Nacimiento Lake Drive Corridor Study

Prepared for the County of San Luis Obispo
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Introduction

This study is a comprehensive corridor analysis of Nacimiento Lake Drive in San Luis Obispo County. The study was developed for the County of San Luis Obispo and developed with assistance from the Transportation Division of the Public Works Department. The findings and recommendations of this study were developed utilizing field measurements, traffic count data, traffic safety data, and Highway Capacity Manual (2000 edition) processes for determining Level of Service. This study makes recommendations for potential operational and safety improvements which address current conditions and future growth along the corridor.

The recommendations for operational and safety improvements and upgrades do not imply that existing conditions are ineffective or unsafe. Overall, the corridor was found to be operating efficiently and safely. However, opportunities do exist to improve operational and safety performance over existing levels at spot locations. Short and Mid-range improvements are identified which can improve these locations. Potential Long-range improvements are also identified to address increased traffic from future development. It is anticipated these projects would be funded through the county's development mitigation account.

Executive Summary

The Nacimiento Lake Drive Corridor Study evaluates the current operating and safety characteristics of the highway, estimates traffic volumes and patterns at Build-out, evaluates those conditions and makes recommendations for improvements. It also provides a log of various inventory items including the number and locations of turnouts, guardrail, and passing zones to name a few.

For completeness, given the 30 year time horizon set for the study, the corridor was assessed from an unconstrained perspective. That is, all potential characteristics which could have a significant effect on safety or operations over this time period were identified with recommendations for mitigation. These are listed in Table 19 entitled Unconstrained Listing of Potential Corridor Improvements (See attachment II).

For planning purposes, the county has estimated that 6 million dollars may be available for corridor improvements over the 30 year horizon. The potential funding sources vary and are designated for specific roadway improvement categories such as maintenance, operations, and in rare cases of severe situations, safety. For this reason, potential roadway improvements in the unconstrained listing must be assessed and prioritized under a constrained funding scenario. The resulting constrained listing is contained in Table 20 entitled Constrained Listing of Potential Corridor Improvements (See attachment III). These improvements are presented as the recommended strategy to maximize facility efficiency and safety within the projected funding ceiling and program categories.

The recommended improvements from the Constrained Listing (Table 20) include the following:

- Minor maintenance level spot shoulder and drainage repair.
- Roadway widening between the Paso Robles City Limits and Mustang Springs Road including turning lanes at the intersection with Mustang Springs Rd.
- Additional warning and speed related signing.
- Left turn channelization at the Adelaida Rd. intersection.
- Remove 4 non-standard passing zones and replace with "NO PASSING" zones.
- Pave 5 new Pullouts throughout the corridor.

Executive Summary Cont.

- Rural Roundabout at the Chimney Rock Rd. intersection.
- Construct 3 new 600' long turnouts and extend 1 existing turnout in Segment III.

It is recognized that as time progresses, funding levels and programs may change. If additional funding opportunities arise in the future, it is expeditious to have contingency improvement strategies at hand. Table 21 entitled Contingency Listing of Potential Corridor Improvements (Attachment IV) contains a listing of contingency improvements should opportunities arise for additional corridor improvements.

Recommended Contingency Improvements (Table 21) include the following:

- Install turn channelization at the Oak Flat Road East intersection.
- Install turn channelization and shoulder widening at the San Marcos Road intersection.
- Convert existing Pullout to a longer Turnout at the Chimney Rock Road intersection.
- Install 2 new turnouts just east of the Gateway Drive intersection.
- When MUTCD signal warrants are met in the future, install signals at the intersections with Mustang Springs Road, Adelaida Road. and Gateway Drive.

The recommendations in Tables 20 and 21 represent working level improvement alternatives which can be incorporated into planning level strategies. Other new improvements not included in these Tables may be needed as corridor characteristics change over the next 30 years.

The Operational section of this report contains a review of current and projected traffic volumes and makes recommendations to improve and accommodate traffic flow. Current corridor funding potential primarily consists of programs which achieve these goals.

The Maintenance section of this report contains an inventory of numerous roadway items and a preliminary assessment of their condition. Some funding exists for the purpose of maintaining the road and traffic control devices.

The Safety section of this report identifies locations where safety improvements may be beneficial. Since these locations do not qualify as stand alone projects, the improvements are presented as options to be considered for inclusion in other upcoming operational or maintenance projects.

Study Scope

The general scope of this study is to quantify certain roadway inventory items, to assess current and future operational and safety performance, and to make recommendations for potential capital improvements. A number of considerations and assumptions were factored into the scope and direction of the study. These included the following:

Segmentation

For purposes of analysis, the corridor was divided into 3 study segments according to traffic volumes, terrain, and Highway Capacity Manual Classification. Table 1 shows the limits of the study segments and their characteristics. A map of the segments is also included as an attachment to this report. The Highway Capacity Manual utilizes different Level of Service (LOS) criteria for 2 lane highways depending on terrain. In mountainous terrain, slower speeds and longer delays are expected by drivers and for this reason LOS values are adjusted up. The result is that traffic volumes and delay associated with a specific LOS in rolling terrain would be assigned a higher LOS in mountainous terrain.

Build-out Concept and Assumptions

The primary contributor to traffic growth on the corridor is the development of Heritage Ranch, and Oak Shores which are resort communities approximately 10 miles from the Paso Robles City Limits. Growth projections for this development were presented in a 2003 study by ATE (Associated Transportation Engineers) which forecasted build-out traffic volumes for Heritage Loop Road, Gateway Drive, and the mainline between the two intersections. In general, build-out traffic volumes in this area are forecasted to be approximately twice the existing 2010 volumes. Using the ATE build-out volumes and historical mainline count data from the County, the approximate number of years to build-out was calculated. Based on mainline historical traffic volumes, a growth factor of 2.1% per year was estimated for Segment II. Using this growth factor, projected build-out volumes would be reached in 31 years. For purposes of this report, a 30 year build-out estimate was considered reasonable and subsequently all build-out values used in this report are attributed to the year 2040.

In order to determine the build-out traffic volumes at principal intersections along the corridor, growth factors for the local intersecting streets were developed from historical traffic count data. The growth factor for each of the local intersecting streets was then applied to the 30 year build-out horizon to get the estimated build-out volumes.

Other than Heritage Ranch, no other potential developments were identified in approximating the future build-out volumes on the mainline or intersecting local streets.

TABLE 1 CORRIDOR SEGMENTS

	Limits	Length	June 2010 ADT (Segment Average)	Terrain	Highway Capacity Manual Classification
Segment I	City Limits to Adelaida Rd.	1.46 miles	7,360 vpd	Rolling	Class 1
Segment II	Adelaida Rd. to Chimney Rock Rd.	6.13 miles	5,740 vpd	Rolling	Class 1
Segment III	Chimney Rock Rd. to Resort Drive	7.72 miles	4,690 vpd (East of Gateway Dr.)	Mountainous	Class 2

Study Scope Cont.

Percent Truck and Recreational Traffic

For purposes of this study, percent traffic by type was estimated to be 6% recreational and 6% truck. These percentages were based on visual observations and informal spot counts.

Minimum proposed paved shoulder widths

The standard shoulder width for two lane conventional highways is 8 feet. Nacimiento Lake Drive has 8 foot wide shoulders on approximately 25% its total 30.6 lane miles. Due to terrain and geological characteristics, the ability to further widen significant sections of the corridor to 8 feet is very limited. Given the recreational value of the route however, a minimum paved shoulder width of 5' is recommended (where practicable) to facilitate bicycle travel, to provide additional paved recovery room for errant vehicles, to improve drainage, and to minimize pavement drop-offs at the edge of travel way. Because of the time horizon and associated increase in traffic volumes, this objective was considered reasonable for consideration on all of the major roadway improvement proposals identified in this study. Obviously, topography and geologic features dictate where paved shoulders can be widened. This study identifies locations where widening the shoulders to 5 feet can be accomplished with minor sliver fills and cuts. Locations requiring extensive retaining walls or major cuts and fills in order to achieve wider shoulders are not considered cost effective and are therefore not recommended.

Signalization

A full traffic signal warrant analysis per MUTCD guidelines requires 8 hour traffic turning movement counts to assess all 3 of the volume related warrants for potential signals. In this study, only peak period turning movement data was available for selected intersections. For this reason, a full signal warrant analysis is outside the scope of this study. However, since the peak hour volume warrant is the primary indicator of the operational justification for a signal, the peak hour warrant was evaluated for 2010 turning volumes and for projected turning volumes at build-out. The warrant analysis sheets are contained in the Technical Appendix and the results are discussed in the Operational Analysis section of the study.

Left Turn Channelization

Two primary factors associated with the consideration for left turn channelization are accident history and delay. Intersections demonstrating a concentration of rear-end accidents were considered candidates for Left Turn Channelization. Additionally, left turn warrants from NCHRP 457 were used to determine if Left Turn Channelization was warranted based on delay. The accident statistics and Left Turn Channelization Warrant Sheets are contained in Technical Appendix. The results are discussed in the Operational Analysis section of the study.

Clear Recovery Zone (CRZ)

The AASHTO Roadside Design Guide contains guidelines for roadside safety considerations when designing projects. Specifically, it contains charts to determine desirable clear recovery distances based on speed, traffic volume and terrain. It also contains an equal severity curve which gives guidance in determining when impacts to a guardrail would be more severe than going over an embankment.

In identifying potential safety improvements to be included in a project, the Roadside Design Guide states that because of limited funds, potential improvements should be prioritized based on their relative potential contribution to safety. This priority can be determined using a benefit/cost analysis and/or engineering judgment.

On rural scenic and recreational 2 lane highways it is generally impractical to remove or shield all fixed objects and embankments within the Clear Recovery Zone. Costs can be excessive and the clear cutting of trees or removal of natural features is often unacceptable from public, political and environmental perspectives. For this

Study Scope Cont.

reason, this study focuses on high embankment locations within the Clear Recovery Zone on horizontal curves where the potential for run-off-the-road collisions is greatest. This approach is consistent with AASHTO objectives to maximize roadside safety on a system-wide basis with the given funds. The identification of all potential safety improvements in this study is based on addressing specific roadside features which can contribute most to safety enhancement given constrained funding.

Funding

The following lists potential funding sources for roadway improvements on Nacimiento Lake Drive:

Development Mitigation Account
These funds are collected as development impact fees and are directed to improvements which mitigate for the incremental traffic impacts associated with new projects.

HSIP: Highway Safety Improvement Program
This program makes Federal funding available for safety projects which meet benefit/cost qualifying criteria on a competitive basis. The County periodically assesses the corridor to determine potential eligibility for these funds.

Categorical Federal Grants:
Federal Funding is available to local agencies for various categories of projects on a competitive basis. These programs include Safe Routes to School, and the Bicycle Transportation Account to name a few. The County periodically assesses the corridor to determine potential eligibility for these funds.

Special Assessment Districts:
Local Agencies will occasionally set up special assessment districts to collect fees from existing development/ facilities to assist in funding improvements which benefit the clientele of those developments. Although an option, the County has not implemented assessment districts at locations along the Nacimiento Lake Drive Corridor at this time.

Given the current funding environment, the estimated funding allocation for Nacimiento Lake Drive over the next 30 years is approximately 6 million dollars.

Because the Nacimiento Lake Drive Corridor possesses a good safety record overall, it is not anticipated that the corridor will qualify for safety funding in the near future. For this reason, it is recommended that potential improvements discussed in the Safety Analysis section of this report be considered in the development of future operational and maintenance projects.

Route Description

Nacimiento Lake Drive (NLD) is a minor rural arterial route which provides access to Nacimiento and San Antonio Lakes from Paso Robles in the south and from Bradley to the north. The section under review in this study is the 15 mile long segment from Paso Robles to the Nacimiento Lake Resort Drive. The highway in this area is also known as Godfrey Road and County Route 14. The study corridor consists of a 2 lane highway which runs generally east-west between Paso Robles and Chimney Rock Rd., and north-south between Chimney Rock Rd. and the Lake. To avoid confusion, all segments of NLD will be referred to in the east-west orientation.

Besides being a popular recreational route, it also serves as a commuter route for residences along the corridor including the Heritage Ranch Resort and Oak Shores communities. Approximately 70 driveways connect with the mainline along this length. In addition, numerous wineries are accessed from Nacimiento Lake Drive. In 2010, the traffic volumes varied from about 7,500 vehicles per day near the Paso Robles city limit to about 1,000 vehicles per day near the Lake Resort entrance.

There are 20 publicly or privately maintained local streets which connect with Nacimiento Lake Drive. None of these intersections are signalized and only two, Gateway Dr. and Heritage Loop Road, possess left turn lanes.

Bicyclists and pedestrians were observed on the highway but the volumes were generally light.

For analysis purposes, the corridor was segmented based on traffic volumes and terrain. A segment map is included as Attachment I. The segments are discussed below in detail below:

SEGMENT I is defined as the 1.4 mile long section of highway between Mountain Springs Road and Adelaida Road (PM 0.0 to PM 1.4). This section winds through rolling terrain. The traffic volumes in June of 2010 were approximately 7,500 vehicles per day. The highway is in cut on the north side and bounded on the south side by a 1,500 foot long ravine. The paved shoulder widths vary from 1 to 8 feet along the segment. There are no passing zones in this segment and the speed limit is limited to 45 mph between PM 0.4 and the City Limits.

SEGMENT II is defined as the 6 mile long section of highway between Adelaida Road and Chimney Rock Road (PM 1.46 to PM 7.59). This section consists of sweeping curves through rolling terrain. A sustained eastbound upgrade of 6% exists between San Marcos Road and Mondo Cellars (PM 5.6 to PM 4.9). With the exception of two passing zones (yellow skip stripe centerline), the entire segment is barrier striped with double solid yellow center lines. The paved shoulder varies from 1 to 8 feet in width with the majority of the length possessing 5 foot wide shoulders or more. Paved shoulder widths less than 5 feet occur at spot locations. The traffic volumes in June of 2010 were approximately 7,500 vehicles per day near Adelaida Road and approximately 5,000 vehicles per day east of Chimney Rock Road. The speed limit along this segment is 55 mph.

SEGMENT III is defined as the 7.7 mile long section of highway between Chimney Rock Road and the Nacimiento Lake Resort Driveway (PM 7.59 to PM 15.59). This section traverses through both mountainous and rolling terrain. Sustained upgrades of 6% or more exist at four locations along this segment. The most significant grade known as "Godfrey Grade" is located between PM 9.5 to PM 10.3. With the exception of 4 passing zones (yellow skip stripe centerline), the entire segment is barrier striped with double solid yellow center lines. Because passing opportunities are limited, 7 turnouts have been constructed where slow moving vehicles can move to the side and allow faster vehicles to pass. The paved shoulder varies from 1 to 8 feet in width with the majority of the shoulders ranging from 1 to 2 feet wide. The traffic volumes west of Chimney Rock Road in June of 2010 were approximately 4,200 vehicles per day. The speed limit along Segment III is 45 mph.

Because of the recreational nature of the route, seasonal variations in traffic demand are significant. During peak periods of commute and weekend recreational demand, some queuing and delay currently occurs.

INVENTORY

There are over 30 lane miles of roadway within the corridor limits. The items listed below were reviewed to develop an inventory of selected roadway features and were identified from field measurements, observations and county records.

- Lane Widths
- Paved Shoulder Widths
- AC Dike
- Grades
- Guardrail
- Turnouts
- Passing Zones
- Left Turn Channelization
- Signs

Measurements and quantities are contained in the Technical Appendix. The findings are summarized below:

Lane Widths:

Standard 12 foot lanes are in place along the majority of the roadway. Exceptions exist on short sections in Segment III and are identified in the Technical Appendix. Table II shows the breakdown of lane widths by percentage of total lane miles.

Table 2	Lane Width		
Total Lane Miles	% 11' lanes	% 12' lanes	% 13' lanes
30.6 Miles	**2.3%**	**98.6%**	**.9%**

Shoulder Widths:

Paved shoulder widths vary from 1 to 10 feet throughout the corridor length but are generally wider in segment II. Table 3 shows the breakdown of paved shoulder widths by percentage of total lane miles.

Asphalt Concrete Dike:

Drainage dike was inventoried through the study limits. The predominant type of dike found on the roadway was the State standard "Type A" which is 6 inches high. Other dikes observed along the shoulder were variable in width and height. Variable dimension dike is referred to in the Technical Appendix as "Hand Formed". Dike was assessed to be in either "Damaged", "Poor", "Fair", or "Good" condition. Locations where the dike was found to be damaged and would fail to transport water are identified in the Technical Appendix. Table 4 lists the total length of dike by type and gives the percent breakdown by condition. Specific dike installations are summarized in the Technical Appendix. This study does not recommend drainage dike repairs/upgrades as stand alone projects. Typically, dike/drainage repair is undertaken by Maintenance Programs either by in-house forces or under maintenance service contracts. Additionally, maintenance pavement rehabilitation projects will include dike repair/upgrades as part of the scope of the projects. It should be noted that the state and county standard on new projects is to install mountable dike on fills. Details for mountable dike (Type D and E) are contained in State Standard Plan A87B and County Standard C-3. It is not recommended that old Type A dike be retroactively removed. However, in the course of scoping major overlay or widening projects, the conversion to mountable dike on fills should be considered.

Table 3	Shoulder Width			
	Total Lane Miles	% 0'-4' Shoulders	% 5'-7' Shoulders	% 8' + Shoulders
Segment I	2.9 miles	20.7%	3.4%	75.9%
Segment II	12.3 miles	38.2%	14.1%	47.7%
Segment III	15.4 miles	90.5%	6.2%	3.3%

Table 4	AC Dike			
	Total Lane Miles	% Good	% Fair	% Poor
TYPE A DIKE	11.7 miles	62.4%	16.6%	21.0%
HAND FORMED	1.6 miles	-	3.3%	96.7%
OTHER	0.18 mile	-	34.1%	65.9%

INVENTORY Cont.

Sustained Grades:

Field measurements were made of predominant sustained grades along the corridor. Most grades were variable and averages were calculated and used in the Operation Analysis. The Technical Appendix summarizes the measurements of 14 sustained grades along the corridor. Of the 14, 7 of the longer and steeper grades were analyzed for their impact on mainline Level of Service (LOS). A discussion of the operational impacts of grades is contained in the Operational Analysis section of this study. Table 4 lists the roadway grades evaluated for operational impacts. The most significant grade occurs in the mountainous section of Segment III at a location known as the Godfrey Grade. This location has been studied in the past, and a Project Study Report and Environmental document were prepared in the early 1990's for a potential project to install a westbound climbing lane. The project is currently listed in San Luis Obispo Council of Governments (SLOCOG) Regional Transportation Plan with an estimated cost of 13 million dollars.

Table 4 Sustained Grades

Location	Postmile	Length	Direc	Average Grade
SEGMENT I				
Mountain Springs Rd. to Mustang Springs Rd.	**Grade 1** PM 0.0 to PM 0.40	2,000'	W/B	4.6%
SEGMENT II				
800' e/o Oak Flat Rd. to Scott's Nursery Driveway	**Grade 3** PM 2.88 to PM 1.66	6,500'	E/B	3.6%
San Marcos Rd. to 1,100' w/o Mondo Cellars	**Grade 5** PM 5.68 to PM 4.93	4,000'	E/B	6.0%
San Marcos Rd. to 1000' e/o Nacimiento Rd.W	**Grade 6** PM 5.68 to PM 6.35	3,500'	W/B	3.0%
SEGMENT III				
500' w/o Chimney Rock Rd. to 5,600' w/o Chimney Rock Rd.	**Grade 7** PM 7.70 to PM 8.65	5,000'	W/B	5.3%
Frazier Rd. to Top of Godfrey Grade	**Grade 9** PM 9.55 to PM 10.32	4000'	W/B	7.2%
Westbound Turn-out to Top of Godfrey Grade	**Grade 10** PM 10.50 to PM 10.32	950'	E/B	10.0%

Turnouts:

Turnouts are paved lanes to the right of the mainline where slower vehicles can temporarily pull out of the through traffic and allow faster vehicles to pass. Seven turnouts currently exist in Segment III and are listed in Table 5. The turnouts vary in length from 400 to 800 feet long and are from 12 to 14 feet wide. A single solid white line separates the turnout from the through lane (see Photo # 32). Field measurements of the turnouts are summarized in the Technical Appendix. The operational benefits of the turnouts are discussed in the Operational Analysis section of this study.

Table 5 Turnouts

Turnout Number	Postmile	Direction	Length
1	PM 8.01 to PM 8.16	W/B	785'
2	PM 8.76 to PM 8.91	E/B	765'
3	PM 9.71 to PM 9.83	E/B	600'
4	PM 10.51 to PM 10.56	W/B	410'
5	PM 11.55 to PM 11.64	E/B	470'
6	PM 13.78 to PM 13.87	W/B	470'
7	PM 14.39 to PM 14.46	E/B	380'

Pullouts:

Pullouts are short paved or unpaved areas where vehicles can pullover to the side of the road and stop temporarily. They are used primarily for emergency refuge and for maintenance and enforcement activities. The only paved

INVENTORY Cont.

pullout in the corridor is at the Chimney Rock Rd. intersection. At this location, a 250 foot long paved area is provided on the south side of the intersection (see Photo #28). Numerous informal dirt pullouts are used by motorists such as the one depicted in Photo # 31.

Delineation:

The delineation of Nacimiento Lake Drive conforms with the California Manual on Uniform Traffic Control Devices (CMUTCD) guidance for markings. The roadway is delineated with a white edge stripe (DETAIL 27B), a double yellow center line (DETAIL 22) and one direction no passing center line stripe (DETAIL 21). Long or sharp curves are also delineated with white reflective carsonite delineators which help demarcate the road at night.

Passing Zones:

Passing zones occur where the center line stripe has a broken pattern and allows passing in one or both directions. Six passing zones are in place at various straight sections of roadway along the corridor. The locations and lengths of these zones are listed in Table 6. Here it can be seen that there are approximately 3.2 lane miles available for passing along the total length of the

Table 6 Passing Zones

Passing Zone Number	Westbound Postmile	Length	Eastbound Postmile	Length
1	PM 4.2 to PM 4.65	2,380'	PM 4.36 to PM 4.77	2,165'
2	PM 5,92 to PM 6.38	2,403'	PM 5.93 to PM 6.55	3,270'
3	PM 8.36 to PM 8.54	950'	PM 8.49 to PM 8.65	845'
4	PM 12.68 to PM 12.96	1,470'	PM 12.81 to PM 13.02	1,100'
5	PM 13.66 to PM 13.80	730'	-	
6	PM 14.14 to PM 14.33	985'	PM 14.21 to PM 14.46	630'
Total		8,920'		8,010'

Turnout # 1 PM 8.01 to PM 8.16 Photo #32

Chimney Rock Rd. Intersection Pullout Photo #28

Unpaved Pullout PM 7.83 Photo #31

INVENTORY Cont.

corridor. This equates to only about 10% of the total 30.6 lane miles of roadway within the corridor limits. Passing zones are limited to this fraction because of sight distance restrictions associated with highway's curvature through rolling and mountainous terrain. A typical passing zone is shown in Photo # 67A.

Left Turn Channelization:

Only two intersections along the corridor possess left turn pockets. The locations and pocket lengths are shown in Table 7. Photo # 57 shows the Left Turn Channelization at Gateway Drive.

Table 7 Left Turn Channelization

Intersection	Postmile	Left Turn Pocket Length
Heritage Ranch/ Gateway Dr.	PM 12.12	325'
Heritage Loop Rd.	PM 14.02	540'

Guardrail:

Metal Beam Guardrail is in place at 8 locations along the corridor. Four of the installations are at high embankment locations and 4 are short rail segments used as part of short retaining wall systems. Table 8 shows the locations and characteristics of the guardrail. The

Table 8 Metal Beam Guardrail

Location	Postmile	Side of Highway	Function	Length
1	PM 9.91 to PM 10.06	W/B	Embankment	790'
2	PM 10.07 to PM 10.22	W/B	Embankment	800'
3	PM 11.85 to PM 11.86	E/B	Retaining	80'
4	PM 12.31 to PM 12.41	E/B	Embankment	510'
5	PM 15.12 to PM 15.14	W/B	Retaining	120'
6	PM 15.15 to Dam	W/B	Embankment	850'
7	PM 15.21 to PM 15.22	E/B	Retaining	80'
8	PM 15.24 to PM 15.25	E/B	Retaining	80'

Eastbound Passing Stripe PM 12.82 At Reservoir Road
Photo # 67A

Left Turn Channelization at Heritage Ranch/Gateway Dr.
Photo # 57

total linear feet of guardrail in the corridor is 3,300 feet.

Signs:

Roadway signs are generally classified into 3 types according to function; Regulatory signs give notice of traffic laws or regulations and consist of black lettering on white background; Warning signs give notice of a situation which may not be apparent to drivers and consist of black lettering on yellow background; Guide signs show route designations, directions, distances, services, points of interest and other geographical,

INVENTORY Cont.

recreational or cultural information. These signs may be green, brown or blue depending on function. The county maintains a database of sign installations on County Roads. A copy of the County's Sign Installation Inventory for Nacimiento Lake Drive is contained in the Technical Appendix. From this inventory, there are 230 signs in place on NLD from the Paso City Limits to the Nacimiento Lake Entrance. The breakdown of signs by type are shown in below:

Sign Inventory

Sign Function	Sign Code	Number
REGULATORY		
Speed Limit	R245, R6	26
Speed Checked by Radar	R48,	8
Litter Fine and Removal	R47, S16	11
Turnouts	R50, R51,R52	16
No Parking	R26	29
Other		5
TOTAL		95
WARNING		
Curve Warning/Alignment	W5, W6, W14, W71, W56	21
Side Street	W7A	18
Bikes	W79, W16	16
Hill	W29	6
Icy	W43	4
Other		18
TOTAL		83
GUIDE SIGNS		
Street Name	G7	15
Destination/Street Name	G8	7
Route Shield/County Route Marker	G25, G35, G36	17
Other		13
TOTAL		52

OPERATIONAL ANALYSIS

Methodology:

This study utilizes the processes and procedures contained in the 2000 Highway Capacity Manual (HCM). The service quality for 2 lane highways are defined in terms of Percent Time Following and Average Travel Speed for Class I Highways (level and rolling terrain) and Percent Time Following for Class II Highways (mountainous terrain). For un-signalized intersections the service quality is defined in terms of Delay at the most impacted leg. Table 9 describes the characteristics of each of the service levels for 2 lane highways. The service quality for Two Way Stop Controlled (TWSC) intersections is defined in terms of the delay experienced on the minor leg of the intersection. Table 10 lists the average minor street delay in seconds associated with each service level. Level of Service is not defined for the intersection as a whole. The County has adopted LOS C as the minimum standard for rural roadway operations with mitigation required for operations in the LOS D-F ranges.

Table 9 LOS For 2 Lane Highways

LOS A	Class I	Motorists able to drive at their desired speed. Average Speed 55 mph or greater. Up to 35% time traveling behind slow vehicles. Flow rates of up to 490 vph total for both directions.
	Class II	Speeds may fall below 55 mph. Up to 40% travel time behind slow vehicles.
LOS B	Class I	Average Speed 50 mph on level terrain. High demand for passing to maintain speeds. Up to 50% time traveling behind slow vehicles. Flow rates of up to 780 vph total for both directions.
	Class II	Speeds may fall below 50 mph. Up to 55% travel time behind slow vehicles.
LOS C	Class I	Average Speed exceeds 45 on level terrain. Chaining of platoons and significant reduction in passing opportunities. Traffic flow is stable but still susceptible to congestion due to turning vehicles and slow traffic. Up to 65% time traveling behind slow vehicles. Flow rates from 780 vph to 1,190 vph total for both directions.
	Class II	Speeds may fall below 45. Up to 70% travel time behind slow vehicles.
LOS D	Class I	Unstable Traffic Flow, passing becomes extremely difficult. Speeds of up to 40 mph. Mean platoon size of 5 to 10 vehicles. Up to 80% time traveling behind slow vehicles. Flow rates from 1190 vph to 1,830 vhp total for both directions.
	Class II	Speeds may fall below 40 mph. Up to 85% travel time behind slow vehicles.
LOS E	Class I	Extensive platooning and virtually no passing opportunities. Average travel speeds between 25 mph and 40 mph. Greater than 80% time traveling behind slow vehicles. The highest volume of LOS E defines the capacity of the highway, 3,200 vph total for both directions.
	Class II	Greater than 85% travel time behind slow vehicles.
LOS F		Heavily congested flow with demand exceeding capacity. Volumes are lower than capacity and speeds are highly variable.

OPERATIONAL ANALYSIS Cont.

Table 10 LOS at TWSC Intersections	
Level of Service	Average Control Delay (Seconds/Vehicle)
A	0-10
B	> 10-15
C	> 15-25
D	> 25-35
E	> 35-50
F	> 50

Mainline Operational Analysis:

Utilizing 2010 traffic count data, the overall existing Peak Hour Level of Service was calculated for each of the 3 Corridor Segments. Since each of the segments have 1 or more sustained grades which affect traffic flow, it is also desirable to estimate the service level at these locations. The HCM procedure for Specific Upgrades was used for determining LOS at the 6 significant upgrades along the corridor.

Average growth rates for the segments were used to estimate 30 year build-out volumes for Segments I and II (build-out volumes for Segment III were estimated from

Table 11 Highway LOS Summary					
			AM PEAK	PM PEAK	WKEND PK
SEGMENT I Class I	HIGHWAY	2010	C-	C-	C-
		BUILD-OUT	D	D	D
	GRADE 1	2010		E+	
		BUILD-OUT		E	
SEGMENT II Class I	HIGHWAY	2010	C	C	C
		BUILD-OUT	C-	D+	D
	GRADE 3	2010			C+
		BUILD-OUT			D+
	GRADE 5	2010			D+
		BUILD-OUT			D
	GRADE 6	2010			C
		BUILD-OUT			D
SEGMENT III Class II	HIGHWAY	2010	C+	C	C
		BUILD-OUT	C	C-	D
	GRADE 7	2010			C-
		BUILD-OUT			D-
	GRADE 9 (Godfrey Grade)	2010			C-
		BUILD-OUT			D-
	GRADE 10	2010			C+
		BUILDOUT			D+

OPERATIONAL ANALYSIS Cont.

the 2003 ATE traffic study). Build-out Level of Service was then calculated for each of the over-all segments and for significant Specific Upgrades. Table 11 summarizes the 2010 and build-out LOS for the segments and prominent up-grades. Because each service level describes a range of operational characteristics which are better at higher levels and degrade at lower levels, it is helpful to use + and - signs to indicate where in the spectrum the study segment falls.

It is also important to note that the segments are classified by type according to HCM criteria. Two lane highways on which motorists do not expect to travel at high speeds, which serve as scenic or recreational routes where sight seeing plays a role, and which pass through rugged terrain are generally assigned to Class II for analysis. For this reason, a Class II highway may have an overall LOS of C but the traffic may be slower and more heavily platooned than a Class I highway with the same LOS. Further information on 2 lane highway classification can be found in the Highway Capacity Manual.

From Table 11 it can be seen that the 2010 peak period Level of Service for each of the over-all segments was "C". At two specific locations with sustained grades, the LOS falls below this level; Grade 1 (LOS E+) and 5 (LOS D+) notably operate in 2010 at levels which start to produce peak period platooning and delay. At build-out volumes, Segment I drops 1 service level, Segment II drops 1 service level in the PM and Weekend Peak, and Segment III drops 1 service level in the Weekend Peak. Similarly, Grades 3, 6, 7, 9, and 10 drop 1 service level. Grade 1 remains in LOS E but at volumes which create more severe operational impacts. Grade 5 remains at LOS D but at the more impacted region of that service level.

Data from the table indicate that as traffic volumes increase, notable platooning and congestion will begin to occur in Segment I westbound during the PM peak. In segment II, the first appearance of notable platooning and congestion will occur during the weekend peak eastbound on grade 5 between San Marcos Road and the Mondo Winery Driveway. In segment III, notable platooning and congestion will occur during the weekend peak westbound at Grade 9 (Godfrey Grade). At 2010 traffic levels, the impacts to average drivers at these locations may be perceived as minor and negligible. As traffic volumes increase over the next 30 years, these locations will become points of "bottleneck" congestion with longer peak period durations.

Intersection Operational Analysis:

Six corridor intersections were selected for operational analysis utilizing HCM procedures. These are listed below along with their 2010 week day ADT (if available):

Mustang Springs Rd.:	557 veh/day
Adelaida Rd.:	1,295 veh/day
San Marcos Rd.:	371 veh/day
Chimney Rock Rd.:	671 veh/day
Gateway Dr.:	-
Heritage Loop Rd.:	966 veh/day
Resort Driveway:	-

The 2010 LOS and Build-out LOS for the intersections are listed in Table 12 (Build-out LOS for the Resort Driveway was not estimated due to a lack of growth data for that area). The Highway Capacity Manual utilizes the worst delay at any of the intersection legs as the measure of effectiveness assigned to the entire intersection. All of the intersections listed above are in a "T" configuration and the controlling delay is at the leg controlled by a stop sign. Overall intersection delay is not estimated in this study.

The intersection which will be most impacted at Build-out volumes is Mustang Springs Rd . In the AM peak (LOS E), it will be difficult to make left turns with average delays ranging from 35 to 50 seconds. Similarly, during the PM peak (LOS D) it will be difficult to make left turns out with the average delay ranging from 25 to 35 seconds. The intersections at Adelaida, San Marcos and Chimney Rock will drop 1 service level at Build-out, but will remain at LOS C or better during all peak hours. At Gateway Dr., on the weekends, the service level will drop 2 service levels from LOS A to LOS C. The least impacted intersection at Build-out is Heritage Loop Drive with the projected service level remaining at LOS A. This is due primarily to the presence of the left turn pocket,

OPERATIONAL ANALYSIS Cont.

Table 12 Intersection LOS Summary

	INTERSECTION	Leg with Stop Control	YEAR	AM PEAK	PM PEAK	WKEND PK
SEGMENT I	Mustang Springs Rd.	W/B Mustang Springs Rd.	2010	B	B	B
			BUILD-OUT	E	D	C
	Adelaida	E/B Adelaida Rd.	2010	B	B	A
			BUILD-OUT	C	B	B
SEGMENT II	San Marcos	W/B San Marcos Rd.	2010	B	B	B
			BUILD-OUT	C	C	C
	Chimney Rock Rd.	S/B Nacimiento Lk. Dr.	2010	B	A	A
			BUILD-OUT	C	B	B
SEGMENT III	Gateway Dr.	E/B Gateway Dr.	2010	B	A	A
			BUILD-OUT	C	B	C
	Heritage Loop Rd.	E/B Heritage Loop Dr.	2010	A	A	A
			BUILD-OUT	A	A	A
	Resort Drive-way	E/B Resort Driveway	2010	-	-	A
			BUILD-OUT	-	-	-

predominant right turns out of the intersection, and low traffic volumes approaching the intersection eastbound.

Grades:

Terrain and adjacent land use limits the potential for installing climbing lanes at sustained grades along the corridor. Grades 5 and 9 (Godfrey Grade) are the two locations which would realize the most operational benefit. Table 13 summarizes the 2010 and Build-out LOS at these two grades and the projected benefit from constructing climbing lanes at these locations. Generally, the climbing lanes would raise the service levels at least one degree and would be effective in reducing delay and platooning caused by slow moving vehicles.

Table 13 Grade 5 and 9 LOS

	GRADE		WKEND PK
SEGMENT II Class I	GRADE 5	2010	D+
		BUILD-OUT	D-
		BUILD-OUT With Climbing Lane	C-
SEGMENT III Class II	GRADE 9 Godfrey Grade	2010	C-
		BUILD-OUT	D-
		BUILD-OUT With Climbing Lane	B

Turnouts:

The Highway Capacity Manual does not contain procedures for evaluating the operational effectiveness of turnouts. However, based on site reviews, it was observed that all 7 of the existing turnouts were used on a regular basis by the public and were effective in reducing delay and platooning. About 75% of the vehicles using the turnouts did so by just slowing in the turnout and allowing faster vehicles to pass. The other 25% of turnout users would stop to allow longer platoons of vehicles to pass. The Highway Capacity Manual estimates that well-located

OPERATIONAL ANALYSIS Cont.

turnouts can provide 20 to 50 percent of the number of passes that would be expected to occur in a 1 mile long passing lane in level terrain. Additionally, the HCM points out that research shows that Turnouts have a good safety record.

Pullouts:

Pullouts are areas to the right of the roadway shoulders where drivers can pull off the roadway and stop. They may be paved or unpaved. Pullouts provide refuge for emergency stops, sight-seeing, maintenance personnel, and enforcement. Typically they are shorter than turnouts (less than 200') and are not signed. They tend to be on informal open dirt surfaces are often formed by user demand depending on the appeal to drivers. Six dirt pullouts and one paved pullout were identified in the corridor which showed use by drivers on a regular basis. Table 14 shows the locations and lengths of the pullouts. Photo #85 shows a well worn pullout at PM 14.58

Table 14 Existing Pullouts

	Location	Dir	Type	Length	Photo
SEGMENT II	5.50	E/B	Dirt	200'	#85
	7.59	E/B	Paved	200'	#28
SEGMENT III	7.69	W/B	Dirt	125'	
	7.73	W/B	Dirt	100'	#31
	9.55	W/B	Dirt	190'	#40,41
	14.58	E/B	Dirt	300'	#84,85
	14.99	W/B		200'	#89

PM 5.58 Facing east. Photo #85

Passing Zones:

Due to rolling and mountainous terrain, passing opportunities are limited to 6 locations along the corridor (see Table 6). Of these, 5 allow passing in both directions. The California MUTCD states that the minimum passing sight distance is 700' in a 45 mph zone and 900' in a 55 mph zone. Passing locations 1, 2, and 4 are well above these minimums. Locations 3, 5, and the westbound direction of location 6 are near the minimum lengths specified for the posted speed limit. It was observed in the field that these shorter passing zones were not utilized as much as the longer zones. Also, during peak periods, the opportunities to pass at any of these locations diminished. These limitations will be further aggravated at build-out volumes where even fewer passing opportunities will be available during peak periods.

In Segment III, it was observed that the turnouts were used significantly more often than the passing zones for overtaking slower vehicles. In general, turnouts appeared to be much more effective in facilitating traffic flow.

Left Turn Channelization:

Currently, left turn channelization is in place at the Gateway Dr. and Heritage Loop intersections. This study evaluated the other predominant intersections to determine if and when additional left turn channelization will be warranted.

The two primary factors used in analyzing the need for Left Turn Channelization were accident history and delay. Intersections demonstrating a concentration of rear-end and turning related accidents are considered candidates for LTC. Additionally, left turn warrants from NCHRP 457 are used to determine if LTC is warranted based on delay. Estimated build-out turning movements and left turn warrant sheets are contained in the Technical Appendix.

OPERATIONAL ANALYSIS Cont.

The following intersections met one or both of the above criteria:

Mustang Springs Rd.: From the 5 year collision history, this intersection is selected as a focus area for safety (see the Safety Analysis section of this study) and demonstrates a pattern of rear-end collisions in the eastbound direction. Additionally, the intersection will meet the LTC delay warrant for all three peak periods at build-out volumes.

Adelaida Rd.: Adelaida Rd. does not currently possess a concentration of rear-end collisions. Operationally, it is currently close to meeting the delay warrant for LTC in the PM peak period. At build-out volumes, it will meet the delay warrant for all peak periods.

Oak Flat Rd. West: From the 5 year collision history, this intersection is selected as a focus area for safety (see the Safety Analysis) and demonstrates a pattern of rear-end and turning related collisions in the westbound direction. Turning movement count data was not available for this intersection so a LTC delay warrant analysis could not be performed.

San Marcos Rd.: This intersection does not currently meet LTC delay warrants. However, the AM and PM warrant is met at build-out volumes.

Mustard Creek Rd.: Turning movement count data was not available for this intersection. However, the May 2010 ADT on Mustard Creek Rd. was 450 vpd which is slightly higher than San Marcos Rd. Given the similarities in volumes it can be assumed that Mustard Creek Rd. would also likely meet AM and PM peak warrants for Left Turn Channelizing at Build-out volumes.

Signalization:

Based on 2010 peak turning count data, current traffic volumes at the intersections along the corridor are not at levels which warrant signals. Warrant # 5, the accident warrant, requires a minimum of 5 accidents of the type correctable by a signal in a 1 year period. Fortunately, none of the intersections along the corridor currently meet the accident warrant for signals.

At build-out volumes, three intersections are projected to meet the peak hour warrant. These are Mustang Springs Rd., Adelaida Rd. and Gateway Drive. Although actual future growth patterns will dictate the potential need for signal installation, the growth figures used in this study suggest that a full warrant signal analysis at the above intersections may be justified approximately midway to build-out volumes (roughly 15 years).

Transit:

Currently, transit services do not exist along the corridor. As growth occurs along the corridor, the justification for potential expansion of existing services may increase. Additionally, community sponsorship of specialized transit/bus services may be discussed as a potential option for the Heritage Ranch Community.

School Bus Service:

School bus service is provided to the Heritage Ranch School off of Heritage Loop Rd. On the corridor, there is a bus stop at Oak Flats. Rd. East.

Bicycle Transportation:

Bicycle use along the corridor is generally light. One informal bike event was observed during site reviews associated with this study. In addition, in 2011, the AMGEN event utilized the route. Bicycling was observed to be heaviest along Segment I. Based on interviews with local bike club organizers, the highest priority improvement recommended for improving bicycle safety and encouraging cycling on the corridor was widening the paved shoulder.

Pedestrian:

Pedestrian traffic along the corridor was observed to be generally light, however joggers were observed regularly in Segment I and in the east end of Segment II.

SAFETY ANALYSIS

Methodology:

This study evaluates Nacimiento Lake Drive corridor safety from 3 perspectives:

1. Reactive: Assessment of accident history to identify locations with accident concentrations or patterns.
2. Proactive: Application of clear recovery zone concepts at potential future Run-off-the-Road locations.
3. Safety Hardware Upgrades: Assessment of guardrail and end treatments.

The identification of any location or item in this analysis is considered a potential candidate for safety upgrades over existing safety levels and does not imply that the current conditions are hazardous to drivers exercising reasonable care.

Accident History:

Highway Analysis: Seven year accident data for the period 1/1/05 to 3/24/12 was obtained from the County Accident Database and was organized sequentially by Postmile through the corridor limits. Accident rates were calculated for each of the corridor segments and intersections using this data and averaged historical traffic volumes. To provide a standard for comparisons, State Accident Rate Group Tables were used to obtain average statewide accident rates for similar types of facilities. The accident summary, accident rate calculations and statewide averages are listed in the Technical Appendix.

Table 15 summarizes the highway segment accident data. The accident rates shown in this table are defined as the number of accidents per million vehicle-miles traveled in the time period (#acc./MVM).

During the study period, the accident rates of the study segments were below the statewide average (SWA) for similar highways. This is a good safety record for the corridor as a whole. But, because segment rates are averages over long distances, it is possible for a highway segment with an average accident rate to contain spot locations of high accident concentrations. Normally, these concentrations occur at horizontal curves or intersections. Such concentrations do no imply that the highway is unsafe; these roadway features tend to be catch points for inattentive or speeding drivers who are not exercising

Table 15 — Estimated Highway Segment Accident Rates (#acc/MVM)

	Length (miles)	# Coll	Total Acc Rate	Statewide Ave Rate
SEGMENT I	1.46	30	1.15	1.90
SEGMENT II	6.13	69	0.75	1.36
SEGMENT III				
Chimney Rock to Gateway Drive	4.53	83	1.48	1.74
Gateway Drive to Resort Drive	3.19	16	1.06	1.87

Table 16 — SAFETY FOCUS AREAS

Location	Limits	Length (Feet)	# Coll	TYPE
1 Vicinity of Mustang Springs Rd.	PM .38 to PM .44	320	10	6-Rear-end 2-Hit Object 1-Other 1– Head-on
2 Intersection at Oak Flat Rd. E	PM 2.70 to PM 2.71	70	5	2-Broadside 2-Rearend 1-Head-on
3 Sweeping curve west of San Marcos Rd. I/S	PM 5.38 to PM 5.53	800	8	4-Overturned 4-Hit Object
4 Curves between Chimney Rock Rd. I/S and Turnout # 1	PM 7.63 to PM 7.79	850	13	11-Hit Object 1-Overturned 1-Head-on
5 Curves East of Frazier Rd.	PM 9.46 to PM 9.50	220	12	7-Overturned 4-Hit Object 1-Head-on
6 Godfrey Grade	PM 9.63 to PM 10.52	4,700	17	3-Head-on (2 fat) 10-Hit Object 1-Sideswipe 3-Overturned
7 Curves West of Godfrey Grade	PM 10.56 to PM 11.47	4,800	16	5-Overturned 9-Hit Object 1-Broadside 1-Head-on

SAFETY ANALYSIS Cont.

reasonable care. A review of the sequential listing of accidents revealed 7 such concentration locations within the study segments. These locations are identified in Table 16 as Safety Focus Areas and are discussed below:

SAFETY FOCUS AREA 1

PM .38 to PM .44

Intersection of Mustang Springs Rd. and NLD:

The 7 year accident record of this intersection shows a total of 10 accidents. Of the 10 collisions, 5 involved rear end collisions on the eastbound approach to the intersection. These types of accidents may be a result of eastbound drivers turning left to utilize a short cut to north Paso Robles or to access a repair business on the northwest corner of the intersection. This intersection is located in the segment of the corridor with the highest mainline traffic volumes. It also experiences high speeds on the eastbound approach (55 mph transitioning into a 45 mph zone). Although the intersection possesses adequate corner sight distance, it is not highly visible to drivers approaching in either direction on the mainline. An intersection warning sign (W7A) is in place on the eastbound approach to the intersection. A 45 mph sign facing eastbound traffic is located across from the intersection (see photo # 07).

SFA 1 Mustang Springs Road Photo # 07

Facing East

SAFETY FOCUS AREA 2

PM 2.70 to PM 2.71

Intersection of Oak Flat Road East and NLD:

Of the 5 collisions which occurred in the area of the intersection during the study period, 4 involved turning movements. The intersection possesses adequate corner sight distance but is not highly visible to drivers on Nacimiento Lake Drive due to the curvature of the approaches from the eastbound and westbound directions. In addition, adjacent to and across from the intersection are private driveways and a school bus stop. Intersection warning signs (W7A) are in place on both the eastbound and westbound approaches to the intersection. The accident data indicates a pattern of rear-end and turning related accidents. Although no turning movement data was available, other features of the intersection were considered noteworthy for a complete assessment of possible improvements. These included:

- The intersection is not highly visible to drivers approaching the intersection. This is due to the vertical curve to the west and the horizontal curve to the east.
- Traffic speed are high on Nacimiento Lake Drive in this area.

SFA 2 Oak Flat Road E Photo #16

Facing West

SAFETY ANALYSIS Cont.

- Two offset driveways are directly in the vicinity of the intersection.
- A school bus stop is located at the intersection.

Photo #16 depicts the westbound approach to the intersection.

SAFETY FOCUS AREA 3
PM 5.38 to PM 5.53
Horizontal Curve and Grade e/o the San Marcos Rd . I/S:

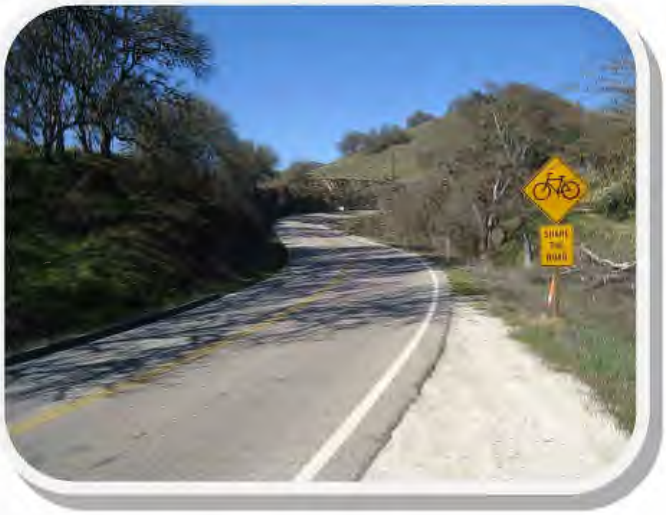
Of the 8 accidents which occurred during the study period, 4 involved running off the road. Six of the 8 accidents were in the eastbound direction which is on a 6% uphill climb (Sustained Grade # 5). This means these accidents occurred on the up-grade with the roadway curving to the left. None of the collisions were reported as head-on. This accident history does not suggest a correctable pattern. Grade 5 is discussed in the Operational Analysis (no photo).

SAFETY FOCUS AREA 4
PM 7.63 to PM 7.79
Curves on Grade 7 just west of Chimney Rock Road:

During the study period, 13 accidents occurred along the curves of the 5% grade between Chimney Rock Rd. and Turnout #1. Of the 13 accidents, 11 involved hitting a fixed object. The breakdown of "movement preceding collision" is:

Ran-off-Road: 7
Proceeding Straight: 2
Turning: 4

The segment consists of a series of reversing curves with little or no paved shoulder (see photo #B16).



SFA 4 Just west of the Chimney Rock Rd. I/S
Photo # B16 Facing west

SAFETY FOCUS AREA 5
PM 9.46 to PM 9.50
Just east of Frazier Road:

SFA 5 Horizontal Curves East of Frazier Rd.
Facing West Photo # B30

SAFETY ANALYSIS Cont.

Safety Focus Area 5 Cont.

During the study period, 12 accidents occurred along the horizontal curves and 6% grade east of Frazier Rd. Of the 12 accidents, 7 involved vehicles which overturned. The breakdown of "movement preceding collision" is:

Ran-off-Road: 8
Proceeding Straight: 4
See photo # 5

SAFETY FOCUS AREA 6
PM 9.63 to PM 10.52
Just West of Frazier Rd. and Along Godfrey Grade:

During the study period, 17 accidents occurred between Frazier Rd and Turnout #4 just west of Godfrey Grade. Of the 17 accidents, 3 were head-on with two of those resulting in fatalities. The breakdown of "movement preceding collision" is

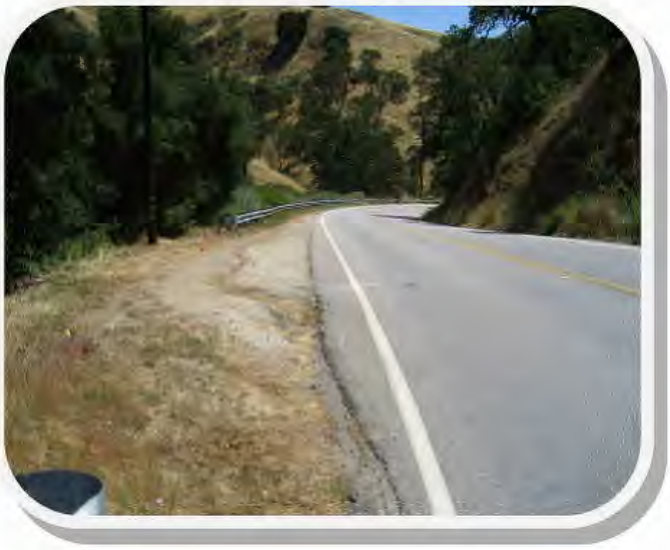
Ran-off-Road: 3
Proceeding Straight: 10
Traveled Wrong Way 1
Crossed into Opposing Lane: 1
Other Unsafe Turning: 2

The segment consists of a series of tight reversing curves with little or no paved shoulder. Approximately 1,600 feet of guardrail is in place on Godfrey Grade. At other locations along the segment, numerous high embankments exist on horizontal curves. A Hill/% grade sign is in place at the top of Godfrey Grade facing eastbound traffic. Photo #46 show Godfrey Grade in the vicinity of the guardrail.

SAFETY FOCUS AREA 7
PM 10.56 to PM 11.47
West of Godfrey Grade:

During the study period, 16 accidents occurred between Turnout #5 and the Heritage Ranch Water Treatment Facility Driveway. This area is characterized by horizontal curves and a 5% grade. Nine of the 16 accidents were "hit object" and 5 were "overturned". The breakdown of "movement preceding collision" is;

Ran-off-Road: 9
Proceeding Straight: 3
Making Left Turn: 1
Other Unsafe Turning: 2
Unsafe Speed: 1



SFA 6 Godfrey Grade Photo#46
Facing East

SFA 7 Just West of Godfrey Grade Photo #B45
Facing West

SAFETY ANALYSIS

The segment consists of a series of horizontal curves with little or no paved shoulder. Based on site reviews, a total of 13 high embankments were observed on horizontal curves. A Winding Road warning sign (W14LT) is in place on the westbound approach to the curves at PM 11.2.

Fatal Collisions: Three fatal accidents occurred in the corridor during the 7 year study period. Two of these occurred between Frazier Rd. and Godfrey Grade in SFA 6. The other occurred at PM 6.08 between Old Nacimiento Rd. East and West. These three incidents were random and did not constitute a pattern or concentration of Fatal accidents.

Intersection Analysis: Table 17 lists the accident data for corridor intersections during the study period. Intersection rates are defined as the number of accidents per million vehicles which traveled through the intersection during the study period (#acc./MV). The estimated actual accident rates and the statewide averages (SWA) for similar facilities are provided for comparison. The statewide averages for intersections are categorized and grouped according to the number of legs and whether they are in Rural, Suburban or Urban settings. All of the intersections in the Nacimiento Lake Drive corridor are in a "T" configuration. "T' intersections in Segment I are in a Suburban setting (SWA = .19 Acc/MVM) and "T" intersections in Segments II and III are in a Rural setting (SWA = .22 Acc/MVM).

Accident rates that are higher than the statewide average do not imply that locations are unsafe. The comparison provides a useful check between actual conditions and what may be "expected" at a broader level, but does not take into account specific site conditions which may differ significantly from the larger statewide "pool". For this reason the comparison is made here with the intent to identify locations which may warrant further investigation.

During the study period, the intersection at Mustang Springs Rd. had the highest accident rate of any of the intersections in the corridor (3 times the statewide average). For this reason it was identified as a Safety Focus Area (#1) discussed above. Similarly, the intersection at Oak Flat Rd. E had an accident rate slightly higher than the statewide average and was also included as a Safety Focus Area (#2). All of the other intersections were estimated to be at or below the statewide average.

Table 17 — **Estimated Intersection Accident Rates (# acc/MV)**

	# Coll	Total Acc Rate	Statewide Ave Rate
Fairview Rd.	1	.08	.19
Mustang Springs Rd.	10	.56	.19
Adelaida Rd.	2	.11	.19
Anthony Way	1	.13	.22
Oak Flat Rd. E	4	.27	.22
Valley Quail Rd.	2	.13	.22
Mustard Creek Rd.	2	.13	.22
Oak Flat Rd.	0	0	.22
San Marcos Rd.	3	.20	.22
Old Nacimiento Rd. E	2	.13	.22
Old Nacimiento Rd. W	0	0	.22
Chimney Rock Rd.	3	.13	.22
Frazier Rd.	0	0	.22
Gateway Drive	1	.08	.22
Windmill Rd.	0	0	.22
Reservoir Rd.	1	.21	.22
Steelhead Rd.	0	0	.22
Heritage Loop Rd.	0	0	.22
Blue Gill Dr.	1	.47	.22
Resort Dr.	0	0	.22

SAFETY ANALYSIS Cont.

Proactive Safety Considerations:

Site assessments were made to identify locations which, because of their geometry and traffic speeds, may experience Run-off-the-Road accident concentrations as traffic volumes increase in the future. Highway sections with a potential for Run-off-the-Road accidents are listed in Table 18. These locations are characterized by curving alignment, grades, and narrow shoulders.

Utilizing the principles of the Roadside Design Guide, high embankments within the clear recovery zone were identified within these highway segments. The length of exposure to high embankments is also summarized in Table 18. The considerations that went into the identification of the highway segments and high embankment locations were:

- Horizontal Curvature
- Grade
- Embankment Height
- Length of Exposure
- Traffic Speeds
- Future Traffic Volumes

Length of exposure was measured in the field. Embankment heights, horizontal curvature, and traffic speeds estimated from field observations. The application of clear recovery zone concepts at these and other locations along the corridor primarily target potential errant drivers and such evaluations do not imply that the locations are unsafe for drivers exercising reasonable care.

Safety Hardware Upgrades:

Guardrail is currently in place at 8 locations in the corridor (see Table 8). Four of the locations shield high embankments and 4 are used as short retaining systems.

Various guardrail features and characteristics were measured in the field and these are summarized in the Technical Appendix. The Caltrans specification for new guardrail calls for an installation height of 27-3/4" ± 1/2" measured from the top of the rail. When the guardrail height is less than 26 inches it begins to lose its ability to redirect higher center of gravity vehicles. All of the embankment guardrail has settled to some extent over the years. It was found that approximately 50% of the embankment guardrail was less than 26 inches in height.

Table 18 High Embankment Locations

Location	Postmile	Alignment	No. of High Embankment Sites	Total Length of Exposure (ft)		Feature	Notes
				LT	RT		
City Limits to Mustang Springs Rd.	0.0 to .39	Curving	1	1,200		High Embankment	
Old Nacimiento Rd E to Old Nacimiento Rd. W	5.92 to 6.55	Tangent	4	1,400	800	High Embankment	
Old Nacimiento Rd. W to Chimney Rock Rd.	6.55 to 7.59	Curving	6	1,000	600	High Embankment	
West of Chimney Rock Rd. to Turnout #1	7.59 to 8.01	Curving	1		500	High Embankment	Location in SFA 4
East of Frazier Rd., Godfrey Grade	9.43 to 10.51	Curving	5	1,050	850	High Embankment	Locations in SFA 5 and 6
West of Godfrey Grade to Gateway Drive.	10.56 to 12.12	Curving/ Tangent	13	600	1500	High Embankment	4 Locations in SFA 7
Steelhead Rd. to Resort Dr.	13.76 to 15.31	Curving	5	150	1400	High Embankment	

SAFETY ANALYSIS Cont.

Overall, the condition of the rail elements and posts are good. Photo # 94 shows a typical guardrail installation.

The leading and trailing guardrail end treatments were also evaluated and the results documented in the Technical Appendix. All of the embankment guardrail installations were fitted with Cable Anchor Assembly's Type - A (CAA-A). These end treatments met the NCHRP Report 235 test standards when they were installed but do not now meet current Report 350 test criteria. Photo #94 depicts a Cable Anchor Assembly Type A.

PM 15.15 Facing West Photo #94

FINDINGS AND RECOMMENDATIONS

The following section discusses the operational and safety characteristics of the Nacimiento Lake Drive Corridor. It also identifies potential strategies that can improve operations and safety as traffic volumes increase over the next 30 years. The Corridor assessments for potential improvements were made at 3 levels: Unconstrained, Constrained and Contingency strategies.

The unconstrained approach looked broadly at all areas along the corridor which could benefit from operational and safety upgrades as traffic volumes increase. Potential improvements which addressed these areas are listed in Table 19 (Attachment II). The potential improvements are categorized as short, medium, or long-range which gives a general indication of priority. This table was developed without consideration of funding sources and limitations. The cost estimates for potential improvements were based on basic site measurements and comparisons with other similar projects constructed in the Central Coast Area.

The constrained planning approach holds improvement costs to 5-6 million dollars based on an estimate of future funding levels over the next 30 years. In this case, proposed improvements were prioritized based on the most pressing operational and safety needs balanced against cost constraints and anticipated funding sources. These improvements are listed in Table 20 (Attachment III).

Table 21 (Attachment IV) contains recommended contingency improvement strategies. These are suggested as fallback improvements which may be considered as alternatives to those contained in the Constrained list or referred to for additional options should funding opportunities improve in the future. The Contingency Improvements were held to a ceiling of approximately 6 million dollars.

Over time, roadway features and traffic characteristics can change. The recommendations listed here are for general reference and planning and it is assumed that they may be altered or adapted as needed to accommodate changes in the corridor over the next 30 years.

Facility Operations:

The traffic volumes along the corridor vary from about 7,500 vpd near Mustang Springs Rd. to 1,000 vpd near the Nacimiento Lake Resort Driveway. At the segment level, the peak period service level is:

Segment I:	LOS C-
Grade 1 (Mountain Sprs. To Mustang Sprs.):	LOS E+
Segment II:	LOS C
Grade 4 (San Marcos to w/o Mondo Cellars):	LOS D+
Segment III:	LOS C
Grade 9 (Godfrey Gd.)	LOS C-

These service levels equate to minor peak period platooning and in the vicinity of the grades. These events may not be perceived as congestion by drivers as they tend to be localized and short lived.

From Table 12, all of the study intersections are currently operating in LOS A-B range. Delays at the intersecting local streets are minimal.

Based on projected Heritage Ranch and Oak Shores growth and historical growth rates on segments I and II, the 30 year build-out traffic volumes along the corridor are generally estimated to be approximately twice the current levels. As the traffic increases to near build-out volumes, the highway and intersections drop approximately 1 service level.

From Table 11, the build-out peak period LOS for the highway segments is projected to be:

Segment I:	LOS D-
Grade 1 (Mountain Sprs. To Mustang Sprs.):	LOS E-
Segment II:	LOS D
Grade 4 (San Marcos to w/o Mondo Cellars):	LOS D-
Segment III:	LOS D
Grade 9 (Godfrey Gd.)	LOS D

Likewise, the service levels at the study intersections will drop approximately 1 service level (see Table 12). A notable exception is the intersection at Mustang Springs Rd. which will drop from LOS B to LOS E in the AM peak and from LOS B to LOS D in the PM peak.

FINDINGS AND RECOMMENDATIONS Cont.

At build-out volumes, platooning, congestion, and delay will be become more pronounced and increase in duration. Bottlenecks will occur in the PM peak on the westbound approach to Mustang Springs Rd. and noticeable platooning and delay will occur eastbound on Grade 5 and westbound on Godfrey Grade (#9). The delay for drivers turning onto NLD at the study intersections will be 2 to 3 times the 2010 levels.

The above projected build-out service levels do not meet the County's objective of LOS C for its highways. The following discusses potential improvements that can improve the operational efficiency of the highway.

Climbing Lanes:

Climbing lanes are a possible improvement in mountainous terrain with grades greater than 3%. Table 13 shows the operational benefit derived from climbing lanes at Grades #5 and #9. The build-out PM peak LOS increases from D to C- at Grade 5 and from D to B at Grade 9. For this reason, the climbing lanes are included in the Unconstrained Listing of Improvements in Table 19 (Attachment II). However, due to the high cost of construction (8 million for Grade #5 and 11 million for Godfrey Grade), these items are not competitive in a constrained funding scenario. The terrain along Grade #1 precludes the ability to widen for an additional lane. For this reason, the potential effect of placing a climbing lane along grade #1 was not evaluated.

Passing Lanes:

Passing lanes are a possible improvement in non-mountainous terrain with grades less than 3%. However, due to grades, horizontal curvature, and the proximity of numerous driveways, passing lanes were determined to be either inappropriate or non-constructible along the corridor.

Passing Zones:

Due to sight distance considerations, passing zones are limited to only six locations along the corridor (See table 6). The westbound passing zone at Steelhead Rd. (#5) appears to have been shortened when the striping for the left turn channelization at Heritage Loop Road was installed. The current length of 730' is just at the minimum recommended by the MUTCD for 45 mph speeds. On the west end of the zone, turnout #6 overlaps and runs parallel for a short distance. Based on the observed highway speed in the area and considering the proximity to the left turn pocket and turnout, it is recommended to eliminate this zone and repaint with barrier stripe. This recommendation is considered

Passing Zone # 5 Facing West Photo # 69

competitive in the constrained funding scenario. It is therefore included in the Constrained Listing of Improvements contained in Table 20 (Attachment III). Photo # 69 depicts the westbound approach to the passing zone.

Turnouts:

During the course of the study it was observed that the existing 7 turnouts in Segment III were frequently used by the public and were effective in reducing platooning and maintaining smoother traffic flow. Since it is not possible to add striped passing zones along the corridor and since climbing lanes cannot be accomplished in a constrained funding scenario, increasing the number of turnouts is a

FINDINGS AND RECOMMENDATIONS Cont.

low cost alternative which can help improve traffic flow.

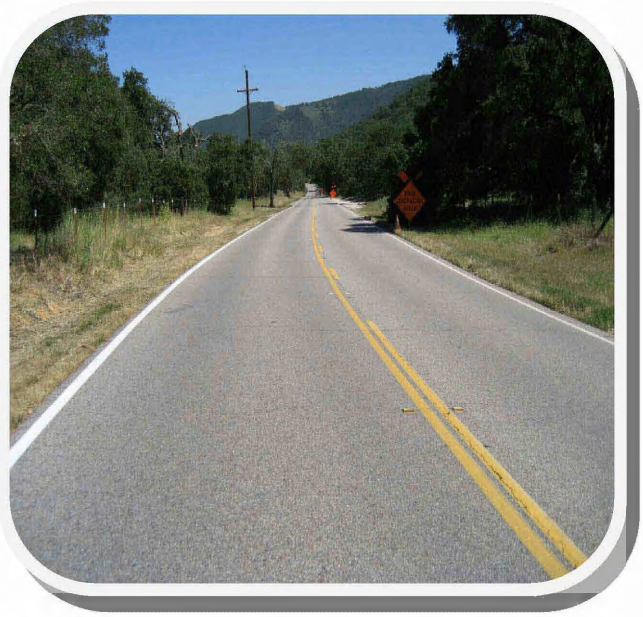
Based on site reviews, 5 possible locations for additional turnouts were identified. These are as follows:

West of Chimney Rock Rd.
PM 8.36 to PM 8.65 E/B and W/B

East of Gateway Dr.
PM 12.02 to PM 12.12 E/B and W/B

East of Heritage Loop Rd.
PM 13.90 to PM 14.00

It was also determined that the exiting pullout on the south side of the Chimney Rock Rd. intersection could be extended and converted into a turnout. The existing turnout at Blue Gill Dr. (#7) was also considered to warrant an eastbound extension of 300 feet as it is the shortest in the corridor at only 380 feet. Due to a curve on the approach it is not readily apparent to eastbound drivers. The extension would provide a length that will be more appealing to slower drivers. The five potential new locations and the two modifications of existing facilities are all included in the Unconstrained Listing of Improvements in Table 19 (Attachment II).



PM 8.36 Facing west Photo #35

Begin Westbound passing (passing zone #3)

Of the 5 possible new turnout sites, two stood out as being in locations which could serve the greatest demand and provide an appealing length. These turnouts would be located roughly on both sides of the highway between PM 8.36 and PM 8.65 (see photo # 35). This location has a relatively flat cross-section and is of sufficient width to accommodate a westbound and eastbound turnout with minimal earthwork. The existing passing in this area is relatively short (950' w/b and 845' e/b). Because of conflicting traffic, passing was observed to occur infrequently. Although this proposed location is only 1000 feet west of Turnout #1 (w/b) and 500 feet east of Turnout #2 (e/b), it is anticipated that it would provide additional appealing opportunities for slow moving vehicles to pull over. This location is considered competitive in the constrained funding scenario and is included in the Constrained Listing Improvements in Table 20 (Attachment III).

A new turnout just east of Heritage Loop Road and the extension of Turnout #7 at Blue Gill Dr. are considered to have good operational benefits and as such are included in the Constrained Listing of Improvements in Table 20 (Attachment III) as a cost effective improvement.

The possible turnouts at Gateway Drive and East of Heritage Loop Road are considered good operational improvement if additional funding becomes available and are therefore placed in the listing of Contingency Projects in Table 21 (Attachment IV). Likewise, the possible conversion of the pullout at the Chimney Rock intersection is also considered a viable contingency project if the roundabout option at the intersection is not pursued.

Pullouts:

Pullouts are the remaining option for providing opportunities for slow moving vehicles to move out of the traffic flow. They also provide emergency refuge and are routinely used by maintenance forces. Based on site reviews, 6 informal dirt pullouts were identified along corridor. The only paved pullout is on the south side of the Chimney Rock Intersection. The pullouts are listed in Table 14. Of the 7, five are in Segment III and two in Segment II. The previous section discussed the potential conversion of the pullout at the Chimney Rock Rd.

FINDINGS AND RECOMMENDATIONS Cont.

intersection to a turnout. The remaining 6 dirt pullout locations were considered to have value to drivers for operational and emergency purposes. The recommendation to pave all 6 dirt pullout locations is considered competitive in the constrained funding scenario and is therefore included in the Constrained Listing of Improvements in Table 20 (Attachment III).

Left Turn Channelization:

Left turn channelization is effective in reducing rear-end and turning related accidents at intersections. It also reduces backups and delays on the mainline. To determine the priority for channelizing intersections in the corridor, accident history was considered along with a left turn channelization delay warrant analysis per NCHRP 457 methods. The following are the recommendations for the studied intersections:

Mustang Springs Rd. - PM 0.4

Based on the reviews cited above, it was determined that Mustang Springs Rd. was the intersection with the greatest need for channelization. This intersection has the highest accident rate of any in the corridor with a pattern of eastbound rear-end type collisions. It will also meet the delay warrant for LTC as volumes increase toward build-out levels.

The intersection is located just west of a series of horizontal curves on an up-grade of 3.0%. A large drainage ravine lies directly across from the intersection. These features severely limit the ability to widen for the additional turn lane. The intersection may have to be relocated to the west to provide room for the required widening. Conceptually, the terrain to the west of the current alignment of Mustang Springs Rd. appears to be conducive to such a re-alignment without major earthwork. Because this improvement involves widening, it would coordinate well with the shoulder widening proposal between the intersection and the City Limits to the east (see Shoulder Widening proposals in this report).

The estimated cost of the intersection improvements along with shoulder widening is 3 Million.

Because this intersection and highway segment experiences the highest traffic volumes in the corridor, left and right turn channelization at the intersection and shoulder widening to the east would improve operations and safety for all users including cyclists and pedestrians. For this reason, it is contained in the Constrained Listing of Improvements in Table 20 (Attachment III) and is recommended as a mid-term improvement. This potential improvement does not take into account Right of Way, Environmental, or Utilities considerations. It is only intended as a possible option which addresses the operational and safety issues at and east of the intersection. A feasibility review of the proposal is beyond the scope of this study. If the concept is deemed to have merit, it is recommended that further study be pursued through a formal feasibility report.

Oak Flat Rd. E - PM 2.71

The intersection at Oak Flat E. has also experienced an accident pattern that is correctable with left turn channelization. Of the 5 collisions which occurred in the area of the intersection during the study period, 4 involved turning movements. Turning movement counts were not available for this intersection so a Left Turn Channelization Delay Warrant analysis was not performed.

Based on the following considerations this intersection was considered competitive as a contingency project and was placed on the Recommended Contingency Improvements listing in Table 21 (Attachment IV):

Accident History

Adjacent Driveways

Curving alignment on the approaches to the intersections

High Approach Speeds

School Bus Stop

FINDINGS AND RECOMMENDATIONS Cont.

Adelaida Rd. - PM 1.46

Other than Chimney Rock Rd, Adelaida Rd. has the highest peak turning movement volume of any of the non-channelized intersections in the corridor. As a result it currently nearly meets the delay warrant for LTC in the PM peak period. As volumes increase to build-out levels, the intersection will meet the delay warrant for all peak periods. The accident record of the intersection is good with no pattern or concentration of accidents recorded at the intersection during the 7 year study period. This positive record may be due to the good approach site distance from each direction on Nacimiento Lake Drive.

The estimated cost of constructing left turn channelization is 1.0 million dollars. Left turn channelization at this intersection will have a significant operational benefit as volumes increase in the future. It is therefore listed in the Constrained Improvement Listing in Table 20 (Attachment III) and is recommended as a mid-term project.

San Marcos Rd.– PM 5.68

The intersection at San Marcos Rd has a good safety record with no concentration or pattern of accidents. Turning volumes are currently low and as a result the intersection does not currently meet the Left Turn Channelization Delay Warrant. At build-out volumes, it will meet the AM and PM delay warrant in the eastbound direction.

At the time Left Turn Channelization is pursued, it is also recommended that shoulder widening to Old Nacimiento Rd E. be included in the project. The cost of this improvement is estimated to be 3 million dollars. Because of cost, safety and operational considerations, this proposal is not competitive in the constrained funding scenario. It is recommended as a contingency project in Table 21 (Attachment IV) should funding sources become available in the future.

Mustard Creek Rd. - PM 3.37

The intersection at Mustard Creek Rd. has a good safety record with no concentration or pattern of accidents. Turning movement counts were not available for this intersection so a Left Turn Channelization Delay Warrant analysis was not performed. The traffic volumes on Mustard Creek Rd. are about 20% higher than San Marcos Rd. so it is reasonable to assume that this intersection would have about the same priority as for Left Turn Channelization as San Marcos Rd.

At the time Left Turn Channelization is pursued, installing a paved shoulder between the intersection and Valley Quail Rd. is recommended. The cost of this work is estimated to be 1.7 million dollars. Because of cost, safety and operational considerations, this proposal is not competitive in the constrained funding scenario. It is recommended as a contingency project in Table 21 (Attachment IV) should funding sources become available in the future.

Other Intersections:

Count data was not available for the other minor intersections along the corridor. If significant growth occurs at these intersections, it is advised to apply the techniques used here for testing to see if LTC will be warranted.

Signalization:

From the Operational Analysis, it was estimated that three intersections may begin to meet the peak hour signal warrant about mid-way to Build-out volumes. These are:
Mustang Springs Rd.
Adelaida Rd.
Gateway Dr.

For this reason it was recommended that a full 8 hour warrant analysis may be warranted in roughly 15 years. Because signals will likely be justified at one or more of these intersections within the next 30 years, they are all listed as Contingency Improvements in Table 21 should they meet warrants in the future.

Intersection Configuration:

Older rural intersections were often laid out when traffic volumes were very low and the geometry would have little effect on traffic flow. As traffic volumes increase, the older configurations may not effectively handle higher

FINDINGS AND RECOMMENDATIONS Cont.

traffic demands. All of the intersections along the Nacimiento Lake Drive corridor are in a "T" configuration. The intersection at Chimney Rock Rd. is configured as a "T", but has a highly disproportionate volume of traffic utilizing the connecting leg. For this reason, this intersection was evaluated as a special case.

Chimney Rock Rd. Intersection Reconfiguration:

At this intersection, westbound drivers headed to the lake must make a right turn to stay on Nacimiento Lake Drive which tees off from the mainline. Traffic on the westbound approach to the intersection is not stopped and may continue straight onto Chimney Rock Rd. or turn right to stay on Nacimiento Lake Drive. The right turn is facilitated by the placement of a large painted island in the center of the intersection. This forms a small radius through-lane for westbound traffic travelling to the lake. Traffic returning from the lake must stop at the eastbound approach to the intersection. This is the only stop sign for mainline traffic on the corridor. Traffic in either direction on Chimney Rock Rd. is not required to stop at the intersection.

The 2010 June ADTs for Nacimiento Lake Drive east of the intersection and Chimney Rock Rd. south of the intersection are:

Nacimiento Lake Drive: 4,600 vpd
Chimney Rock Rd. 700 vpd

This means that roughly 90% of the traffic using this intersection stay on Nacimiento Lake Drive. Peak period LOS evaluations show that the intersection is currently operating at LOS A (AM Peak, Weekend Peak) and LOS B (PM Peak). At build-out volumes, the LOS fall to B and C (see Table 12). The reason the intersection remains at a high level of service is that the amount of conflicting turning movements is very low. At the stop sign, for example, the wait is usually very short because there is minimal conflicting through traffic on Chimney Rock Rd.

Often, as traffic increases on rural intersections with stop control on the mainline, there is pressure from users to free up the traffic flow. This is especially the case for commute routes. Re-aligning Nacimiento Lake Drive to the north on a large radius curve and connecting Chimney Rock Rd. at a right angle would require right of way and involve a significant level of earthwork. Such a project would likely exceed 2 million dollars. A less expensive alternative is a rural roundabout. These facilities reduce delays and effectively distribute traffic through the intersection. The existing intersection footprint is large enough to accommodate a roundabout. The estimated cost for this improvement is 1.1 million dollars. The roundabout option would standardize traffic movements at the intersection and reduce the potential for accidents as traffic volumes increase. The Rural Roundabout alternative is listed in the Constrained Improvement Listing in Table 20 (Attachment III) as a recommended long term project.

Facility Safety:

This section summarizes conclusions from the previous Safety Analysis section, and makes recommendations for potential safety improvements which may be incorporated into upcoming maintenance and operational projects. All of the improvements discussed here are contained in the Unconstrained Listing of Improvements in Table 19 (Attachment IV) for reference. Accident history, the potential for future Run-off-the-Road accidents and existing safety hardware upgrades were the primary considerations in developing the following safety improvement options:

Embankment Guardrail and Shoulder Widening (Table 18):

City Limits to Mustang Springs
PM 0.0 to PM .39
Topic: The narrow paved shoulders just east of Mustang Springs Rd. is not sufficient for bikes and pedestrians. A steep ravine exists on the south side of the roadway.

This short segment currently carries approximately 7,600 vehicles per day in the summer months. It is not a Safety Focus Area. The proposed improvement is shoulder widening and guardrail along the edge of the ravine. A retaining wall would be required along the north side of the roadway. Widening in this area would increase recovery area, improve bicycling and pedestrian safety and

FINDINGS AND RECOMMENDATIONS Cont.

reduce the severity of potential Run-off-the-Road type collisions. Because the widening would directly coordinate with proposed intersection improvements at the Mustang Springs intersection, improvements at both locations are recommended as one project (see the Intersection discussion in this report). The estimated cost of improvements at the Mustang Springs intersection and shoulder widening to the east is 3 Million dollars.

Old Nacimiento Rd. E. to Old Nacimieno Rd W.
PM 5.92 to PM 6.55
Topic: High embankments with approximately 2,200 feet of exposure and narrow paved shoulders. The alignment is on a tangent but the segment contains a passing zone which results in higher speeds.

The segment has experienced a very low occurrence of collisions and for this reason is not a Safety Focus Area. The mitigating safety improvement is shoulder widening and guardrail along the embankments. This would increase recovery area, improve bicycling safety and reduce the severity of potential Run-off-the-road collisions. The estimate for this work is 1.2 million dollars, however the improvement does not qualify as a stand alone project. It is identified in the Unconstrained Listing of Potential Improvments in Table 19 (Attachment II) only as a potential safety upgrade to be considered in whole or in part should the opportunity arise for inclusion in other categories of future projects.

Old Nacimiento Rd. W to Chimney Rock Rd.
PM 6.55 to PM 7.59

Topic: High embankments with approximately 1,300 feet of exposure. The alignment is curving with narrow paved shoulders.

Although this location is not a Safety Focus Area, safety can be enhanced by reducing the severity of potential Run-off-the-Road collisions. The mitigating safety improvement is shoulder widening and guardrail along the embankments. This would increase recovery area, improve bicycling safety and reduce the severity of potential Run-off-the-Road collisions. The estimate for this work is 1.2 million dollars however, the improvement does not qualify as a stand alone project. It is identified in the Unconstrained Listing of Potential Improvments in Table 19 (Attachment II) only as a potential safety upgrade to be considered in whole or in part should the opportunity arise for inclusion in other categories of future projects.

East of Frazier Rd., Godfrey Grade
PM 9.43 to PM 10.51

Topic: High embankments with approximately 1,900' of exposure. East of Frazier Rd., the alignment is curving on a 6% grade. On Godfrey Grade, the alignment is curving on a 12% grade. This segment includes Safety Focus Areas 5 and 6 which were discussed in the Safety Analysis. It is also inclusive of 2 fatal accident locations. On Godfrey Grade, approximately 1,600 feet of guardrail is in place. About half of this guardrail does not meet current height standards for guardrail. In addition, the guardrail end treatments do not meet current crash standards.

Due to the steep terrain through the canyon, re-alignment is not practicable. The mitigating safety improvements are shoulder widening (approximately 80% of segment length), new guardrail at high embankments, and the upgrade of existing guardrail. These improvements would increase recovery area, improve bicycling safety, and reduce the severity of Run-off-the-road collisions. The estimated cost for this improvement is $800K however, the improvement does not qualify as a stand alone project. It is identified in the Unconstrained Listing of Potential Improvments in Table 19 (Attachment II) only as a potential safety upgrade to be considered in whole or in part should the opportunity arise for inclusion in other categories of future projects.

FINDINGS AND RECOMMENDATIONS Cont.

West of Godfrey Grade to Gateway Drive
PM 10.56 to PM 12.12

Topic: High embankments with approximately 2,000 feet of exposure. This segment consists of a series of tight reversing curves with little or no paved shoulder. This segment includes Safety Focus Area 7 discussed in the Safety Analysis.

Due to the steep terrain through the canyon, re-alignment is not practicable. The mitigating safety improvement is shoulder widening (approximately 80% of segment length) and guardrail along the embankments. This would increase recovery area, improve bicycling safety and reduce the severity of Run-off-the-road collisions. The estimate for this work is $900K however, the improvement does not qualify as a stand alone project. It is identified in the Unconstrained Listing of Potential Improvments in Table 19 (Attachment II) only as a potential safety upgrade to be considered in whole or in part should the opportunity arise for inclusion in other categories of future projects.

Steelhead Rd. to Resort Driveway
PM 13.76 to PM 15.31

Topic: High embankments with approximately 1,500 feet of exposure. This segment consists of a series of both sweeping and tight reversing curves with little or no paved shoulders. Four sections of guardrail are in place along this segment (#s 5-8 from Table 8). Three of the 4 are used as short earth retaining systems. Location #6 is an 850 foot long stretch of embankment guardrail with non-standard end-treatments.

The mitigating safety improvement is shoulder widening (approximately 80% of segment length), and guardrail along the embankments. This would increase recovery area, improve bicycling safety and reduce the severity of potential Run-off-the-road collisions. It is also recommended to upgrade the guardrail end-treatments.

The estimate for this work is $500K however, the improvement does not qualify as a stand alone project. It is identified in the Unconstrained Listing of Potential Improvments in Table 19 (Attachment II) only as a potential safety upgrade to be considered in whole or in part should the opportunity arise for inclusion in other categories of future projects.

Guardrail Upgrade Shoulder Widening

Gateway Drive to Steelhead Rd.
PM 12.12 to PM 13.76

Topic: Narrow paved shoulders through winding alignment. Non-standard guardrail exists on the outside of a curve from PM 12.31 to PM 12.41.

The mitigating safety improvement is shoulder widening (approximately 80% of segment length) and guardrail reconstruction at the curve. This would increase recovery area, improve bicycling safety and upgrade safety hardware. The estimate for this work is $600K however, the improvement does not qualify as a stand alone project. and is therefore not considered competitive in the constrained funding scenario. It is identified in the Unconstrained Listing of Potential Improvments in Table 19 (Attachment II) only as a potential safety upgrade to be considered in whole or in part should the opportunity arise for inclusion in other categories of future projects.

Realignment

West of Chimney Rock Rd. to Turnout #1 (see Table 18)
PM 7.59 to PM 8.01

Topic: Tight reversing curves on a 5% grade exist with little or no paved shoulders. One high embankment exists on the outside of the curve on the W/B approach to Turnout #1. The length of exposure is approximately 500 feet. This segment encompasses Safety Focus Area #4 .

The mitigating safety improvements are minor realignment of the curves and installation of 5 foot paved shoulders for approximately 80% of segment length. This would involve the installation of an approximate 100'x8' retaining wall in cut. These improvements increase paved recovery area, improve bicycling safety and reduce the

FINDINGS AND RECOMMENDATIONS Cont.

severity of potential Run-off-the-road accidents. The estimate for this work is 2.8 million dollars however, the improvement does not qualify as a stand alone project. It is identified in the Unconstrained Listing of Potential Improvments (Table 19) only as a potential safety upgrade to be considered in whole or in part should the opportunity arise for inclusion in other categories of future projects.

West of Anthony Way
PM 2.00 to PM 2.25

Topic: This segment consists of a Sharp "S" curve on an approximate 3% grade. The speed limit is 55 mph in the area. Although this location is not a Safety Focus Area, a potential exists for future collisions as traffic volumes increase.

1 - The mitigating safety improvements are to replace the "S" curve with flatter reversing curves. This would be a long term modification if a need develops. The cost for this work is estimated to be 1.1 million dollars and is therefore not competitive in the constrained funding scenario. A benefit/cost analysis is recommended to determine if a re-alignment would be warranted in the future should a pattern of correctable collisions develops.

2 - If cross-center line accidents start to occur over the next 30 years, a mitigating improvement would be a soft barrier (Rumble Strip) along the centerline.

Soft Barrier

West of Mondo Cellars to San Marcos Rd.
PM 4.93 to PM 5.68

Center line rumble strip

Topic: This segment consists of a long horizontal curve on a 6% grade. The grade is discussed in the Operational Analysis as a potential climbing lane location (Grade # 5). This segment was also evaluated in the Safety Analysis as Safety Focus Area #3. In that analysis the accident history did not indicate a correctable pattern collisions. However, due to the length of the horizontal curve, and grade, a potential exists for cross-centerline collisions as traffic volumes increase. If cross-centerline accidents do start to over the next 30 years, a mitigating improvement would be a soft barrier (Rumble Strip) along the centerline. Because there is currently no identified benefit to the improvement it is not competitive in the constrained funding scenario.

Signing and Striping

During the course of the site reviews, warning signs were found to be in good condition and appropriately placed. Based on facility observations and the review of the accident history, the following are recommendations for additional supplemental signing which will aid in notifying of conditions not readily apparent to drivers:

SEGMENT I

Eastbound Approach to Mustang Springs Rd.
PM .49 to PM .39

Speed Feedback and Speed Zone

Topic: On the eastbound approach to Mustang Springs Rd. the speed limit drops from 55 mph to 45mph (See Photo #7). It was observed that drivers tended to brake at the last minute as they enter the curves to the east of the intersection. The vicinity of the intersection is Safety Focus Area #1 and during the study period experience a high concentration of accidents.

Due to the accident concentration in the vicinity of Mustang Springs Rd. "Reduced Speed Ahead" signs placed in advance of the intersection are recommended to give drivers early notice of the speed limit change.

Another useful tool in getting drivers to decrease their speeds are Speed Feedback Signs. These electronic signs display the drivers speed on a display over the speed limit panel. These have been used effectively where high speed rural two lane highways transition into a city environment. For this reason Speed Feedback Signs are also recommended to improve safety on this section of Nacimiento Lake Drive.

The reduced speed sign and Speed Feedback Sign are recommended as a short range strategies in the constrained funding scenario and are therefore contained in the Constrained Listing of Improvements in Table 20.

FINDINGS AND RECOMMENDATIONS Cont.

SEGMENT II

Passing Zones #1 and #2
PM 4.2/4.8 and PM 5.92/6.55
Regulatory Signs

Topic: Due to their lengths, passing zones #1 and #2 are used frequently. From field observations it was noted that the overtaking speeds were quite high and some passes could not be completed within the zone.

Given the higher speed limit in Segment II (55 mph) the installation of "DO NOT PASS" (R4-1) signs at the end of the passing zones is recommended. Signs would be placed at the end of each passing zone in both directions:

PM 4.36 e/b
PM 4.65 w/b
PM 5.93 e/b
PM 6.38 w/b

These regulatory signs are recommended as a short range strategies in the constrained funding scenario and are therefore contained in the Constrained Listing of Improvements in Table 20 (Attachment III).

SEGMENT III

Roadway Approaches to Safety Focus Areas #4, #5, #7
PM 8.10, PM 8.85, and PM 11.55

Winding Road Warning Signs

Topic: A number of locations exist either on the approach to or contained in Safety Focus Ares in which the curving alignment ahead may not be readily apparent to drivers.

Winding Road Signs (W1-5) are recommended at the approaches to the curves on the approach to or contained in Safety Focus Areas #4, #5, and #7. The specific recommended locations are:
PM 8.10 e/b
PM 8.85 w/b
PM 11.55 e/b

Relocate Winding Road Sign
Topic: A Winding Road warning sign currently exists on the eastbound approach to Safety Focus Area #7 which can be relocated to a more visible position.
Based on field observations , it is recommended that it be relocated 150 feet east of its current location to improve its visibility to on-coming drivers.

The new winding road signs and sign relocation are recommended as short range strategies in the constrained funding scenario and are therefore contained in the Constrained Listing of Improvements in Table 20 (Attachment III).

Delineation

Outside of Curve at the Crest of Godfrey Grade
PM 9.56
Delineators
Topic: During a night review, it was observed that the curve at the top of Godfrey Grade would benefit from improved night delineation.

Placing delineators on the outside of the curve at PM 9.56 e/b is recommended as a Short-range Strategy in the constrained funding scenario. This recommendation is therefore contained in the Constrained Listing of Improvements in Table 20 (Attachment III).

FINDINGS AND RECOMMENDATIONS Cont.

Pavement Drop-off

Fairview Intersection, N/W Quadrant

PM .25

Drainage Inlet

Topic: A drainage trench and drop-off exists in the westbound shoulder (See Photo #5). This drop off can present an obstacle to bicyclists and pedestrians.

Reconstruction of the drainage inlet is recommended as a Short-range improvement in the constrained scenario and is included on the Constrained Improvement Listing in Table 20 (Attachment III).

North/West corner of Fairview Intersection. Photo #5

CONCLUSIONS

The following are general conclusions based on reviews and analysis performed in this study.

Operational

- Currently, the overall peak period level of service of each of the 3 highway study segments is LOS C.
- A sustained grades exists within each of the study segments which temporarily creates a LOS lower than the segment as a whole. The locations are:

Seg I	Grade 1	LOS E+
Seg II	Grade 5	LOS D+
Seg III	Grade 9	LOS C-

These conditions tend to be short in duration and may not be noticeable or inconvenient to drivers.

- Currently, the level of service of the prominent intersections along the corridor is LOS A and B.
- Build-out traffic volumes are projected to be approximately twice the 2010 levels throughout the corridor.
- Based on estimated growth factors, the time horizon to Build-out was determined to be approximately 30 years. The Build-out year assumed in this study was therefore 2040.
- At Build-out traffic volumes, the peak period level of service on all 3 highway study segments drops approximately 1 level to the LOS D range.
- At Build-out traffic volumes, the level of service at the predominant grades listed above drop approximately 1 service level as shown below:

Seg I	Grade 1	LOS E
Seg II	Grade 5	LOS D
Seg III	Grade 9	LOS D-

- Future peak period congestion and potential bottlenecks will begin to occur at :

  Westbound approach to Mustang Springs Rd. during the PM peak period.

  Eastbound uphill grade (#5) just east of San Marcos Rd. during the weekend peak period.

  Godfrey Grade (#9) during the weekend peak period.

- These future choke points may be perceived as inconvenient to drivers.
- The cost of installing climbing lanes to address congestion at Grades 5 and 9 are too high to make them competitive in the constrained funding scenario.
- Lesser cost alternatives such as additional turnouts and paving pullouts were recommended to aid in improving traffic flow.

Safety

- The average accident rates for the 3 study segments were than the statewide average for similar highways.
- Based on accident history, 7 Safety Focus Areas were identified and analyzed. There was no indication that any of the locations were unsafe when used with reasonable care. Options for making incremental improvements to safety were identified but these types of improvements do not qualify as stand alone projects. They were presented as options should opportunities arise for inclusion in other categories of future projects.
- The Mustang Springs Rd. intersection is the only intersection with an accident rate significantly higher than the statewide average for similar facilities. The intersection was identified as a Safety Focus Area #1. Improvements to the intersection and roadway segment east to the City limits were recommended to improve operations and safety. These recommendations are contained in the Constrained Listing of Potential Improvements in Table 20 (Attachment III).
- The existing guardrail along the corridor is old and not up to current standards. It is recommended that the guardrail be brought up to current height requirements and be retrofitted with current standard end treatments.

CONCLUSIONS Cont.

Improvement Recommendations

- The Unconstrained Listing of Potential Corridor Improvements in Table 19 (Attachment II) is a comprehensive approach which identified numerous potential improvements that can have a positive effect on improving facility operations and safety over the 30 year time horizon set for the study.
- The Constrained Listing of Potential Corridor Improvements in Table 20 (Attachment III) is a paring down of alternatives based on an anticipated funding level and sources. For purposes of this study, the funding limit for improvement prioritization was approximately 6 million dollars. The recommended improvements for the corridor over the next 30 years include the following:

- Spot shoulder and drainage repair near Fairview Intersection. Estimated Cost: $10 K.
- Roadway widening between the Paso Robles City Limits and Mustang Springs Road including turning lanes at the intersection with Mustang Springs Rd. Estimated Cost: $3 Million
- Additional warning and speed related signing and striping modifications. Estimated Cost: $ 17.5 K
- Left turn channelization at the Adelaida Rd. intersection. Estimated Cost: $1.1 Million
- Remove 4 non-standard passing zones and replace with "NO PASSING" zones. Estimated Cost: $2,500.
- Construct 200' long Pullout eastbound east of San Marcos Road. Estimated Cost: $80 K.
- Rural Roundabout at the Chimney Rock Rd. intersection. Estimated Cost: $1.1 Million.
- Construct two 100' long pullouts eastbound west of Chimney Rock Rd. Estimated Cost: $70 K.
- Construct two new 600' long turnouts west of Chimney Rock Rd. Estimated Cost: $500 K.
- Construct new 600' long eastbound turnout just east of Heritage Loop Rd., extend the existing eastbound turnout at Blue Gill Rd., and pave 2 new pullouts west of Steel Head Rd. Estimated Cost: $300 K.

- The Contingency Improvement Listing in Table 21 (Attachment IV) is a listing of contingency alternatives should items from the constrained list be dropped or replaced, or should additional funding become available in the future. The recommended contingency improvements are listed below:

- Install turn channelization at the Oak Flat Road East intersection. Estimated Cost: $1 Million
- Install turn channelization and shoulder widening at the San Marcos Road intersection. Estimated Cost: $3 Million
- Install Left Turn Channelization and shoulder widening at the Mustard Creek Road intersection. Estimated Cost: $1.7 Million
- Convert existing Pullout to a longer Turnout at the Chimney Rock Road intersection. Estimated Cost: $100K
- Install 2 new turnouts just east of the Gateway Drive intersection. Estimated Cost: $300K
- When MUTCD warrants are met in the future, install signals at the intersections with Mustang Springs Road, Adelaida Rd. and Gateway Drive. Estimated Cost Each: $150K

- Tables 20 and 21 represent working level improvement alternatives which can be incorporated into planning level strategies.

The Nacimiento Lake Drive Corridor Study is presented as a planning document which should be considered flexible in interpretation and application. The findings and recommendations contained in this study are based on 2010/2011 data available for land use, traffic volumes, and accident history. These elements may change in pattern, duration, or location as growth occurs in the future. Modifications to the recommendations contained herein are expected and encouraged to meet the changing needs of the corridor over the next 30 years.

REFERENCES

2010 Highway Capacity Manual	…	FHWA
2010 MUTCD	…	California DOT, Caltrans
2006 Roadside Design Guide		AASHTO
NCHRP 457 Evaluating Intersection Improvements	…	NCHRP
Heritage Ranch Commercial Center Project	…	ATE
Traffic Control Devices	…	County of San Luis Obispo Public Works Dept.
2010 Count Data	…	County of San Luis Obispo Public Works Dept.
Traffic Volumes December 2008	…	County of San Luis Obispo Public Words Dept.
2006 Collision Data on State Highways	…	California DOT, Caltrans
NLD Accident Data	…	County of San Luis Obispo Public Works Dept.

ATTACHMENT I

Nacimiento Lake Drive

TABLE 19
NLD CORRIDOR STUDY

UNCONSTRAINED LISTING OF POTENTIAL CORRIDOR IMPROVEMENTS

LOCATION	PM	ISSUE	IMPROVEMENT DESCRIPTION	COST	TIME FRAME	CATEGORY	BENEFIT
SEGMENT I							
City Limits to Mustang Springs Rd. Intersection	PM 0.0 to PM .39	Narrow shoulders not sufficient for bikes and pedestrians. Rear-end Collisions / Furture Congestion	Widen paved shoulders to 5'. Construct 5' to 10' gravity retaining walls on north side of highway. Construct 1,200' guardrail on south side adjacent to creek and trees. Improve Mustang Springs Intersection, install left and right turn channelization.	$3.0M	Mid-range	Safety/ Operations	Improve paved recovery area Improve pedestrian and bicycle access Improve safety for errant vehicles Improve Traffic Flow, Reduce potential for rear-end collisions.
North/West quadrant of Fairview Intersection	PM .25	Drainage trench and drop-off in westbound shoulder.	Construct drop inlet, paved shoulder	$10K	Short-range	Facility preservation/ Safety	Eliminate drop-off. Improve Drainage
Eastbound Approach to Mustang Springs Rd.	PM .49 to PM .39	Speed and Collisions	A) Reduced Speed Ahead Signs B) Radar Speed Feedback Sign	$10K	Short-range	Safety/ Operations	Reduced speeds/collision potential
Mustang Springs Intersec Adelaida Rd. Intersection	PM .40 PM 1.46	Potential turning conflicts as traffic volumes increase	Signalize Intersections	$300K	Long-range	Safety/ Operations	Reduce Delay Improve Safety
Adelaida Rd. Intersection	PM 1.46	Potential for mainline delay and rear-end collisions.	Construct left turn channelization.	$1.1 M	Long-range	Safety/ Operations	Improve mainline traffic flow and reduce potential for rear-end collisions
			TOTAL	$4.42M			
SEGMENT II							
Various	PM 4.36 eb PM 4.65wb PM 5.93 eb PM 6.38 wb	Potential for unsafe passing.	Install "NO PASSING ZONE" " -" " -" " -"	$2.5K	Short-range	Safety	Reduce collision potential
West of Anthony Way	PM 2.00 to PM 2.25	Sharp "S" curve. Potential for ROR or Head-on collisions	Eliminate "S" curve, replace with flatter reversing curves	$1.1 M	Long-range	Safety	Collision reduction potential as traffic volumes increase
West of Anthony Way	PM 2.00 to PM 2.25	Sharp "S" curve. Potential for ROR or Head-on collisions	Install "Soft Barrier" on roadway centerline if x-centerline collisions occur	$70K	Mid-range	Safety	Collision reduction potential as traffic volumes increase
Oak Flat Road East	PM 2.71	Rear-end and broadside accident potential. Speed differentials caused by turning vehicles.	Construct left turn channelization and two way left turn lane at driveways.	$1.0M	Mid-range	Safety/ Operations	Reduce accident potential. Improve intersection operations.

TABLE 19 NLD CORRIDOR STUDY	UNCONSTRAINED LISTING OF POTENTIAL CORRIDOR IMPROVEMENTS						
LOCATION	PM	ISSUE	IMPROVEMENT DESCRIPTION	COST	TIME FRAME	CATEGORY	BENEFIT
SEGMENT II							
Valley Quail Rd. to Mustard Creek Rd.	PM 3.10 to PM 3.37	Narrow paved shoulders Potential future turning movement conflicts at Mustard Creek Rd.	Widen paved shoulders to 8'. Construct Left Turn Channelization at Mustard Creek Rd.	$1.7M	Long-range	Safety Operations	Reduce potential turning conflicts at intersection Improve paved recovery area Improve bicycle safety
San Marcos Rd. to West of Mondo Cellars	PM 4.93 to PM 5.68	Steep sustained grade, potential for speed differentials, delay and congestion. Accident Potential.	Construct Eastbound climbing lane	$8 M	Long-range	Operations	Improve traffic flow
West of Mondo Cellars to San Marcos Road	PM 4.93 to PM 5.68	Potential for ROR collisions	Install "Soft Barrier" on centerline of highway if x-centerline collisions occur	$80K	Mid-range	Safety	Collision reduction potential as traffic volumes increase.
700' East of San Marcos Rd.	PM 5.55	Steep sustained grade, potential for speed differentials, delay and congestion.	Construct 200' long paved Pullout eastbound.	$80K	Short-range	Operations	Provide pullout area for slow /disabled vehicles.
San Marcos Rd. Intersection to Old Nacimiento Rd. East	PM 5.68 to PM 5.92	Speed differentials caused by turning vehicles. Narrow paved shoulders	Construct Left Turn Channelization at San Marcos Rd. Widen Paved shoulders to 5'between San Marcos Rd. and Old Nacimiento Rd. East.	$3.0M	Long-range	Operations	Reduce potential future turning conflicts. Improve paved recovery room. Improve bicycling safety.
Old Nacimiento Rd. East to Old Nacimiento Rd. West	PM 5.92 to PM 6.55	Steep Embankments and potential for ROR accidents. Narrow paved shoulders.	Construct 1,400' Guardrail left and 800' Guardrail Rt. at 4 specific locations within these limits. Widen paved shoulders to 5 ft. through project limits.	$1.2M	Mid-range	Safety	Reduce severity of collisions. Improve paved recovery area. Improve bicycling safety.
Old Nacimiento Rd. West to Chimney Rock Rd.	PM 6.55 to PM 7.59	Steep Embankments and potential for ROR Accidents. Narrow paved shoulders.	Construct 1,000' Guardrail left and 300' Guardrail right at 6 specific locations.	$1.2M	Mid-range	Safety	Reduce severity of collisions. Improve paved recovery area. Improve bicycling safety.
Chimney Rock Road Intersection	PM 7.59	Minimal passing opportunities	Improve existing Pullout on south side of the intersection. Extend paving east 100' stripe and mark with delineators.	$100K	Short-range	Operations	Improve traffic flow
Chimney Rock Road Intersection	PM 7.59	Intersection layout may not be adequate for projected future commute traffic. Potential for turning conflicts and right of way confusion.	Construct Rural Roundabout.	$1.1M	Mid-range	Operations/ Safety	Improve operation and safety of the intersection . Reduce delay.
			TOTAL	$18.63M			

TABLE 19 NLD CORRIDOR STUDY — UNCONSTRAINED LISTING OF POTENTIAL CORRIDOR IMPROVEMENTS

LOCATION	PM	ISSUE	IMPROVEMENT DESCRIPTION	COST	TIME FRAME	CATEGORY	BENEFIT
SEGMENT III							
Various	PM 8.10 eb PM 8.85 wb PM 9.56 eb PM 11.02 wb PM 11.55 eb PM 13.66 to PM 13.80 wb	Sharp Curves Sharp Curves Night visibility Sign Visibility Sharp Curves Passing zone too short	Install Winding Road sign (W1-5) Install Winding Road sign (W1-5) Install delineators on outside of eastbound curve at the top of Godfrey Grade. Relocate W1-5 150' east of present location Install Winding Road sign (W1-5) Eliminate passing zone—place 2-way barrier stripe.	$500 $500 $500 $500 $500 $5K	Short-range	Safety	Reduce collision potential
West of Chimney Rock Road	PM 7.69 PM 7.73	Delay and congestion caused by slow moving vehicles	Pave 2-100' long pullouts westbound. Construct guardrail around pullouts	$70K	Short-range	Operational	Improve traffic flow. Provide emergency refuge.
West of Chimney Rock Rd. to existing Turnout	PM 7.59 to PM 8.01	Steep grade and sharp curves.	Minor re-alignment to facilitate 5' paved shoulders. Install 500' guardrail e/b on right-hand curve east of turnout. Approximate 100'x8' retaining wall in cut.	$2.8M	Long-range	Safety	Reduce potential ROR collisions. Reduce collision severity. Improve bicycling safety.
West of Chimney Rock Rd.	PM 8.16 to PM 8.76	Limited passing opportunities and steep grades cause speed differentials and delay. Steep embankment on outside of curve.	Construct 2 Turnouts; 600' long eb and wb between PM 8.36 to PM 8.65. Construct 300' guardrail eastbound between PM 8.70 to PM 8.76 Construct 5' shoulders east and west of turnouts.	$800K	Mid-range	Operational/ Safety	Improve traffic flow, reduce delay. Reduce potential ROR collisions. Reduce collision severity. Improve bicycling safety.
East of Frazier Road, Godfrey Grade	PM 9.43 to PM 10.51	Curving alignment and steep embankments. Narrow paved shoulder	Construct 2,000' of new guardrail on numerous high embankments. Reconstruct 800' existing guardrail on Godfrey Grade. Construct 5'-8' paved shoulders through 80% of project limits.	$800K	Mid-range	Safety	Reduce potential ROR collisions. Reduce collision severity. Improve bicycling safety.
Godfrey Grade	PM 9.69 to PM 10.49	Curving alignment and steep grade causes speed differentials and delay.	Construct westbound climbing lane.	$13M	Long-range	Operational	Improve facility Level of Service. Reduce delay and peak period congestion as traffic volumes increase.
West of Godfrey Grade to Heritage Ranch Gateway Dr.	PM 10.56 to PM 12.12	Curving alignment and steep embankments. Narrow paved shoulders.	Construct 1,350' guardrail westbound at 7 locations westbound. Construct 600' guardrail eastbound at 6 locations. Construct 5' paved shoulders through 80% of project limits.	$900K	Mid-range	Safety	Reduce potential ROR collisions. Reduce collision severity. Improve bicycling safety.

TABLE 19 NLD CORRIDOR STUDY	UNCONSTRAINED LISTING OF POTENTIAL CORRIDOR IMPROVEMENTS						
LOCATION	PM	ISSUE	IMPROVEMENT DESCRIPTION	COST	TIME FRAME	CATEGORY	BENEFIT
SEGMENT III							
East of Gateway	PM 12.02 to PM 12.12	Curvature and grades create speed differentials, delay and future congestion.	Construct 2 new turnouts e/b and w/b just east of Gateway Rd. I/S from PM 12.02 to PM 12.12.	$300K	Mid-range	Operational/ Safety	Improve traffic flow.
Gateway Dr. to Steelhead Rd.	PM 12.12 to PM 13.76	Narrow paved shoulders. Existing non standard guardrail at PM 12.31/ 12.41	Widen paved shoulder to 5' through 90% of the project limits. Relocate and upgrade 500' of guardrail.	$300K	Mid-range	Operational/ Safety	Improve paved recovery area. Improve bicycling safety.
Gateway Dr.	PM 12.12	Potential turning conflicts as traffic volumes increase	Signalize Intersection	$150K	Long-range	Operational/ Safety	Reduce Delay Improve Safety
Between Steelhead Rd. and Resort Dr.	PM 13.90 to PM 14.99	Curvature and grades create speed differentials, delay and future congestion	Construct e/b turnout just east of Heritage Loop Rd. Intersection (PM 13.90 / 14.0) Extend existing e/b Blue Gill Rd. turnout 300' east (PM 14.33 to PM 14.46). Construct 2 paved pullouts approximately 200' long each at PM 14.58 e/b and PM 14.99 w/b.	$300K	Short-range	Operational	Improve traffic flow. Provide emergency and maintenance refuge.
Steelhead Rd. to Resort Dr.	PM 13.76 to PM 15.31	Narrow paved shoulders. Narrow travel lanes at Heritage Loop Rd I/S. Sharp curves and steep embankments. Non-standard Guardrail at 2 locations	Construct 1,525' guardrail total at 5 high embankment locations. Widen paved shoulder to 5' through 80% of the project limits. Upgrade guardrail end treatments at 2 locations	$500K	Mid-range	Operational/ Safety	Improve paved recovery area. Improve bicycling safety. Improve paved recovery area. Reduce collision severity.
			TOTAL	19.93M			
			CORRIDOR TOTAL	42.98M			

Table 19A	ESTIMATED TIME FRAMES			
SEGMENT	Short Range	Mid-Range	Long Range	TOTAL
I	$20 K	$3.0 M	$1.4 M	$4.42 M
II	$183 K	$4.65 M	$13.8 M	$18.63 M
III	$78 K	$3.9 M	$15.95M	$19.93 M
TOTAL	**$280 K**	**$12.0M**	**$31.55M**	**$42.98 M**

TABLE 20 NLD CORRIDOR STUDY	CONSTRAINED LISTING OF POTENTIAL CORRIDOR IMPROVEMENTS						
LOCATION	PM	ISSUE	IMPROVEMENT DESCRIPTION	COST	TIME FRAME	CATEGORY	BENEFIT
SEGMENT I							
North/West quadrant of Fairview Intersection	PM .25	Drainage trench and drop-off in westbound shoulder.	Construct drop inlet, paved shoulder	$10K	Short-range	Facility preservation/ Safety	Eliminate drop-off. Improve Drainage
City Limits to Mustang Springs Rd. Intersection	PM 0.0 to PM .39	Narrow shoulders not sufficient for bikes and pedestrians. Rear-end Collisions / Future Congestion	Widen paved shoulders to 5'. Construct 5' to 10' gravity retaining walls on north side of highway. Construct 1,200' guardrail on southside adjacent to creek and trees. Improve Mustang Springs Intersection, install left and right turn channelization.	$3.0M	Mid-range	Safety/ Operations	Improve paved recovery area. Improve pedestrian and bicycle access. Improve safety for errant vehicles. Improve traffic flow, Reduce potential for rear-end collisions.
Eastbound Approach to Mustang Springs Rd.	PM .49 to PM .39	Speed and Collisions	A) Reduced Speed Ahead Signs B) Radar Speed Feedback Sign	$10K	Short-range	Safety/ Operations	Reduced speeds/collision potential
Adelaida Rd. Intersection	PM 1.46	Potential for mainline delay and rear-end collisions	Construct Left Turn Channelization	$1.1M	Mid-range	Safety/ Operations	Improve mainline traffic flow and reduce potential for rear-end collisions
			TOTAL	$4.12M			
SEGMENT II							
Various	PM 4.36 eb PM 4.65wb PM 5.93 eb PM 6.38 wb	Potential for unsafe passing.	Install "NO PASSING ZONE"	$2.5K	Short-range	Safety	Reduce collision potential
700' East of San Marcos Rd.	PM 5.55	Steep sustained grade, potential for speed differentials, delay and congestion.	Construct 200' long paved Pullout eastbound.	$80K	Short-range	Operations	Provide pullout area for slow / disabled vehicles.
Chimney Rock Road Intersection	PM 7.59	Intersection Layout may not be adequate for projected for future commute traffic. Potential for turning conflicts and right of way confusion.	Construct Rural Roundabout	1.1M	Mid-range	Operations/ Safety	Improve the operation and safety of the Intersection. Reduce Delay.
			TOTAL	$1.18M			

TABLE 20
NLD CORRIDOR STUDY

CONSTRAINED LISTING OF POTENTIAL CORRIDOR IMPROVEMENTS

LOCATION	PM	ISSUE	IMPROVEMENT DESCRIPTION	COST	TIME FRAME	CATEGORY	BENEFIT
SEGMENT III							
Various	PM 8.10 eb PM 8.85 wb PM 9.56 eb PM 11.02 wb PM 11.55 eb PM 13.66 to PM 13.80 wb	Sharp Curves Sharp Curves Night visibility Sign Visibility Sharp Curves Passing zone too short	Install Winding Road sign (W1-5) Install Winding Road sign (W1-5) Install delineators on outside of eastbound curve at the top of Godfrey Grade. Relocate W1-5 150' east of present location Install Winding Road sign (W1-5) Eliminate passing zone—place 2-way barrier stripe.	$500 $500 $500 $500 $500 $5K	Short-range	Safety	Reduce collision potential
West of Chimney Rock Road	PM 7.69 PM 7.73	Delay and congestion caused by slow moving vehicles	Pave 2-100' long pullouts westbound. Construct guardrail around pullouts	$70K	Short-range	Operational	Improve traffic flow. Provide emergency an maintenance refuge.
West of Chimney Rock Rd.	PM 8.36to PM 8.76	Limited passing opportunities and steep grades cause speed differentials and delay. Steep embankment on outside of curve.	Construct 2 Turnouts; 600' long eb and wb between PM 8.36 to PM 8.65. Construct 300' guardrail eastbound between PM 8.70 to PM 8.76	$500K	Mid-range	Operational/ Safety	Improve traffic flow, reduce delay. Reduce potential ROR collisions. Reduce collision severity. Improve bicycling safety.
Between Steelhead Rd. and Resort Dr.	PM 13.90 to PM 14.99	Curvature and grades create speed differentials, delay and future congestion	Construct e/b turnout just east of Heritage Loop Rd. Intersection (PM 13.90 / 14.0) Extend existing e/b Blue Gill Rd. turnout 300' east (PM 14.33 to PM 14.46). Construct 2 paved pullouts approximately 200' long each at PM 14.58 e/b and PM 14.99 w/b.	$300K	Short-range	Operational	Improve traffic flow. Provide emergency and maintenance refuge.
			TOTAL	$.88M			
			CORRIDOR TOTAL	$6.18M			

Table 22A	ESTIMATED TIME FRAMES			
SEGMENT	Short Range	Mid-Range	Long Range	TOTAL
I	$20 K	$4.1 M	-	$4.12 M
II	$82.5 K	$1.1 M	-	$1.18 M
III	$380 K	$0.5 M	-	$0.88 M
TOTAL	**$482 K**	**$5.70 M**	**-**	**$6.18 M**

TABLE 21 NLD CORRIDOR STUDY	RECOMMENDED CONTINGENCY IMPROVEMENTS						
LOCATION	PM	ISSUE	IMPROVEMENT DESCRIPTION	COST	TIME FRAME	CATEGORY	BENEFIT
SEGMENT I							
Mustang Springs Intersection Adelaida Rd. Intersection	PM .40 PM 1.46	Potential for mainline delay and rear-end collisions.	Signalize Intersections	$300K (2)	Long-range	Safety/ Operations	Reduce Delay Improve Safety
SEGMENT II							
Oak Flat Road East	PM 2.71	Potential for turning movement related collisions. Speed differentials caused by turning vehicles.	Construct left turn channelization and two way left turn lane at driveways.	$1.0 M	Long-range	Safety/ Operations	Improve mainline traffic flow and reduce potential for rear-end collisions
Valley Quail Rd. to Mustard Creek Rd.	PM 3.10 to PM 3.37	Narrow paved shoulders Potential future turning movement conflicts at Mustard Creek Rd.	Widen paved shoulders to 8'. Construct Left Turn Channelization at Mustard Creek Rd.	$1.7M	Long-range	Safety Operations	Reduce potential turning conflicts at intersection Improve paved recovery area Improve bicycle safety
San Marcos Rd. Intersection to Old Nacimiento Rd. East	PM 5.68 to PM 5.92	Speed differentials caused by turning vehicles. Narrow paved shoulders	Construct Left Turn Channelization at San Marcos Rd. Widen Paved shoulders to 5'between San Marcos Rd. and Old Nacimiento Rd. East.	$3.0M	Long-range	Operations	Reduce potential future turning conflicts. Improve paved recovery room. Improve bicycling safety.
Chimney Rock Road Intersection	PM 7.59	Minimal Passing Opportunities	Improve exiting Pullout on south side of the intersection. Extend paving east 100' and stripe and mark with delineators.	$100K	Mid-range	Operations/ Safety	Improve Traffic Flow
SEGMENT III							
Gateway Dr.	PM 12.02 to PM 12.12	Curvature and grades create speed differentials, delay and future congestion.	Construct 2 new turnouts e/b and w/b just east of Gateway Rd. I/S from PM 12.02 to PM 12.12.	$300K	Mid-range	Operational/ Safety	Improve traffic flow.
Gateway Dr.	PM 12.12	Potential turning conflicts as traffic volumes increase	Signalize Intersection	$150K	Long-range	Operational/ Safety	Reduce Delay Improve Safety
			TOTAL	**$6.55 M**			