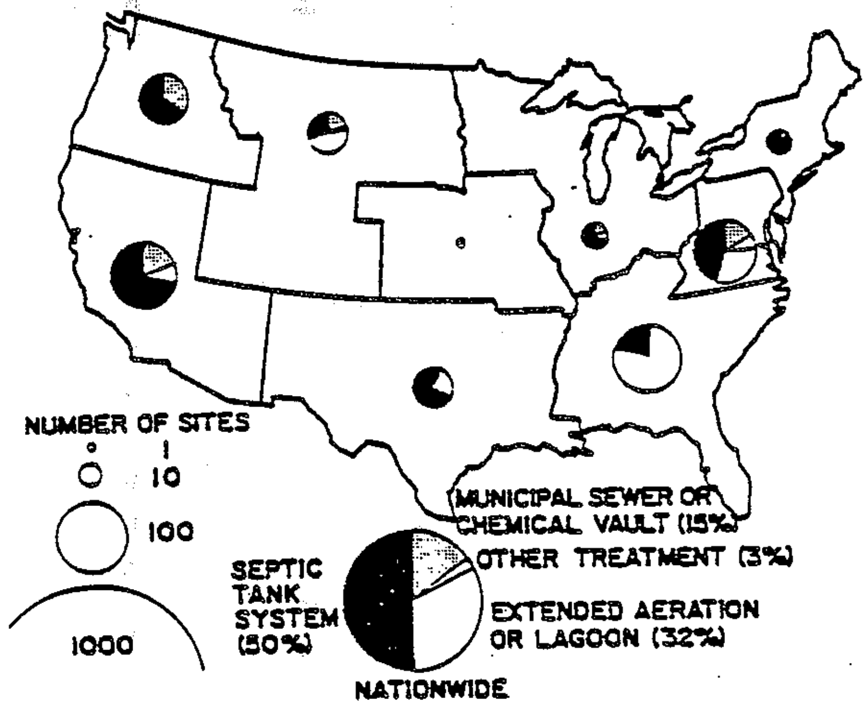


Fig. 1: Rest Area Wastewater Disposal Methods In Each FHWA Region (3)

TABLE 1: Roadside Rest Waste Disposal Methods (3)

Waste Disposal Method	Percent of Sites Using Method	Max. Design Flow gallons/day
Septic tank with leach field	43%	15,000
Septic tank with sand filter	7%	15,000
Extended aeration activated sludge	27%	35,000
Lagoons	5%	60,000
Physical-chemical	2%	20,000
Recirculation-incineration	1%	50,000
Municipal sewer	6%	15,000
Chemical vault holding tank	9%	400

CONCLUSIONS

Based upon field observations and data available to the investigators, the following conclusions are drawn:

1. Wastewater flow rate and septic tank detention time estimates are based upon available data. These estimates show that under peak flow conditions most of the septic tanks hold the wastewater for less than one day. (See Table 5.)

2. Overloading is the major cause of malfunction of roadside rest septic tank systems.

3. Field observations indicate that only the septic tanks at Westley SRRA are experiencing a severe overloading problem at the present time.

4. Maintenance personnel at Westley SRRA report that some of the septic tanks develop large accumulations of scum in short periods of time.

5. Large quantities of scum in some septic tanks at Westley SRRA cause the influent lines to the septic tanks to back up and cause flooding in the comfort stations.

6. The incoming paper and solids stick together forming an almost impermeable scum layer because of the short reaction time provided by the septic tanks at Westley SRRA.

7. The rapid buildup of scum in the Westley SRRA septic tanks is presently controlled by pumping.

RECOMMENDATIONS

Long-Term Recommendations:

1. Modify the existing system on the southbound (SB) side at Westley SRRA by replacing the two 7,500 gallon tanks with a much larger septic tank (20,000 gallons or more).

2. To research wastewater disposal method alternatives which may be appropriate for the Westley SRRA, such as oxidation ponds or a small package treatment plant.

Short-Term Recommendations:

1. To help alleviate the rapid scum buildup problem at Westley SRRA, use of a more easily biodegradable toilet paper and paper seat covers should be made.

2. Adequate maintenance should be performed at all rest areas. Regular and frequent inspection of inlet septic tank manholes and clearing of large accumulations of scum in the inlet portion of the tanks that have blocked inlet lines will reduce problems of floor flooding and unsanitary conditions for the public using the rest rooms at the rest areas.

3. Tank scum depths should be observed on a weekly basis and maintenance personnel should be instructed to pump the tanks when required even if needed every two or three months. In most cases this will reduce the need of pumping the tanks to dryness.

4. More frequent accurate traffic surveys should be conducted to determine the actual traffic stopping factors for all SRRAs.

5. Percolation and permeability tests should be conducted at sites where leach field problems exist to determine the extra leach field capacity that may be required or if alternate disposal facilities are required.

6. This study should be extended to evaluate each of the 91 SRRAs in the State of California Highway System. Through additional research more data can be obtained on the factors leading to problems with septic tank systems.

IMPLEMENTATION

Copies of this report will be distributed to the Caltrans District and Headquarters Offices for implementation. Copies will be provided to other interested parties upon request.

The information contained in this report will be useful for planning, design and operation of wastewater treatment facilities at the Caltrans Safety Roadside Rest Areas. TransLab personnel are available to assist in the solution of any technical problems that may arise.

BENEFITS

Valuable wastewater information for each rest area is tabulated in the Appendix for easy access. Estimates of average day and peak wastewater flow rates are made for the nine selected wastewater treatment systems.

SEPTIC TANK - LEACH FIELD DISPOSAL SYSTEMS CONCEPTS

The septic tank with an underground leach field is the most common type of sewage treatment(5). The popularity of septic tank systems for rest area wastewater treatment is related to their low cost, relative ease of operation and maintenance (when functioning correctly), and the ability to handle fluctuations in loading and in periods of nonuse(3). Septic tank systems are also hidden from view resulting in no vandalism or aesthetic degradations(5).

A septic tank serves two functions(3)(6); 1) to retain wastewater long enough for suspended solids (scum and sludge) to be separated before the clarified liquid passes to the leach field, and 2) to store the separated sludge and scum, where it will undergo anaerobic decomposition, until it is removed by pumping out the tank; grease and lighter solids will often form a floating scum in the top of the tank (Figure 2).

The efficiency of the separation of the floatable and settleable solids, is a function of tank surface area and not of volume(1). For a given volume, the larger the tank surface area, the more effective will be the sedimentation providing the surface area is one tank and not the sum of many in series. Many tanks are divided into two sections with a baffle to confine most of the sludge and scum to the first compartment(1). Pumping of a septic tank is recommended when the sludge level in the final compartment is close to the outlet(3).

The clarified liquid component of the wastewater is withdrawn from the tank at a point between the sludge and the floating scum layers and conveyed to the absorption

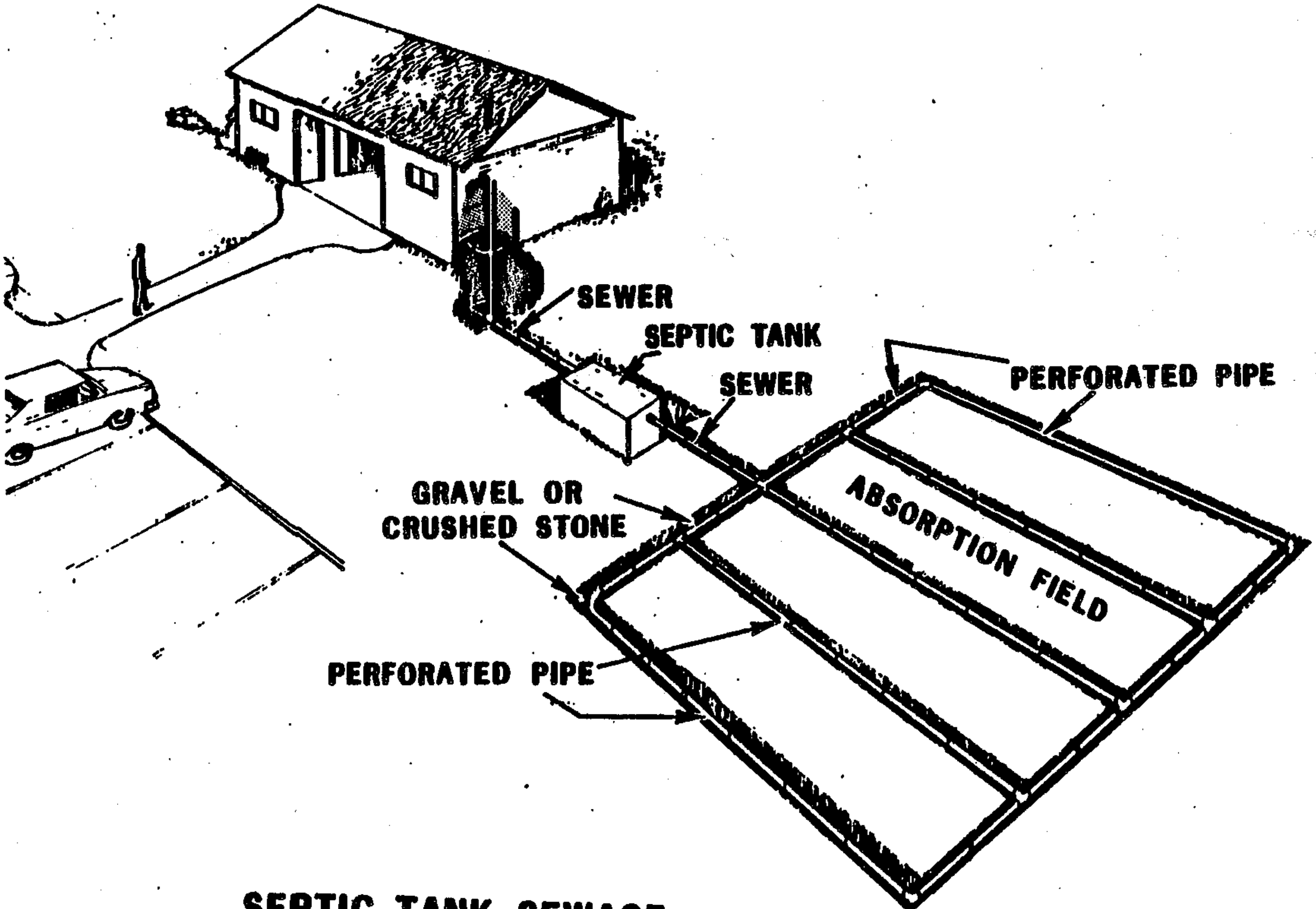


FIGURE 2

SEPTIC TANK SEWAGE DISPOSAL SYSTEM (15)

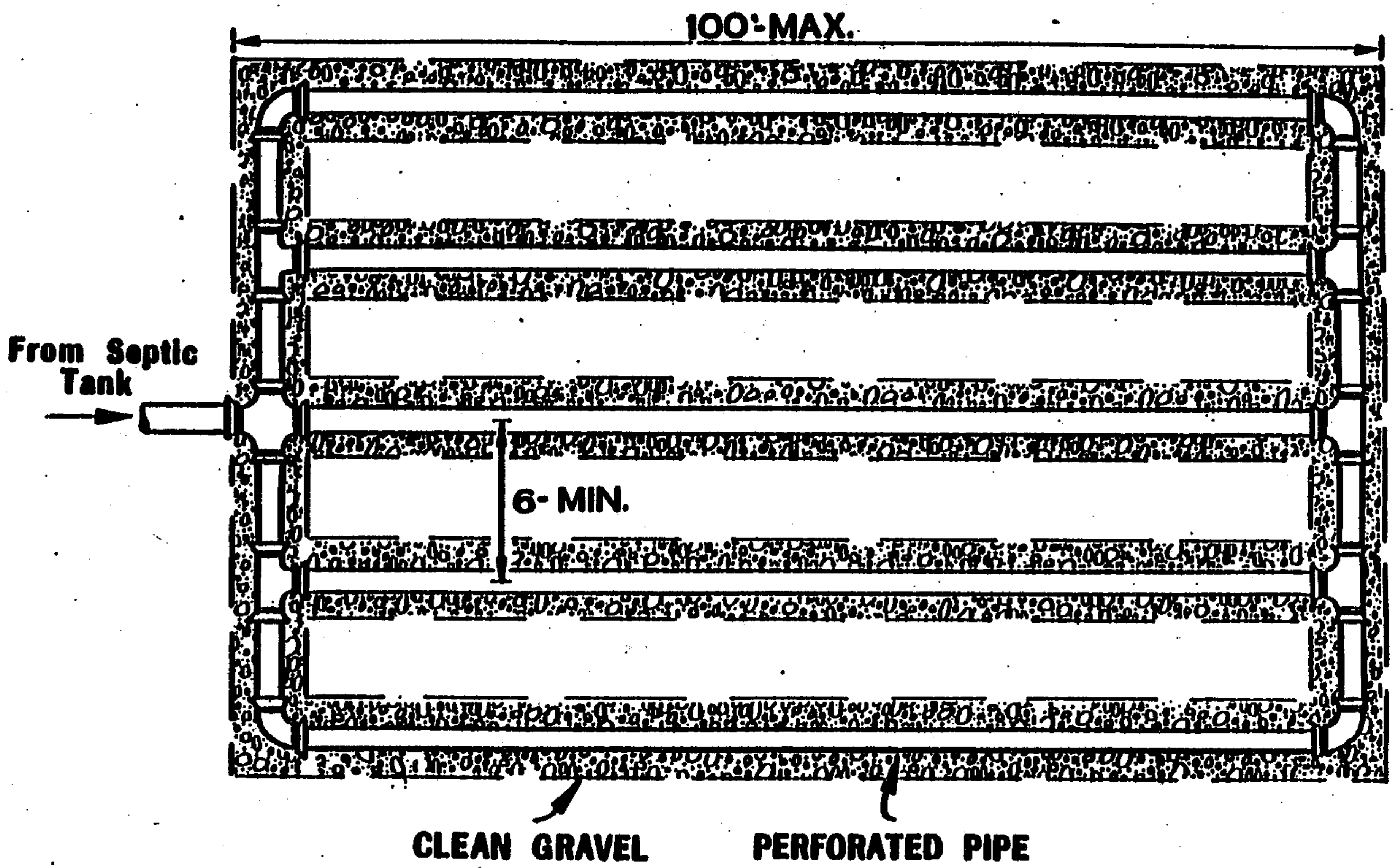


FIGURE 3

DRAIN FIELD (15)

field where it is distributed through a system of perforated pipes. These pipes are located underground in a series of gravel-filled trenches where the effluent is spread evenly over a large disposal area in the soil. This disposal area is referred to as a drain field or an absorption field, (Figures 2 and 3). In a properly functioning absorption field, the soil particles filter out the residual suspended solids as the liquid drains or percolates through the soil. The bulk of the dissolved compounds are then decomposed aerobically and/or anaerobically by soil microorganisms(6).

The percolation test aids in the sizing of septic tank leach fields by determining the percolation value for the soil, an index of the rate of seepage of water into the soil(7). Some soils are found to be unsuitable for septic tank effluent disposal due to a low percolation test value.

Despite their wide use, septic tank systems have not usually performed in a satisfactory manner; in fact, the majority become unsatisfactory sooner or later. Their widespread use has been due largely to the lack of a better alternative(1). An extensive investigation of both the septic tank and the associated drain field made by Coltteral and Norris in 1969, gave the following picture of septic tank performance(8):

> "The septic tank system, though simple in concept, is actually a complex physical, chemical and biological system which once constructed, functions virtually, without controls of any kind. System performance is a function of the design of the system components, the construction techniques

employed, the strength and chemical characteristics of the wastes, the rate of hydraulic loading, the aerial geology and topography, the physical and chemical composition of the soil mantle, and the care given to periodic maintenance."

THE PROBLEMS

Septic tank-leach field system failure is often manifested by the surfacing of partially treated wastewater in the leach field(17). Additional signs of system failure are offensive odors of surfacing sewage, and sewage backing-up into the comfort stations. Common causes of such failure in both the septic tank and the leach field are hydraulic overloading of the septic tank and leach field, failure to pump the septic tank with the result that septage overflows to clog the leach field, inadequate design of the leach field and/or septic tank, poor construction of the leach field, poor maintenance of the disposal system, and misapplication and/or misuse (i.e., poor site conditions) of the disposal system.

The literature suggests that the main cause of operational problems that have been experienced with the septic tank wastewater systems is due to inadequate septic tank capacity for the loads experienced and inadequate leach field capacity because of underdesign or site limitations.

Septic Tank Failure

After researching the literature, it appears that the most common cause of septic tank failure is overloading. In an overloaded system the septic tank does not have a large enough capacity to handle high wastewater flows. This condition is most common in periods of peak usage. Because of the small size tank that can be installed at a reasonable cost and the high usage of the SRRAs, wastewater production has far exceeded the capacity of the systems(2). As sludge and scum accumulate in a septic tank, the effective liquid volume and detention time decrease. With the large accumulations, sludge scouring increases, treatment efficiency decreases, and suspended solids pass through the tank(4).

When failure occurs, the septic tank is generally pumped to keep additional solids away from the leach field. Pumping of the septic tank to remove excess buildup of sludge and scum is commonly performed yearly or on a 6-month basis. In an overloaded system the septic tank must be pumped out more frequently to remove the excess solids.

When a septic tank is pumped out completely, the rate of anaerobic decomposition decreases. Without seed sludge the system may require six months or more to reestablish the biological balance on which good pretreatment of the effluent depends(9). Neglect in pumping the tank will result in built-up sludge and scum being carried over into the percolation system, thus causing failure of the seepage bed, and/or solids can buildup to the extent that they block the septic tank inlet causing raw sewage to back up into the comfort station. Once the septic tank is pumped, the septage must be hauled away and disposed of. The costs associated with pumping the septic tank can run high if a system must be pumped at frequent intervals.

Another source of septic tank failure concerns systems in which the comfort station wastewater is combined with RV dump wastewater in the septic tank. Recreational vehicle (RV) wastes appear to impair the operation of and cause premature failure of septic tank-leach field systems, particularly in California where RV traffic has been intensive(3). The usual causes of the problem are:
1) high strength RV wastes normally cause a rapid accumulation of solids in septic tanks (conventional schedules for pumping of septage may then be inadequate to

avoid carry-over of sludge from septic tanks to clog leach fields.).; and 2) preservative chemicals added to RV wastes are toxic which decrease the biological degradation rate of wastes both in the septic tank and the leach field. Consequently, solids accumulate more rapidly in the septic tank, aggravating the effect of high rate of solids loading.

Clogging of the septic tank inlet with paper can cause the system to malfunction. This problem can be alleviated by providing the septic tank inlet with a baffle rather than a tee. A baffle reduces inlet flow velocities, reduces short circuiting, and clogs less than the tee. The clogging problem can also be avoided with proper and regular maintenance by clearing the tee inlets of paper.

Leach Field Failure

Failure of the septic tank-leach field disposal system is not always due to problems with the septic tank, but is more often caused by failure of the leach field.

On site disposal systems should be situated in locations where the soil infiltrative capacity for sewage effluent is satisfactory. This can be deduced from soil maps provided by the United States Department of Agriculture or from a soil evaluation, including percolation tests performed at the site with clean water(10). However, the percolation test cannot predict the effects of physical clogging due to suspended solids in the septic tank effluent, or from microbiological influences(1).

Regardless of the initial permeability of the soil, many septic systems fail after a few years of use. The reduction in the rate of water seepage through the soil purification bed may be due to one or more factors including:

Physical Clogging of Leach Fields(1)(6)

Suspended solids in the effluent physically clog the pore space in the soil, thus reducing its permeability. In addition, certain operations of heavy equipment that tend to vibrate the soil cause compaction and migration of the soil fines so that they are more or less fitted around larger ones to form a more impervious soil. Smearing of the soil by equipment operation will also reduce its permeability.

Chemical Clogging of Leach Fields(1)(6)

Ion exchange and swelling of colloids are the most important chemical factors in changing the permeability of a soil. For example, a septic tank effluent high in sodium could very likely reduce the infiltrative capacity of the soil by this phenomenon.

Microbiological Clogging of Leach Fields(1)(6)(11)

Soil pores are blocked by the cells of soil microorganisms growing on dissolved and suspended organic matter present in the effluent. As a result, a gradual blocking of the soil capillaries occurs, since air cannot be drawn into the soil in a quantity sufficient to maintain an adequate rate of aerobic decomposition of incoming organic materials. An impermeable clogged or crusted layer will form in the soil below and surrounding the seepage bed. Consequently, huge volumes of anaerobic septic tank effluent accumulate in the seepage bed.

Other factors which can cause a leach field system to be unsatisfactory are dense soil, a high ground water table, high annual precipitation, or when the disposal area is inadequate in size(1).

The most reliable remedy one could prescribe in an attempt to cure a failed leach field system is to stop using it(6). A field allowed to rest for a period of time (about six months) will sometimes rejuvenate itself. However, unless the resting period is long enough, the bed is not adequately reaerated to again be placed into service.

Recent Studies

Many recent studies have been conducted throughout the United States dealing with the problems experienced with the septic tank - leach field disposal system.

A study conducted in Illinois(2) found that the septic tank disposal system did not work effectively. The high usage was not anticipated and consequently, the septic tank systems were overloaded. Odor problems developed and the percolation fields became saturated with the resulting escape of poorly treated water. The researchers found that these problems resulted from insufficient concern with two specific design considerations.

First, the tank volume must be adequate to provide for effective separation and stabilization of the suspended solids in the wastewater. Unless these solids are retained in the septic tank, the leach field will become clogged. Inadequate sizing of the septic tank for the wastewater flow has caused this problem in many cases.

The second design consideration involves providing an adequate size leach field for the existing soil conditions. In porous soils not subjected to high water tables during wet periods, large leach fields are not necessary. However, in soils with a high water table, or in impervious soils, the size of the leach field required for proper disposal becomes excessive. In most cases these factors have not been adequately evaluated in the design of the septic tank systems. In those systems properly designed, but where problems occurred, adequate land generally was not available for the leach fields. Consequently, in many, cases the septic tank system has not functioned satisfactorily and has become unacceptable as a wastewater treatment system for highway rest areas. The system, if properly sized for the anticipated usage rate and soil conditions, can satisfy the treatment requirements for these rest areas. However, the system may be expensive and require large land areas for leach fields(2).

In the state of Washington(10), 100 failing septic tank systems were analyzed in western Washington and it was concluded that unsuitable soil conditions were most often associated with failure, followed in importance by high water tables (Table 2). While 41% of the failures occurred in clay soil, a surprisingly large number also occurred in sandy (25%) and gravelly (20%) soils.

TABLE 2—Factors Implicated in Failing Systems in State of Washington (10)

Factor (1)	Percentage of Failing Systems Associated with Certain Factor			
	Western Washington (2)	Eastern Washington (3)	Shellfish beaches (4)	Five counties in Washington (5)
Impervious soil	62	35	86	25
High water table	56	25	86	27
Faulty construction	26	11	N/A	9
Under-design	23	52	N/A	17
Damage; no maintenance	22	37	N/A	1
Steep slope	5	2	N/A	12
Age	N/A	N/A	N/A	38

Note: N/A = not applicable.

They also studied 566 failing systems in eastern Washington and noted that the most frequent possible cause of failure was the underdesign of the system. A survey of 397 failing septic tanks on beaches in shellfish growing areas in the State of Washington indicated that 86% were located in unsuitable sites with high water tables and impervious soils. A tabulation of possible causes of failure of 241 systems in five counties in the State of Washington indicated that age beyond 16 years was the most common identifier of failure, followed in importance by high ground water table (Table 2).

Another study in West Virginia(4) investigated the operation and efficiency of sewage treatment facilities at various rest areas located in geographically different locations of the United States. Results show that the problem with the septic tank leach-field systems appears to be an underdesigned system for periods of high usage. Such underdesign is a result of an inadequate method of predicting usage. It is essential that sewage have a retention time of at least 24 hours in the tank before overflowing into the leach field. This is completely volume related; the more wastewater in, the shorter the retention period.

Based on the results of these and other studies, the failure of the septic tank system to treat and dispose of wastewater safely does not seem to be due to inherent shortcomings of the septic tank - leach field, but more to its misapplication and misuse. Patterson, Minear and Nedved (1971) in a review of the literature dealing with septic tanks found the principal causes of malfunctions to be poor site conditions and improperly constructed or maintained systems(12).

SITE VISITS

As part of this study field observations were made at nine SRRAs in California. All sites were located off major highways and all utilized the septic tank - leach field system for wastewater disposal. The investigators met with the maintenance foremen in charge of each rest area. Interviews and site investigations were conducted in order to document the system problems at each site and also to gather general information on the existing facility. Information on the existing facility at all SRRAs throughout California is listed in the inventory in Appendix A. What follows are summaries for each roadside rest visited.

Westley SRRA

Southbound (SB)

The Westley SB rest area consists of two comfort station buildings. There are two 7,500 gal septic tanks at the site, and also one 4,500 gal septic tank which serves the RV dump station. The SB rest area has three leach fields which are alternated once a year (used one year, rested two years). The septic tanks are pumped at least four times a year (usually before major holidays) and whenever needed. The problems experienced at this rest area are due to overloading.

The SB facility gets excessive amounts of traffic during the peak summer months. At these times the rest area will receive 4 to 5 times as much use as normal. The SB facility is considered to receive twice as many visitors as the NB (Northbound) facility. This is also a very popular stopping place for buses heading south. At times, during peak months, the SB comfort station had to be closed down because the septic tank could not handle the large flows and raw sewage started to back up into the comfort station building.

It was observed during the pumping of the septic tanks at the SB SRRA that the scum buildup had become so severe that the tank inlet was blocked. One septic tank had a solid scum cake that appeared to extend the full depth of the tank. This scum layer had a consistency of what appeared to be a tightly compacted mass of paper intermixed with scum. Pumping was very difficult because the scum layer has an almost impenetrable surface. The scum has to be broken down into small chunks in order to be pumped out of the tank.

Northbound (NB)

The NB facility is very much the same as the SB with the exception that it does not receive as much use. The NB rest area does experience some of the same problems, but to a lesser degree.

The apparent cause for malfunctioning of the septic tank systems at the Westley NB and SB roadside rests is that the septic tanks do not have the capacity to provide both the proper detention period and proper treatment needed for the large inflows of wastewater during the periods of peak use.

Turlock SRRA

Southbound

The Turlock SB rest area consists of one comfort station building which is served by two 7,500 gallon septic tanks; one for the women's rest room and one for the men's. The septic tanks are pumped 3 to 4 times a year. The site originally had two leach fields. Recently two new leach fields have been added to handle the distribution and disposal of the NB effluent which is currently pumped over to the SB leach fields by the NB pump station. The leach fields are alternated once a year. The maintenance personnel interviewed made the comment that by pumping the NB wastewater to the SB leach fields, the SB leach fields could become overloaded and eventually fail.

The septic tanks at this site have similar scum accumulation problems similar to the tanks at the Westley rest areas, but not as severe. The tank serving the women's rest room has more scum buildup than the men's. It was reported that as long as the tanks are routinely pumped there are no serious problems.

Northbound

The NB rest area consists of one comfort station building which is served by two 7,500 gallon septic tanks; one tank for the women's rest room and one for the men's. The NB tanks are pumped approximately four times a year. The leach field at this site has failed. This leach field had been in continual use since 1976 with no period of rest. The flow from the facility was great enough to cause the old field to fill at a faster rate than could be percolated into the ground. Effluent subsequently surfaced in the field. With the new pump station, the NB effluent is being pumped to the SB leach fields. The old NB field is still used when the pump station is filled to capacity.

The septic tanks at this rest area show signs of scum accumulation. The NB facility receives a little more usage than the southbound facility; therefore, the scum problem is more severe. The sewage which is stored at the pump station before being pumped out produces unpleasant odors which reach the comfort stations in the warmer months. The tee inlets in the septic tanks were replaced with a drop-type inlet due to problems with clogging.

COALINGA-AVENAL SRRA

Southbound

The existing system has two 8,000 gallon septic tanks (one per comfort station building) and each tank discharges effluent to 16 seepage pits. The seepage fields are rotated once every six months.

The old disposal system which had 4,500 gallon septic tanks had experienced problems before 1982 when the new 8,000 gallon tanks were installed. The current septic tanks have tee inlets. There is an existing problem with solids buildup at the tee. As a result, these inlets must be checked and cleared at least once a month. With the proper maintenance there is no problem with the system backing up because of clogging at the tee. Regular pumping of the septic tanks is needed about 3 to 4 times a year in order to keep the system running smoothly. It is important that all solids are removed from the septic tanks when they are pumped out.

The seepage fields are reported to be working very well and showing no signs of failure. In the past these fields have been saturated because of heavy rains or flooding caused by runoff from nearby agricultural fields.

<u>Northbound</u>

The NB facility has two 8,000 gal septic tanks with 16 seepage pits for each tank. Both the NB and SB rest areas were reported to receive the same amount of traffic. The problems at this site are similar to those at the southbound site.

The Coalinga-Avenal SRRAs do not seem to have a problem with overloading. The key to keeping the system functioning properly is proper maintenance. Currently the maintenance duties at this rest area are being contracted out to the private sector. Concern was expressed by the Caltrans maintenance people that by contracting out, the rest area facility would not receive the proper and regular maintenance needed to keep the system more or less problem free.

JOHN "CHUCK" ERRECA SRRA

Northbound and Southbound

Each of the NB and SB John "Chuck" Erreca SRRAs have two comfort stations. Each comfort station is served by two 6,000 gallon septic tanks (total of four tanks per SRRA); one for the women's rest room and one for the men's. There are two leach fields at each site and a diversion valve to direct the effluent to either leach field A or B. The existing comfort stations currently have two MICROPHOR toilets, and one low flush energy saving IFO Sanitar toilet in each of the women's rest rooms; there are two MICROPHOR toilets in the men's rest room. The MICROPHOR toilets use approximately two quarts of water per flush, while the low flush IFO Sanitar toilets use approximately three gallons per flush. A conventional toilet will use five to seven gallons of water per flush.

Before modifications were made to the rest area (the 2,500 gallon septic tanks were replaced with the 6,000 gallon tanks in 1980), the septic tanks were pumped every six months. Now the septic tanks are still pumped periodically, but currently it has been a year and a half since the tanks have been pumped. They were at the point where pumping was needed at the time of the field observation.

The previous disposal system had problems with the inlet in the septic tanks. The inlet was located below the surface scum crust in the septic tank. The inlet was constantly becoming plugged so that raw sewage would back up into the comfort station. Now the inlet has been raised to the top of the tank where plugging is not as much of a problem. However, paper from the comfort stations is building up in the tanks around the area of the inlet. This problem is especially evident in the women's rest room septic tanks on the NB side. It was reported that it usually takes about two to three weeks for the paper to significantly build up. At this time, the inlet has to be cleared out by maintenance personnel. At times the paper has built up enough to block the inlet and cause a system back up of sewage into the comfort station. The apparent cause of the buildup problem is the inability of the microorganisms to break down the toilet paper and cause it to disintegrate rapidly enough in the septic tank. A small square type toilet tissue is used in the women's rest room in the right NB comfort station. A softer roll type tissue is used in the women's rest room in the left NB comfort station. The paper buildup problem was observed to be less severe in the left comfort station. There appears to be more of a paper problem in the northbound rest area tanks than in the southbound septic tanks.

Another problem occurring at this SRRA is the failure of the diversion valve in both the NB site and SB site leach fields. The diversion valves were reported to be inoperative. They cannot be turned to alternate the use of the leach fields. This problem could result in an overloading of the one leach field in use. Presently, there are no reported signs of failure in either the NB or SB leach fields.

The type of toilet tissue used at the roadside rest does not break down fast enough for the amount of flow entering the septic tanks. The cleaning and disinfection agents which are being used must be biodegradable. Nonbiodegradable agents are not compatible with a septic tank and contribute to the paper buildup in the tanks. The diversion valves in the leach fields should be replaced to allow the leach fields to be alternated between operation and resting at six month intervals.

ELKHORN SRRA

This rest area is located on I-5 SB. It was visited during a percolation test in January 1986. The maintenance foreman was not available for an interview, but information on the current condition of the rest area and disposal system was taken from field observations and current facility investigation reports conducted by the Office of Structures Design, Sanitary Section.

The Elkhorn roadside rest is operating with a 10,000 gallon septic tank which discharges effluent to an evapotranspiration bed. The septic tank takes is pumped twice each year, in April and September. The evapotranspiration bed has been in continuous operation for 15 years with no period of rest. It appeared that only 2/3 of the bed was in operation. This is more than likely caused by poor construction. It has been suggested that an additional evapotranspiration bed be constructed in the near future. This will allow the old bed time to rejuvenate itself.

During winter months of heavy rainfall raw sewage has backed up into the comfort station forcing closure of the facility. The cause of the backup was the failure of the evapotranspiration bed to accept and distribute the effluent. High groundwater and a saturated soil condition prevent the effluent from percolating into the soil.

GOLD RUN SRRA

Eastbound (EB) and Westbound (WB)

Gold Run SRRA was originally scheduled for a site visit, but weather conditions precluded a field evaluation at this time.

According to the facility report a new 21,300 gallon cast-in-place septic tank was installed at each of the EB and WB sites. The system also uses two treatment ponds, a primary pond and a secondary pond, and a sprinkler irrigation system (which is used in the summer months) to dispose of the septic tank effluent. A sprinkler system was also recently added to the existing leach field to increase the rate of evaporation.

DUNNIGAN SRRA

Northbound and Southbound

The Dunnigan NB and SB SRRAs were originally among those roadside rest areas to be evaluated. Currently the rest area is undergoing major sewage system modifications. The original system consisted of a septic tank and seepage pit disposal system. The septic tanks were removed and an evaporation pond system is being installed.

SITE VISIT CONCLUSIONS

The following conclusions can be drawn from the information obtained during the site visits:

- The Westley SB SRRA is overloaded. This condition is due to excessive public use and the inability of the septic tanks to provide the proper treatment of the sewage because of short detention times. The tanks have to be pumped often because of rapid scum buildup.

- Some overloading is occurring at the Westley NB SRRA, but it does not experience as much use as the SB site.

- There are some overloading problems at the NB and SB Turlock SRRAs, such as scum buildup in the septic tanks. The leach field at the NB site has failed.

- Some blockage at the inlet tees in the septic tanks is occurring at the NB and SB SRRAs at Coalinga-Avenal. With proper maintenance the system will function properly.

- The systems at John "Chuck" Erreca SRRA need new distribution boxes installed in order that the leach fields can be alternated every six months. There is a continuous problem with toilet paper accumulating around the NB septic tank inlet. The type of paper being used does not break down fast enough. A study should be conducted to find a more biodegradable type toilet paper to be used at this site. The rate of scum accumulation is increased due to the fact that MICROPHOR toilets and low flush toilets are currently in use at both the NB and SB locations.

- The evapotranspiration bed at the Elkhorn roadside rest is not functioning properly, especially during the winter months.

ROADSIDE REST AREA USE

In order to provide adequate rest area facilities for the highway traveler it is important to know and properly project rest area usage. Unfortunately little information is available on methods used as a basis for predicting current and future SRRA usage. One study, "The 1968 National Rest Area Usage Study"(13), initiated a nationwide survey of rest areas on Federal-aid and State primary highway systems. The study was undertaken to assist in determining rest area needs in terms of facilities and spacing by measuring the present demand for and characteristics of the use of existing rest areas. The estimated annual usage of the SRRA system in California in 1981 was 47,380,817 persons(14).

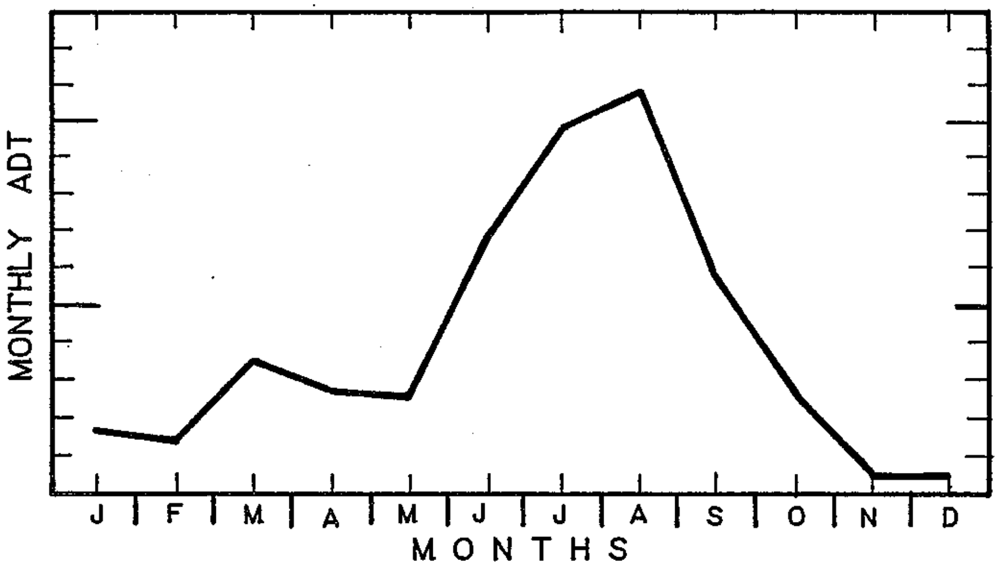
Traffic

An important factor in predicting the usage of a particular SRRA is current traffic information. Traffic information is related to other factors that determine the amount of wastewater produced at a roadside rest area. The number of vehicles and vehicle types which stop at a roadside rest is directly related to the number and type of vehicles which travel the highway adjacent to the SRRA. In usage calculations it is assumed that the number of vehicles stopping at a particular rest area is determined by the stopping factor (the percentage of highway traffic stopping at a roadside rest area). The percentage of the main line traffic stopping at the rest area is influenced by a number of factors and has a wide range of values. Studies conducted by the Federal Highway Administration found that the percentage of vehicles entering the rest area ranged from 0.6 to 25.3 with a median value of 8.1(2).

In a California study, mechanical counts taken in 1979 in conjunction with a study of sewage production found a wide range of usage, from 3 to 35 percent of main line traffic, at selected SRRA units(14). Results of this study, indicated that the units at four of the SRRA were under designed and would require updating of the facilities well before the end of the design life(14).

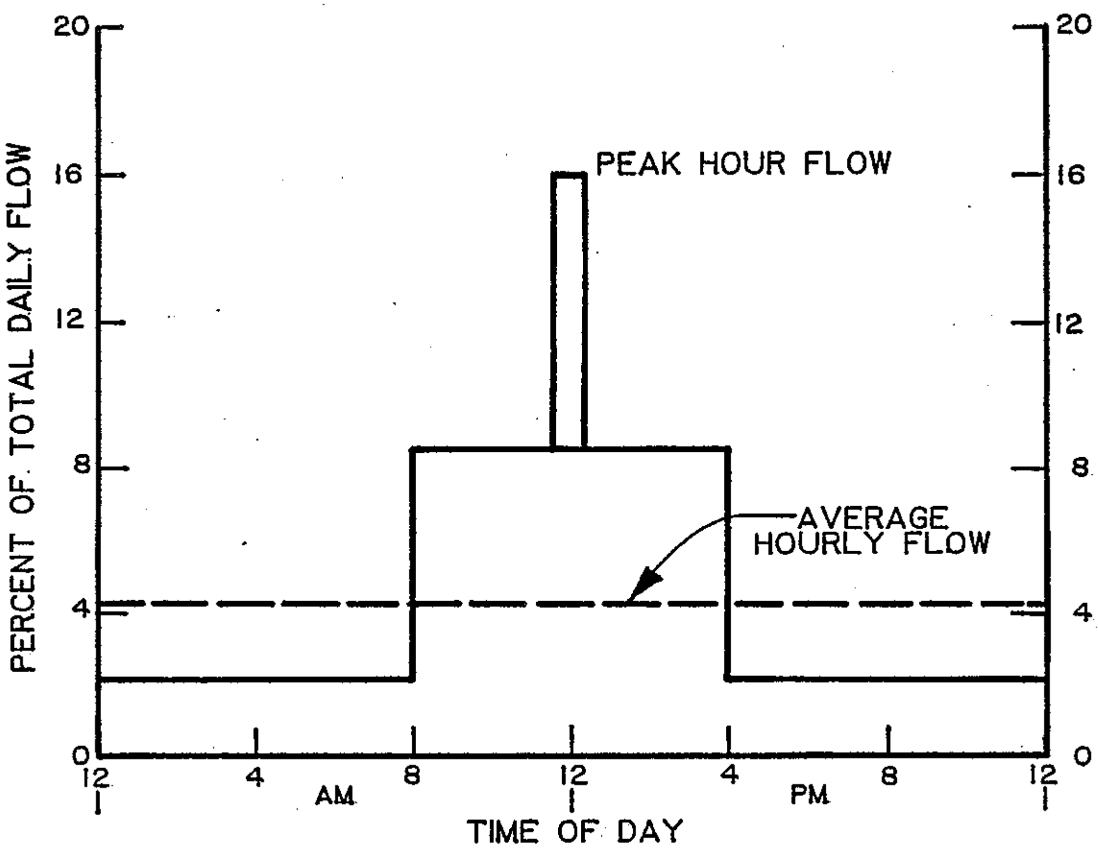
The month and time of day are two of the factors which affect the percentage of vehicles which stop at the SRRA. Figure 4 shows the typical annual traffic pattern(14). This figure indicates that the peak months for SRRA usage are the summer months, particularly July and August. Rest area usage also varies with the time of day. Figure 5 presents the typical hourly traffic flow variation at a roadside rest(15). The majority of the vehicles will stop within a peak eight-hour period. The FHWA suggests that approximately 9% of the passing traffic stops at the rest area. Approximately 16% of the daily usage will occur during a peak 1-hour period, while 67% of daily usage will occur during a peak 8-hour period(15). An additional factor used for SRRA usage prediction is the traffic growth factor. When designing a roadside rest area, the design is not only based on current traffic, but also on a traffic volume projected 20 years into the future. The growth factor is multiplied by the current traffic volume to give a 20-year projected volume.

The number of persons using the roadside rest area is another factor which is often determined and used for predicting the wastewater production. The vehicle occupancy of the traffic stopping at the rest area has been measured by a number of studies. While the number of people is a function of vehicle type and the purpose of



TYPICAL ANNUAL TRAFFIC CONFIGURATION

FIGURE 4 (14)



TYPICAL HOURLY FLOW

FIGURE 5. (15)

travel, the weighted average of 3.1 occupants per car obtained from these studies will give a good estimate of the number of people using the rest area. These surveys also showed that approximately 75% of the occupants of those vehicles stopping at the rest area used the rest room facilities. To give an example of the number of people which utilized the California SRRA system in 1981, Table 6 tabulates the the number of users at each roadside rest area by month and total(14).

For the purposes of this report actual traffic counts or person counts were not required. Instead, current traffic information was utilized in predicting the usage for the SRRAs which were visited in the field. This report is only concerned with comfort station usage, RV usage was not considered. Traffic volume information was taken from the 1984 Traffic Volumes on California State Highways(16). The traffic volumes for all 91 SRRAs in California as well as information for the SRRAs visited are listed in Appendix B.

Stopping factors for the following SRRAs; Coalinga-Avenal NB and SB, John "Chuck" Erreca NB and SB, Westley NB and SB, Elkhorn, Dunnigan NB and SB, Turlock NB and SB, and Gold Run EB and WB, were estimated using information in the "1984 Ramp Volumes on the California State Freeway System" for the corresponding districts(23). These stopping factors were determined based on available information, and actual values may differ. The stopping factors are listed for each rest area in Table 3.

The growth factors and 20 year projected traffic volumes for the rest areas under consideration in this report, are listed in Table 4.

SEWAGE FLOW RATES

Total wastewater production at a roadside rest is the sum of the water used for flushing urinals and toilets, supplying lavatories and water used for cleaning the rest room lobby areas. It may also include the wastewater from drinking fountains and from the RV Sanitary Station (RVSS) including RV wastes and wash down water. Wastewater production will vary from site to site(18).

Many states are using estimates of 5 gallons per person and 3.1 persons per vehicle using the SRRA, resulting in 15.5 gallons per each vehicle that enters the rest area. The 1968 rest area usage summary(19), which recorded roadside rests with rest rooms as their only source of sewage, reported an average 7.6 gallons per vehicle using the roadside rests during the peak usage period of the summer.

Stuart(20), after actually measuring the volume of traffic, water and sewage from the roadside rest area in South County, Tennessee, reported that the sewage flows varied from 4.25 to 8.22 gallons per vehicle with the upper figure occurring after heavy rainfall.

Zaltzman, in his report, after studying water usage and sewage production for five rest areas in five states: Florida, New Hampshire, Colorado, Iowa and Tennessee, concluded that each vehicle stopping at a roadside rest

TABLE 3

SRRA STOPPING FACTORS

NO	ROADSIDE REST	DIR	STOPPING FACTORS % MAINLINE TRAFFIC
9	COALINGA-AVENAL	NB	19.4
10	COALINGA-AVENAL	SB	19.6
11	JOHN "CHUCK" ERRECA	NB	28.0
12	JOHN "CHUCK" ERRECA	SB	22.0
13	WESTLEY	NB	14.4
14	WESTLEY	SB	17.6
15	ELKHORN	NB/SB	3.3 *
16	DUNNIGAN	NB	13.4
17	DUNNIGAN	SB	14.5
45	TURLOCK	NB	14.7
46	TURLOCK	SB	14.7
81	GOLD RUN	EB	20.0
82	GOLD RUN	WB	14.0

* For Traffic in Both Directions

TABLE 4

20 YEAR GROWTH FACTORS

NO	ROADSIDE REST	DIR	20 YEAR (2005) GROWTH FACTOR **	MAINLINE ADT	PEAK MONTH ADT
9	COALINGA-AVENAL	NB	1.80	13,680	19,260
10	COALINGA-AVENAL	SB	1.80	13,680	19,260
11	JOHN "CHUCK" ERRECA	NB	1.62	12,555	18,549
12	JOHN "CHUCK" ERRECA	SB	1.62	12,555	18,549
13	WESTLEY	NB	1.75	14,436	18,288
14	WESTLEY	SB	1.75	14,436	18,288
15	ELKHORN	NB/SB	1.64	39,360*	45,100*
16	DUNNIGAN	NB	1.60	14,320	15,920
17	DUNNIGAN	SB	1.60	14,320	15,920
45	TURLOCK	NB	1.95	21,450	25,838
46	TURLOCK	SB	1.95	21,450	25,838
81	GOLD RUN	EB	1.42	14,058	19,170
82	GOLD RUN	WB	1.42	14,058	19,170

* Traffic Volume for Both Directions

** Caltrans Data

area will generate an average of 5.5 gallons of sewage during the peak demand periods(18). Similarly a report prepared by the FHWA suggests a sewage flow of 5.5 gallons per vehicle entering the rest area(15).

In this report the amount of wastewater flow per vehicle is based on an average value determined in a research study conducted by William Grottkau of the Transportation Laboratory(18). The study determined the gallonage of sewage produced at the rest rooms per axle of traffic entering the rest area for nine different roadside rests. This study was done during 1979 and 1980.

In the study a mean value of seven different sites was determined to be 2.20 gallons per axle and the standard deviation is 0.87(18). When MICROPHOR toilets are in use, a lesser amount of wastewater per axle is produced. In Grottkau's report(18), the wastewater flow was measured at the NB and SB SRRAs at John "Chuck" Erreca, where MICROPHOR water saving fixtures have been installed, an average of 0.24 gallon of sewage per axle was generated by vehicles entering the roadside rest.

WASTEWATER PRODUCTION RATES

In order to calculate the detention times of the local SRRAs considered, wastewater production rates were estimated for each roadside rest area.

The equation used in this report for estimating the wastewater production rates at the roadside rests was taken from the report, "A Design Method for Roadside Rest Septic Tank Leach Field Systems" by William Grottkau of the Transportation Laboratory(18). The calculations performed are a "default" analysis for predicting sewage production rates based on information collected in the study. The default analysis for the prediction of rest room sewage generation utilizes:

- A reliability factor;
- a predicted average daily traffic for the peak month;
- an average roadside rest stopping factor
- the average number of gallons of sewage generated per vehicle (this is actually broken down by axle counts).

The reliability factor evolves from a statistical evaluation of the variances of: the traffic volume, the roadside rest stopping factors for a disaggregated sample, and the sewage generated per axle. The variances of these three parameters are combined according to joint probability theory to produce a reliability constant. This constant is used so that a sewage disposal system, which is designed for a specific wastewater production rate by the default analysis, will be adequate 95 out of 100 times. Since a decrease in the septic tank detention time can occasionally be tolerated, it is felt that the above confidence level is reasonable(18) (see Appendix C).

The predicted average daily traffic (ADT), as well as the predicted peak month average daily traffic are both used to calculate the sewage production rate for the septic tank leach field systems for both an average and a peak day. Comparisons of the average and peak sewage production rates can give a good idea of how much more wastewater is generated on a peak day than on an average day. The peak month ADT is generally used for determining sewage production rates because of the greater sensitivity of septic tank leach field systems to shock loading(18). A rough estimate of these values was obtained from the "1984 Traffic Volumes on California State Highways".

The average stopping factor for the SRRAs is used in the sewage production formula. Stopping factors appear to be very site-specific. Characteristics which have an effect on the stopping factors are(18):

- Distance from next rest area;
- distance from commercial facilities;
- distance from population centers;
- distance from major traffic generators such as recreational and tourist attractions;
- whether the site is serving one or two directions of traffic flow;

- proximity to metropolitan areas as affected by home to work trips;

- visibility of rest area from highway;

- adequacy of signing;

- ease of entry from opposite direction where one site serves both directions of travel.

The average number of gallons of sewage generated per single axle count is used in the sewage production formula. The value was taken from the axle counts and water meter readings at seven roadside rests during the summer months of 1980, as determined by Grottkau's study(18). The truck traffic was accounted for by multiplying the average number of gallons of sewage generated per single axle by the number of axles per vehicle. The number of axles per vehicle was estimated from the latest available truck traffic information for the highway. Truck traffic information was taken from the 1984 "Annual Average Daily Truck Traffic on the California State Highway System"(21), which lists for each segment of roadway in the state: the annual average daily vehicle total (ADT); percent trucks; the number of two axle trucks, three axle trucks, four axle trucks and the number of trucks with five or more axles.

All traffic information is listed in Appendix B.

CALCULATIONS

The wastewater production rate Qr in SRRAs consists of the flow rate from the rest rooms.

$$Qr = Rr \times ADT\ (ADTpm) \times Sr/100 \times Av \times Gr$$

Where: Qr = Design sewage flow rate from rest rooms; gallons/day

Rr = Reliability factor for rest room data, evolved from joint probability theory (see APPENDIX C)

ADT (ADTpm) = Predicted average daily traffic or peak month average daily traffic; vehicle/day

Sr = Mean percentage of highway traffic entering roadside rest (mean roadside rest stopping factor)

Av = Number of axles per vehicle on the highway at the proposed location

Gr = Mean wastewater volume generated at the rest rooms; gallons/axle

Sample Problem

Given the following information for the NB roadside rest at Coalinga-Avenal (06-FRE-5, PM 1.4):

1. Average number of axles per vehicle on Highway 5 @ PM 1.4 (Av, axles/vehicle)

$$Av = \frac{\text{ADT AXLE COUNT}}{\text{AADT}}$$

Where:

AADT = Average Annual Daily Traffic

Axle count is found by multiplying number of axles per truck by their respective populations. Number of cars is multiplied by two axles.

DESCRIPTION	VEHICLES	AXLES/VEH	AXLES
PASSENGER CAR	5,100	2	10,200
2 AXLE TRUCKS	305	2	610
3 AXLE TRUCKS	82	3	246
4 AXLE TRUCKS	83	4	332
5 AXLE TRUCKS	2,030	5	10,150
TOTAL	7,600	-	21,538

$$Av = \frac{21{,}538 \text{ axles}}{7{,}600 \text{ vehicles}} = 2.8 \text{ axles/vehicle}$$

2. <u>Rest Room Wastewater Flow Rate</u>(Qr, gallons/day)

Qr = Rr x ADT 2001 x Sr/100 x Av x Gr

Where:

Rr = 2.0 (Reliability factor for rest room data, see APPENDIX C)
ADT = 7,600 vehicles/day
Sr = 19.4 % (Mean roadside rest stopping factor, see APPENDIX C)
Av = 2.80 axles/vehicle
Gr = 2.2 gallons/axle (Mean rest room wastewater, volume)
Qr = 2.0 x 7,600 vehicles/day x 19.4/100 x 2.8 axles/veh x 2.2 gallons/axle
Qr = 18,165 gallons/day

The same calculation is made for the peak sewage production rate using the peak month average daily traffic (ADTpm).

ADTpm = 10,700 vehicles/day
Av = 2.8 axles/vehicle
Sr = 19.4%
Gr = 2.2 gallons/axle
Rr = 2.0
Qr = 25,575 gallons/day

The wastewater production rate established from these calculations appears to be slightly high. Wastewater production rate calculations for all roadside rest areas investigated in this study are presented in APPENDIX D.

DETENTION TIME OF WASTE IN SEPTIC TANK

The septic tank must be able to provide enough detention time for wastewater in order for it to receive proper treatment. A septic tank should be able to provide a minimum detention time of 24 hours. The following table was taken from the report titled "Recreational Vehicle Waste Disposal in Roadside Rest Septic Tank Systems" (SERL report)(3). This table shows average detention times for rest room wastewater and RVs wastewater as related to septic tank pump-out intervals.

Tr = Detention time of rest room wastewater in septic tank, days

Tt = Detention time of RV wastewater in septic tank, days

Septic Tank Pumpout Interval, Months*	Tr, Days*	Tt, Days*
3	1.5	1.7
6	1.5	3.3
12	1.5	6.2
60	1.5	19.6

* The above data are applicable to rest rooms utilizing conventional toilets, i.e., not MICROPHOR toilets.

When a septic tank system becomes overloaded, the wastewater does not receive the proper degree of treatment. The bacteria in the septic tank are not given enough time to sufficiently break down the solid waste materials coming into the tank. This condition leads to failure of the system, either from solids accumulating within the tank causing blockage of the inlet and requiring more frequent pumping, and/or by allowing solids to be carried to the leach fields.

Detention times were calculated for the roadside rests investigated in this report. The average and peak detention time provided by the existing systems at the SRRAs are listed in Table 5.

Calculations

1. AVERAGE DETENTION TIME (Using Avg. Wastewater Flow Rate):

DT = Detention time of rest room wastewater in septic tank; days

$$DT = \frac{\text{Capacity of septic tank}}{\text{Wastewater Flow Rate}} \quad \frac{\text{(gallons)}}{\text{(gallon/day)}} = \text{days}$$

Example Calculation

Coalinga-Avenal NB

Septic Tank Capacity: 16,000 gallons

Avg. Estimated Wastewater Flow Rate: 18,200 gallon/day

$$DT = \frac{16,000 \text{ gallons}}{18,200 \text{ gallons/day}} = 0.88 \text{ day}$$

Average Detention Time = 0.88 day

(This value is less than 1 day minimum detention time.)

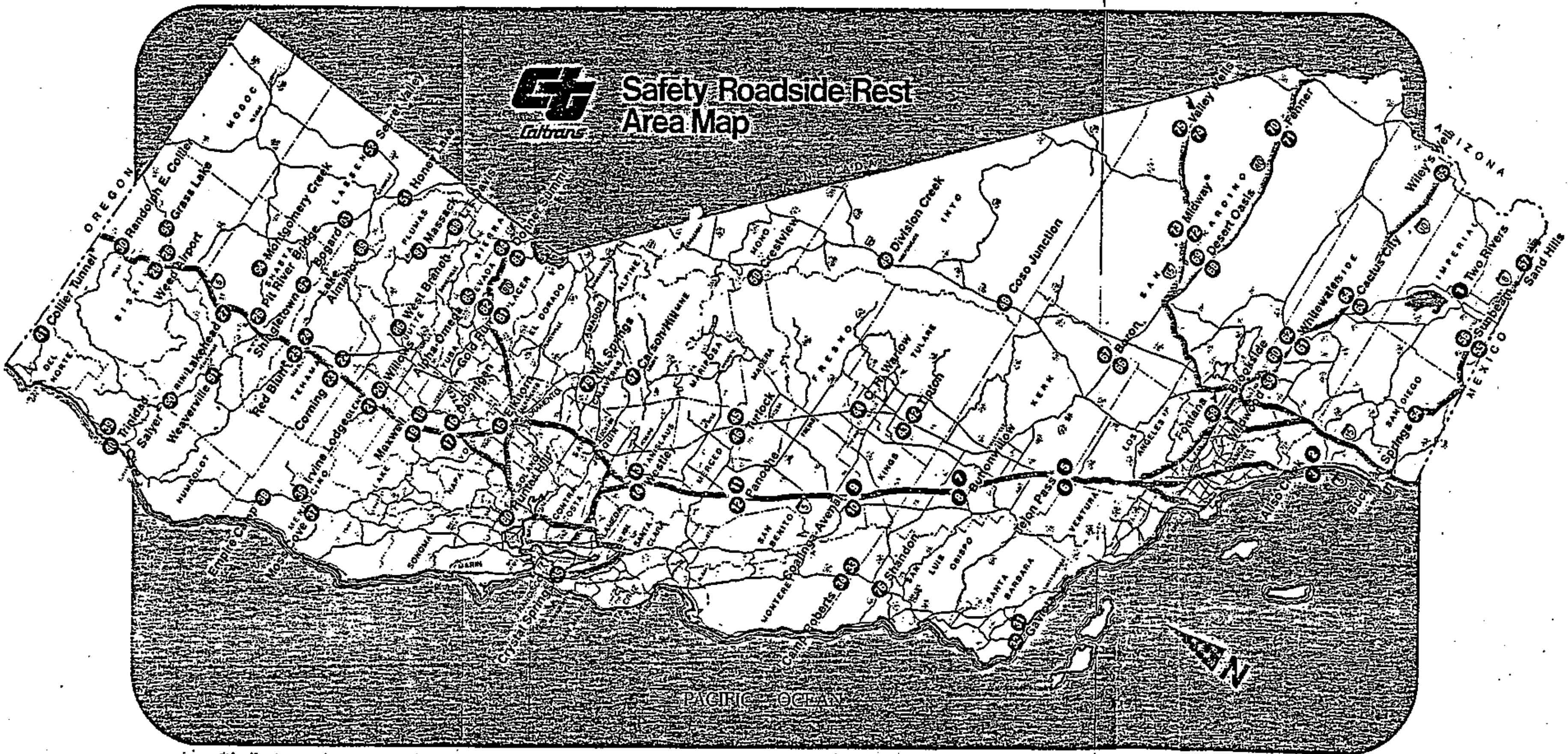
TABLE 5

SRRA WASTEWATER FLOW RATES AND SEPTIC TANK DETENTION TIMES

NO	ROADSIDE REST	DIR	AVG. WASTEWATER FLOW PER DAY (GALLONS/DAY)	PEAK WASTEWATER FLOW PER DAY (GALLONS/DAY)	AVERAGE FLOW DETENTION TIME (DAYS)	PEAK FLOW DETENTION TIME (DAYS)
9	COALINGA-AVENAL	NB	18,200	25,575	0.88	0.63
10	COALINGA-AVENAL	SB	18,350	25,850	0.87	0.62
11	JOHN "CHUCK" ERRECA	NB	25,500	30,100	0.94	0.63
12	JOHN "CHUCK" ERRECA	SB	20,000	29,925	1.2	0.80
13	WESTLEY	NB	13,300	16,900	1.1	0.89
14	WESTLEY	SB	16,300	20,650	0.92	0.73
15	ELKHORN	NB/SB	8,200	20,650	1.3	1.1
16	DUNNIGAN	NB	13,600	9,400	— *	— *
17	DUNNIGAN	SB	14,700	20,775	— *	— *
45	TURLOCK	NB	17,250	21,350	0.87	0.72
46	TURLOCK	SB	17,700	27,325	0.85	0.70
81	GOLD RUN	EB	20,000	27,325	1.1	0.78
82	GOLD RUN	WB	14,000	19,130	1.5	1.1

* The Septic Tanks at Dunnigan SRRA Have Been Removed
No Detention Time was Calculated For This Site

Where MICROPHOR toilets are installed, the wastewater flow rate is much less than the average SRRA wastewater flow rate. However, this low value is not used in the design of a system. Similar calculations are made to determine the peak month detention times using the peak wastewater flow rate rather than the average wastewater flow rate. All detention time calculations are listed in APPENDIX D.



*Indicates under construction

FIGURE 6

ANNUAL ESTIMATE OF USAGE

SAFETY ROADSIDE REST USAGE STUDY

SRR NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALISO CREEK (NB)	87330	90128	117190	125753	117190	130545	149752	150052	109037	101212	95259	84479	1356926
ALISO CREEK (SB)	133392	137665	179002	192081	179002	199400	228737	229196	165021	154596	145502	129037	2072629
ALHAMBRA	0	0	0	4466	4845	4746	5091	5342	4678	4270	0	0	33437
ALPHA OMEGA	8558	9010	10134	11077	12016	11769	12625	13248	11602	10590	10859	10863	132149
BOGARD	0	0	0	18714	20300	19884	21330	22382	19602	17891	0	0	140103
BORON (EB)	18457	19010	23669	25283	29147	30745	33197	32068	28849	27275	24930	22673	315303
BORON (WB)	11758	12110	15078	16106	18567	19585	21147	20428	18378	17375	15881	14444	200855
BROOKSIDE (PAIR W/WILDWOOD)	41705	42956	53482	57128	65858	69468	75009	72459	65186	61629	56330	51231	712438
BUCKMAN SPRINGS	31723	32672	40680	43454	50095	52841	57055	55115	49583	46877	42847	38969	541910
BUTTONWILLOW (NB)	80473	83051	107989	115879	107989	120295	137994	138270	99555	93265	87779	77846	1250385
BUTTONWILLOW (SB)	46094	47570	61854	66373	61854	68903	79040	79199	57023	53421	50278	44589	716197
C H WA-LOW	36989	35280	39686	40923	43202	44465	46140	48163	44279	42974	39711	37712	499525
CACTUS CITY (EB)	44285	45610	56789	60661	69931	73765	79648	76940	69217	65450	59813	54400	756500
CACTUS CITY (WB)	41404	42643	53095	56715	65382	68966	74467	71935	64784	61183	55922	50861	707288
CAMP ROBERTS (NB)	28730	25726	28028	29558	31863	35223	37097	41219	34584	32510	28920	28730	382189
CAMP ROBERTS (SB)	34841	34781	37894	39981	43077	47619	50154	55727	46757	43952	39099	38841	516703
CARSON HILL	1139	1199	1349	1474	1599	1566	1680	1763	1544	1409	1445	1445	17611
COALINGA AVENAL (NB)	50157	51764	67307	72225	67307	74977	86008	86180	62050	58130	54711	48519	779333
COALINGA AVENAL (SB)	50284	51895	67477	72407	67477	75167	86226	86398	62207	58277	54849	48642	781306
CORNING (NB)	23655	22158	26371	29363	31052	35308	38240	41793	34014	28796	29403	28335	368488
CORNING (SB)	30870	28917	34415	38320	40524	46078	49905	54541	44389	37581	38372	36979	480892
COSO JUNCTION (NB)	36452	51971	57212	62643	59337	59321	78299	81732	64858	47615	38757	47813	686009
CRESTVIEW (SB)	21917	31248	34399	37665	35677	35668	47078	49142	38997	28629	23303	28748	412471
CRYSTAL SPRINGS	24506	24017	26973	29479	32802	33144	35695	42545	31991	29768	26556	26335	363810
DESERT OASIS (EB)	20802	21425	26676	28495	32850	34650	37416	36142	32514	30740	28097	25554	355360
DESERT OASIS (WB)	26464	27256	33936	36250	41790	44080	47596	45978	41363	39106	35743	32508	452069
DIVISION CREEK (NB)	12948	19460	20322	22251	21077	21071	27812	29031	23038	16919	13767	16983	243673
DONNER SUMMIT (EB)	62937	56576	71315	66698	69021	80115	96450	99741	79053	67567	57432	58648	865552
DONNER SUMMIT (WB)	45032	40481	51027	47724	49386	57324	69012	71367	56564	48345	41093	41964	619317
DOUGLAS CITY	5383	5668	6375	6968	7558	7403	7941	8333	7298	6661	6830	6833	83252
DUNNIGAN (NB)	37772	35383	42110	46887	49584	56381	61063	66735	54314	45983	46951	45247	588408
DUNNIGAN (SB)	76799	71961	85619	95332	100816	114634	124154	135688	110432	93493	95463	91996	1196366
ELKHORN	28402	27835	31261	34166	38017	38413	41370	49308	37077	34500	30778	30522	421646
EMPIRE CAMP(PR W/DEAN CRK)	11396	10204	11118	11724	12638	13971	14715	16350	13718	12895	11471	11396	151594
FENNER (EB)	15409	15870	19760	21108	24333	25667	27714	26772	24085	22770	20813	18929	263229
FENNER (WB)	29512	30395	37845	40426	46603	49158	53079	51274	46127	43610	39861	36253	506142
FONTANA	39272	38489	43226	47243	52567	53115	57204	68188	51267	47704	42558	42204	583029
GAVIN CANYON	57117	55978	62869	68710	76454	77250	83197	99162	74563	69381	61896	61381	847958
GAVIOTA(NB)	56497	50590	55119	58126	62667	69265	72951	81057	68009	63930	56871	56497	751568
GAVIOTA(SB)	32100	28744	31317	33026	35601	39355	41450	46055	38642	36324	32313	32100	427027
GOLD RUN (EB)	114939	103322	130240	121808	126050	146311	176143	182154	144372	123395	104885	107106	1580723
GOLD RUN (WB)	69531	62504	78787	73686	76253	88509	106556	110192	87336	74646	63449	64793	956240
GRASS LAKE	0	0	0	20903	22674	22209	23824	24999	21895	19983	0	0	156488
HILLCREST	0	0	0	3752	4070	3986	4276	4487	3930	3587	0	0	28087
HONEY LAKE	9835	10354	11646	12729	13808	13525	14508	15224	13333	12169	12479	12484	152095
HUNTER HILL	50614	49605	55710	60886	67749	68454	73724	87871	66073	61481	54849	54392	751408
IRVINE LODGE(PR W/MOSS CV)	12423	11124	12120	12781	13777	15230	16041	17823	14954	14057	12505	12423	165259
I T DAVIS	0	0	0	1965	2137	2088	2240	2350	2058	1879	0	0	14712
LAKE ALMANOR	0	0	0	16972	18411	18033	19345	20299	17778	16226	0	0	127063
LAKEHEAD (PAIR W/OBRIEN)	60235	56424	67152	74770	79071	89909	97376	106422	86614	73328	74873	72154	938326
MASSACK	0	0	0	15856	17200	16847	18072	18963	16608	15158	0	0	118703
MAXWELL (NB)	31906	29887	35570	39605	41803	47624	51579	56370	45878	38848	39659	38219	497019
MAXWELL (SB)	33474	31357	37318	41552	43942	49965	54115	59142	48134	40750	41609	40098	521455
MIDWAY (EB)	37417	39538	47983	51255	59087	62326	67298	65009	58484	55293	50538	45964	639191
MIDWAY (WB)	26397	27187	33850	36158	41684	43969	47476	45862	41258	39007	35653	32426	450924
MOSS COVE	19164	17160	18697	19717	21254	23495	24745	27495	23069	21685	19291	19164	254936
MOUNTAIN SPRINGS	26916	28338	31874	34838	37791	37015	39707	41666	36498	33306	34152	34166	416260
OBRIEN (PAIR W/ LAKEHEAD	63235	56424	67152	74770	79071	89909	97376	106422	86614	73328	74873	72154	938326
PANOCHE(NB)	69363	71585	93079	99880	93079	103686	118941	119180	85009	80389	75660	67090	1077749

Table 6a

ANNUAL ESTIMATE OF USAGE

SAFETY ROADSIDE REST USAGE STUDY

SRR NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
PANOCHE (SB)	69267	71486	92952	99143	92952	103544	118779	119016	85692	89279	75556	67006	1076769
R E COLLIER	4769	4467	5316	5919	6260	7119	7709	8425	6857	5905	5927	5712	74286
RED BLUFF (NB)	28363	26566	31617	35204	37229	42312	45949	50107	40781	34525	35253	33912	441795
RED BLUFF (SB)	17914	14780	19971	22236	23515	26739	28959	31649	25758	21807	22267	21458	274354
SALYER	0	0	0	16749	18169	17796	19090	20932	17544	16712	0	0	125391
SAND HILLS	33264	34259	42656	45565	52528	55407	59827	57793	51991	49154	44928	40867	568233
SECRET VALLEY	2761	2906	3269	3573	3876	3796	4073	4273	3743	3416	3503	3504	42693
SHANDON	26001	23283	25367	26751	28837	31877	33574	37305	31300	29423	26173	26001	345891
SHINGLETOWN	0	0	0	2591	2810	2752	2953	3098	2713	2477	0	0	19393
SUNBEAM (EB)	21640	22288	27750	29642	34172	36045	38921	37597	33823	31978	29228	26503	369666
SUNBEAM (WB)	15041	15491	19208	20603	23751	25053	27052	26132	23509	22226	20315	18476	256935
TIPTON (NB)	75505	72093	81096	83623	88281	90862	94284	98418	90481	87814	81147	77061	1020745
TIPTON (SB)	52504	53078	56332	58087	61323	63116	65493	68364	62851	60998	56367	53529	709041
TRINIDAD (NB)	12294	11009	11995	12649	13635	15073	15875	17639	14800	13912	12376	12294	163551
TRINIDAD (SB)	11460	10262	11180	11790	12709	14050	14798	16442	13795	12968	11536	11460	152448
TWO RIVERS	5896	6072	7560	8076	9310	9820	10604	10243	9215	8712	7963	7242	100714
TURLOCK (NB)	64974	61972	69712	71884	75888	78107	81049	84602	77779	75487	69756	66243	877452
TURLOCK (SB)	63579	60642	68215	70341	74259	76430	79309	82786	76109	73866	68258	64821	858613
VALLEY WELLS (EB)	58763	52824	66586	62275	64444	74802	90054	93127	73811	63086	53623	54759	808155
VALLEY WELLS (WB)	45909	41269	52020	48652	50347	58439	70355	72756	57665	49286	41893	42780	631371
WEED AIRPORT (NB)	30557	28623	34066	37930	40112	45610	49398	53907	43938	37199	37982	36603	476005
WEED AIRPORT (SB)	31717	29711	35360	39371	41636	47343	51274	56038	45607	38612	39425	37994	494087
WEST BRANCH	4210	4432	4985	5449	5911	5790	6211	6517	5708	5209	5342	5344	65107
WESTLEY (NB)	52329	49018	58338	64956	68693	78109	84595	92454	75246	63704	65046	62684	815171
WESTLEY (SB)	54368	50929	60612	67488	71370	81152	87892	96057	78178	66186	67581	65126	846937
WHITEWATER (EB)	45691	47059	58594	62589	72153	76108	82179	79385	71416	67519	61714	56128	780534
WHITEWATER (WB)	44017	45334	56446	60294	69508	73318	79166	76475	68798	65044	59451	54071	751922
WILDWOOD (PAIR W/BROOKSIDE)	28473	29326	36514	39003	44963	47428	51211	49470	44504	42076	38458	34977	486403
WILEYS WELL	18558	19114	23798	25421	29306	30912	33378	32243	29006	27423	25066	22797	317020
WILLOWS (NB)	30808	28859	34345	38242	40442	45985	49804	54430	44299	37504	38294	36904	479914
WILLOWS (SB)	37396	35030	41690	46420	49090	55819	60454	66070	53773	45524	46484	44796	582544
	3057082	3001641	3628757	3949805	4143475	4505085	4992209	5201832	4246518	3842298	3487815	3324309	47390917

QUICK CHECK 47380680

ZERO USAGE IS INDICATED WHERE THE UNIT WAS CLOSED FOR REPAIR OR CLOSED FOR THE WINTER

USAGE INDICATED IS IN PERSONS VISITING THE SAFETY ROADSIDE RESTS

END OF JOB

Table 6b

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APPENDIX A

INVENTORY OF CALIFORNIA SAFETY ROADSIDE REST AREAS

(THIS INVENTORY IS AVAILABLE FOR USE ON A P.C. LOTUS DATA DISK IN WATER QUALITY SECTION)

REST AREAS ON NORTH-SOUTH ROUTES
(Beginning in Southern California)

NO	ROADSIDE REST	DIST-CO-RTE	P.M.	DIR	STRUCTURE NO.	RESTROOM	WATER	PICNIC TABLES	TELEPHONE	RV DUMP STATION
1	TWO RIVERS	11-IMP-111	29.3	NB/SB	58R0002	X	X	X	X	X
2	ALISO CREEK	11-SD-5	R59.3/R60.2	NB	57R0001R/L	X	X	X	X	X
3	ALISO CREEK	11-SD-5	R59.3/R60.2	SB	57R0001R/L	X	X	X	X	X
5	TEJON PASS	06-KER-5	1.0	NB	50R0002R/L	X	X	X	X	X
6	TEJON PASS	06-KER-5	1.0	SB	50R0002R/L	X	X	X	X	X
7	BUTTONWILLOW	06-KER-5	54.1	NB	50R0001R/L	X	X	X	X	
8	BUTTONWILLOW	06-KER-5	54.1	SB	50R0001R/L	X	X	X	X	
9	COALINGA-AVENAL	06-FRE-5	1.4	NB	42R0002R/L	X	X	X	X	
10	COALINGA-AVENAL	06-FRE-5	1.4	SB	42R0002R/L	X	X	X	X	
11	JOHN "CHUCK" ERRECA	10-MER-5	0.6	NB	39R0001R/L	X	X	X	X	
12	JOHN "CHUCK" ERRECA	10-MER-5	0.6	SB	39R0001R/L	X	X	X	X	
13	WESTLEY	10-STA-5	27.2	NB	38R0001R/L	X	X	X	X	X
14	WESTLEY	10-STA-5	27.2	SB	38R0001R/L	X	X	X	X	X
15	ELKHORN	03-SAC,YOL-5	33.8	NB/SB	24R0002	X	X	X	X	
16	DUNNIGAN	03-YOL,COL-5	26.1	NB	22R0001R/L	X	X	X	X	
17	DUNNIGAN	03-YOL,COL-5	26.1	SB	22R0001R/L	X	X	X	X	
18	MAXWELL	03-COL-5	R24.3	NB	15R0001R/L	X	X	X	X	
19	MAXWELL	03-COL-5	R24.3	SB	15R0001R/L	X	X	X	X	
20	WILLOWS	03-GLE-5	R14.6	NB	11R0001R/L	X	X	X	X	X
21	WILLOWS	03-GLE-5	R14.6	SB	11R0001R/L	X	X	X	X	X
22	CORNING	02-TEH-5	R10.3	NB	08R0002R/L	X	X	X	X	
23	CORNING	02-TEH-5	R10.3	SB	08R0002R/L	X	X	X	X	
24	H.S. MILES	02-TEH-5	33.3	NB	08R0001R/L	X	X	X	X	
25	H.S. MILES	02-TEH-5	34.7	SB	08R0001R/L	X	X	X	X	
26	O'BRIEN	02-SHA-5	R31.1	NB/SB	06R0003	X	X	X	X	
27	LAKEHEAD	02-SHA-5	R43.2	NB/SB	06R0001	X	X	X	X	
28	WEED AIRPORT	02-SIS-5	R25.9	NB	02R0003R/L	X	X	X	X	
29	WEED AIRPORT	02-SIS-5	R25.9	SB	02R0003R/L	X	X	X	X	
30	RANDOLPH E COLLIER	02-SIS-5	R58.1	NB/SB	02R0001	X	X	X	X	
31	GAVIOTA	05-SB-101	46.9	NB	51R0001R/L	X	X	X	X	
32	GAVIOTA	05-SB-101	46.9	SB	51R0001R/L	X	X	X	X	
33	CAMP ROBERTS	05-MON-101	R3.1	NB	44R0003R/L	X	X	X	X	
34	CAMP ROBERTS	05-MON-101	R5.1	SB	44R0003R/L	X	X	X	X	
35	CRYSTAL SPRINGS	04-SM-280	R13.6	NB/SB	35R0001	X	X	X	X	
36	IRVINE LODGE	01-MEN-101	61.5	NB/SB	10R0003	X	X	X	X	X
37	MOSS COVE	01-MEN-101	58.9	NB/SB	10R0004	X	X	X	X	X
38	EMPIRE CAMP	01-MEN-101	82.5	NB/SB	10R0001	X	X	X	X	X
39	TRINIDAD	01-HUM-101	R105.2	NB	04R0001R/L	X	X	X	X	X
40	TRINIDAD	01-HUM-101	R105.2	SB	04R0001R/L	X	X	X	X	
41	COLLIER TUNNEL	01-DN-199	33.4	NB/SB	01R0001	X	X	X	X	X
42	PHIL S. RAINE	06-TUL-99	22.4	NB	46R0001R/L	X	X	X	X	
43	PHIL S. RAINE	06-TUL-99	22.4	SB	46R0001R/L	X	X	X	X	
44	C.H. WARLOW	06-TUL-99	52.0	NB/SB	46R0002	X	X	X	X	X
45	TURLOCK	10-STA-99	R0.30	NB	38R0002R/L	X	X	X	X	
46	TURLOCK	10-STA-99	R0.30	SB	38R0002R/L	X	X	X	X	
47	CARSON HILL	10-CAL-49	2.60	NB/SB	30R0002	X	X	X		
48	COSO JUNCTION	09-INY-395	R17.71	NB/SB	48R0003	X	X	X	X	X
49	DIVISION CREEK	09-INY-395	R84.0	NB/SB	48R0001	X	X	X	X	X
50	CRESTVIEW	09-MNO-395	R32.3	NB/SB	47R0002	X	X	X	X	
51	HONEY LAKE	02-LAS-395	49.6	NB/SB	07R0003	X	X	X	X	
52	SECRET VALLEY	02-LAS-395	96.5	NB/SB	07R0001	X	X	X		

REST AREAS ON EAST-WEST ROUTES
(Beginning in Southern California)

NO	ROADSIDE REST	DIST-CO-RTE	P.M.	DIR	STRUCTURE NO.	RESTROOM	WATER	PICNIC TABLES	TELEPHONE	RV DUMP STATION
54	BUCKMAN SPRINGS	11-SD-8	R48.8	EB/WB	57R0004	X	X	X	X	X
55	SUNBEAM	11-IMP-8	R31.2	EB	58R0003R/L	X	X	X	X	X
56	SUNBEAM	11-IMP-8	R31.2	WB	58R0003R/L	X	X	X	X	X
57	SAND HILLS	11-IMP-8	80.2	EB/WB	58R0004	X	X			
58	FONTANA	08-SBd-10	14.3	WB	54R0009	X	X	X	X	
59	WILDWOOD	08-SBd-10	38.2	EB	54R00010	X	X	X	X	
60	BROOKSIDE	08-RIV-10	4.2	WB	56R0001	X	X	X	X	
61	WHITEWATER	08-RIV-10	26.2	EB	56R0002R/L	X	X	X	X	
62	WHITEWATER	08-RIV-10	26.2	WB	56R0002R/L	X	X	X	X	
63	CACTUS CITY	11-RIV-10	72.0	EB	56R0003R/L	X	X	X	X	X
64	CACTUS CITY	11-RIV-10	72.0	WB	56R0003R/L	X	X	X	X	X
65	WILEY'S WELL	11-RIV-10	135	EB/WB	56R0005	X	X	X	X	X
66	BORON	09-KER-58	R138.9	EB	50R0006R/L	X	X	X	X	X
67	BORON	09-KER-58	R138.9	WB	50R0006R/L	X	X	X	X	X
68	DESERT OASIS	08-SBd-40	R28.4	EB	54R0005R/L	X	X	X	X	
69	DESERT OASIS	08-SBd-40	R28.4	WB	54R0005R/L	X	X	X	X	
70	FENNER	08-SBd-40	R105.5	EB	54R0006R/L	X	X	X	X	
71	FENNER	08-SBd-40	R105.5	WB	54R0006R/L	X	X	X	X	
72	CLYDE V. KANE	08-SBd-15	R107.4	EB	54R0004R/L	X	X	X	X	
73	CLYDE V. KANE	08-SBd-15	R107.4	WB	54R0004R/L	X	X	X	X	
74	VALLEY WELLS	08-SBd-15	161.0	EB	54R0002R/L	X	X	X	X	
75	VALLEY WELLS	08-SBd-15	161.0	WB	54R0002R/L	X	X	X	X	
76	SHANDON	03-SLO-46	49.5	EB/WB	49R0001	X	X	X	X	
79	MT. SPRINGS	10-AMA-88	10.11	EB/WB	26R0001	X		X		
80	HUNTER HILL	10-SOL-80	6.5	WB	26R0001	X	X	X	X	
81	GOLD RUN	03-PLA-80	41.8	EB	19R0001R/L	X	X	X	X	X
82	GOLD RUN	03-PLA-80	41.8	WB	19R0001R/L	X	X	X	X	X
83	DONNER SUMMIT	03-NEV-80	35.7	EB	17R0002R/L	X	X	X	X	
84	DONNER SUMMIT	03-NEV-80	35.7	WB	17R0002R/L	X	X	X	X	
85	ALPHA OMEGA	03-NEV-20	35.7	EB/WB	17R0001	X		X		
86	WEST BRANCH	03-BUT-70	29.0	EB/WB	12R0001	X		X		
87	MASSACK	02-PLU-70	49.8	EB/WB	09R0003	X	X	X	X	
88	L.T. DAVIS	02-PLU-70	R79.1	EB/WB	09R0004	X	X	X	X	
89	LAKE ALMANOR	02-PLU-36	R12.8	EB/WB	09R0001	X	X	X	X	
90	SLAYER	01-TRI-299	3.8	EB/WB	05R0001	X	X	X	X	X
91	DOUGLAS CITY	02-TRI-299	57.0	EB/WB	05R0002	X	X	X		
92	SHINGLETON	02-SHA-44	34.7	EB/WB	06R0004	X	X	X	X	
93	BOGARD	02-Las-44	14.53	EB/WB	07R0002	X	X	X		
94	HILLCREST	02-SHA-299	60.6	EB/WB	06R0002	X	X	X	X	
95	BRASS LAKE	02-SIS-97	21.8	NB/SB	02R0002	X	X	X		

REST AREAS ON NORTH-SOUTH ROUTES
(Beginning in Southern California)

NO	SEPTIC TANK	TANK SIZE (gal, ea)	LEACH FIELD	SIZE OF LEACH FIELD (sf)	SEEPAGE PITS (No)	OXIDATION POND (No)	TERMINAL POND	HOLDING TANK (no)	HOLDING TANK CAPACITY (gal)
	SEWAGE			DISPOSAL		SYSTEM			
1	1	3000	x	600	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-
5	4 (1 RV)	9000	x (RV)	650	-	1 Lined Facul.	-	-	-
6	4 (1 RV)	9000	x (RV)	650	-	4 Rapid Infil.	-	-	-
7	2	9000	-	-	44 (4'x24')		-	-	-
8	2	9000	-	-	41 (4'x24')	-	-	-	-
9	2	8000	-	-	32 (16ea ST)	-	-	-	-
10	2	8000	-	-	32 (16ea ST)	-	-	-	-
11	2	6000	x	2000	-	-	-	-	-
12	2	6000	x	2100	-	-	-	-	-
13	2 (1 RV)	7500 (RV 4500	x (RV)	2400 (RV 1600)	-	-	-	-	-
14	2 (1 RV)	7500 (RV 4500	x (RV)	2400 (RV 1600)	-	-	-	-	-
15	1	10,500	x	3000	-	-	-	-	-
16	1	7580	-	-	7	-	-	-	-
17	1	7580	-	-	15	-	-	-	-
18	-	-	-	-	-	x 4 @ 1.5	-	-	-
19	-	-	-	-	-	x acres (NB)	-	-	-
20	-	-	-	-	-	4	-	-	-
21	-	-	-	-	-	4 (NB)	-	-	-
22	1	12,000	x	400 (SB)	-	-	-	-	-
23	1	12,000	x	400	-	-	-	-	-
24	1	20,400	x	2840	-	-	-	-	-
25	2	12,600, 6000	x	2650	-	-	-	-	-
26	2	2700	-	-	3 (36"x30')	-	-	-	-
27	2	12,000, 5400	x		-	-	-	-	-
28	x	?	x	1370	-	-	-	-	-
29	x	?	x	1300	-	-	-	-	-
30	North - 4	2,2000 2,150	x	3080	-	-	-	-	-
	South - 3	2000	x	3080					
31	1	7500	x	720	-	-	-	-	-
32	1	7500	x	1720	-	-	-	-	-
33	1	3000	x	510	-	-	-	-	-
34	1	6000	x	750	-	-	-	-	-
35	?	?	?		-	-	-	-	-
36	1	4800	x	550	-	-	-	-	-
37	1	4800	x	470	-	-	-	-	-
38	1 (1 RV)	5400 (RV 600	x	600	-	-	-	-	-
39	1	4800			10 (4'x20')	-	-	-	-
	1 RV	RV 9000			RV 6(5'x20')				
40	1	4800	x			-	-	-	-
41	1 (1RV)	7500, 1200	x	470	RV 1(4'x20')	-	-	-	-
42	-	-	-	-	-	4	-	-	-
43	-	-	-	-	-	4 (NB)	-	-	-
44	2	4500	x	750	-	-	-	1	5000
45	2	7500	x	2000	-	-	-	-	-
46	2	7500	x	1400	-	-	-	-	-
47	-	-	-	-	-	-	-	-	-
48	1 (1 RV)	9000 (RV 4500	x	1800	-	-	-	-	-
49	1 (1 RV)	9000 (RV 7500	x	900 (RV 400)	-	-	-	-	-
50	1	3000	x	480	-	-	-	-	-
51	2	2100, 1100	x	A=400, B=300-450	-	-	-	-	-
52	?	?	?		-				

REST AREAS ON EAST-WEST ROUTES
(Beginning in Southern California)

	SEWAGE		DISPOSAL			SYSTEM			
NO	SEPTIC TANK	TANK SIZE (gal, ea)	LEACH FIELD	SIZE OF LEACH FIELD (ft)	SEEPAGE PITS (No)	OXIDATION POND (No)	TERMINAL POND	HOLDING TANK (no)	HOLDING TANK CAPACITY (gal)
54	2 (1 RV)	5000 (RV 5000)	x	3500	RV 1(5'x10')	-	-	-	-
55	1	7500	x	920	-	-	-	-	-
	2 RV	RV 5000, 1000	x	400					
56	1	6000	x	-	-	-	-	(1 RV)	5000
	2 RV	RV 5000, 1000	x	450					
57	-	-	-	-	-	-	-	-	-
58	-	-	-	-	-	-	-	-	-
59	2	2000	-	-	2	-	-	-	-
60	1	2000	x	250	1	-	-	-	-
61	1	6000	-	-	4 (5'x30')	-	-	-	-
62	1	6000	-	-	4 (5'x30')	-	-	-	-
63	-	-	x	200	-	2	-	(1 RV)	5000
64	2	4000	-	-	-	2 (EB)	-	(1 RV)	5000
65	1	9000	-	-	16(5'x45')	-	-	-	-
	1 RV	RV 1000			RV 2(5'x45')			(1 RV)	5000
66	1	4500	x	450	3(5'x40')	-	-	-	-
67	1	4500	x	450	-	-	-	-	-
68	-	-	-	-	-	2-110'x70'	1 Terminal	-	-
69	-	-	-	-	-	2-110'x70'	1 Terminal	-	-
70	1	6700	x	1260	-	-		-	-
71	1	6700	x	1260	-	-	-	-	-
72	2	7500, 9000	-	-	12 (5'x30')	-		-	-
73	2	7500, 9000	-	-	12 (5'x30')	-		-	-
74	2	6000	x	1200	-	-		-	-
75	2	6000	x	2000	-	-		-	-
76	1	9000	?	?	9(7'x30')	?		-	-
79	-	-	-	-	-	-	-	-	-
80	-	-	-	-	-	-	-	-	-
81	1	21300	x	3450	-	2	-	-	-
82	1	21300	x	3450 (EB)	-	2 (EB)	-	-	-
83	-	-	-	-	-	-	-	-	-
84	-	-	-	-	-	-	-	-	-
85	-	-	-	-	-	-	-	-	-
86	-	-	-	-	-	-	-	-	-
87	1	2000	x	300	-	-	-	-	-
88	1	4500	x	900	-	-	-	-	-
89	1	1500	x	300	-	-	-	-	-
90	1	9000	x	A=800, B=900	-	-	-	-	-
	(1 RV)	(RV 6000)		RV C=250, D=300	-	-	-	-	-
91	1	3000	x	300	-	-	-	-	-
92	?	?	x	300	-	-	-	-	-
93	1	7000	x	1120	-	-	-	-	-
94	1	2000	x	300	-	-	-	-	-
95	2	1500	x	820, 480	-	-	-	-	-

REST AREAS ON NORTH-SOUTH ROUTES
(Beginning in Southern California)

NO	PUMPING STA (no)	OTHER	COMFORT STATION: NO. C.S. BLDGS	TOTAL NO. TOILETS	TOTAL NO. URINALS	TOTAL NO. LAVATORIES	NO. LOW FLUSH TOILETS	WASTE WATER VOL. PER FLUSH
1	-		?	7	7	7	-	-
2	-	Force Main	1	14	4	10	-	-
3	-	Force Main	2	18	6	12	-	-
5	-		2	14	6	12	-	-
6	-		2	14	6	12	-	-
7	-		1	11	4	9 (1 SS)	-	-
8	-		1	11	4	9 (1 SS)	-	-
9	-		2	10	4	8	-	-
10	-		2	10	4	8	-	-
11	-		2	10	4	8	6 microphor, 2 IFO	2 qts, 3 gal
12	-		2	10	4	8	6 microphor, 2 IFO	2 qts, 3 gal
13	-		2	?	7	7	-	-
14	-		2	?	?	7	-	-
15	-	Evapotranspiration Bed	1	7	2	6	-	-
16	-		1	7	2	6	-	-
17	-		1	7	2	6	-	-
18	1		1	10	3	9 (1 SS)	-	-
19	1		1	10	3	9 (1 SS)	-	-
20	1	RV Dump Combined w/ C.S. Sewer System	2	10	4	8	-	-
21	1	RV Dump Combined w/ C.S. Sewer System	2	10	4	8	-	-
22		1,1500 gal Dosing Tank	1	7	2	5	-	-
23		1,1500 gal Dosing Tank	1	7	2	5	-	-
24			1	8	4	8	-	-
25			?	?	?	?	-	-
26			1	7	2	4	-	-
27			1	9	3	7 (1 SS)	-	-
28	-		1	10	3	9 (1 SS)	-	-
29	-		1	10	3	9 (1 SS)	-	-
30	-		1	7	2	6	-	-
							-	-
31	-		1	10	3	8 (2 SS)	-	-
32	-		1	10	3	8 (2 SS)	-	-
33	-		?	?	?	?	-	-
34	-		?	?	?	?	-	-
35	-	Gravity Sewer to City of Hillsborough	1	10	3	6	-	-
36	-	RV Dump (Combined)	1	7	2	4	-	-
37	-	RV Dump (Combined)	1	7	2	4	-	-
38	-		1	5	2	4	-	-
39	-		1	6	2	5 (1 SS)	-	-
							-	-
40	-		1	6	2	5 (1 SS)	-	-
41	-		1	7	2	7 (1 SS)	-	-
42	1		2	14	6	14 (2 SS)	-	-
43	1		2	14	6	14 (2 SS)	-	-
44	-	RV Dump Combined w/ C.S. Sewer System	1	7	2	4	-	-
45	-		1	10	3	7 (1 SS)	-	-
46	-		1	10	3	7 (1 SS)	-	-
47	-	2 Vault Toilets(no water)	?	?	?	7	-	-
48	-		1	9	2	7 (1 SS)	-	-
49	-		1	7	2	7 (1 SS)	-	-
50	-	RV Dump System (Combined)	1	5	2	4	-	-
51	-		1	7	2	4	-	-
52	-		?	?	?	?	-	-

REST AREAS ON EAST-WEST ROUTES
(Beginning in Southern California)

NO	PUMPING STA (no)	OTHER	COMFORT STATION: NO. C.S. BLDGS	TOTAL NO. TOILETS	TOTAL NO. URINALS	TOTAL NO. LAVATORIES	NO. LOW FLUSH TOILTS	WASTE WATER VOL PER FLUSH
54	-		2	10	4	9 (1 SS)	-	-
55	-		1	9	2.	6 (1 SS)	-	-
56	-		1	9	2	6 (1 SS)	-	-
57	-	Vault Toilets(No Water)	?	?	?	?	-	-
58	1	4" Force Main to Sewer System	2	14	6	12	-	-
59	-		1	7	?	?	-	-
60	-		1	3	1	2	-	-
61	-		1	7	2	6	-	-
62	-		1	7	2	6	-	-
63	-		1	7	2	6	-	-
64	-		1	7	2	6	-	-
65	-		1	10	3	7 (1 SS)	-	-
66	-	RV Dump Combined w/C.S. Sewer System	1	8	2	6	-	-
67	-		1	8	2	6	-	-
68	-	Package Treatment Plant	1	7	2	6	-	-
69	-	Package Treatment Plant	1	7	2	6	-	-
70	-	Dosing Tank	1	?	?	?	-	-
71	-	Dosing Tank	1	?	?	?	-	-
72	-		1	12	4	9 (1 SS)	-	-
73	-		1	12	4	9 (1 SS)	-	-
74	-		1	9	3	6 (1 SS)	-	-
75	-		1	9	3	6 (1 SS)	-	-
76	-		1	4	1	5	-	-
79	-	Vault Toilets(No Potable Water)	?	?	?	?	-	-
80	-	6" Gravity Sewer Line-City of Vallejo	1	10	3	7 (1 SS)	-	-
81	-	RV Dump disposal System Combined With	1				-	-
82	-	Comfort Station ; Dosing Tank	1				-	-
83	-	Sewer Line Connects to Donner Summit	1	?	?	?	-	-
84	-	Public Utilities District System	1	?	?	?	-	-
85	-	Pit Toilets (No Water)	1	-	-	-	-	-
86	-	Vault Toilets (No Water)	1	8	-	-	-	-
87	-		1	5	2	4	-	-
88	-		1	5	2	4	-	-
89	-		?	?	?	?	-	-
90	-		1	7	2	7 (1 SS)	-	-
91	-		1	5	2	4	-	-
92	-		1	7	?	7	-	-
93	-		1	5	1	4	-	-
94	-		1	4	1	2	-	-
95	-		1	5	2	4		

APPENDIX B

TRAFFIC DATA

1984 TRAFFIC VOLUMES FOR CALIFORNIA ROADSIDE RESTS

REST AREAS ON NORTH-SOUTH ROUTES
(Beginning in Southern California)

NO	ROADSIDE REST	Peak Hour	1984 ADT 1 Pk. Mo.	1984 ADT 1 Annl.	Truck % Tot Veh 2
1	TWO RIVERS	440	4600 *	4000 *	23.5
2	ALISO CREEK	4100	49,500	41,500	8.8
3	ALISO CREEK	4100	49,500 *	41,500 *	8.8
5	TEJON PASS	2700	23,750 +	17,250 +	29.1
6	TEJON PASS	2700	23,750 +	17,250 +	29.1
7	BUTTONWILLOW	1550	10,050	7850	30.8
8	BUTTONWILLOW	1550	10,050	7850	30.8
9	COALINGA-AVENAL	1525	10,700	7600	32.9
10	COALINGA-AVENAL	1525	10,700	7600	32.9
11	JOHN "CHUCK" ERRECA	1600	11,450	7750	28.0
12	JOHN "CHUCK" ERRECA	1600	11,450	7750	28.0
13	WESTLEY	875	10,450	8250	24.0
14	WESTLEY	875	10,450	8250	24.0
15	ELKHORN	2500	27,500 *	24,000 *	16.0
16	DUNNIGAN	1175	9950	8950	22.9
17	DUNNIGAN	1175	9950	8950	22.9
18	MAXWELL	950	8800	7850	26.7
19	MAXWELL	950	8800	7850	26.7
20	WILLOWS	950	9550	7950	26.8
21	WILLOWS	950	9550	7950	26.8
22	CORNING	825	9300	7450	23.0
23	CORNING	825	9300	7450	23.0
24	H.S. MILES	1025	12,750	10,000	23.2
25	H.S. MILES	1025	12,750	10,000	23.2
26	O'BRIEN	1500	17,800 *	13,800 *	27.9
27	LAKEHEAD	1250	15,300 *	11,600 *	33.2
28	WEED AIRPORT	500	6250	4400	35.6
29	WEED AIRPORT	500	6250	4400	35.6
30	RANDOLPH E COLLIER	1050	13,100 *	9200 *	30.6
31	GAVIOTA	1275	13,000	9100	13.4
32	GAVIOTA	1275	13,000	9100	13.4
33	CAMP ROBERTS	775	10,150	6000	17.2
34	CAMP ROBERTS	775	10,150	6000	17.2
35	CRYSTAL SPRINGS	7600	72,000 *	68,000 *	1.2
36	IRVINE LODGE	800	6000 *	4700 *	16.9
37	MOSS COVE	820	5800 *	4500 *	16.4
38	EMPIRE CAMP	670	5400 *	4200 *	17.9
39	TRINIDAD	580	5800 *	4100 *	14.9
40	TRINIDAD	610	6100 *	4300 *	14.9
41	COLLIER TUNNEL	260	2600 *	1900 *	22.0
42	PHIL S. RAINE	1275	12,400	10,200	27.6
43	PHIL S. RAINE	1275	12,400	10,200	27.6
44	C.H. WARLOW	3250	36,500 *	32,500 *	35.1
45	TURLOCK	1225	13,250	11,000	18.8
46	TURLOCK	1225	13,250	11,000	18.8
47	CARSON HILL	330	4000 *	3250 *	7.6
48	COSO JUNCTION	1900	8000 *	5300 *	12.0
49	DIVISION CREEK	610	6500 *	4900 *	15.4
50	CRESTVIEW	630	6600 *	3000 *	5.3
51	HONEY LAKE	500	5100 *	3850 *	11.7
52	SECRET VALLEY	130	1500 *	1050 *	22.3

1984 TRAFFIC VOLUMES FOR CALIFORNIA ROADSIDE RESTS

REST AREAS ON EAST-WEST ROUTES
(Beginning in Southern California)

NO	ROADSIDE REST	Peak Hour	1984 ADT 1 Pk. Mo.	1984 ADT 1 Annl.	Truck % Tot Veh 2
54	BUCKMAN SPRINGS	910	9000 *	7300 *	8.8
55	SUNBEAM	325	2900	2600	13.4
56	SUNBEAM	325	2900	2600	13.4
57	SAND HILLS				20.0
58	FONTANA	7400	91,000 *	82,000 *	14.1
59	WILDWOOD	3400	45,500 *	40,000 *	21.1
60	BROOKSIDE	3000	40,500 *	35,500 *	26.7
61	WHITEWATER	2475	20,750	16,500	21.9
62	WHITEWATER	2475	20,750	16,500	21.9
63	CACTUS CITY	395	5000	4400	43.6
64	CACTUS CITY	395	5000	4400	43.6
65	WILEY'S WELL	770	9800 *	8500 *	43.3
66	BORON	575	4850	4400	28.0
67	BORON	575	4850	4400	28.0
68	DESERT OASIS	310	3700	3450	56.7
69	DESERT OASIS	310	3700	3450	56.7
70	FENNER	275	3250	3050	51.9
71	FENNER	275	3250	3050	51.9
72	CLYDE V. KANE	850	7800	7100	22.7
73	CLYDE V. KANE	850	7800	7100	22.7
74	VALLEY WELLS	950	9100 +	7350 +	20.0
75	VALLEY WELLS	950	9100 +	7350 +	20.0
76	SHANDON	1100	12,800 *	8300 *	34.8
79	MT. SPRINGS	560	6900 *	6100 *	6.0
80	HUNTER HILL	6500	67,000 *	54,000 *	9.6
81	GOLD RUN	1425	13,500	9900	14.3
82	GOLD RUN	1425	13,500	9900	14.3
83	DONNER SUMMIT	1425	13,500	9900	9.1
84	DONNER SUMMIT	1425	13,500	9900	9.1
85	ALPHA OMEGA	320	3050 *	1900 *	8.7
86	WEST BRANCH	230	2700 *	2150 *	17.0
87	MASSACK	300	3500 *	2300 *	8.0
88	L.T. DAVIS	330	3700 *+	2500 *+	14.3
89	LAKE ALMANOR	340	3850 *	2400 *	15.7
90	SLAYER	290	2850 *+	2200 *+	20.5
91	DOUGLAS CITY	320	3600 *	2900 *	10.5
92	SHINGLETON	200	1550 *	880 *	14.4
93	BOGARD	220	2150 *	1500 *	25.4
94	HILLCREST	240	2600 *	2100 *	25.0
95	GRASS LAKE	220	3150 *	2250 *	45.9

* Traffic Volume For Both Directions
\+ Traffic Volume at Nearest Post Mile

1) 1984 Traffic Volumes on Calif State Hgwys., Caltrans Div. of Traffic Eng., 1984
2) 1984 Annual Average Daily Truck Traffic on the Calif. State Hgwy System., Division of Traffic Eng, August 1985.

CURRENT SRRA TRAFFIC INFORMATION

NO.	ROADSIDE REST	PEAK HOUR	1984 ADT 1		TRUCK % TOT. VEH. 2	TOTAL NO. TRUCKS	% TRUCK BY AXEL 2				AADT SRRA RAMPS, (YEAR) 3
			PK. MO.	ANNUAL			2	3	4	5+	
9	COALINGA-AVENAL	1525	10,700	7600	32.9	2500	12.2	3.3	3.3	81.2	1390, (1982)
10	COALINGA-AVENAL	1525	10,700	7600	32.9	2500	12.2	3.3	3.3	81.2	1400, (1982)
11	JOHN "CHUCK" ERRECA	1600	11,450	7750	28.0	2170	15.0	5.0	5.0	75.0	1800, (1980)
12	JOHN "CHUCK" ERRECA	1600	11,450	7750	28.0	2170	15.0	5.0	5.0	75.0	1400, (1980)
13	WESTLEY	875	10,450	8250	24.0	1980	16.6	7.1	4.6	71.7	900, (1980)
14	WESTLEY	875	10,450	8250	24.0	1980	16.6	7.1	4.6	71.7	1100, (1980)
15	ELKHORN	2500	27,500 *	24,000 *	16.0	3840 *	20.5	9.5	3.5	66.5	800, (1984)
16	DUNNIGAN	1175	9950	8950	22.9	2050	11.6	4.2	1.5	82.7	1200, (1984)
17	DUNNIGAN	1175	9950	8950	22.9	2050	11.6	4.2	1.5	82.7	1300, (1984)
45	TURLOCK	1225	13,250	11,000	18.8	2068	15.5	9.2	3.0	72.3	1400, (1980)
46	TURLOCK	1225	13,250	11,000	18.8	2068	15.5	9.2	3.0	72.3	1400, (1980)
81	GOLD RUN	1425	13,500	9900	14.3	1416	26.2	3.9	3.9	66.0	1700, (1983)
82	GOLD RUN	1425	13,500	9900	14.3	1416	26.2	3.9	3.9	66.0	1200, (1983)

* Traffic Volume For Both Directions
\+ Traffic Volume at Nearest Post Mile

1) 1984 Traffic Volumes on Calif State Hgwys., Caltrans Div. of Traffic Eng., 1984
2) 1984 Annual Average Daily Truck Traffic on the Calif. State Hgwy System, Division of Traffic Eng., August 1985
3) 1984 Ramp Volumes on the Calif. State Frwy System, Districts 3,10,&6, Caltrans Division of Traffic Eng., June 1985

MAINLINE AND SRRA TRAFFIC VOLUMES 1980 - 1985

NO	ROADSIDE REST	DIR	1980 ADT PEAK HOUR	1980 ADT PEAK MONTH	1980 ADT ANNUAL ADT	1981 ADT PEAK HOUR	1981 ADT PEAK MONTH	1981 ADT ANNUAL ADT	1982 ADT PEAK HOUR	1982 ADT PEAK MONTH	1982 ADT ANNUAL ADT
9	COALINGA-AVENAL	NB	925	7450	4950	775	6400	4900	1350	10150	7150
10	COALINGA-AVENAL	SB	925	7450	4950	775	6400	4900	1350	10150	7150
11	JOHN "CHUCK" ERRECA	NB	1150	9650	6400	975	10950	7250	975	10350	7300
12	JOHN "CHUCK" ERRECA	SB	1150	9650	6400	975	10950	7250	975	10350	7300
13	WESTLEY	NB	650	7900	6250	825	9800	7750	825	9850	7800
14	WESTLEY	SB	650	7900	6250	825	9800	7750	825	9850	7800
15	ELKHORN	NB/SB	2400	22900	19100	2100	26500	20400	2100	26500	20400
16	DUNNIGAN	NB	900	8700	7250	1025	10700	7800	1025	10700	7800
17	DUNNIGAN	SB	900	8700	7250	1025	10700	7800	1025	10700	7800
45	TURLOCK	NB	1050	11350	9500	1125	12250	10250	1125	12250	10250
46	TURLOCK	SB	1050	11350	9500	1125	12250	10250	1125	12250	10250
81	GOLD RUN	EB	1250	11850	8700	1325	12300	9050	1325	12300	9050
82	GOLD RUN	WB	1250	11850	8700	1325	12300	9050	1325	12300	9050

MAINLINE AND SRRA TRAFFIC VOLUMES 1980 - 1985

NO	ROADSIDE REST	DIR	1983 ADT PEAK HOUR	1983 ADT PEAK MONTH	1983 ADT ANNUAL ADT	1984 ADT PEAK HOUR	1984 ADT PEAK MONTH	1984 ADT ANNUAL ADT	AADT SRRA RAMPS,	(YEAR)	STOPPING FACTORS % MAINLINE
9	COALINGA-AVENAL	NB	1475	9950	7450	1525	10700	7600	1390,	(1982)	19.4
10	COALINGA-AVENAL	SB	1475	9950	7450	1525	10700	7600	1400,	(1982)	19.6
11	JOHN "CHUCK" ERRECA	NB	1500	10800	7300	1600	11450	7750	1800,	(1980)	28.0
12	JOHN "CHUCK" ERRECA	SB	1500	10800	7300	1600	11450	7750	1400,	(1980)	22.0
13	WESTLEY	NB	825	9850	7800	875	10450	8250	900,	(1980)	14.4
14	WESTLEY	SB	825	9850	7800	875	10450	8250	1100,	(1980)	17.6
15	ELKHORN	NB/SB	2250	2800	21400	2500	27500	24000	800,	(1984)	3.3
16	DUNNIGAN	NB	1075	11350	8300	1175	9950	8950	1200,	(1984)	13.4
17	DUNNIGAN	SB	1075	11350	8300	1175	9950	8950	1300,	(1984)	14.5
45	TURLOCK	NB	1125	1225	10250	1225	13250	11000	1400,	(1980)	14.7
46	TURLOCK	SB	1125	1225	10250	1225	13250	11000	1400,	(1980)	14.7
81	GOLD RUN	EB	1250	11650	8550	1425	13500	9900	1700,	(1983)	20.0
82	GOLD RUN	WB	1250	11650	8550	1425	13500	9900	1200,	(1983)	14.0

APPENDIX C

STATISTICS USED IN DETERMINING RELIABILITY FACTORS

APPENDIX

Statistics Used in Determining Reliability Factors*

In the flow rate equation, the resulting flow is the product of several mean values. The standard deviation of the product is calculated using a type of interaction formula which determines the standard deviation of the combined product. Then the range of values expected to encompass 90% of the population, assuming a normal distribution, is calculated. The upper and lower limits are equal to:

$$\bar{X}_{TOT} \pm 1.65 S_{TOT}$$

where:

$\bar{X}_{TOT}$ = product of individual mean values
S_{TOT} = standard deviation of combined product

After the upper limit ($\bar{X}_{TOT} + 1.65 S_{TOT}$) is established, it is divided by the combined mean ($\bar{X}_{TOT}$) to produce a reliability factor R_R (for rest room sewage) or R_T (for TSS sewage).

The following formulae are used to determine the standard deviation of the sewage flow rate for rest room sewage in order to establish the reliability factor R_R.

$$S^2_{ADT \cdot S_R} = \bar{X}^2_{S_R} \cdot S^2_{ADT} + \bar{X}^2_{ADT} \cdot S^2_{S_R} + S^2_{ADT} \cdot S^2_{S_R}$$

*Duncan, Acheson, J., "Quality Control and Industrial Statistics, third edition, page 93.

where:

$\overline{X}_{ADT}$ = mean ADT

S_{ADT} = standard deviation of ADT

$\overline{X}_{S_R}$ = mean roadside rest stopping factor

S_{S_R} = standard deviation of roadside rest stopping factors

$S_{ADT \cdot S_R}$ = standard deviation of the combined product of the ADT and the roadside rest stopping factor

and

$$S^2_{TOT} = \overline{X}^2_{G_R} \cdot S^2_{ADT \cdot S_R} + \overline{X}^2_{ADT \cdot S_R} \cdot S^2_{G_R} + S^2_{G_R} \cdot S^2_{ADT \cdot S_R}$$

where:

$\overline{X}_{ADT \cdot S_R}$ = product of $\overline{X}_{ADT}$ and $\overline{X}_{S_R}$ $(\overline{X}_{ADT} \cdot \overline{X}_{S_R})$

$\overline{X}_{G_R}$ = mean rest room wastewater volume

S_{G_R} = standard deviation of rest room wastewater volume

S_{TOT} = standard deviation of combined product

and

$$\overline{X}_{TOT} + 1.65 S_{TOT}$$

where:

$\overline{X}_{TOT}$ = product of $\overline{X}_{ADT}$, $\overline{X}_{S_R}$, and $\overline{X}_{G_R}$

The reliability factor for rest room sewage is then calculated:

$$R_R = \frac{\overline{X}_{TOT} + 1.65 S_{TOT}}{\overline{X}_{TOT}}$$

The standard deviation of the sewage flow rate for the TSS sewage is similarly calculated and the following formulae are used to determine the standard deviation of the sewage flow rate for the TSS sewage in order to establish the reliability factor R_T.

$$S^2_{ADT \cdot S_R \cdot S_T} = \overline{X}^2_{S_T} \cdot S^2_{ADT \cdot S_R} + \overline{X}^2_{ADT \cdot S_R} \cdot S^2_{S_T} + S^2_{S_T} \cdot S^2_{ADT \cdot S_R}$$

where:

$\overline{X}_{S_T}$ = mean TSS stopping factor

S_{S_T} = standard deviation of TSS stopping factors

$S_{ADT \cdot S_R \cdot S_T}$ = standard deviation of the combined product of the ADT, roadside rest stopping factor, and TSS stopping factor.

$$S^2_{TOT'} = \overline{X}^2_{G_T} \cdot S^2_{ADT \cdot S_R \cdot S_T} + \overline{X}^2_{ADT \cdot S_R \cdot S_T} \cdot S^2_{G_T} + S^2_{GT} \cdot S^2_{ADT \cdot S_R \cdot S_T}$$

where:

$\overline{X}_{ADT \cdot S_R \cdot S_T}$ = product of $\overline{X}_{ADT}$, $\overline{X}_{S_R}$ and $\overline{X}_{S_T}$

$\overline{X}_{G_T}$ = mean TSS wastewater volume

S_{G_T} = standard deviation of TSS wastewater volume

$S_{TOT'}$ = standard deviation of combined product.

and

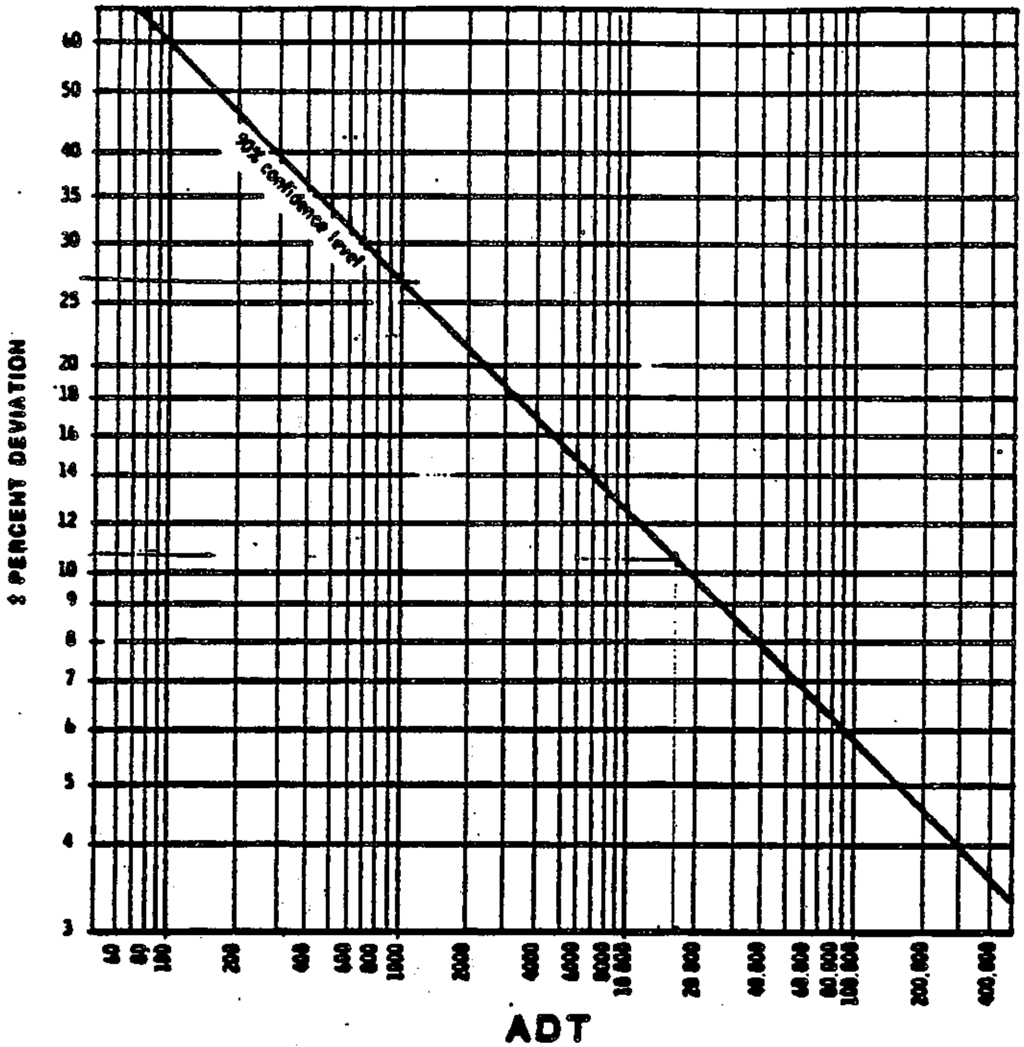
$$\overline{X}_{TOT}' + 1.65S_{TOT}'$$

where:

$\overline{X}_{TOT}'$ = product of $\overline{X}_{ADT}$, $\overline{X}_{S_R}$, $\overline{X}_{S_T}$ and $\overline{X}_{G_T}$

The reliability factor for TSS sewage is then calculated:

$$R_T = \frac{\overline{X}_{TOT}' + 1.65S_{TOT}'}{\overline{X}_{TOT}'}$$



STANDARD DEVIATION OF ADT, S_{ADT}

From the above graph: $ADT + \frac{(\%\,DEV.)}{100} \times ADT = ADT + 1.65S_{ADT}$

$$S_{ADT} = \frac{\%\,DEV \times ADT}{1.65 \times 100}$$

Example: ADT = 1000, % DEV = 27%

ADT = 1000, % DEV = 27%

$$S_{ADT} = \frac{27 \times 1000}{1.65 \times 100} = 164$$

$$\bar{X}_{ADT} = ADT = 1000$$

RELIABILITY FACTOR R_R

Use R_R = 2.0

$\overline{X}_{ADT}$	S_{ADT}	$\overline{X}_{ADT \cdot S_R}$	$S_{ADT \cdot S_R}$	(1) $\overline{X}_{TOT}$	S_{TOT}	(2) $\overline{X}_{TOT}+1.65S_{TOT}$	R_R=(2)/(1)
100	36	13.7	7.01	30.14	20.4	63.8	2.12
400	87	54.8	22.60	120.56	71.6	238.8	1.98
1,000	164	137.0	52.57	301.40	172.3	585.6	1.94
4,000	412	548.0	196.86	1,205.60	666.5	2,305.3	1.91
10,000	770	1,370.0	482.07	3,014.00	1,649.6	5,735.9	1.90
40,000	1,939	5,480.0	1,896.90	12,056.00	6,547.4	22,859.3	1.90
100,000	3,515	13,700.0	4,717.54	30,140.00	16,328.6	57,082.2	1.89

Roadside rest stopping factor:

$\overline{X}_{S_R}$ = 0.137
S_{S_R} = 0.0469

Rest room wastewater per axle:

$\overline{X}_{G_R}$ = 2.20
S_{G_R} = 0.87

APPENDIX D

SRRA WASTEWATER FLOW RATE AND DETENTION TIME CALCULATION

SEWAGE FLOW RATE CALCULATIONS

Average waste water flow rate:

COALINGA - AVENAL SRRA - NB

				1984 ADT				
AADT	Pk. Month ADT	% Trucks	No. of Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
7600	10,700	32.9	2,500	305	82	83	2030	5100

	Vehicles	Axle/Veh.	Axles
Passenger Car	5100	2	10,200
2 Axle Truck	305	2	610
3 Axle Truck	82	3	246
4 Axle Truck	83	4	332
5 Axle Truck	2030	5	10,150
	7600	-	21,538

$Av = \frac{21,538}{7600} = 2.8$

Avg No Axle/Veh = 2.8 Axle/Veh

Rest Room Waste Water Flow Rate: (Q_R Gals/Day)

$Q_R = R_R \times ADT \times S_R/100 \times Av \times G_R$

$R_R = 2.0$ (See Appendix C)

$S_R = 19.4\%$

Av = 2.8 Axle/Veh

ADT = 7600 Veh (See Appendix B)

$G_R = 2.2$ Gal/Axle

$Q_R = (2.0) \times (7600 \text{ Veh}) \times (0.194) \times (2.8 \text{ Axle/Veh}) \times (2.2 \text{ Gal/Axle})$

$Q_R = 18,165$ Gal/Day

COALINGA-AVENAL SRRA - SB

R_R = 2.0
S_R = 19.6
ADT - 7600 Vehicles
Av = 2.8 Axle/Vehicles
G_R = 2.2 Gal/Axle

Q_R = (2.0) x (7600 Vehicles) x (0.196) x (2.8 Axle/Veh) x (2.2 Gal/Axle)

Q_R = 18,352 Gal/Day

JOHN "CHUCK" ERRECA ROADSIDE REST

	AADT	Pk Mo ADT	% Trucks	1984 ADT Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Panoche NB:	7750	11,450	28	2170	326	108	108	1628	5580

	Vehicles	Axles/Veh	Axles
Passenger Cars -	5,580	2	11,160
2 Axle Trucks	326	2	652
3 Axle Trucks	108	3	324
4 Axle Trucks	108	4	432
5 Axle Trucks	1,628	5	8,140
Total	7,750	-	20,708

$$Av = \frac{\text{ADT Axle Count}}{\text{AADT}} = \frac{20{,}708}{7750} = 2.67 \text{ Axle/Veh}$$

Rest Room Flow Rate (Q_R: Gal/Day) See Pg. 45

$Q_R = R_R \times ADT \times S_R/100 \times Av \times G_R$

R_R = 2.0 (Reliability Factor: Appendix C)

S_R = 28% (Stopping Factor Based on 1980 Ramp Counts)

Av = 2.67 Axles/Vehicle

G_R = 2.2 Gal/Axle (Mean Rest Room Waste Water Volume, Table 13)

ADT = 7750

Q_R = 2.0 x 7750 Veh/Day x 28/100 x 2.67 Axle/Veh x 2.2 Gal/Axle

Q_R = 25,493 Gal/Day

(PANOCHE) JOHN "CHUCK" ERRECA ROADSIDE REST

	AADT	Pk Mo ADT	% Trucks	1984 ADT Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Panoche SB	7750	11,450	28	2170	326	108	108	1628	5580

	Vehicles	Axles/Veh	Axles
Passenger Cars -	5,580	2	11,160
2 Axle Trucks	326	2	652
3 Axle Trucks	108	3	324
4 Axle Trucks	108	4	432
5 Axle Trucks	1,628	5	8,140
Total	7,750	-	20,708

$$Av = \frac{20{,}708}{7750} = 2.67 \text{ Ax/Ve}$$

Rest Room Waste Water Flow Rate: (Q_R Gal/Day)

$Q_R = R_R \times ADT \times S_R/100 \times Av \times G_R$

$R_R = 2.0$ ADT = 7750 $S_R/100 = .22$ Av = 2.67

$G_R = 2.2$ Gal/Axle (Table 13)

$Q_R = (2.0) \times (7750) \times (0.22) \times (2.67) \times (2.2) =$ 20,030 Gal/Day

WESTLEY ROADSIDE REST

	AADT	Pk Mo ADT	% Trucks	1984 ADT Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Westley NB:	8250	10,450	24	1980	329	140	91	1420	6270

	Vehicles	Axles/Veh	Axles
Passenger Cars -	6,270	2	12,540
2 Axle Trucks	329	2	658
3 Axle Trucks	140	3	420
4 Axle Trucks	91	4	364
5 Axle Trucks	1,420	5	7,100
Total	8,250	-	21,082

$$Av = \frac{21,082}{8250} = 2.56 \text{ Ax/Ve}$$

Rest Room Waste Water Flow Rate: (Q_R Gal/Day)

$$Q_R = R_R \times ADT \times S_R/100 \times Av \times G_R$$

R_R = 2.0 (See App. C) ADT: 8250

S_R = 14.4 (Based on 1980 Ramp Counts and Traffic Volumes)

Av = 2.55 Axle/Veh G_R = 2.2 Gal/Axle (Table 13)

Q_R = (2.0) x (8250) x (.144) x (2.56) x (2.2) = 13,381.6 Gal/Day
(13,400) Gal/Day)

WESTLEY SB: S_R = 17.6%

Q_R = (2.0) x (8250) x (.176) x (2.56) x (2.2) = 16,355.3 Gal/Day
(16,360 Gal/Day)

ELKHORN ROADSIDE REST

	AADT	Pk Mo ADT	% Trucks	1984 ADT Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Elkhorn NB/SB:	24,000	27,500	16.0	3840	787	365	134	2554	20160

	Vehicles	Axles/Veh	Axles
Passenger Cars -	20,160	2	40,320
2 Axle Trucks	787	2	1,574
3 Axle Trucks	365	3	1,095
4 Axle Trucks	134	4	536
5 Axle Trucks	2,554	5	12,770
Total	24,000	-	56,295

$$Av = \frac{56,295}{24,000} = 2.35 \text{ Ax/Ve}$$

Rest Room Waste Water Flow Rate: (Q_R Gal/Day)

$Q_R = R_R \times ADT \times S_R/100 \times Av \times G_R$

R_R = 2.0 (See App. C) ADT: 24,000

S_R = 3.3% (Based on 1984 Traffic Volumes and Ramp Counts)

Av = 2.35 Axle/Veh G_R = 2.2 Gal/Axle

Q_R = (2.0) x (24,000 veh) x (0.033) x (2.35 Axle/Veh) x (2.2 Gal/Axle) =
8,189.3 Gal/Day
(8,200 Gal/Day)

DUNNIGAN ROADSIDE REST

	1984 ADT								
	AADT	Pk Mo ADT	% Trucks	Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Dunnigan NB	8950	9950	22.9	2050	238	86	31	1695	6900

	Vehicles	Axles/Veh	Axles
Passenger Cars -	6,900	2	13,800
2 Axle Trucks	238	2	476
3 Axle Trucks	86	3	172
4 Axle Trucks	31	4	124
5 Axle Trucks	1,695	5	8,475
Total	8,950	-	23,047

$$Av = \frac{23{,}047}{8{,}950} = 2.58 \text{ Ax/Ve}$$

Rest Room Waste Water Flow Rate: (Q_R Gal/Day)

$Q_R = R_R \times ADT \times S_R/100 \times Av \times G_R$

R_R = 2.0 (See App. C) ADT: 8,950

S_R = 13.4% (Based on 1984 Ramp Counts)

Av = 2.58 Axle/Veh G_R = 2.2 Gal/Axle (Table 13) or

Q_R = (2.0) x (8950) x (13.4/100) x (2.58) x (2.2) = 13,614 Gal/Day

Dunnigan SB:

S_R: 14.5%

Q_R = (2.0)(8950)(14.5/100) x (2.58) x (2.2) = 14,732 Gal/Day

TURLOCK ROADSIDE REST

	1984 ADT								
	AADT	Pk Mo ADT	% Trucks	Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Turlock NB:	11,000	13,250	18.8	2068	320	190	62	1496	8932

	Vehicles	Axles/Veh	Axles
Passenger Cars -	8,932	2	17,864
2 Axle Trucks	320	2	640
3 Axle Trucks	190	3	570
4 Axle Trucks	62	4	248
5 Axle Trucks	1,496	5	7,480
Total	11,000	-	26,802

$$Av = \frac{26,802}{11,000} = 2.44 \text{ Ax/Ve}$$

Rest Room Waste Water Flow Rate: (Q_R Gal/Day)

Q_R = R_R (Reliability Factor) x ADT (1984 AADT) x S_R/100 (Stopping Factor/100) x Av (Axles/Veh) x G_R (Gal/Axle)

Q_R = 2.0 (See Appendix C) ADT = 11,000 Veh

S_R = 14.6% (Based on 1982 Traffic Volumes and Ramp Counts)

Av = 2.44 Axle/Veh G_R = 2.2 Gals/Axle

Q_R = (2.0) x (11,000 Veh) x (0.146) x (2.44 Axle/Veh) x (2.2 Gal/Axle) = 17,242 Gal/Day (17,250)

Turlock SB

R_R = 2.0   ADT = 11,000 Veh   Av = 2.44 Veh/Axle G_R = 2.2 Gal/Axle
S_R = 15.0% (Based on 1982 Traffic Volumes and Ramp Counts)
Q_R = (2.0) x (11,000 Veh) x (0.150) x (2.44 Veh/Axle) x (2.2 Gal/Axle) = 17,714 Gal/Day (17,700)

GOLD RUN ROADSIDE REST

	AADT	Pk Mo ADT	% Trucks	1984 ADT Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Gold Run EB:	9900	13,500	14.3	1416	371	55	55	935	8484

	Vehicles	Axles/Veh	Axles
Passenger Cars -	8,484	2	16,968
2 Axle Trucks	371	2	742
3 Axle Trucks	55	3	165
4 Axle Trucks	55	4	220
5 Axle Trucks	935	5	4,675
Total	9,900	-	22,770

$Av = \frac{22,770}{9900} = 2.3$ Ax/Ve

Rest Room Waste Water Flow Rate: (Q_R Gal/Day)

Q_R = R_R (Reliability Factor) x ADT (1984 AADT) x S_R/100 (Stoppage Factor/100) x Av (Average Axle/Veh) x G_R (Avg Gal/Axle)

R_R = 2.0 (See Appendix C)   ADT = 9900

S_R = 20% (Based on 1983 Traffic Volumes and Ramp Counts)

Av = 2.3 Axle/Veh G_R = 2.2 Gal/Axle (Table 13)

Q_R = (2.0) x (9900 Veh) x (0.20) x (2.3 Axle/Veh) x (2.2 Gal/Axle) = 20,038 Gal/Day (20,000 Gal/Day)

Gold Run WB

R_R = 2.0 (See Appendix A)   ADT = 9900
Av = 2.3 Axle/Veh G_R = 2.2 Gal/Axle (See Table 13)
S_R = 14.0% (Based on 1983 Traffic Volumes and Ramp Counts)
Q_R = (2.0) x (9900 Veh) x (0.140) x (2.3 Axle/Veh) x (2.2 Gal/Axle) = 14,026 Gal/Day (14,000)

ESTIMATED METHOD A - PEAK SEWAGE FLOW RATE:

	1984 ADT							
	Pk Mo ADT	% Trucks	Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Coalinga Avenal WB:	10,700	32.9	3520	430	116	116	2858	7180

	Vehicles	Axles/Veh	Axles
Passenger Cars -	7,180	2	14,360
2 Axle Trucks	430	2	860
3 Axle Trucks	116	3	348
4 Axle Trucks	116	4	464
5 Axle Trucks	2,858	5	14,290
Total	10,700	-	30,322

$$Av = \frac{30,322}{10,700} = 2.8 \quad Ax/Ve$$

Avg. No. Axle/Veh = 2.8

Rest Room Flow Rate: (Q_R Gal/Day)

Q_R = (2.0) (10,700) x (19.4/100) x (2.8) x (2.2) = 25,574 Gals/Day
(25,575)

Coalinga Avenal (SB):

Q_R = (2.0) (10,700) x (0.196) x (2.8) (12.2) = 25,837 Gals/Day
(25,850)

John Chuck Erreca (NB):

	1984 ADT							
	Pk Mo ADT	% Trucks	Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
	11,450	28	3206	481	160	160	2405	8244

ESTIMATED METHOD A - PEAK SEWAGE FLOW RATE: (Continued)

	Vehicles	Axles/Veh	Axles
Passenger Cars -	8,244	2	16,488
2 Axle Trucks	481	2	962
3 Axle Trucks	160	3	480
4 Axle Trucks	160	4	640
5 Axle Trucks	2,405	5	12,025
Total	11,450	-	30,595

$$Av = \frac{30,595}{11,450} = 2.7$$

Q_R = (2.0) x (11,450) x (0.28) x (2.7) x (2.2) = 38,087 Gal/Day (38,100)

JOHN "CHUCK" ERRECA (SB):

Q_R = (2.0) (11450) (.22) (2.7) (2.2) = 29,926 Gal/Day
(29,925)

	1984 ADT							
	Pk Mo ADT	% Trucks	Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Westley NB:	10,450	24	2508	416	178	116	1798	7942

	Vehicles	Axles/Veh	Axles
Passenger Cars -	7,942	2	15,884
2 Axle Trucks	416	2	832
3 Axle Trucks	178	3	534
4 Axle Trucks	116	4	464
5 Axle Trucks	1,798	5	8,990
Total	10,450	-	26,704

$$Av = \frac{26,704}{10,450} = 2.56 \text{ Ax/Ve}$$

Q_R = (2.0) x (10,450) x (0.144) x (2.56) x (2.2)
Q_R = 16,950 Gals/Day
(16,950)

Westley SB:

Q_R = (2.0) x (10,450) x (0.176) x (2.55) x (2.2) = 20,636 Gal/Day
(20,650)

ELKHORN ROADSIDE REST:

	1984 ADT Pk Mo ADT	% Trucks	Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Elkhorn:	27,500	16.0	4400	902	418	154	2926	23100

	Vehicles	Axles/Veh	Axles
Passenger Cars -	23,100	2	46,200
2 Axle Trucks	902	2	1,804
3 Axle Trucks	418	3	1,254
4 Axle Trucks	154	4	616
5 Axle Trucks	2,926	5	14,630
Total	27,500	-	64,504

$$Av = \frac{64,504}{27,500} = 2.35 \text{ Ax/Ve}$$

$$Q_R = (2.0) \times (27,500) \times (0.033) \times (2.35) \times (2.2) = 9,383.55 \text{ Gal/Day}$$

(9,400)

TURLOCK ROADSIDE REST (NB):

	1984 ADT							
	Pk Mo ADT	% Trucks	Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Turlock:	13,250	18.8	2491	386	230	75	1800	10759

	Vehicles	Axles/Veh	Axles
Passenger Cars -	10,759	2	21,518
2 Axle Trucks	386	2	772
3 Axle Trucks	230	3	690
4 Axle Trucks	75	4	300
5 Axle Trucks	1,800	5	9,000
Total	13,250	-	32,280

$$Av = \frac{32,280}{13,250} = 2.44 \text{ Ax/Ve}$$

Q_R = (2.0) x (13,250) x (0.146) x (2.44) x (2.2) = 20,769 Gal/Day
(20,775)

Turlock (SB):

Q_R = (2.0) x (13,250) x (0.15) x (2.44) (2.2) = 21,338 Gal/Day
(21,350)

GOLD RUN (EB):

	1984 ADT Pk Mo ADT	% Trucks	Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
~~Turlock:~~	13,500	14.3	1930	506	75	75	1274	11570

	Vehicles	Axles/Veh	Axles
Passenger Cars -	11,570	2	23,140
2 Axle Trucks	506	2	1,012
3 Axle Trucks	75	3	225
4 Axle Trucks	75	4	300
5 Axle Trucks	1,274	5	6,370
Total	13,500	-	31,047

$$Av = \frac{31,047}{13,500} = 2.3 \text{ Ax/Ve}$$

Q_R = (2.0) x (13,500) x (0.20) x (2.3) x (2.2) = 27,324 Gal/Day (27,325)

Gold Run (WB):

Q_R = (2.0) x (13,500) x (0.14) x (2.3) (2.2) = 19,127 Gal/Day (19,130)

JOHN "CHUCK" ERRECA (PANOCHE) ROADSIDE REST:

Using the measured value of 0.22 gal/axle for the microphor toilets at the Panoche SRRA. (Taken from Bill Grotkau's report).

Pk. Mo. ADT: 11,450 Stopping Factor: 28% Gal/Axle: 0.22
Reliability Factor: 2.0 Avg. Axles/Veh: 2.8

NB:

Q_R = (2.0) x (11,450) x (.28) x (2.8) x (0.22) = 3,950 Gal/Day

SB:

Q_R = (2.0) x (11,450) x (.22) x (2.8) x (0.26) = 3, 668 Gal/Day

PEAK DETENTION TIME:

NB: Tank capacity: 24,000 Gal. DT: $\frac{\text{24,000 Gal}}{\text{3950 Gal/Day}}$ = 6.1 Day
Pk. Est. Flow Rate: 3,950

SB: Tank Capacity: 24,000 Gal. DT: $\frac{\text{24,000 Gal}}{\text{3668 Gal/Day}}$ = 6.5 Day
Pk. Est. Flow Rate: 3,668

JOHN "CHUCK" ERRECA (PANOCHE) ROADSIDE REST:

				1984 ADT					
	AADT	Pk Mo ADT	% Trucks	Total No Trucks	2 Axle Trucks	3 Axle Trucks	4 Axle Trucks	5 Axle Trucks	Cars
Panoche NB:	7750	11,450	28	2170	326	108	108	1628	5580

	Vehicles	Axles/Veh	Axles
Passenger Cars -	5,580	2	11,160
2 Axle Trucks	326	2	652
3 Axle Trucks	108	3	324
4 Axle Trucks	108	4	432
5 Axle Trucks	1,628	5	8,140
Total	7,750	-	20,708

$$Av = \frac{\text{ADT AXLE COUNT}}{\text{AADT}} = \frac{20,708}{7750} = 2.67 \text{ Axle/Vehicle}$$

Rest Room Flow Rate (Q_R: Gal/Day) *See Pg. 45

$Q_R = R_R \times ADT \times S_R/100 \times Av \times G_R$

R_R = 2.0 (Reliability Factor; Appendix C)

S_R = 28% (Stopping Factor, Based on 1980 Ramp Counts)

Av = 2.67 Axles/Vehicles

G_R = 2.2 Gal/Axle (mean rest room waste water volume, Table 13)

ADT = 7750

Q_R = 2.0 x 7750 Veh/Day x 28/100 x 2.67 Axle/Veh. x 2.2 Gal/Axle

Q_R = 25,493 Gal/Day

Try using G_R = 0.22 Gal/Axle (measured value for NB Panoche)

Q_R = 2.0 x 7750 x 28/100 x 2.67 x 0.22 = 2,549 Gal/Day

AVERAGE DETENTION TIME

$$DT: = \frac{\text{Capacity of Tank}}{\text{Flow Volume}} = \frac{\text{Volume Units}}{\text{Volume/Time}}$$

COALINGA-AVENAL: NB

Tank Capacity: 16,000 Gal.

Average Est. Flow Rate: 18,200 Gal/Day

$$DT = \frac{16{,}000 \text{ Gal}}{18{,}200 \text{ Gal/Day}} = 0.88 \text{ Day}$$

COALINGA-AVENAL: SB

Tank Capacity: 16,000 Gal.

Average Est. Flow Rate: 18,350 Gal/Day

$$DT = \frac{16{,}000 \text{ Gal.}}{18{,}350 \text{ Gal/Day}} = 0.87 \text{ Day}$$

JOHN "CHUCK" ERRECA: NB

Tank Capacity: 24,000 Gal.

Average Est. Flow Rate: 25,500 Gal/Day

$$DT = \frac{24{,}000 \text{ Gal}}{25{,}500 \text{ Gal/Day}} = 0.94 \text{ Day}$$

AVERAGE DETENTION TIME

JOHN "CHUCK" ERRECA: SB

Tank Capacity: 24,000 Gal

Average Est. Flow Rate: 20,030 Gal/Day

$$DT = \frac{24,000 \text{ Day}}{20,030 \text{ Gal/Day}} = \underline{1.2 \text{ Day}}$$

WESTLEY NB: (Comfort Station)

Tank Capacity: 15,000 Gal.

Average Est. Flow Rate: 13,400 Gal/Day

$$DT = \frac{15,000 \text{ Gal}}{13,400 \text{ Gal/Day}} = \underline{1.1 \text{ Day}}$$

WESTLEY SB: (Comfort Station)

Tank Capacity: 15,000 Gal

Average Est. Flow Rate: 16,360 Gal/Day

$$DT = \frac{15,000 \text{ Gal}}{16,360 \text{ Gal/Day}} = \underline{0.92 \text{ Day}}$$

ELKHORN:

Tank Capacity: 10,500 Gal.

Average Est. Flow Rate: 8,200 Gal/Day

$$DT = \frac{10,500 \text{ Gal}}{8200 \text{ Gal/Day}} = \underline{1.3 \text{ Day}}$$

TURLOCK NB:

Tank Capacity: 15,000 Gal
Average Est. Flow Rate: 17,250 Gal/Day

$$DT = \frac{15{,}000\ \text{Gal}}{17{,}250\ \text{Gal/Day}} = \underline{0.87\ \text{Day}}$$

TURLOCK SB:

Tank Capacity: 15,000 Gal
Average Est. Flow Rate: 17,700 Gal/Day

$$DT = \frac{15{,}000\ \text{Gal}}{17{,}700\ \text{Gal/Day}} = \underline{0.85\ \text{Day}}$$

GOLD RUN EB:

Tank Capacity: 21,300 Gal
Average Estimated Flow Rate: 20,000 Gal/Day

$$DT = \frac{21{,}300}{20{,}000} = \underline{1.1\ \text{Day}}$$

GOLD RUN WB:

Tank Capacity: 21,300 Gal.
Average Estimated Flow Rate: 14,000 Gal/Day

$$DT = \frac{21{,}300\ \text{Gal}}{14{,}000\ \text{Gal/Day}} = \underline{1.52\ \text{Day}}$$

PEAK DETENTION TIME CALCULATIONS:

$$DT = \frac{\text{Capacity of Tank}}{\text{Flow Volume}} \quad \frac{\text{(Volume)}}{\text{(Vol/Day)}}$$

COALINGA-AVENAL NB:

$$DT = \frac{16{,}000 \text{ Gal}}{25{,}575 \text{ Gal/Day}} = 0.63 \text{ Day}$$

Tank Capacity: 16,000 Gal

Pk. Est. Flow Rate: 25,575

COALINGA-AVENAL SB:

$$DT = \frac{16{,}000 \text{ Gal}}{25{,}850 \text{ Gal/Day}} = 0.62 \text{ Day}$$

Tank Capacity: 16,000 Gal

Pk. Est. Flow Rate: 25,850

JOHN "CHUCK" ERRECA NB:

$$DT = \frac{24{,}000 \text{ Gal}}{38{,}100 \text{ Gal/Day}} = 0.63 \text{ Day}$$

Tank Capacity: 24,000 Gal

Pk. Est. Flow Rate: 38,100

JOHN "CHUCK" ERRECA SB:

$$DT = \frac{24{,}000 \text{ Gal}}{29{,}925 \text{ Gal/Day}} = 0.80 \text{ Day}$$

Tank Capacity: 24,000

Pk. Est. Flow Rate: 29,925

WESTLEY SB:

$$DT = \frac{15{,}000}{20{,}650 \text{ Gal/Day}} = 0.73 \text{ Day}$$

Tank Capacity: 15,000 Gal

Pk. Est. Flow Rate: 20,650

WESTLEY NB:

$$DT = \frac{15{,}000 \text{ Gal}}{16{,}950 \text{ Gal/Day}} = 0.88 \text{ Day}$$

Tank Capacity: 15,000 Gal

Pk. Est. Flow Rate: 16,950 Gal/Day

PEAK DETENTION TIME CALCULATIONS: (Continued)

ELKHORN:

Tank Capacity: 10,500 Gal
Pk. Est. Flow Rate: 9,400 Gal/Day

$$DT = \frac{10,500}{9,400} = 1.1 \text{ Day}$$

TURLOCK NB:

Tank Capacity: 15,000 Gal
Pk. Est. Flow Rate: 20,775 Gal/Day

$$DT = \frac{15,000}{20,775} = 0.72 \text{ Day}$$

TURLOCK SB:

Tank Capacity: 15,000 Gal
Pk. Est. Flow Rate: 21,350 Gal/Day

$$DT = \frac{15,000}{21,350} = 0.70 \text{ Day}$$

GOLD RUN EB:

Tank Capacity: 21,300 Gal
Pk. Est. Flow Rate: 27,325 Gal/Day

$$DT = \frac{21,300}{27,325} = 0.78 \text{ Day}$$

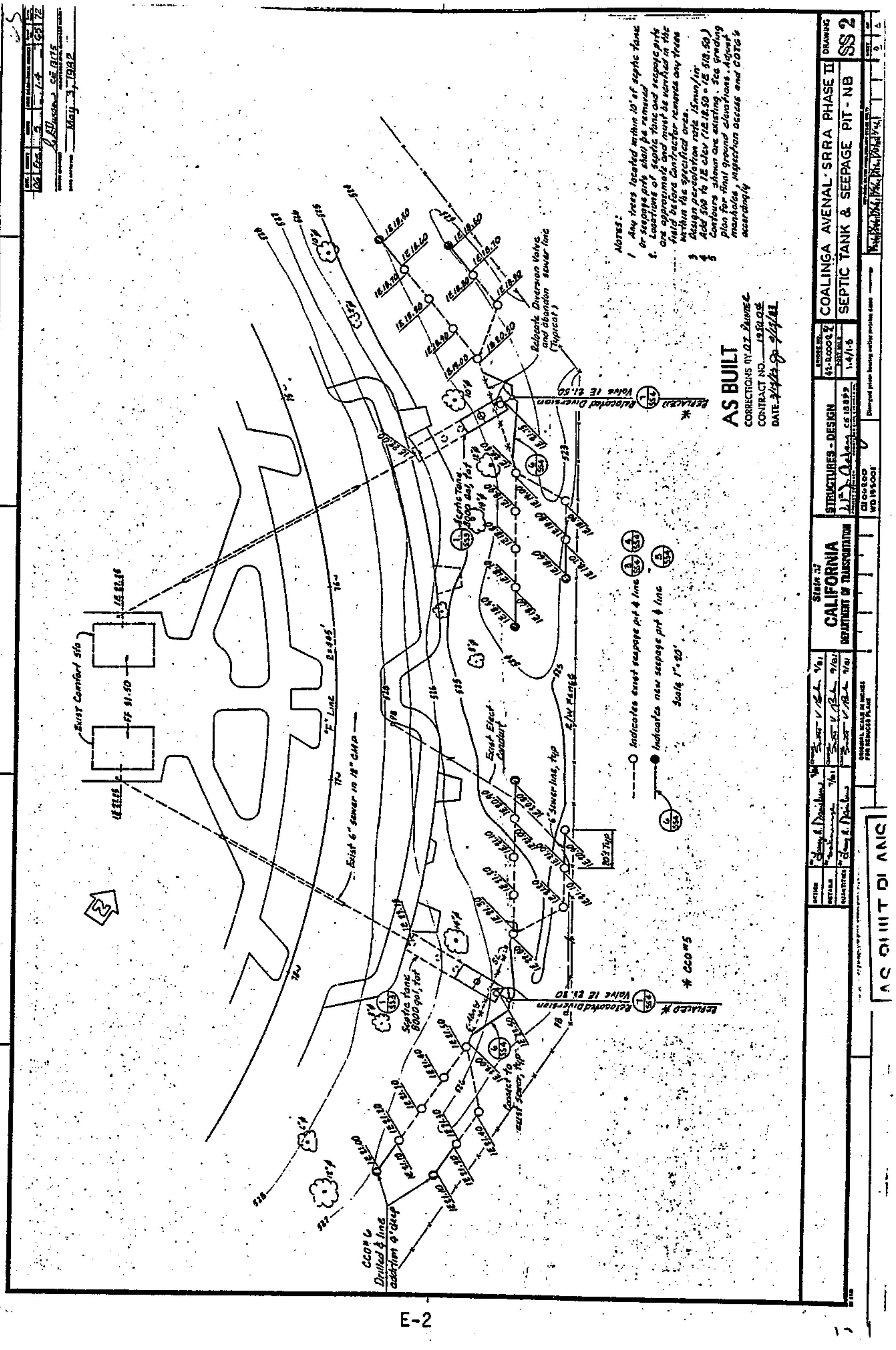
GOLD RUN WB:

Tank Capacity: 21,300 Gal
Pk. Est. Flow Rate: 19,130 Gal/Day

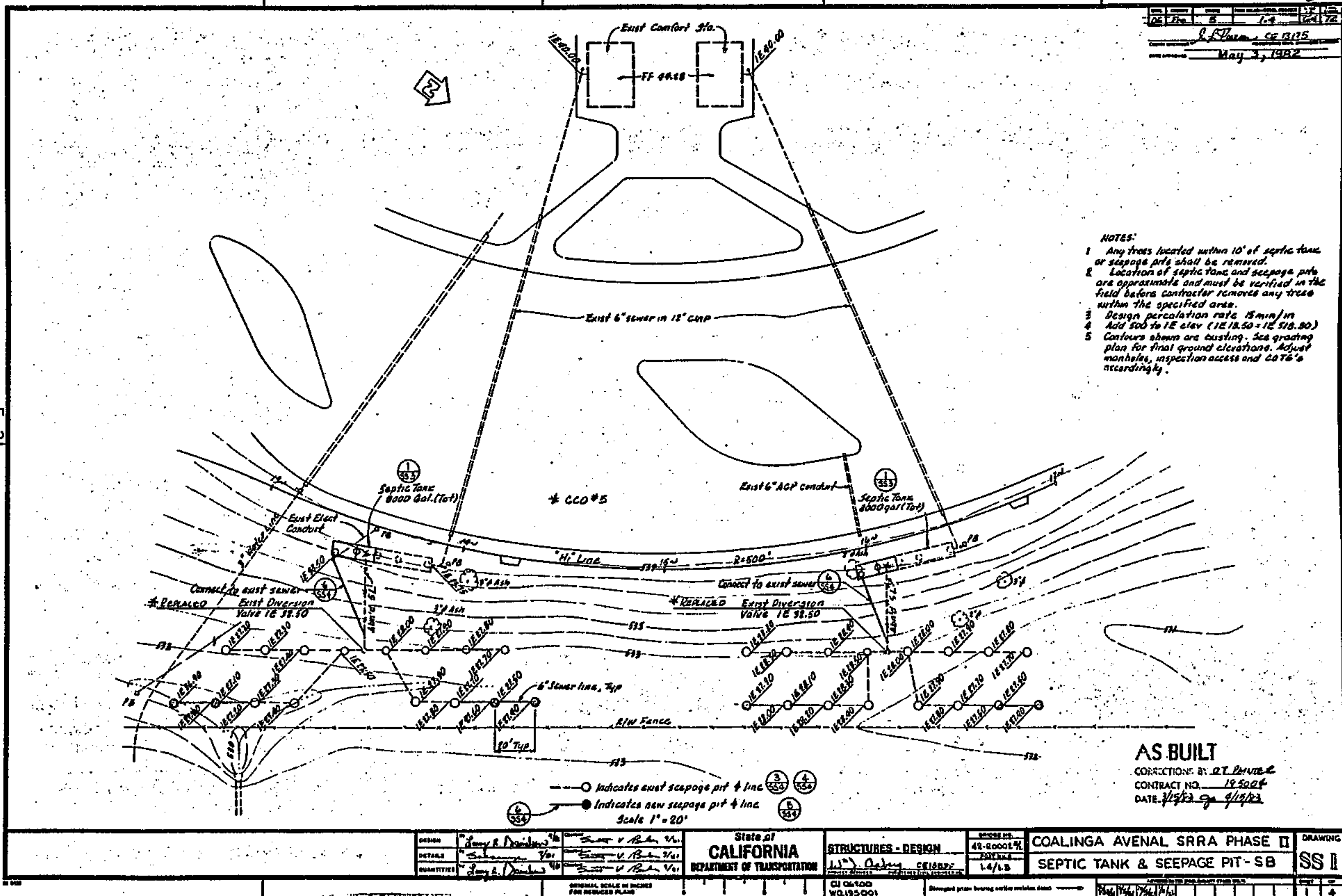
$$DT = \frac{21,300 \text{ Gal}}{19,130 \text{ Gal/Day}} = 1.1 \text{ Day}$$

APPENDIX E

SEWAGE DISPOSAL
SYSTEMS PLANS OF SRRAS

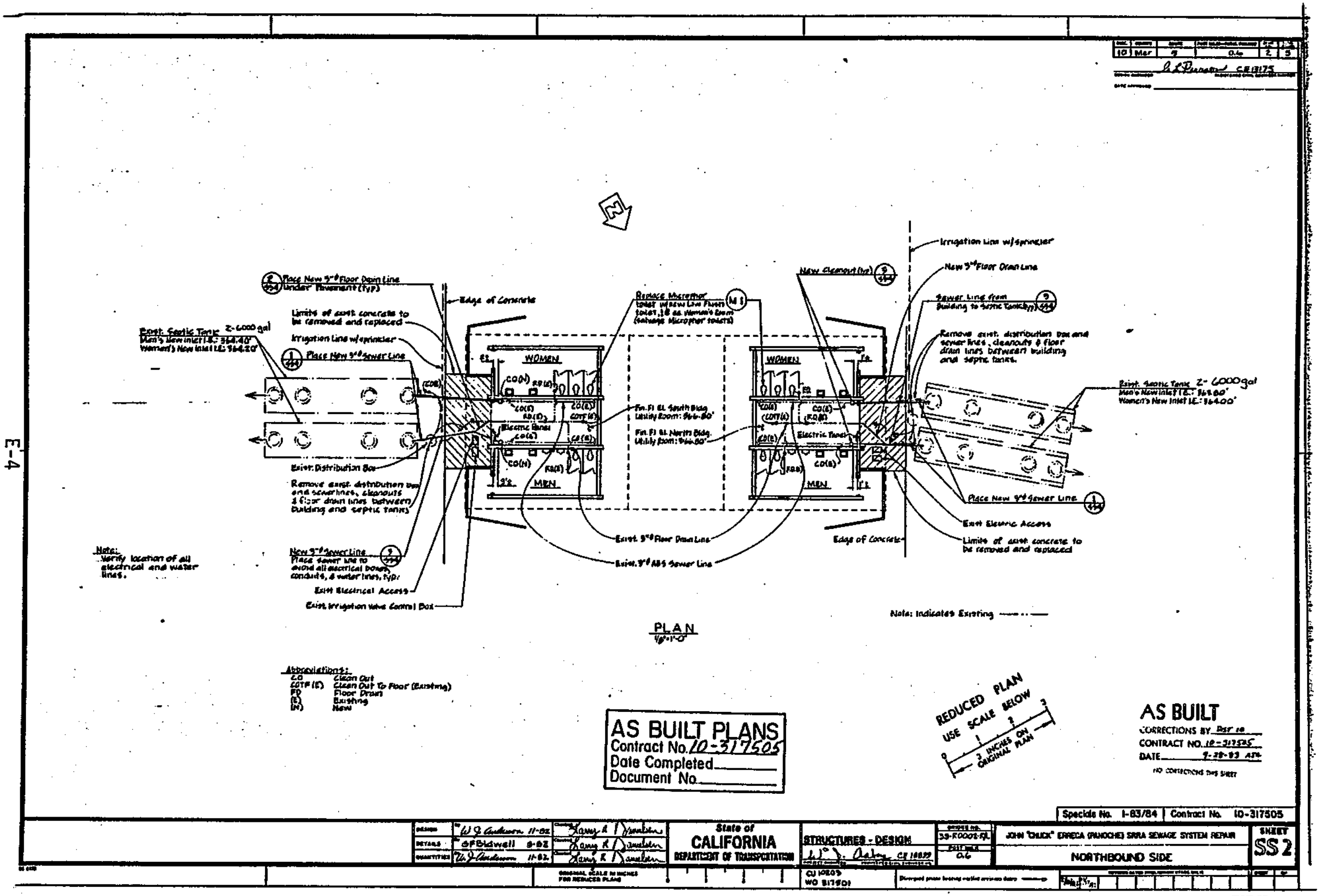

COALINGA AVENAL SRRA PHASE II
SEPTIC TANK & SEEPAGE PIT - NB
SS 2
State of CALIFORNIA
DEPARTMENT OF TRANSPORTATION
STRUCTURES - DESIGN
AS BUILT
CORRECTIONS BY D.T. Palmer
Notes:
1 Any trees located within 10' of septic tank or seepage pits shall be removed
2 Locations of septic tank and seepage pits are approximate and must be verified in the field before Contractor removes any trees within the specified area.
3 Design percolation rate 15 min/in
4 Add 500 to IE elev (IE 18.50 = IE 518.50)
5 Contours shown are existing. See grading plan for final ground elevations. Adjust manholes, injection access and COTG's accordingly
Indicates exist seepage pit & line
Indicates new seepage pit & line
Scale 1"=20'
Exist Comfort Sta
FF 91.50
"E" Line
Exist 6" sewer in 18" CMP
Exist Elect Conduit
6" Sewer line, typ
R/W Fence
Septic Tank 8000 gal, Tot
Relocated Diversion Valve
Relocate Diversion Valve and abandon sewer line (Typical)
Connect to exist sewer, typ
CCO#6 Drilled & line addition 4' deep
CCO#5

E-2

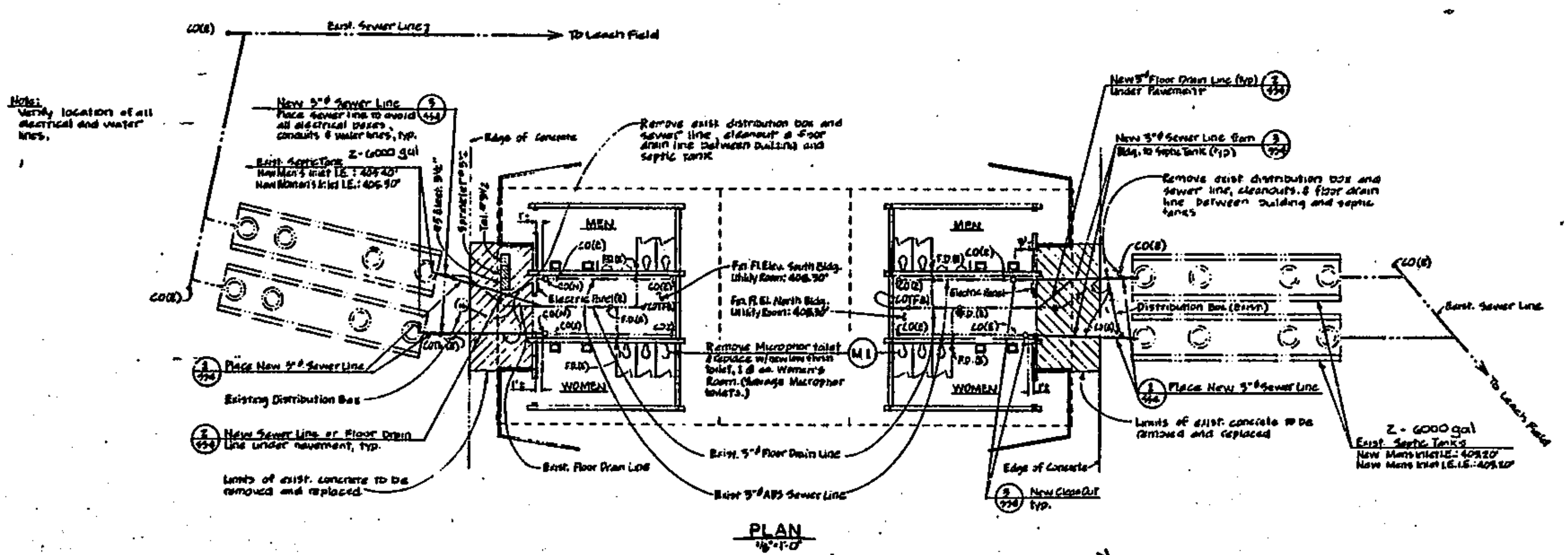


AS BUILT PLANS

E-4



Exist. Septic Tank 2-6000 gal
Men's New Inlet I.E.: 364.40'
Women's New Inlet I.E.: 364.20'
Place New 9"Ø Floor Drain Line Under Pavement (Typ)
Limits of exist. concrete to be removed and replaced
Irrigation Line w/sprinkler
Place New 9"Ø Sewer Line
Edge of Concrete
Exist. Distribution Box
Remove exist. distribution box and sewer lines, cleanouts & floor drain lines between building and septic tanks
New 9"Ø Sewer Line
Place sewer line to avoid all electrical boxes, conduits, & water lines, typ.
Exist Electrical Access
Exist. Irrigation Valve Control Box
Note:
Verify location of all electrical and water lines.
WOMEN
MEN
Electric Panel
Replace Microphor toilet w/new Low Flush toilet, 18 ea. Women's Room (Salvage Microphor toilets)
Fin. Fl. El. South Bldg. Utility Room: 366.80'
Fin. Fl. El. North Bldg. Utility Room: 366.80'
Exist. 9"Ø Floor Drain Line
Exist. 9"Ø ABS Sewer Line
New Cleanout (typ)
Irrigation Line w/sprinkler
New 9"Ø Floor Drain Line
Sewer Line from Building to Septic Tank (typ)
Remove exist. distribution box and sewer lines, cleanouts & floor drain lines between building and septic tanks.
Exist. Septic Tank 2-6000 gal
Men's New Inlet I.E.: 364.60'
Women's New Inlet I.E.: 364.00'
Place New 9"Ø Sewer Line
Exist Electric Access
Limits of exist concrete to be removed and replaced
Edge of Concrete
Note: Indicates Existing
PLAN
1/8"=1'-0"
Abbreviations:
CO Clean Out
COTF (E) Clean Out To Floor (Existing)
FD Floor Drain
(E) Existing
(N) New
AS BUILT PLANS
Contract No. 10-317505
Date Completed
Document No.
REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN
AS BUILT
CORRECTIONS BY Dist 10
CONTRACT NO. 10-317505
DATE 9-28-93
NO CORRECTIONS THIS SHEET
Specials No. 1-83/84
Contract No. 10-317505
DESIGN W J Anderson 11-82
DETAILS G F Bidwell 9-82
QUANTITIES W J Anderson 11-82
State of CALIFORNIA
DEPARTMENT OF TRANSPORTATION
STRUCTURES - DESIGN
CE 18839
39-R0002-RL
0.6
JOHN "CHUCK" ERRECA (PANOCHE) SRRA SEWAGE SYSTEM REPAIR
NORTHBOUND SIDE
SHEET SS2
CU 10203
WO 317501
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS
10 Mer
0.6
2 5
CE 18175



Note: Indicates Exist.

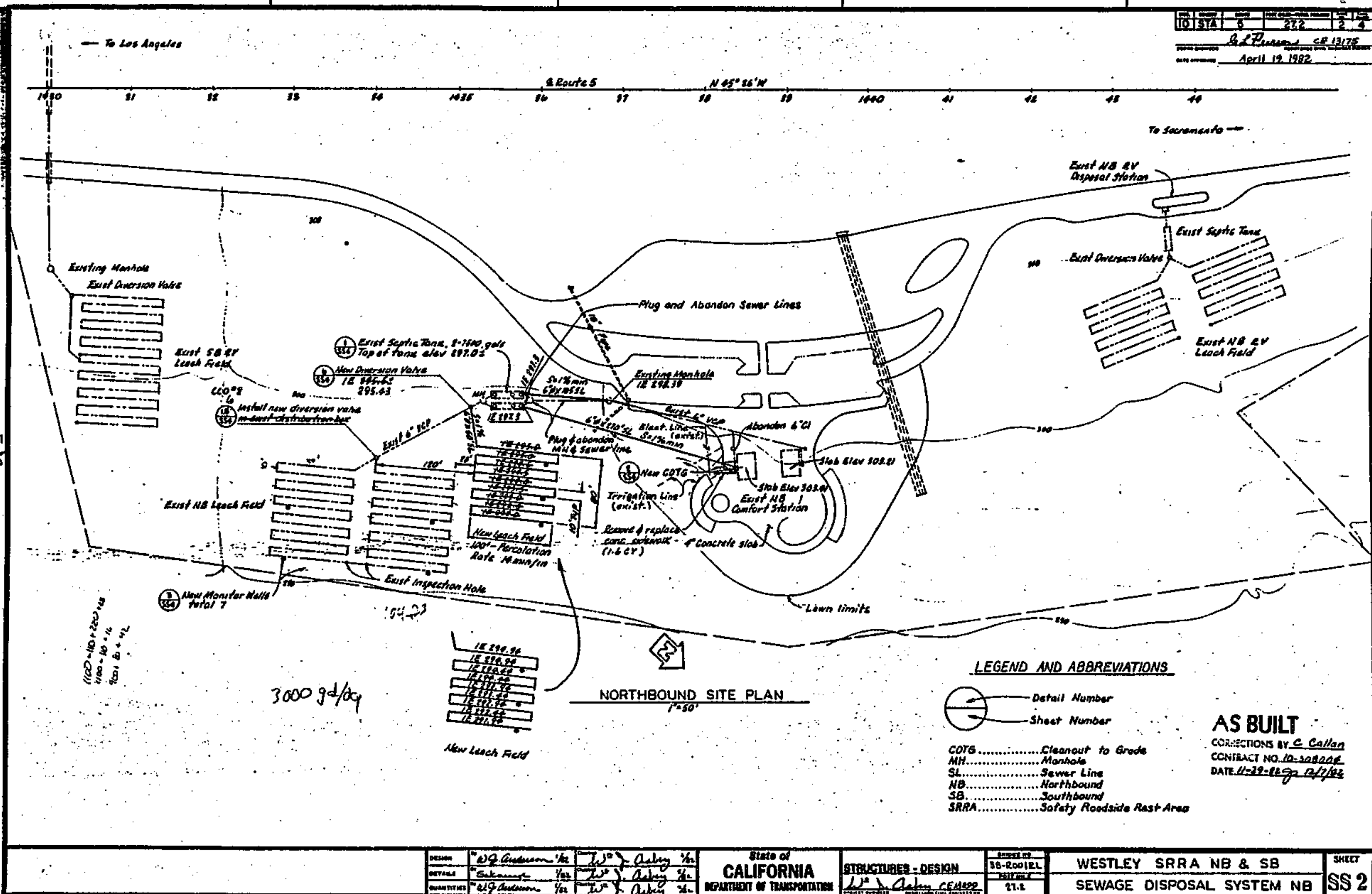
AS BUILT PLANS
Contract No. 10-317505
Date Completed________
Document No.________

REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

AS BUILT
CORRECTIONS BY DIST 10
CONTRACT NO. 10-317505
DATE 9-28-83 ATC
NO CORRECTIONS THIS SHEET

DESIGN	W.J. Anderson 11-82		State of CALIFORNIA DEPARTMENT OF TRANSPORTATION	STRUCTURES - DESIGN		JOHN "CHUCK" ERREECA (PANOCHE) SRRA SEWAGE SYSTEM REPAIR	SHEET SS3
DETAILS	G.F. Bidwell 8-82				0.1	SOUTHBOUND SIDE	
QUANTITIES	W.J. Anderson 11-82						

Specials No. 1-83/84 | Contract No. 10-317505



LEGEND AND ABBREVIATIONS

Detail Number
Sheet Number

COTG............Cleanout to Grade
MH..............Manhole
SL..............Sewer Line
NB..............Northbound
SB..............Southbound
SRRA............Safety Roadside Rest Area

NORTHBOUND SITE PLAN

1"=50'

AS BUILT
CORRECTIONS BY C. Callan
CONTRACT NO. 10-308004
DATE 11-29-82

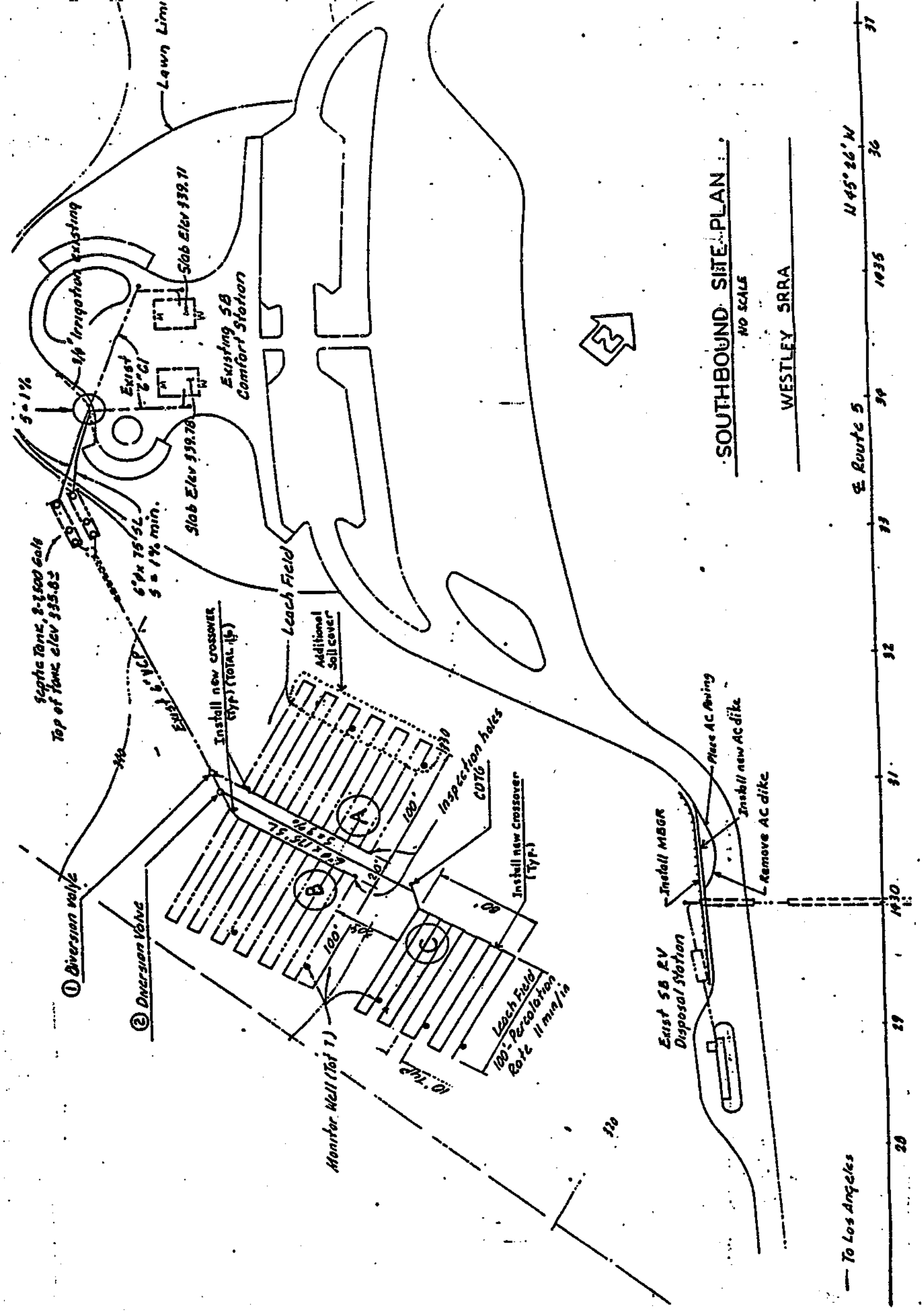
April 19, 1982

State of CALIFORNIA
DEPARTMENT OF TRANSPORTATION
STRUCTURES - DESIGN

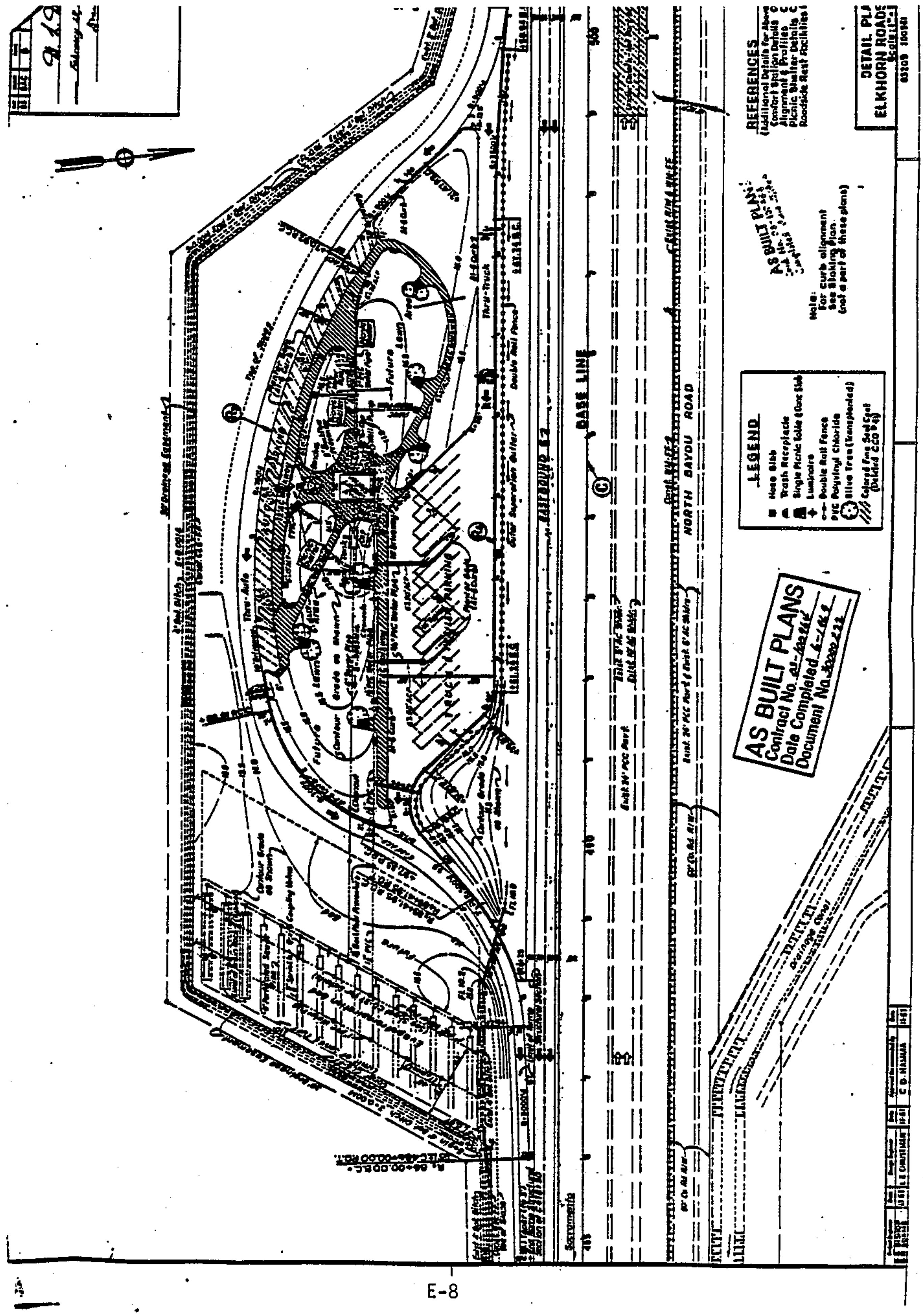
WESTLEY SRRA NB & SB
SEWAGE DISPOSAL SYSTEM NB

SHEET SS 2

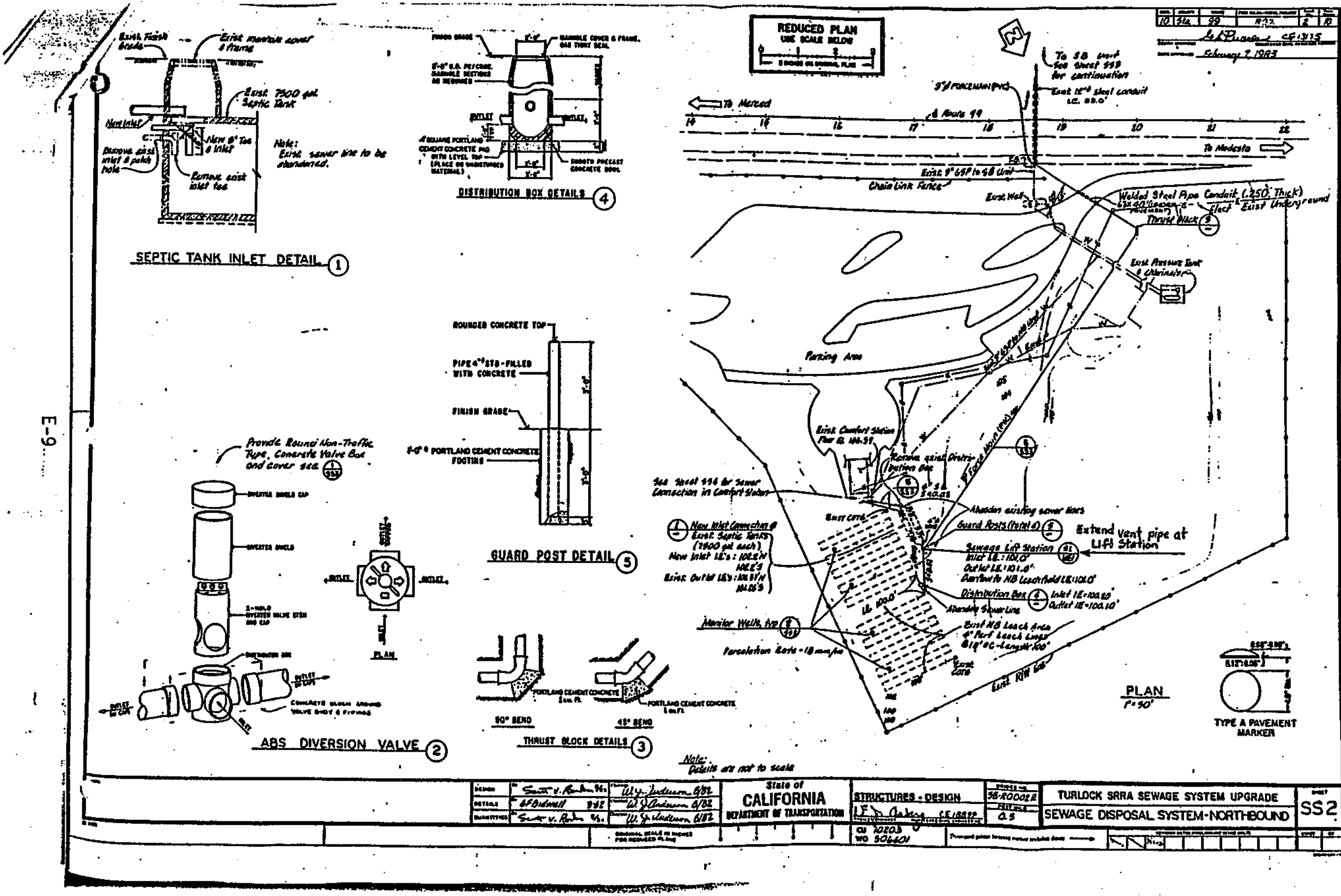
AS BUILT PLANS

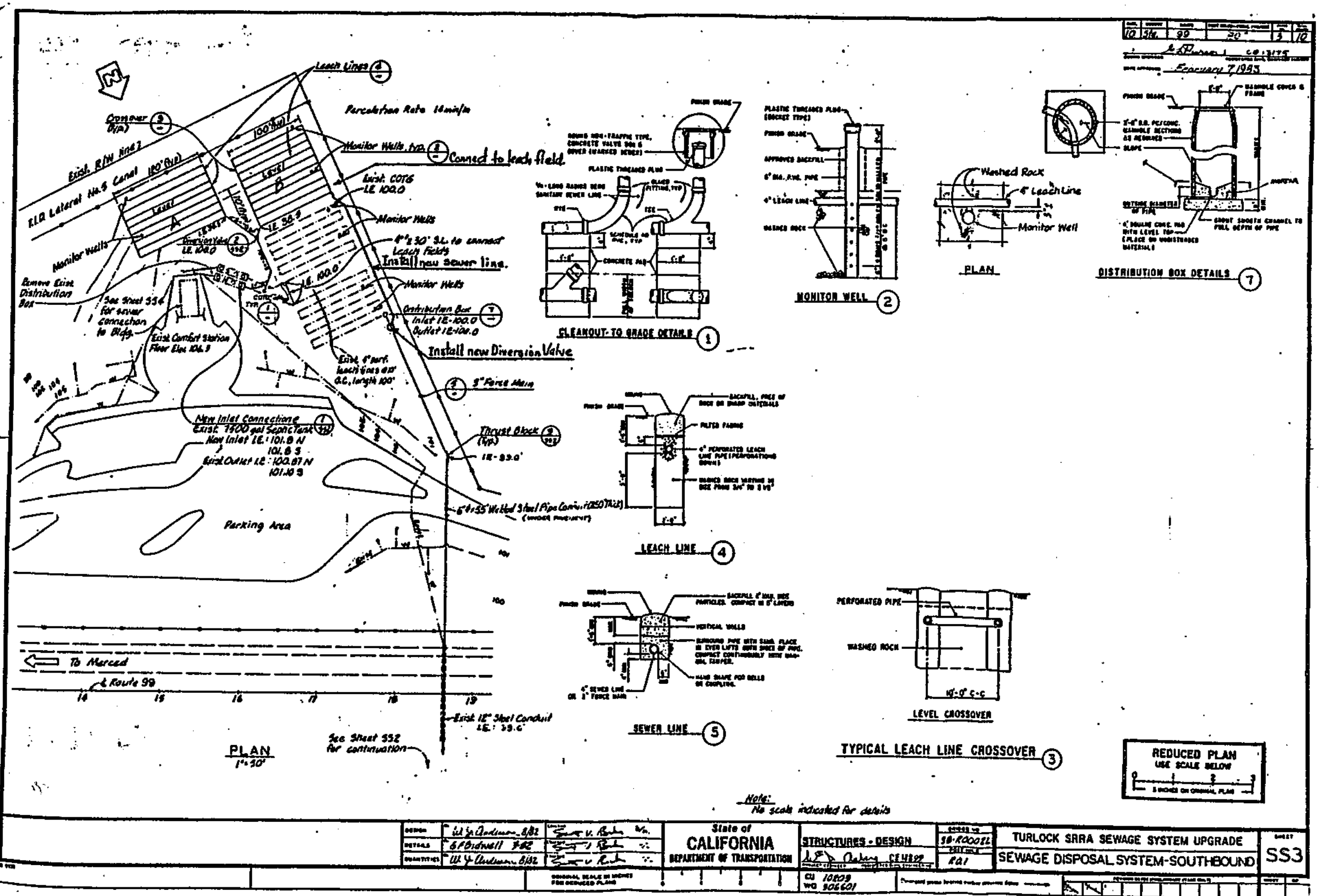


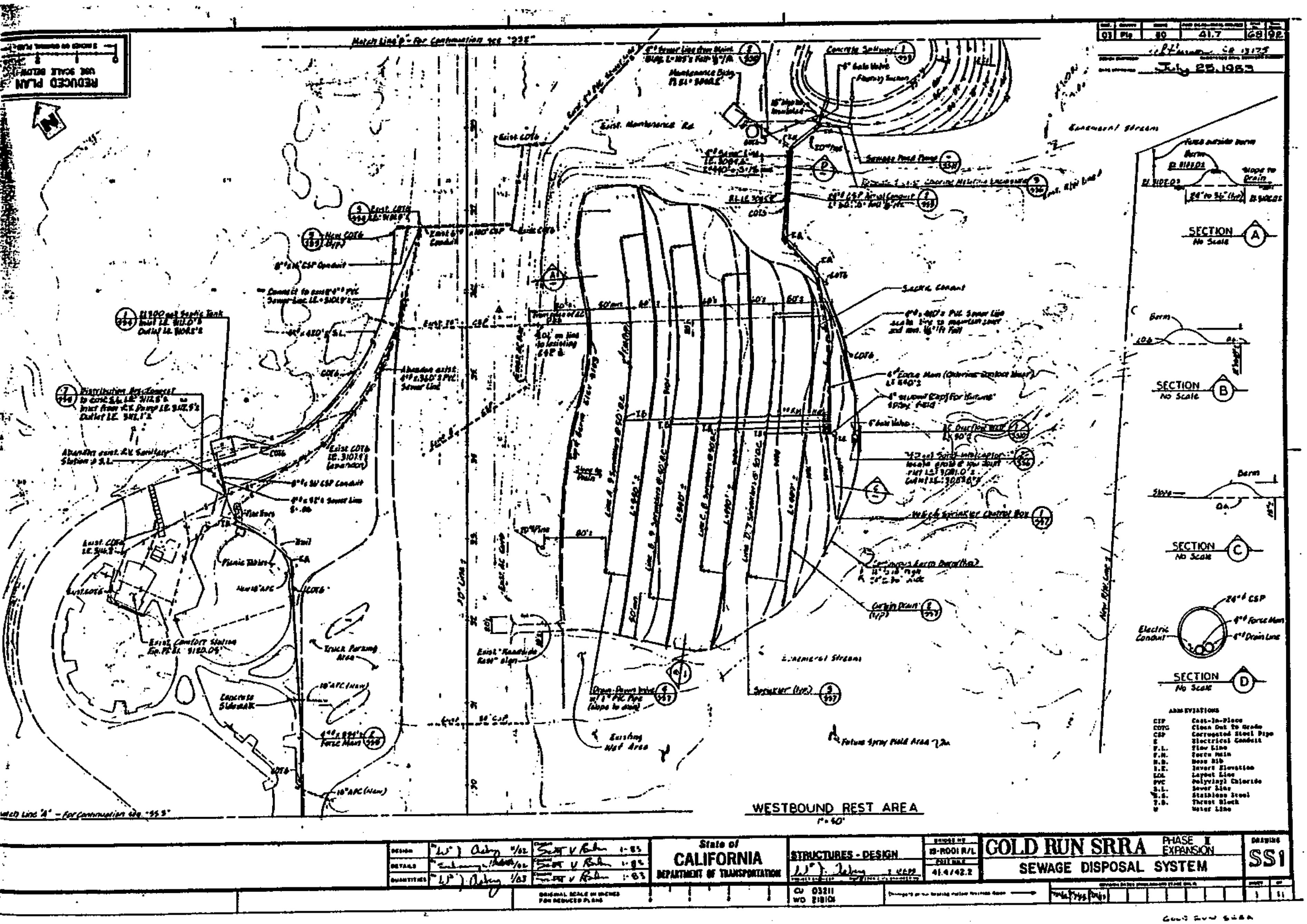
SOUTHBOUND SITE PLAN
NO SCALE
WESTLEY SRRA
N 45° 26' W
℄ Route 5
To Los Angeles
Lawn Limit
3/4" Irrigation existing
Slab Elev 339.71
Existing SB Comfort Station
Exist 2" CI
S = 1%
Slab Elev 339.78
6" ⌀ x 75' SL
S = 1% min.
Septic Tank, 2-2,500 Gals
Top of Tank elev 335.82
Leach Field
Exist 6" VCP
Install new crossover (typ) (TOTAL 16)
Additional Soil cover
Inspection holes
COTG
Install new crossover (Typ.)
① Diversion valve
② Diversion Valve
Monitor Well (Tot 1)
Leach Field
100' - Percolation Rate 11 min/in
Install MBGR
Place AC Paving
Install new AC dike
Remove AC dike
Exist SB RV Disposal Station



AS BUILT PLANS
LEGEND
REFERENCES
DETAIL PLA
ELKHORN ROADS
NORTH BAYOU ROAD
BASE LINE
EASTBOUND I-5
ELKHORN SRRA


REDUCED PLAN
USE SCALE BELOW
SEPTIC TANK INLET DETAIL (1)
Note:
Exist. sewer line to be abandoned.
DISTRIBUTION BOX DETAILS (4)
GUARD POST DETAIL (5)
ROUNDED CONCRETE TOP
PIPE 4" STD-FILLED WITH CONCRETE
FINISH GRADE
ABS DIVERSION VALVE (2)
PLAN
THRUST BLOCK DETAILS (3)
90° BEND
45° BEND
To Merced
To Modesto
Parking Area
Extend vent pipe at Lift Station
PLAN
TYPE A PAVEMENT MARKER
Note:
Details are not to scale
State of CALIFORNIA
DEPARTMENT OF TRANSPORTATION
STRUCTURES - DESIGN
TURLOCK SRRA SEWAGE SYSTEM UPGRADE
SEWAGE DISPOSAL SYSTEM-NORTHBOUND
SS2


Leach Lines
Percolation Rate 14min/in
Crossover
Exist. R/W line
E.I.D Lateral No.5 Canal
Monitor Wells, typ.
Connect to leach field.
Exist. COTG
IE 100.0
Monitor Wells
Level A
Level B
Diversion Valve
IE 100.0
IE 98.9
4"x 30' SL to connect Leach Fields
Install new sewer line.
Monitor Wells
Distribution Box
Inlet IE-100.0
Outlet IE-100.0
Install new Diversion Valve
Remove Exist. Distribution Box
See Sheet SS4 for sewer connection to Bldg.
Exist. Comfort Station Floor Elev. 106.3
Exist. 4" perf. leach lines @ 10' O.C., length 100'
3" Force Main
New Inlet Connections
Exist. 1500 gal Septic Tank
New Inlet IE: 101.8 N
101.8 S
Exist. Outlet IE: 100.87 N
101.10 S
Thrust Block (Typ)
IE - 83.0'
6"x.35 Welded Steel Pipe Conduit
Parking Area
To Merced
Route 99
14
15
16
17
18
19
Exist. 12" Steel Conduit
PLAN
1"=30'
See Sheet SS2 for continuation
CLEANOUT-TO GRADE DETAILS
1
MONITOR WELL
2
Washed Rock
4" Leach Line
Monitor Well
PLAN
DISTRIBUTION BOX DETAILS
7
LEACH LINE
4
SEWER LINE
5
PERFORATED PIPE
WASHED ROCK
10'-0" C-C
LEVEL CROSSOVER
TYPICAL LEACH LINE CROSSOVER
3
REDUCED PLAN
USE SCALE BELOW
Note:
No scale indicated for details
State of
CALIFORNIA
DEPARTMENT OF TRANSPORTATION
STRUCTURES - DESIGN
CU 10209
WO 306601
TURLOCK SRRA SEWAGE SYSTEM UPGRADE
SEWAGE DISPOSAL SYSTEM-SOUTHBOUND
SS3
February 7, 1985



REDUCED PLAN
USE SCALE BELOW
WESTBOUND REST AREA
1"=40'
SECTION A
No Scale
SECTION B
No Scale
SECTION C
No Scale
SECTION D
No Scale
Berm
Slope to Drain
24"φ CSP
4"φ Force Main
4"φ Drain Line
Electric Conduit
Ephemeral Stream
Future Spray Field Area
Existing Wet Area
Truck Parking Area
Concrete Sidewalk
Picnic Tables
Sewage Pond Pump
Concrete Spillway
Exist. Maintenance Rd.
Exist. Comfort Station
ABBREVIATIONS
CIP Cast-In-Place
COTG Clean Out To Grade
CSP Corrugated Steel Pipe
E Electrical Conduit
F.L. Flow Line
F.M. Force Main
R.B. Base Rib
I.E. Invert Elevation
LOL Layout Line
PVC Polyvinyl Chloride
S.L. Sewer Line
S.S. Stainless Steel
T.B. Thrust Block
W Water Line
State of CALIFORNIA
DEPARTMENT OF TRANSPORTATION
STRUCTURES - DESIGN
GOLD RUN SRRA
PHASE II EXPANSION
SEWAGE DISPOSAL SYSTEM
SS1
July 25, 1983
41.7
41.4/42.2
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