CITY OF SANTEE TRANSPORTATION IMPROVEMENT MASTER PLAN

Final Report

Submitted to

City of Santee

Submitted by

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EXECUTIVE SUMMARY

The purpose of the City of Santee Transportation Improvement Master Plan is to identify existing and future transportation opportunities, constraints and needs; and develop strategies for staged implementation to improve traffic operations throughout the City. This document, through an engineering process, identifies the existing deficiencies and future transportation needs and develops a set of operational and technological based transportation improvements for a phased implementation. The objective is to employ operational improvements and Intelligent Transportation Systems (ITS) strategies to meet the City's transportation needs and to attain the following benefits:

- Greater efficiencies from the transportation system;
- Increased roadway safety;
- Improved traffic signal operations;
- Improved interagency/inter-jurisdictional public communications and coordination;
- Accommodate increased travel through the region;
- Accommodate the anticipated changes in traffic volumes resulting from increased land development.
- Improved incident response and scene management;
- Expanded traveler information dissemination;
- Enhanced convenience, effectiveness and interconnectivity of transit operations;
- Support economic development;

It is expected that by implementing the operational improvements and ITS strategies the overall existing and future circulation within the City would noticeably improve.

Overall, the City's circulation system is currently operating at reasonably acceptable levels throughout the day, although a few of the major intersections do experience heavy congestion during peak periods. Current traffic conditions within the City are heavily influenced by the partial completion of State Route (SR) 52. When SR 52 is completed in 2011, as currently scheduled, the net volume on Mission Gorge Road will drop as much as 20% as the pass through traffic will then be diverted to the new freeway.

There will be considerable changes to the level of service (LOS) as well as the general traffic operations, as a result of traffic increase due to new development. There are two major planned developments within the Northern and downtown portion of the City (Fanita Ranch and Riverview Office Park Project, respectively). The priority corridors whose volume will be affected by the new developments may require capacity increase and timing and coordination adjustments. In addition, there is a 5 year Capital Improvement Program (CIP) with 54 different projects, of which 44 are fully funded. This CIP is scheduled for the Fiscal Years (FY) 2006 through 2010 and includes projects that will alleviate the projected increase in vehicle delay.

Through a review of the existing conditions and discussion workshops with City staff, the following is a summary of the general transportation needs identified for the City of Santee:

- Completion of State Route 52 to State Route 67
- Improve overall circulation within the City
- Minimize the overall trip delay to travelers
- Improve traffic signal operations at congested intersections

- Improve traffic flow along priority corridors
- Minimize delay to side street traffic at major intersections
- Increase roadway safety
- Accommodate the anticipated changes in traffic volumes resulting from the new residential and commercial developments
- Accommodate and control the increased regional pass through traffic
- Increase public transportation ridership, specifically the San Diego Trolley ridership

In order to meet the City's needs and to take advantage of the many advancements in technology and the deployment of ITS, a number of strategies, applicable to the City of Santee, have been identified. ITS can readily provide traffic management staff with the tools to more effectively and efficiently manage the existing transportation system through real-time traffic information, quick incident/emergency response, and other traffic control management strategies. The potential strategies take advantage of both traditional and more advanced technological based (ITS) types of improvements. These strategies are:

1. Operational Improvements
2. Advanced Transportation Management Systems (ATMS)
3. Advanced Traveler Information Systems (ATIS)
4. Advanced Public Transportation Systems (APTS)

A vision plan has been formed to satisfy the existing and anticipated future needs and contains the applicable recommended improvements. A series of short-term, intermediate, and long-term projects were developed to improve traffic operations:

PROJECTS		COST
SHORT-TERM PROJECTS		
P1: Reinstallation of Advance Loop Detection at Critical Intersections		**$ 52,000.00**
	Description: This project involves the design and construction of the advance vehicle detection systems at five intersections.	
P2: Installation of Protected/Permissive Left-Turn at other locations		**$ TBD**
	Description: Additional locations will be considered as they are identified by City staff.	
P3: Continued Signal Coordination Improvements		**$ 100,000.00**
	Description: This project will prepare timing plans for signal coordination along the priority corridors.	
5% Contingency for Operation & Maintenance (Short-Term Projects)		*$ 7,500.00*
INTERMEDIATE PROJECTS		
P4: Continued Signal Coordination Improvements		**$ 100,000.00**
	Description: Two to three years after the previous signal coordination improvement, plans would need to be revised again to accommodate the changes in traffic and signal operation.	
P5: Traffic Control System (TCS) Upgrade		**$ 782,500.00**
	Description: This pilot project includes the installation of the BI Tran QuicNet/4 software and hardware and the replacement of the existing controllers with Type 170 controllers at two major corridors (Mission Gorge Road and Cuyamaca Street) and TSP at 5 intersections near trolley line.	
P6: Deployment of Video Detection at Major Intersections		**$ 83,000.00**
	Description: Concurrent with paving projects, this project will install video detection cameras for all approaches at two locations – Magnolia Avenue at Mast Boulevard and Mission Gorge Road.	

PROJECTS	COST
P7: Install Communication along Gaps in the Traffic Signal System	**$ 967,000.00**
Description: This project recommends closing the interconnect gap along the entire corridors of Mission Gorge Road and Cuyamaca Street concurrent with or before the TSC upgrade. As well as installing interconnect along Magnolia Avenue from Mast Boulevard to the TMC.	
5% Contingency for Operation & Maintenance (Intermediate Projects)	*$ 96,500.00*
LONG-TERM PROJECTS	
P8: Critical Intersection Improvements	**$ TBD**
Description: As development occurs, potential improvements critical intersections should be implemented, which include operation improvements, signal modifications, and geometric enhancements as directed by City staff.	
P9: Continued Signal Coordination Improvements	**$ 100,000.00**
Description: Every 2 to 3 years after coordination plans have been modified it is recommended that the plans be reviewed again, especially since projects are being implemented citywide.	
P10: Remote Traffic Control Workstation at Sheriff's Department	**$ 64,000.00**
Description: After the TCS upgrades on Cuyamaca Street, a new remote workstation, via a telephone line, at the Sheriff Department should be communicating via the new system.	
P11: Continued Traffic Signal Control System Upgrade	**$ 360,000.00**
Description: Once the first two corridors are upgraded and fully functional, major corridors intersecting Mission Gorge Road or Cuyamaca Street, should begin their controller replacement.	
P12: Installation of CCTV Cameras at Critical Intersections	**$ 390,000.00**
Description: During or after the controller upgrade, installation of the proposed CCTV monitoring cameras should also be deployed. There are a total of 10 recommended CCTV camera locations.	
P13: City of Santee TMC Capacity Expansion	**$ 390,000.00**
Description: Depending on the progress of ATIS, ATMS, and communication improvements, the TMC is recommended to be upgraded once a large portion of the enhancements has occurred.	
P14: Web-based Traveler Information Dissemination	**$ 60,000.00**
Description: With all the new developments, especially the extension of SR 52, the community will greatly benefit from a web-based traveler information guide.	
P15: Deployment of Trailblazer Signs	**$ 78,000.00**
Description: Trailblazer signs should be placed along Mission Gorge Road (East and West of SR 52/SR 125) and Magnolia Avenue (South of Prospect to SR 67) to guide traffic in and out of Santee.	
P16: System Integration	**$ 390,000.00**
Description: During the planning stages of the TMC expansion, system integration should be a large factor in the final design.	
P17: Continue to Install Signal Interconnect System	**$2,006,500.00**
Description: Major corridors, which still require interconnect include Mast Boulevard, Carlton Oaks Drive, Prospect Avenue, Carlton Hills Boulevard, and Magnolia Avenue. Modes of communication consist of fiber, twisted pair, and wireless.	
P18: Roadway Improvements	**$ TBD**
Description: Widening of lanes, extension of corridor, and other roadway improvements.	
Contingency for Operation & Maintenance (Long-Term Projects)	*$ 192,000.00*
TOTAL (Short-Term, Intermediate, and Long-Term Projects)*	***$ 6,219,500.00***

***** Total cost does not include projects whose costs remain to be determined (TBD).

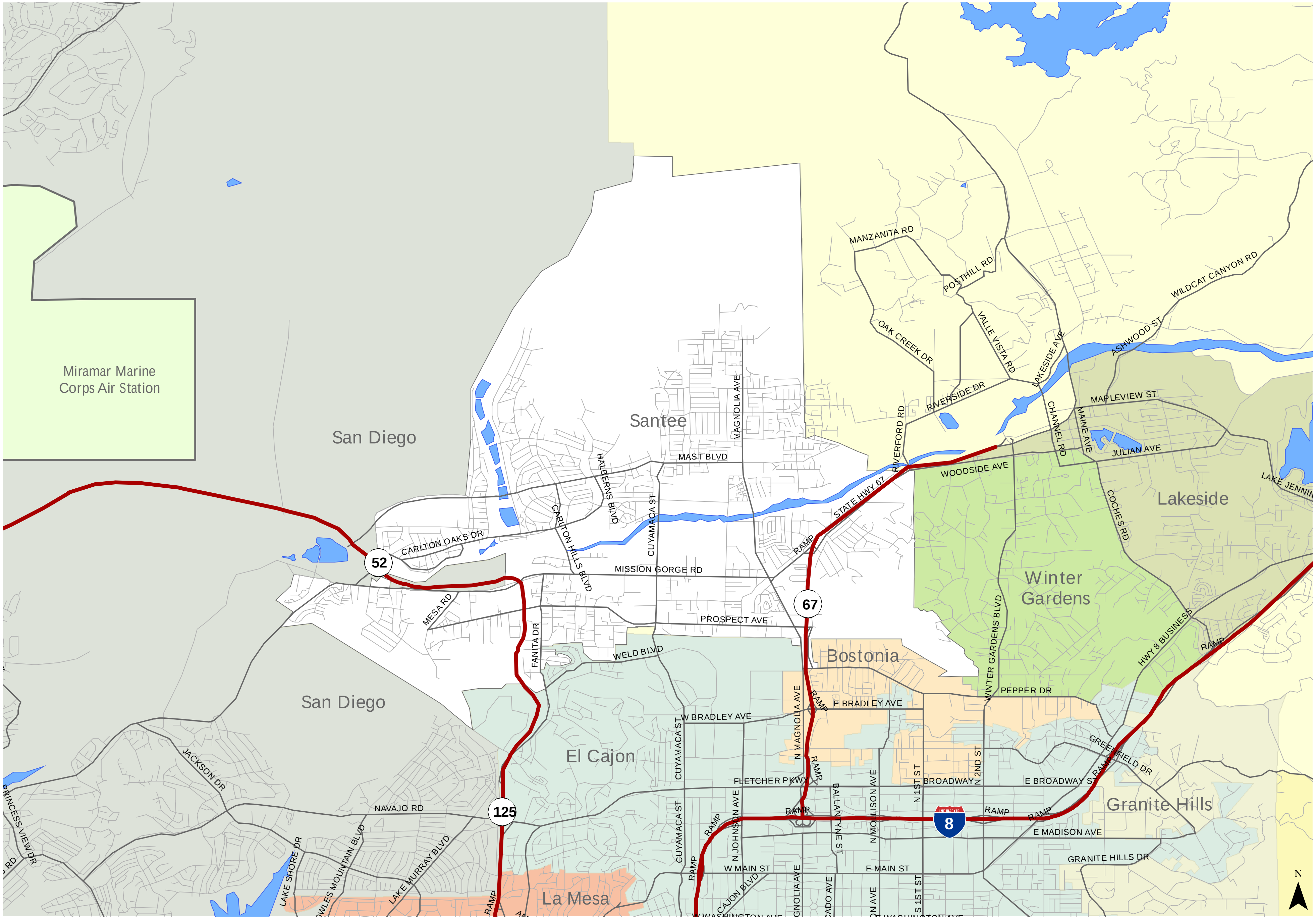
The City of Santee is the ultimate decision maker as to when and where the proposed improvements are deployed. These strategies and programs may be modified to meet specific funding requirements, area growth patterns, and CIP's. It is envisioned that when the proposed improvements are completed, the projects will collectively reduce the city-wide travel time; shorten the travel time along Prime arterials; provide opportunity for real time surveillance of traffic flow and incidents; reduce response time; and enhance intersection levels of service.

1.0 INTRODUCTION

The City of Santee is located in Central San Diego County about 18 miles east of downtown San Diego. Santee is bordered on the west and southwest by the City of San Diego and Marine Corps Air Station Miramar, on the south by the City of El Cajon and the community of Bostonia, on the north by San Diego County lands and on the east by the unincorporated communities of Lakeside, Eucalyptus Hills and Winter Gardens. Regional access to the City is provided via State Routes 52, 67 and 125. **Figure 1.1** shows the City of Santee in an area wide context.

Santee's circulation and transportation systems play major roles in shaping the future form and character of the City by directly affecting the location of commercial, industrial, housing, recreational and public uses. The overall goal of the City's circulation and transportation systems is to provide for safe and efficient vehicular movement on major roads, while discouraging unnecessary traffic movement in residential neighborhoods and minimizing pass through traffic on City streets. This can be primarily accomplished by effectively designing traffic routes according to their functions, while maintaining design sensitivity to surrounding land uses and providing adequate regional freeway access points throughout the City.

The purpose of this document, City of Santee Transportation Improvements Master Plan, is to examine the City's current transportation system and traffic operations, identify existing and future transportation opportunities and constraints, and develop short-term, intermediate and long-term strategies to improve traffic operations.



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City of Santee Transportation Improvement Master Plan

Study Area - City of Santee, California

Figure 1.1

2.0 EXISTING TRANSPORTATION CONDITIONS

This section of the report documents the existing transportation network in the City of Santee. It provides an inventory of the existing traffic, transit, and signal system and communication infrastructure of the City. This section also summarizes other pertinent projects currently underway within the City.

2.1 Streets and Highways Network

The City's presently adopted circulation system identifies the following classification of roadways:

- Freeways – State Route (SR) 52, SR 67 and SR 125 provide regional access to the City. These freeways are being constructed and maintained by the California Department of Transportation (Caltrans).

- Prime Arterials –Prime arterials are high capacity roadways providing regional access. Along these roadways, direct access to adjacent parcels is minimized to maximize speed and limit interference with traffic flow. Prime arterials normally have two or three travel lanes in each direction, and may have central medians. The following arterials are designated as Prime arterials:
  - Magnolia Avenue (Mission Gorge Road to Prospect Avenue)
  - Mission Gorge Road (State Route 125 to Magnolia Avenue)

- Major Arterials – Major arterials have relatively high capacity and provide area-wide access. Direct access or adjacent parcels are also minimized to maximize speed and limit interference with traffic flow. Major arterials normally have two or three travel lanes in each direction, and may have median islands. The following roadways are designated as Major arterials:
  - Carlton Hills Boulevard
  - Cuyamaca Street
  - Magnolia Avenue (Princess Joann Road to Mission Gorge Road)
  - Mast Boulevard
  - Mission Gorge Road (Western City Limits to State Route 125)
  - Prospect Avenue (Between Cuyamaca Street and Magnolia Avenue)
  - Woodside Avenue (Between Magnolia Avenue and State Route 67)

- Collectors – Collectors are intermediate capacity roadways providing access between local streets and the arterial street system. Speeds are generally higher than those on local streets, and on-street parking may be limited in some cases to provide smoother traffic flow. Collector streets generally have one or two travel lanes in each direction.

- Local Streets – Local streets are low capacity roadway providing direct access to individual parcels. Local streets are not intended to carry regional through traffic and traffic speeds should be low to provide safe access to and from individual residences or businesses. On-street parking is generally provided and does not interfere with circulation functions.

2.2 Public Transportation

As an alternative to automobile travel, several transit opportunities exist in the City of Santee.

- Bus Service – Bus Service in the City of Santee is provided by Metropolitan Transit System (MTS), served by seven bus routes. All these routes stop at Santee Transit Station to allow passengers to transfer to the San Diego trolley. Also, there are two express bus routes, with stops at Santee, providing access to high employment areas outside the City. The City has worked closely with the MTS Board and SANDAG (County) Transit Services to increase transit opportunities and to implement a bus stop shelter program within the City.

- San Diego Trolley – The present San Diego Trolley route to Santee (the "Green Line" via Mission Valley) provides service to Old Town and transfers can be made to travel to downtown San Diego via the "Orange Line" at the Grossmont Center Station. The San Diego Trolley also provides access to the Coaster, which provides intercity passenger rail service between San Diego and Los Angeles.

- Senior Citizen and Handicapped transit – Reduced fees, priority seating and kneeling buses are provided for senior citizens and disabled transit users. Also, all the buses and trolleys have lift mechanisms to assist customers in wheelchairs or with other mobility impairments to board. Special public transportation is also provided to the senior and the disabled by a "Dial-A-Ride" service which utilizes lift equipped vans for wheelchair accessibility. This service provides curb to curb weekday service.

2.3 Emergency Services

The City's emergency services include fire and police. The Santee Fire Department operates emergency vehicles out of their fire stations located at:

- Headquarters (Office) – 10601 Magnolia Avenue
- Fire Station 4 – 8950 Cottonwood Avenue
- Fire Station 5 – 9130 Carlton Oaks Drive

The City has emergency vehicle preemption systems at all traffic signals within the City to improve emergency vehicle response times. The Fire department is the only entity that operates the signal preemption via Opticom at signalized intersections.

The City of Santee is served by the San Diego County Sheriff's department. The Santee Sheriff's Station serves the City of Santee and the unincorporated communities of Lakeside and El Cajon. The office is located at 8811 Cuyamaca Street.

2.4 Traffic Conditions

An assessment was made of the existing traffic conditions. The purpose of examining the existing level of congestion is to compile existing information to be utilized in the development of priority corridors, critical intersections and identification of deficiencies and needs for the subsequent development of improvement strategies.

2.4.1 Corridor Conditions

Current traffic conditions within the City are heavily influenced by the partial completion of the SR 52. Consequently, much of the regional traffic is pass-through traffic using the City's East-West surface streets to access the freeway. In particular, drivers may use Mission Gorge Road as a connector route between SR 52 and SR 67. When SR 52 is completed in 2011, as currently scheduled, the volume on Mission Gorge Road will drop as much as 20% as the pass through traffic will then be diverted to the new freeway. **Figure 2.1** provides the most recent ADT information along the City's arterials. Some of the key corridor conditions are:

- Mission Gorge Road presently exists as a six-lane road and carries between 34,600 and 57,500 average daily trips (ADT) with approximately 5% per year increase. Mission Gorge Road experiences an observed average of 3-4% trucks. Mission Gorge Road is a key road in Santee's transportation network because it serves as a regional arterial as well as providing access to the primary commercial areas of the City.

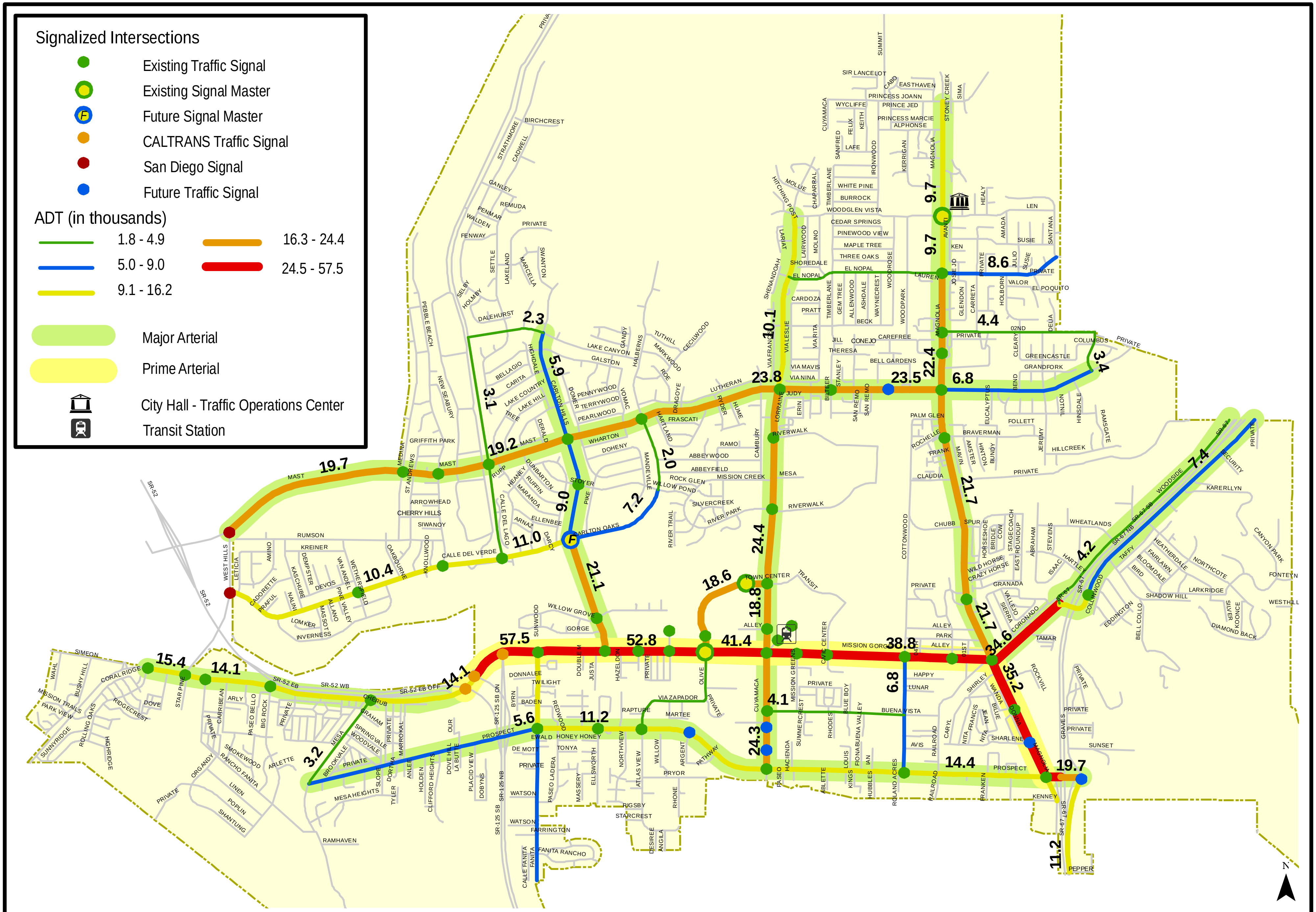
- Mast Boulevard at four lanes carries between 19,600 to 23,800 average daily trips with the highest traffic volume occurring between Cuyamaca Street and Magnolia Avenue.

- Prospect Avenue carries between 5,600 to 19,200 average daily trips. Prospect Avenue is predominantly a two-lane road at this time.

- Magnolia Avenue and Cuyamaca Street are four-lane roads except south of Mission Gorge Road where both streets widen to six lanes. Traffic volumes average between 5,500 to 35,200 daily trips on Magnolia Avenue and 10,100 to 24,300 daily trips on Cuyamaca Street, with the highest volumes being in the immediate vicinity of Mission Gorge Road and Prospect Avenue.

- SR 52 extends from SR 125 west to Interstate 5. The portion of the freeway in Santee carries between 41,500 to 71,000 average daily trips. State Routes 67 and 125 are important regional routes carrying between 35,000 to 48,000 ADT.

In 2003, the City hired a Traffic Engineering consultant to develop coordinated traffic signal timing plans along all major arterials within the City. After the coordinated timing plans were implemented, the City was able to address public complaints regarding travel time delays by conducting a series of travel time surveys estimating the amount of time and average speed it took to traverse the length of key corridors within the City. The ultimate goal of the improvement strategies that the signal coordination project achieved was a reduction in the travel time and increase in the average speed it took to traverse the City's key corridors with minimum delay to side street travelers. These studies revealed that travel times improved after some minor signal timing fine tuning.



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City of Santee Transportation Improvement Master Plan

Existing Average Daily Traffic (ADT)

Figure 2.1

2.4.2 Intersection Conditions

Overall, the City's circulation system is operating at reasonably acceptable levels throughout the day, although a few of the major intersections do experience heavy congestion during peak hours. These intersections are in the core commercial areas along Mission Gorge Road and include the intersections of Mission Gorge Road with Cuyamaca, Magnolia, Carlton Hills and the approaches to the ramps for State Routes 52, 67 and 125.

As part of the city wide traffic signal coordination project, the level of service (LOS) calculations were performed at all major intersections. In the 2000 Highway Capacity Manual (HCM), LOS for signalized intersections is defined in terms of delay. The level of service analysis results in seconds of delay expressed in terms of letters A through F. Delay is a measure of driver discomfort, frustration, fuel consumption, and lost travel time.

For signalized intersections, levels of service criteria are stated in terms of average control delay per vehicle for a 15-minute peak analysis period. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Table 2.1 summarizes the delay thresholds for signalized intersections.

Table 2.1: Level of Service Thresholds for Signalized Intersections

Average Control Delay Per Vehicle (seconds/vehicle)	Level of Service
0.0 ≤ 10.0	A
10.1 to 20.0	B
21.1 to 35.0	C
35.1 to 55.0	D
55.1 to 80.0	E
≥ 80.0	F

Level of service A describes operations with very low delay, (i.e. less than 10.0 seconds per vehicle). This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.

Level of service B describes operations with delay in the range 10.1 seconds and 20.0 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher level of average delay.

Level of service C describes operations with delay in the range 20.1 seconds to 35.0 seconds per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.

Level of service D describes operations with delay in the range 35.1 seconds and 55.0 seconds per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or higher v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are more frequent.

Level of service E describes operations with delay in the range of 55.1 seconds to 80.0 seconds per vehicle. This is considered to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.

Level of service F describes operations with delay in excess of over 80.0 seconds per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with over-saturation (i.e., when arrival flow rates exceed the capacity of the intersection). It may also occur at high v/c ratios below 1.00 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Table 2.2 lists the levels of service (LOS) of signalized intersections in the City of Santee. The intersections in bold are major intersections, as identified by City staff. The intersection rankings represent the top 10 congested signalized intersections in the City. Mission Gorge Road at Magnolia Avenue intersection has the highest congestion followed by Mission Gorge Road at Cuyamaca Street.

Table 2.2: Signalized Intersection Levels of Service[1]

No.	Intersection	AM Peak	PM Peak	Rank
1	**Mission Gorge Rd./Magnolia Ave.**	**D**	**F**	**1**
2	**Mission Gorge Rd./Cuyamaca St.**	**D**	**D**	**2**
3	**Mission Gorge Rd./Fanita Dr.**	**B**	**E**	**3**
4	**Mission Gorge Rd./Town Center Pkwy.**	**C**	**E**	**4**
5	**Mast Blvd./Magnolia Ave.**	**D**	**D**	**5**
6	**Mission Gorge Rd./Carlton Hills Blvd.**	**D**	**C**	**6**
7	**Magnolia Ave./Prospect Ave.**	**C**	**D**	**7**
8	**Mast Blvd./Cuyamaca St.**	**D**	**D**	**8**
9	**Mast Blvd./Carlton Hills Blvd.**	**C**	**C**	**9**
10	**Carlton Hills Blvd./Carlton Oaks Dr.**	**C**	**C**	**10**
11	Carlton Hills Blvd./Willow Grove Dr.	A	A	--
12	Carlton Oaks Dr. /Fanita Pkwy.	A	A	--
13	Cuyamaca St./River Park Dr.	A	B	--
14	Cuyamaca St./Town Center Pkwy.	B	C	--
15	Cuyamaca St./Buena Vista Ave.	A	B	--
16	Cuyamaca St./Prospect Ave.	C	C	--
17	Magnolia Ave./Woodglen Vista Dr.	B	B	--
18	Magnolia Ave./El Nopal	C	C	--
19	Magnolia Ave./Second St.	B	A	--
20	Magnolia Ave./Carefree Dr.	B	A	--
21	Magnolia Ave./Braverman Ave.	A	A	--

[1] Intersection Levels of Service (LOS) was provided by the City of Santee.

No.	Intersection	AM Peak	PM Peak	Rank
22	Magnolia Ave./New Frontier Mobile	A	A	--
23	Magnolia Ave./Alexander Wy.	A	A	--
24	Mast Blvd./Medina Dr.	B	A	--
25	Mast Blvd./Pebble Beach Dr.	A	A	--
26	Mast Blvd./Fanita Pkwy.	C	B	--
27	Mast Blvd./Halberns Blvd.	B	B	--
28	Mast Blvd./Bilteer Dr.	A	A	--
29	Mission Gorge Rd./Father Junipero	A	A	--
30	Mission Gorge Rd./West Hills Pkwy.	B	C	--
31	Mission Gorge Rd./Rancho Fanita Dr.	B	A	--
32	Mission Gorge Rd./Big Rock Rd.	A	A	--
33	Mission Gorge Rd./Mesa Rd.	A	B	--
34	Mission Gorge Rd./Tamberly Wy.	B	C	--
35	Mission Gorge Rd./Cottonwood Ave.	B	B	--
36	Mission Gorge Rd./Edgemoor Dr.	A	A	--
37	Prospect Ave./Fanita Dr.	C	C	--
38	Prospect Ave./Ellsworth Lane	A	A	--
39	Prospect Ave./Atlas View Dr.	A	A	--
40	Town Center Pkwy./Home Town Buffet	A	B	--
41	Town Center Pkwy./Costco Entry	B	C	--
42	Carlton Hills Blvd./Stoyer Dr.	C	B	--
43	Cuyamaca St./Trolley Square Dwy.	C	B	--
44	Mission Gorge Rd./Mission Greens Rd.	A	B	--

2.4.3 Existing and Planned Intelligent Transportation System (ITS) Elements

The Clock Tower Transit Center is currently operating a Next Bus signing system, which is known as an Advanced Traveler Information System (ATIS) element, and is also wired for a kiosk which would be especially beneficial at its location. These are elements owned and operated by the Metropolitan Transit System in the City.

The City has Opticom at signals that are currently being used only for Fire preemption, which is known as an Advanced Transportation Management System (ATMS) element. Due to the increase in roadway construction improvements and new developments, the City has available one locally programmable portable Dynamic Message Sign (DMS) at its disposal to use when major construction or incident has occurred on city streets.

Another ATMS element the City uses is video detection cameras. The video detection cameras are at the following locations:

- Cuyamaca Street and Trolley Square Driveway/Home Depot Driveway
- Mission Gorge Road and Cuyamaca Street
- Mission Gorge Road and Mission Greens Road
- Mission Gorge Road and Town Center Parkway

- Mission Gorge Road and Lowes East Driveway/Mobile Estates Driveway
- Mission Gorge Road and Lowes West Driveway/Roller Skate Land Driveway

The City has an existing closed circuit television (CCTV) camera at the intersections of Mission Gorge Road and Cuyamaca Street that is used for monitoring real-time traffic along the two corridors and to monitor the trolley operation.

The City has received federal Congestion Mitigation and Air Quality (CMAQ) grants to upgrade traffic signal controllers and cabinets for the Cuyamaca Street trolley corridor and to interconnect existing traffic signals along Mast Boulevard.
As a test project, the city is considering the use of protected/permissive left-turn operation at Carlton Oaks Drive at Fanita Parkway and Pebble Beach Drive. This ATMS element will help facilitate traffic flow on Carlton Oaks Drive.

2.5 Priority Corridors

For the purposes of this analysis, the priority corridors are those roadways that have or will have a significant role in the City's transportation network. This is based on existing conditions as identified by average daily traffic (ADT), accident information, importance of the roadways to the existing transportation system, regional significance, and the roadway importance to the City's future transportation system. The following prime and major arterials are identified as priority corridors.

East-West Corridors:

- *Mast Boulevard* – Mast Boulevard is an East/West four lane corridor that runs through the City from West Hills Pkwy to Magnolia Avenue. It is a four lane road and carries between 19,600 and 23,800 average daily trips with the highest traffic volume occurring between Cuyamaca Street and Magnolia Avenue. It provides a direct connection to State Route 52 (SR 52) at the west end of the City.

- *Mission Gorge Road* – Mission Gorge Road is an East/West Corridor that runs from Magnolia Avenue to West City Limit. It is an important corridor because it is being used as an alternative route to the proposed SR 52 freeway extension. It presently exists as a four to six lane road and carries between 34,600 and 57,500 average daily trips.

- *Prospect Avenue* – Prospect Avenue is an East/West major road that runs from Magnolia Avenue to Fanita Drive. It is predominantly a two-lane road and carries between 5,600 and 19,200 average daily trips. The highest traffic volume occurs between Cuyamaca Street and Magnolia Avenue. Prospect Avenue provides direct access to State Route 67 (SR 67) at Magnolia Avenue.

North-South Corridors:

- *Cuyamaca Street* – Cuyamaca Street is a north/south four to six lane corridor that traverses from Prospect Avenue to the northern terminus point past Mast Boulevard. Average daily traffic volumes are between 10,100 and 24,300. The trolley runs in the median of Cuyamaca Street from Prospect Avenue to the Santee Trolley Square.

- *Magnolia Avenue* – Magnolia Avenue is a major north/south four to six lane corridor that traverses through the City from Prospect Avenue to Len Street. It provides direct access to SR 67 at Prospect Avenue. Average daily traffic volume is between 5,500 and 35,200.

- *Carlton Hills Boulevard* – Carlton Hills Boulevard is a four lane north/south corridor that traverses from Mission Gorge Road and through the residential areas to Lake Canyon Road. The average daily traffic volume is between 5,000 and 21,100; however, it is expected to increase after the completion of SR 52 in 2011.

2.6 Existing Signal System

Traffic Control System: The City uses the Econolite ARIES traffic control system, which is a MS-Windows based data management and closed loop monitoring and control system from Econolite Incorporated. The system is capable of applying the time-of-day and traffic responsive control strategies to the traffic signals from City Hall. There are three on-street Master Econolite ASC/M controllers throughout the City, each controlling a separate zone (group) of the City's signalized intersections. Communications from City Hall to the Master Controllers currently are via dial up phone lines. Local controllers are National Electronic Manufacturers Association (NEMA) Econolite ASC/2 (**Figure 2.2**) and are mostly connected to the field Masters via leased phone lines and hardwire interconnect. Santee is the only City in the San Diego County region that uses NEMA type controllers. All local city jurisdictions including Caltrans use a Type 170 controller hardware for their traffic signals.

Figure 2.2: NEMA Econolite ASC/2 Controller at Mission Gorge Rd & Cuyamaca St

In the spring 2003, the City hired a Traffic Engineering consultant to develop coordinated traffic signal timing plans city wide.

Coordinated Systems: Coordinated signalized intersections in the City of Santee utilize time of day coordination plans. The coordinated systems developed by the Traffic Engineering consultant use various cycle lengths throughout the City. **Table 2.3** summarizes the cycle lengths for AM, midday and PM peak periods. City staff fine-tuned these timing plans in response to citizen complaints. The coordinated systems utilize 100 to 140 second cycle lengths depending on the corridor and time of day. City staff continually monitors the operation of the traffic signal system and makes adjustments accordingly.

Table 2.3: Signal Coordination Parameters

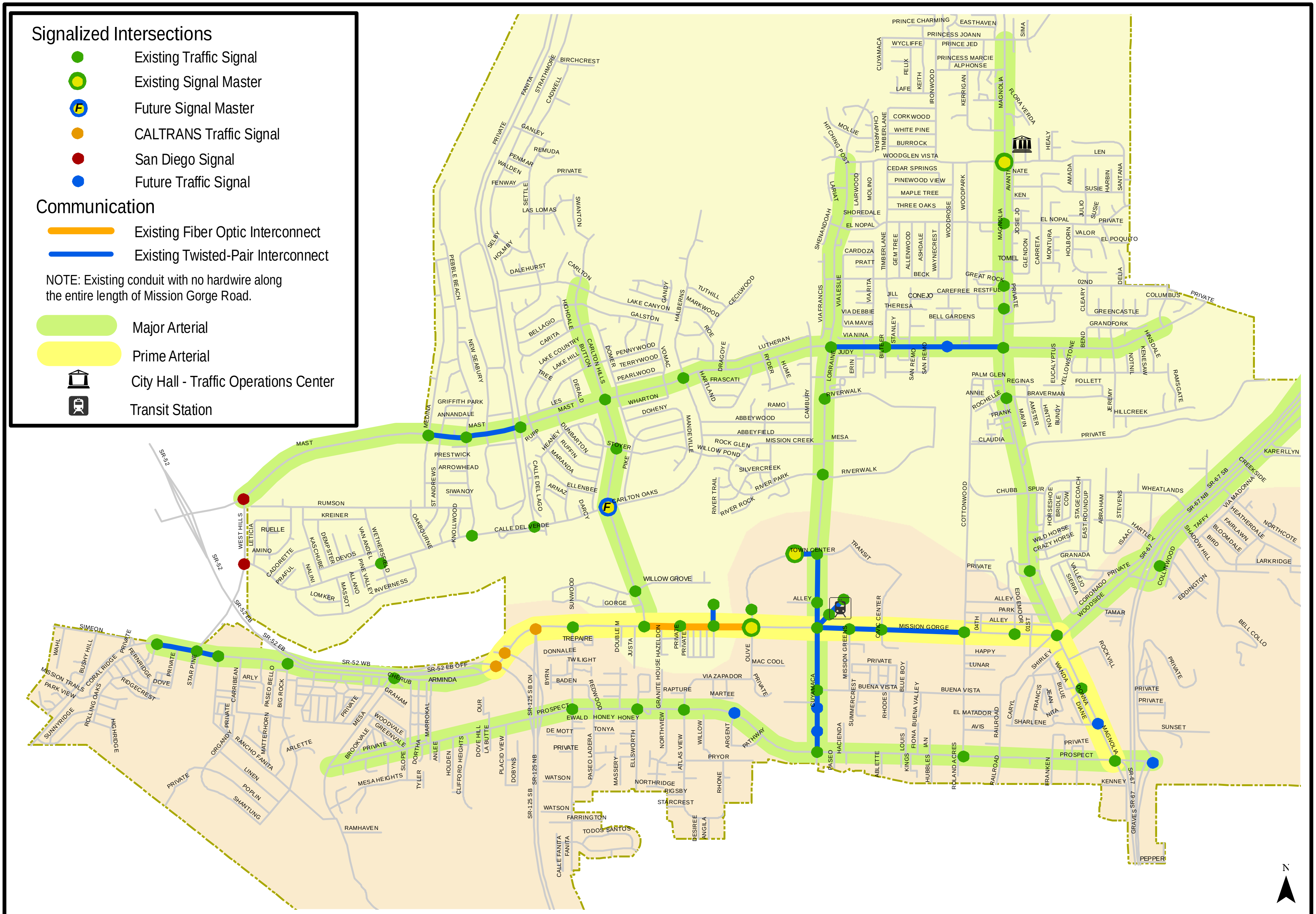
No.	Intersection	Peak Period		
		AM	Midday	PM
1	Carlton Hills Blvd./Carlton Oaks Dr.	110	Free	110
2	Carlton Hills Blvd./Willow Grove Dr.	110	Free	110
3	Carlton Oaks Dr./Fanita Pkwy.	110	Free	110
4	Cuyamaca St./River Park Dr.	110	110	120
5	Cuyamaca St./Town Center Pkwy.	110	110	120
6	Cuyamaca St./Buena Vista Ave.**	140	140	140
7	Cuyamaca St./Prospect Ave.**	140	140	140
8	Magnolia Ave./Woodglen Vista Dr.	100	Free	120
9	Magnolia Ave./El Nopal	100	Free	120
10	Magnolia Ave./Second St.	100	Free	120
11	Magnolia Ave./Carefree Dr.	100	Free	120
12	Magnolia Ave./Braverman Ave.	100	Free	120
13	Magnolia Ave./New Frontier Mobile	100	Free	120
14	Magnolia Ave./Alexander Wy.	100	Free	120
15	Magnolia Ave./Prospect Ave.	Free	Free	Free
16	Mast Blvd./Medina Dr.	100	Free	110
17	Mast Blvd./Pebble Beach Dr.	100	Free	110
18	Mast Blvd./Fanita Pkwy.	100	Free	110
19	Mast Blvd./Carlton Hills Blvd.	100	Free	110
20	Mast Blvd./Halberns Blvd.	100	Free	110
21	Mast Blvd./Cuyamaca St.	100	Free	110
22	Mast Blvd./Bilteer Dr.	100	Free	110
23	Mast Blvd./Magnolia Ave.	100	Free	110
24	Mission Gorge Rd./Father Junipero	110	Free	120
25	Mission Gorge Rd./West Hills Pkwy.	110	Free	120
26	Mission Gorge Rd./Rancho Fanita Dr.	110	Free	120
27	Mission Gorge Rd./Big Rock Rd.	110	Free	120
28	Mission Gorge Rd./Mesa Rd.	110	Free	120
29	Mission Gorge Rd./Fanita Dr.	110	110	120
30	Mission Gorge Rd./Carlton Hills Blvd.	110	110	120
31	Mission Gorge Rd./Town Center Pkwy.	110	110	120
32	Mission Gorge Rd./Cuyamaca St.**	140	140	140
33	Mission Gorge Rd./Tamberly Wy.	110	110	120
34	Mission Gorge Rd./Cottonwood Ave.	110	110	120
35	Mission Gorge Rd./Edgemoor Dr.	110	110	120
36	Mission Gorge Rd./Magnolia Ave.	110	110	120

No.	Intersection	Peak Period		
		AM	Midday	PM
37	Prospect Ave./Fanita Dr.	110	Free	110
38	Prospect Ave./Ellsworth Lane	110	Free	110
39	Prospect Ave./Atlas View Dr.	110	Free	110
40	Town Center Pkwy./Home Town Buffet	110	110	120
41	Town Center Pkwy./Costco Entry	110	110	120
42	Carlton Hills Blvd./Stoyer Dr.	110	Free	110
43	Cuyamaca St./Trolley Square Dwy.	110	110	120
44	Mission Gorge Rd./Mission Greens Rd.	110	110	120

Notes: *** - Trolley intersections*

2.7 Communication System

Physical Signal Interconnect: Figure 2.3 provides the location of each signalized intersection in the City and the associated controlling jurisdiction. It also illustrates the City's interconnection between the signalized intersections. The City has a mixture of leased telephone interconnect, twisted pair copper wire, and fiber optics cable network connecting the majority of the signalized intersections to the on-street Master Controllers. The City assesses the signal system from City Hall via telephone modem to the individual traffic signals.



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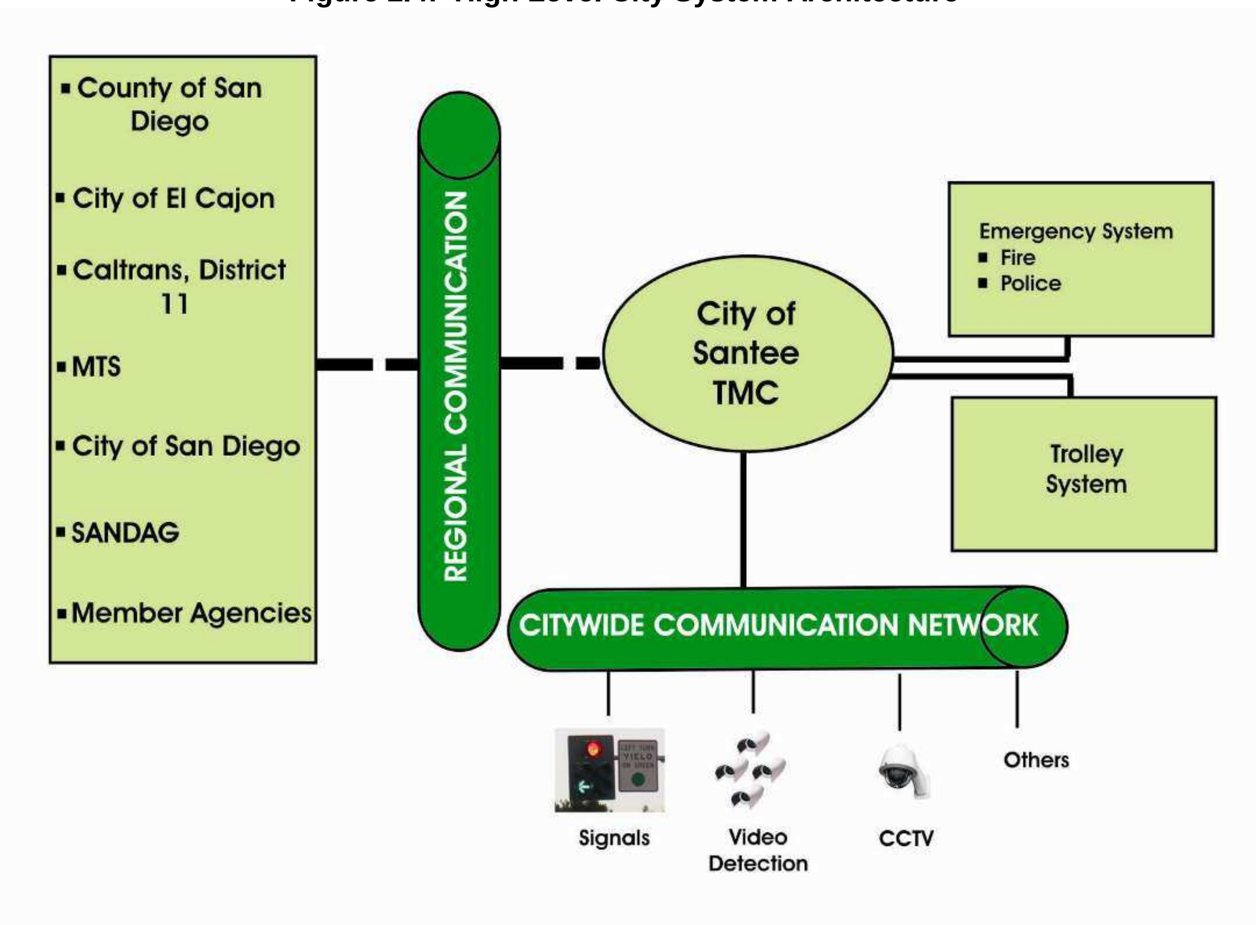
City of Santee Transportation Improvement Master Plan

Existing Signalized Intersections and Communication Infrastructure

Figure 2.3

Regional System Architecture: The City of Santee is a member agency of the San Diego Association of Government, SANDAG, serving as a forum for regional decision making. Consensus with all member agencies developed a Regional System Architecture for ITS Traffic Signal Communications System. **Figure 2.4** presents a high level connectivity between the City of Santee's TMC, field elements, citywide emergency services and external centers. According to the San Diego Regional Architecture, it is envisioned that the City of Santee will have opportunities to exchange information with both neighboring and regional transportation agencies and centers. The City of Santee is among the San Diego Regional ITS planning subcommittee members. It is planned, according to the San Diego Regional ITS Architecture, that the City will, in the future, have the capability to share and exchange data and information, via direct connection, wireless and Internet means, with several agencies for various functionalities, as shown in **Table 2.4.**

Figure 2.4: High Level City System Architecture



Regional Arterial Management System (RAMS): The RAMS project, administered by SANDAG, is intended to establish a coordinated management system for traffic signals on arterial streets and roadways in the San Diego region. The RAMS consists of traffic signal management system software and hardware, the supporting network software, hardware and temporary interconnection between jurisdictions within the San Diego region. The permanent interconnection would be provided by the future Intermodal Transportation Systems Management (IMTMS) regional network project. The RAMS project's two tiers of development – Tier 1 and Tier 2 – are interrelated, but separate, deployment efforts. Tier 1 is an upgrade to existing traffic signal control system software produced by BITran Systems. Tier 2 will be a new software application developed for the San Diego region. The City of Santee's traffic signal system is not compatible with the RAMS project. Efforts will be made as part of the recommendations of this Master Plan to deploy this system in the City.

Table 2.4: San Diego Regional ITS Architecture - City of Santee*

Function	Organization
Advanced Transportation Management Systems (ATMS)	Caltrans D-11
Advanced Transportation Information and Management Systems (ATIMS)	SANDAG
Regional Transportation Management Systems (RTMS)	County of San Diego City of El Cajon City of San Diego

**Source: San Diego Regional ITS Architecture*

2.8 On-going Major Projects

There are several on-going projects that may generate additional traffic on the City's transportation network. Two of the largest developments that will impact the transportation infrastructure are the Fanita Ranch and the Riverview Office Park projects. Also, ambient growth due to various minor developments in the City will contribute additional traffic. The City's general plan circulation element was updated in 2002 and in that plan intersection capacity improvements were identified to accommodate future growth.

Fanita Ranch

Fanita Ranch is a property of approximately 2,600 acres on undeveloped land in the northern portion of the City of Santee, northeast of State Route 52 (SR-52) and west of SR-67. The proposed project consists of the development of 1,380 single-family dwelling units, 241 acres of pedestrian-oriented Village Center and community-serving recreations resource including health and wellness center, a village green and bandstand, a botanical garden and demonstration/retail nursery. The remainder of the property is reserved for a regional park and other open space. Access to the site is proposed via the northerly extension of Fanita Parkway and Cuyamaca Street.

Riverview Office Park

The Riverview Office Park project site consists of approximately 154 acres of land that is primarily vacant with the exception of the Las Colinas Women's Detection Center, the Edgemoor County Hospital, the historic Polo barn, Fire Station #4, Homestead school facility, vacant County structures, and limited commercial facilities.

The proposed project is intended to provide for a significant, high end, master planned office park development including businesses engaged in scientific, technical, communication, or other related business. The project is generally located between Cuyamaca Street on the west, Magnolia Avenue on the east, Mission Gorge Road to the south, and the San Diego River to the north.

New development typically results in an increase of traffic. A significant increase in traffic may reduce the effectiveness of an intersection, especially if it is formatted for a specific volume capacity. The priority corridors whose volume will be affected by the new developments may require signal timing and coordination adjustments.

Table 2.5 lists the future levels of service (LOS) of new signalized intersections and those that require improvements as a result of the Fanita Ranch and other future developments.

Table 2.5: Future LOS Year 2010 and Beyond[2]

INTERSECTION	Peak Hour LOS		Notes
	Before	After	
Carlton Oaks Dr / Carlton Hills Blvd	F	D	Mitigation Required
Mast Blvd / West Hill Pkwy[3]	F	C	Additional Lanes Required
Mission Gorge Rd / Fanita Dr[3]	E	B	Additional Lanes Required
Mission Gorge Rd / Cuyamaca St	E	E	Additional Lanes Required
Mission Gorge Rd / Magnolia Ave[3]	E	D	Additional Lanes Required
Woodglen Vista Dr / Cuyamaca St	F	C	New Signal
El Nopal / Cuyamaca St	F	C	New Signal
Woodside Ave / SR 67 Off-Ramp	F	D	Mitigation Required

2.9 Capital Improvement Program (CIP)

The 5 year Capital Improvement Program (CIP) is scheduled for the Fiscal Years (FY) 2006 through 2010 and will be implemented based on community needs, available funding, prior City Council direction, and staff resources available to oversee the projects. Some CIP projects that may influence the recommendations in this Master Plan are listed below. For a detailed list of traffic related CIP projects, see **Appendix B**.

<u>Traffic Management Master Plan:</u> This project will provide funding for a consultant to prepare a Citywide Traffic Management Master Plan. The process will include review of existing conditions, assessment of current and future needs, evaluation of options for improvement, and preparation of an implementation plan. In order to better address traffic needs within the City, the preparation of Traffic Management Master Plan is needed. The Master Plan will concentrate on maximizing the effectiveness of our traffic signal system, while also comprehensively addressing all aspects of the City's transportation network. Approximately $70,000 in Traffic Mitigation fees will be collected in FY 2005-2006. The "Transportation Improvement Master Plan", this project, is the outcome of this CIP project.

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[2] Source: Traffic Impact Analysis Report, "Village at Fanita" prepared by Linscott Law & Greenspan, September 19, 2005 (**Appendix B**). Mitigation should be implemented as recommended in the report and by the City of Santee.
[3] Source: Before and After Peak Hour LOS and Notes provided by the City of Santee on September 13, 2006.

Mission Gorge Widening: This project will widen Mission Gorge Road from Carlton Hills Boulevard to State Route 125 in response to forecasted traffic volume increases over the next decade. It is in accordance with the Circulation Element of the City's General Plan. The estimated cost is more than $9.4 million. The proposed CIP designates nearly $2 million in Traffic Mitigation fees to be collected over the next five years for this project. Planning and design is scheduled to begin in FY 2006-07, but construction may not begin until additional funding is identified.

Cuyamaca Street Improvements Adjacent to Town Center Community Park: Northbound Cuyamaca Street between River Park Drive and Mission Creek Drive is required to be widened for the development of Town Center Community Park. In addition to the street widening, a 25-foot landscaped parkway with a meandering sidewalk/bikeway will be included. This project provides better access to Town Center Community Park by widening Cuyamaca Street to major arterial standards to comply with the Town Center Specific Plan. The proposed CIP designates approximately $2.3 million in Traffic Mitigation fees to be collected over the next two years for this project, beginning in FY 2006-07.

Olive Lane Improvements: Install missing curb, gutter and sidewalks and widen Olive Lane Road to a four lane collector between Mission Gorge Road and Via Zapador. Forecasted traffic volumes for 2020 and the Circulation Element of the General Plan show the need to widen Olive Lane. Curb, gutter and drainage facilities will be installed to control water runoff and sidewalks will be installed to improve pedestrian safety. Approximately $4.6 million in Traffic Mitigation fees is expected to be collected over the next four years. The proposed CIP is set to begin in FY 2006-07.

SR 67/Prospect Avenue Interchange Improvements: Construct a new on-ramp from Magnolia Avenue to southbound SR 67 and widen the northbound SR 67/Prospect Avenue off-ramp to three lanes. The project, totaling $5.3 million, will be funded and constructed by the Sky Ranch Developer and maintained by Caltrans, beginning FY 2006-07.

Traffic Management Master Plan Implementation: This project will provide software and hardware improvements to existing traffic signals throughout the City in order to maximize the effectiveness of the City's traffic signal system to improve traffic flow. Specific locations will be prioritized based on the recommendations of the Traffic Management Master Plan which is currently underway. Approximately $800,000 in Traffic Signal fees are expected to be available for this program over the next five years, beginning in FY 2007-08. See the deployment schedule for details of the Master Plan recommended projects.

Bicycle Master Plan Update: Preparation of a new Bikeway and Pedestrian Master Plan to identify existing facilities and deficiencies throughout the City. The objective of the new Bikeway and Pedestrian Master Plan study is to review and make recommendations as to how the current bikeway and pedestrian network within the City planning area can be updated to best suit the needs of the City now and in the future. The existing Bike and Trail Study was prepared in 1989 and needs to be updated.

3.0 NEEDS ASSESSMENT

Through a review of the existing conditions and discussions with City staff, the following is a summary of the general transportation needs identified for the City of Santee:

- Completion of State Route 52 to State Route 67
- Improve overall circulation within the City
- Minimize the overall trip delay to travelers
- Improve traffic signal operations at congested intersections
- Improve traffic flow along priority corridors
- Minimize delay to side street traffic at major intersections
- Increase roadway safety
- Accommodate the anticipated changes in traffic volumes resulting from the new residential and commercial developments
- Accommodate and control the increased regional pass through traffic
- Increase public transportation ridership, specifically the San Diego Trolley ridership

As the growth in population due to increased urbanization continues, traffic congestion levels will also continue to increase. In the past, transportation agencies generally addressed transportation problems through capacity enhancements such as roadway widening. These types of solutions are still applicable; however, they are becoming more difficult to attain due to a number of reasons such as lack of right-of-way, cost, environmental impacts, etc. In recent years, with the emergence of new and more powerful hardware and software technologies and better communication capabilities, more cost effective Intelligent Transportation System (ITS) solutions have become available to allow transportation professionals to better manage traffic and increase efficiency and safety.

ITS improvements can readily provide traffic management staff with the tools to more effectively and efficiently manage the existing transportation system through real-time traffic information, quick incident/emergency response, and other traffic control management strategies. As an example, studies conducted by the Los Angeles Department of Transportation on their ITS deployments have identified fuel consumption reduction of 13%, decreased air emissions of 14%, reduced vehicle stops of 41%, reduced travel time of 18%, increased average speed of 16%, and decreased delay of 44% through the implementation and operation of ITS strategies.

In order to meet the City's needs as summarized above and to take advantage of the many advancements in technology and the deployment of ITS, a number of strategies, applicable to the City of Santee, have been identified. It should be noted that these potential strategies take advantage of both traditional and more advanced technological (ITS) types of improvements:

1. Operational Improvements
2. Advanced Transportation Management Systems (ATMS)
3. Advanced Traveler Information Systems (ATIS)
4. Advanced Public Transportation Systems (APTS)

Table 3.1 provides a matrix that links the identified needs with the potential strategies. Specific projects from each of these strategies will be developed and documented in future sections.

Table 3.1: Needs and Strategies Matrix

Needs	Operations Improvement		Advanced Transportation Management Systems				Advanced Traveler Information Systems				APTS
	Corridor Wide	Critical Intersections	Traffic Signal System	TMC	Remote Workstation	CCTV	DMS	Web Page	Media	Info Displays	
Improve overall circulation within the City	■	■	■	■	■	■	■	■	■	■	■
Minimize the overall trip delay to travelers	■	■	■				■				
Improve traffic signal operations at congested intersections		■	■	■	■	■					
Improve traffic flow along priority corridors	■	■	■	■	■	■					
Minimize delay to side street traffic at major intersections		■	■								
Increase roadway safety		■				■	■				
Accommodate to new residential and commercial developments	■	■	■	■		■	■	■	■	■	■
Accommodate and control increased regional pass through traffic	■			■			■	■	■	■	
Increase public transportation ridership, specifically the San Diego Trolley ridership								■	■	■	■

3.1 Operational Improvements

There are several operational improvements that should be considered in the City to meet the transportation improvement needs. These improvements are distinguished by having low capital costs while providing considerable traffic operations benefits. These improvements are separated into two categories: corridor-wide improvements that apply to the entire corridor or multiple corridors, and critical intersection improvements that affect only one intersection.

3.1.1 Corridor Wide

Corridor-wide improvements are applied to the entire corridor or to multiple corridors within the project area. In the short-term, this is a corridor-improvement need to develop optimized signal timing plans every 2 to 3 years (and sooner if new developments in and around the City are completed). This is especially important for the priority corridors. The traffic pattern on Mission Gorge Road may change due to the completion of the SR 52 extension or the occurrence of incidents on SR 52 or SR 67. In the long term, the City should consider potential road widening to allow for the projected traffic along the major corridors. In addition, it will be important to provide signal timing coordination between the City and Caltrans intersections.

Improved Signal Coordination

In 2003, the City hired a Traffic Signal consultant to develop coordinated traffic signal timing plans city wide. In reviewing the provided computer files, the signal coordination patterns in use in the City appear to be satisfactory. Because of changes in traffic volumes or patterns, and changes in signal control strategies, some updates are necessary and coordination patterns should be reviewed and fine-tuned for each corridor for each period (AM, mid-day and PM). Other than a general updating of coordination patterns, the two potential areas where traffic operations might benefit are time-of-day schedules, and special events/incident conditions.

- Time-of-Day Schedules
  The most benefit to coordination will probably be achieved by better fitting patterns to traffic flow. A close examination of flow patterns in different areas of the City might find that coordination could be ended earlier where the predominant type of traffic is commuter and congestion is relatively light. In these areas, the onset of peak volume is relatively sudden, and it dissipates rapidly. On the other hand, in commercial and/or retail districts, the peak volume is attained somewhat slower, and it also dissipates slower. This means that signal coordination is useful for longer periods than on routes that are primarily commuter.

  To match coordination patterns to traffic flow, the collection of data on volumes and time trends is necessary. Some information might be available through detector logging from the signal system. If not, directional traffic counts should be performed for typical 7-day periods, with 15-minute resolution. Sample locations should include coordinated arterials in business, residential, and mixed land use areas, and some side-street approaches in the same areas. These data should be examined to determine times of day when a coordination pattern is best suited.

- Special Events/Incidents:
  Another area of potential benefit is in the area of special events or incidents, particularly near the State Routes. Traffic patterns differ from typical weekday traffic patterns, and are

sometimes disrupted by lane closures, diversions, or accidents. These situations are better served with traffic-responsive or traffic-adaptive schemes.

Traffic-responsive: Traffic-responsive operation consists of comparing traffic conditions against pre-determined factors to see which coordination pattern is the best fit. The system then selects the appropriate pattern from its library of patterns and implements it. That pattern stays in effect until traffic conditions change enough to warrant another pattern that provides better performance.

All the traffic conditions and coordination patterns must be pre-determined. If a combination of factors cause conditions that were not anticipated, it is possible that the timing patterns implemented by the system are in fact poorly suited for the traffic conditions result, the exactly opposite of the intended operation. Also, traffic-responsive operation depends heavily on traffic flow detectors and their polling rate. If special event or incident patterns have already been developed for manual activation, then a traffic-responsive system would allow those patterns to be implemented without operator intervention.

Considerable data are required to make the traffic-responsive operation work effectively. It is recommended that data on traffic demand and signal system patterns from past events be compiled and evaluated. From there, parameters should be set so that the signal system can look for particular patterns of traffic flow and respond by implementing the appropriate signal pattern.

Traffic-adaptive: Another potential method of matching signal operations to traffic flow is through the use of an adaptive traffic signal system. An adaptive system reacts to detector information in real time, changing offsets and splits as new traffic data is received. Sophisticated systems try to predict what conditions will be, based on historical data, so that new signal patterns will be in place in time for the changed conditions. Traffic-adaptive operation allows the system to continually change cycle lengths, offsets, splits and phase sequence to best serve the existing or predicted traffic conditions. There is no required background cycle length, so intersections do not have to operate on the same cycle length. Traffic-adaptive operation requires more effort and expertise during implementation, but requires less effort to maintain the coordination thereafter, and is better able to react to changing conditions.

Many agencies in California have implemented traffic adaptive systems, which are either operational or under evaluation, including SCOOT installation in Anaheim; SCATS in Menlo Park, Sunnyvale and Chula Vista; and streetwide in Cupertino.

Again, adaptive traffic control requires considerable experience, system detector information, and a traffic control system that supports this operation (the City's current system does not) to implement effectively. It is important that the need, traffic condition, cost and benefit be carefully evaluated before such a system is considered and implemented. If future condition does warrant such a system, it is recommended that a test system be established on one or two corridors so that City staff can evaluate the cost of City wide implementation and become familiar with the intricacies of an adaptive system before progressing to a citywide deployment. This recommendation will be included as one of the short and long-term improvement strategies in the City's Transportation Improvement Master Plan.

Protected-Permissive Left Turn Signals

The protected-permissive signal displays a green arrow for the "protected" movement, and a circular green for the "permissive" movement. Drivers must yield the right of way to other vehicles when turning left on a permissive green.

Protected-only left-turn phasing is less efficient because a clearance interval (yellow/all-red) must always be displayed following a green arrow, and the green arrow does not always correlate with the arrival of vehicles in the left turn lane. With a protected-permissive signal, even if vehicles arrive after the green arrow has ended, they may still proceed to make a left turn during the permissive interval as long as there is a sufficient gap in oncoming traffic.

However, the protected/permissive signal is no panacea, either. Drivers sometimes are confused by the circular green when displayed over a left turn lane, mistaking it for a protected phase. Also, the transition from protected to permissive is relatively subtle. The yellow arrow usually changes to circular green without an intervening red. This sometimes leads to left turners usurping the right-of-way from through traffic.

In addition, the problem of the "yellow trap" prevents using the protected phase in lagging mode. This problem is caused when an adjacent through phase is terminated to serve an opposing protected left turn, but the opposing through phase remains green. The left turner in the permissive direction sees the signal turning yellow and anticipates that a yellow is also being displayed to opposing traffic. In fact, opposing traffic still faces a green. This yellow trap reduces the flexibility of signal coordination by eliminating lagging left turn phases.

There are two changes that could enhance protected/permissive signal operations: queue detection, and alternate displays and logic.

- Queue detection provides a protected left-turn phase only when the vehicles waiting in the left-turn lane exceed some number, usually two or three. This is achieved by placing a detector some 40 to 70 feet back from the stop line, with a delay timer. Moving traffic will not place a call, but if traffic backs up onto the detector, a call will be placed for the protected left turn phase. During off-peak times, the protected phase can often be skipped since there are usually sufficient gaps in opposing traffic.

- The flashing yellow arrow or "Dallas display" eliminates the yellow trap, and therefore enables lagging left turn operation. In addition, the flashing yellow arrow reduces ambiguity when a separate display is provided for left turners. The flashing yellow arrow is substituted for the circular green when the *opposing* through traffic receives a green. With the Dallas display, the circular green is still used, but it also is displayed at the same time as the opposing through green. The Dallas display requires tight visual louvering of the circular green and yellow to prevent conflicting indications being displayed to the same approach.

National Cooperative Highway Research Program (NCHRP) Project 3-54 has established that the flashing yellow arrow reduces the incidence of drivers mistaking the circular green for a protected left turn phase. The researchers are recommending that the flashing yellow arrow be allowed in the Manual on Uniform Traffic Control Devices (MUTCD) as an optional alternative. There are currently a few such deployments under evaluation in California. Noteworthy deployments include one in the City of El Cajon, two in the City of Pasadena and a fourth has been deployed in the City of Fullerton. The FHWA has already approved the Dallas display as an alternative to the standard display.

These alternate displays and associated controller logic schemes not only offer improved throughput and increased coordination flexibility, but they also provide the ability to use protected-permissive, permissive/protected, protected-only, or permissive-only modes by time of day. During periods of very low traffic, the protected mode could be omitted entirely, reducing the number of phases and allowing effective coordination during lighter traffic. During periods of heavy traffic where gaps are few and sight distance is obstructed, the permissive mode could be omitted so that the driver could turn only on the green arrow. During the remainder of the day, permissive/protected operation could be used with queue detection, so a temporary overload of left turners could be flushed out with a lagging protected left turn phase.

As a pilot project, the City has recently installed protected-permissive operation at the intersections of Carlson Hills Drive/Fanita Parkway and Carlton Hills Drive/Pebble Beach Drive.

Enhanced Vehicle Detection and Surveillance

Proper vehicle detection provides improved traffic operations and safety at signalized intersections. Detectors on side streets benefit traffic flow by returning green time to the main street. Detectors on the main street can improve operations by allowing the main street green to be ended when a coordinated platoon of traffic has passed through the intersection. Additional detection can reduce delay during non-peak hours when coordination is not in effect. Also, detectors can reduce the likelihood of rear-end collisions by terminating the green when no vehicles are in the dilemma zone. The City of Santee has good vehicle detection coverage at all of its signalized intersections. However, it is important to ensure that all of these detectors are properly maintained to ensure the most efficient operation. As an alternative to the inductive loop detection system, video detection cameras are discussed in Section 3.2.4 of this report.

3.1.2 Critical Intersections

For the purposes of this analysis, critical intersections are those major signalized intersections that have significant impact on the traffic operations along a corridor or corridors. The critical intersections (top 10 ranked intersections) in the City of Santee were identified by City staff based on intersection delay. There are three main areas in which these signalized intersections were studied for potential improvements. These include:

Signal Modifications: These enhancements provide upgrades to signal equipment (i.e. signal controllers, poles, mast arms, indications, etc) and vehicle/pedestrian detection.

Geometry Enhancements: These enhancements include capacity modifications such as turn lane storage length modifications, re-striping of lanes, addition of lanes, etc.

Operation Improvements: These enhancements improve the operational efficiency of the intersections by modifying signal timing, signal coordination, updating vehicle and pedestrian clearance intervals to match new recommendations, modifying left-turn treatments (i.e. changing protected only left-turn operation to protected/permissive operation).

The above category of improvements would require different levels of financial commitment by the City depending on the needs of each specific intersection or roadway segment. The top 10 ranked intersections within the City (as identified by City staff based on intersection delay shown in **Table 2.1**) were examined for potential improvements. It should be noted that before improvement projects are developed, each intersection and proposed improvement should be reviewed and studied in more detail with reference to safety and efficiency. In particular the real-time level of service and volume-to-capacity ratios at each intersection should be measured and calculated and thoroughly analyzed.

3.1.3 Field Review

The initial step in identifying the deficiencies of an intersection is to asses its existing conditions. A detailed field review was conducted along with a detailed photo inventory of the 10 critical intersections. The improvements/enhancements were categorized into three groups: (1) signal, (2) geometry, and (3) operation, as described in **Section 3.1.2**. At each intersection, photos were taken and a quick sketch of the existing conditions and possible improvements was prepared. Measurements were taken to determine the existing location of visible advance loop detectors for calculating whether or not the detectors where placed outside of the dilemma zone (**Appendix A**).

3.1.4 Analysis

In addition to the field review and operational observation conducted, the levels of service at the 10 critical intersections were reviewed and further analyzed. The suggested improvements are based on a combination of engineering judgment, levels of service values, and the site geometric/right-of-way availability conditions. Detailed analysis will be needed during the developmental stages.

Table 3.4 is a summary of improvements that are recommended for the 10 critical intersections based on the on-site investigation. Following the table is a brief description of the recommendations for each intersection. As identified in the circulation element of the general plan and other future developments, some critical intersections require additional lane capacity to improve the level of service to acceptable standards.

Table 3.4: Summary of Potential Improvements at Critical Signalized Intersections

INTERSECTION	PROPOSED ENHANCEMENT Signal Modifications
Mission Gorge Rd & Magnolia Ave	• Relocate advance loop detection for the westbound traffic
Mission Gorge Rd & Cuyamaca St	• Upgrade signal/trolley equipment
Mission Gorge Rd & Fanita Dr	• Relocate advance loop detection for the northbound traffic

INTERSECTION	PROPOSED ENHANCEMENT
	Signal Modifications
Mission Gorge Rd & Town Center Pkwy.	• Relocate advance loop detection for the northbound traffic
Magnolia Ave & Prospect Ave	• Install Caltrans compliant 170 signal controller and cabinet
Mast Blvd & Cuyamaca St	• Relocate advance loop detection for westbound traffic
Mast Blvd & Carlton Hills Blvd	• Relocate advance loop detection for westbound traffic

Mission Gorge Road & Magnolia Avenue

Based on the field observation, the eastbound, westbound and southbound thru movements may require additional modification. The observations to increase capacity for these movements were conducted; however, field investigations indicated that there is no room for additional capacity in all directions. As for minor modifications, **Appendix A** indicates that the westbound advance loop detection is currently placed within the dilemma zone. Therefore, the westbound advance loop detectors should be relocated to at least the Caltrans suggested minimum setback distance of 285 feet.

Mission Gorge Road & Cuyamaca Street

Mission Gorge Road and Cuyamaca Street is the intersection with the highest accident rate in the City of Santee. This intersection is shared by the Green Line Trolley and recent ITS enhancements were installed. Video detection is used for the light rail traffic and a CCTV monitoring camera is already in place to monitor the traffic at this busy intersection. Green time is taken from the eastbound and westbound thru movements to serve the light rail movements, which are also very frequent. Mid-range and long term improvements include upgrading traffic signal equipment to provide better trolley and vehicle traffic flow through the Cuyamaca Street corridor. Also, a northbound right-turn lane as a long-term capacity enhancement to potentially improve the current level of service should be further analyzed.

Mission Gorge Road & Fanita Drive

It is recommended that the northbound advance loop detectors be relocated to a distance of at least 230 feet away from the stop line to avoid the dilemma zone (**Appendix A**). It is observed that future developments may congestion the eastbound and westbound movements; therefore, further investigation is recommended as new developments are deployed.

Mission Gorge Road & Town Center Parkway/Olive Lane

The northbound advance loop detectors are only 153 feet away from the stop line, which is below the Caltrans minimum requirement of 185 feet.

Mast Boulevard & Magnolia Avenue

There is a high school on the northeast quadrant of Mast Boulevard and Magnolia Avenue. The City may want to consider generating coordination/flush plans to accommodate for the quick, yet heavy, school peak periods throughout the day.

Mission Gorge Road & Carlton Hills Boulevard

Mission Gorge Road and Carlton Hills Boulevard is a three legged intersection with many closely spaced driveways on the south side without any traffic signal to monitor the flow in and out of the shops. Therefore, it is recommended that further analysis be conducted for the consolidation of the south side driveways and an additional northbound signal. As future development occurs on the south side of the street, consolidation of the driveways will occur.

Magnolia Avenue & Prospect Avenue

Construction for a new on-ramp to SR 67 will occur in the next year as part of a condition of approval for the Sky Ranch Project. The existing traffic signal controller should be changed to a Caltrans compliant controller so that communication with the Caltrans signals will be possible. This feature will allow for smoother traffic flow at this intersection.

Mast Boulevard & Cuyamaca Street

The westbound advance loop detector set-back distance is located 169 feet. This distance is within the dilemma zone, a distance closer to the stop line than the Caltrans recommended set-back distance. Therefore, it is recommended that advance loop detectors be relocated to at least 230 feet for westbound traffic. Mast Boulevard and Cuyamaca Street was also evaluated for left turn operation modification; however, no operational change is recommended because the combination of a vertical and horizontal slope creates a major visibility constraint.

Mast Boulevard & Carlton Hills Boulevard

Advance loop detectors for the westbound traffic are in poor condition and in the dilemma zone; therefore, it is recommended to relocate them to at least 230 feet. The middle lane stop line loop detector was exposed; its operation should be verified.

Carlton Hills Boulevard & Carlton Oaks Drive

Operational modifications may need to be revisited due to changes in future volumes resulting from current and planned developments. Access to businesses and/or residents should be evaluated before a decision is made to implement any changes.

3.2 Advanced Transportation Management Systems (ATMS)

The application of Advanced Transportation Management Systems (ATMS) is generally considered one of the more robust areas of ITS design and deployment, as it is very mature in terms of both number of deployments and its characteristics. ATMS can be as basic as the deployment of or upgrade of a traffic signal control system to as complex as an integrated area-wide system, which includes roadway surveillance, and data/video/control sharing among several agencies. Some of the key ATMS elements applicable to the City of Santee are the items summarized below.

3.2.1 Traffic Signal System

A traffic signal system will be comprised of the traffic control software system (TCS) and the traffic signal controllers. The traffic control software system provides centralized monitoring, management, and control of the traffic signal controller at signalized intersections supported by the City's communication interconnect. The traffic signal controllers are physically located at each signalized intersection and serve as the "brains" of the intersection. It runs operational commands sent by the TCS.

Traffic Control Software System

As mentioned previously, the City currently operates an ARIES traffic control system, which is a MS Windows-based data management and closed loop monitoring and control system from Econolite Incorporated. The ARIES system works well, but is considered an older generation Traffic Control Software (TCS) and does not include many of the advanced features that would be necessary as the City of Santee continues to grow. Additionally, the ARIES system is not envisioned to be compatible with the San Diego Regional Arterial Management System (RAMS) Project.

The function of the TCS is to provide the software tools to manage, monitor, and control the traffic signal controllers connected to a City-owned signal interconnect system from a centrally located traffic management center. As the City's signal interconnect expands to include additional signalized intersections, these new traffic signal controllers will be integrated into the TCS.

There are a number of traffic control software systems that are likely candidates for a signal system in size and nature to the City of Santee's existing requirements and that will also meet the needs for future network expansion. These systems are supported by established vendors that specialize in traffic control software systems, and the associated controller software. Some of the systems are proven and widely deployed while others have been developed more recently and have limited deployment experience. Most of the systems meet the current State of California recommended AB3418/AB3418E communication protocol, and can be upgraded to meet the current National Transportation Communications for Intelligent Transportation System (NTCIP) protocol. However, these two protocols do have conflicting requirements and therefore, only one protocol can be selected. When considering an upgrading of the existing ARIES system, the City should consider QuicNet/4 or the latest version of QuicNet compatible with QuicNet/4, by BI Tran, the system supporting the San Diego RAMS effort. QuicNet supports both AB3418ad NTCP protocols. All traffic signal controllers would need to be replaced with a Type 170 controller in order to communicate with the QuicNet/4 software.

Traffic Signal Controllers

All traffic signal controllers have a direct interface to the TCS. Traditionally, the traffic signal controller operates internally-stored signal timing plans based on the time-of-day or other mode, and the TCS will simply monitor the traffic signal controllers, retrieve detector data, and synchronize the traffic signal controller clocks so that they can be operated in a coordinated fashion without continuous centralized control. If the TCS and the traffic signal controllers are fully compatible, the TCS will also provide the City with a robust, remote interface to the traffic signal controller, allowing the City to upload/download signal timing plans to the local controller, or establish sub-networks of signalized intersection groupings, thereby creating a traffic responsive signal system which can automatically respond to varying traffic volumes. Ideally, the interface between the traffic signal controller and the TCS will be completed with a direct interface over a high-bandwidth, fiber optic communication system. However, some controllers may require an external communications translator / communicator interface, or “black box” to support the interface.

There are a few traffic control software systems best suited to interface with each of the traffic signal controller types (NEMA, Type 170 and Model 2070 controllers). Again, it is best if these systems provide a direct interface to the signal controller, however some systems may provide full or partial functionality via a “black box” located in the traffic signal controller cabinet.

New signal controllers are typically non-proprietary, offering an open architecture, multitasking, and upgradeable units that provide the most advanced functionality. Most new controllers have the capability to easily implement future functionality without the need to replace the signal controller. The two types of controllers that best meet these requirements are the Type 170, Model 2070 Controller and the NEMA TS2 Controller.

3.2.2 Traffic Management Center (TMC)

The key function of the TMC (sometimes also called a Traffic Operation Center, or TOC) is to provide traffic management staff with the capability to interface with the traffic control equipment/system and to monitor traffic information from a central location. The components of a typical TMC include a video wall for viewing closed circuit television images, operator workstation(s), and space for communication and other miscellaneous equipment. However, this does not mean that a large dedicated space is required. The functionality of the “TMC” could be housed within one or two computers and one equipment rack at a minimum. Generally, however, it would expand to a larger area of office space including a dedicated

operations theater, equipment room and attached conference room for presentations and TMC management meetings.

The TMC typically serves as the critical communication hub between the field elements and other departments. The TMC will usually have the ability to control signalized intersections, CCTV cameras, Dynamic Message Signs (DMS), and other field devices deployed by an agency. The TMC system can also monitor priority requests at signals, if transit priority and/or emergency vehicle operation are deployed. In addition, the staff could interface with partner agencies and share information across jurisdictional boundaries in anticipation of incidents affecting the City's mobility. For example, signal operation access, and CCTV camera video and control, can be set such that modification can be done by one or multiple agencies, or by one or multiple departments within an agency. In the Development Service Building, the City of Santee has a dedicated computer workstation that controls the traffic signal timing and the CCTV camera at Mission Gorge Road and Cuyamaca Street.

3.2.3 Remote Workstations

As an extension of the TMC, remote workstations, such as the Police (Sheriff) Department can be provided such that either partial or full functionality of the TMC workstations is accessible from the remote workstations. This requires that the operator workstation software be developed as a client/server application, with clients connecting to the server for data exchange and device control. Communication between the server and clients will normally use a TCP/IP protocol and the system communication infrastructure must be developed to support this protocol.

The City's LAN may be able to support the exchange of data between the TMC server and remote workstations. To support full motion, high quality video at the remote workstation, a video channel switch must be dedicated for each simultaneous analog video feed needed, or a dedicated fiber strand for the transmission of high-quality IP video. The full motion video could also be transmitted to the remote workstation via the City's LAN, but the quality of the video will be dramatically diminished and is not recommended.

3.2.4 Video Monitoring

With the use of closed circuit television (CCTV) cameras, operators are able to provide manual intervention and, if required, dispatch equipment and personnel to repair equipment failures or assist in incident removal in a coordinated method. The surveillance images can also be shared with other departments (e.g., fire department, police department, etc) and the potential exists for integration with partner agencies as well. Within the realm of video monitoring there are two types of camera deployments, CCTV with pan/tilt/zoom (PTZ) capability, and fixed view cameras. Both camera types serve a unique implementation need and each has strengths and weaknesses that should be discussed prior to design or implementation. For example, both camera types can be used for intersection monitoring, although fixed view cameras require one unit per approach direction and typically would not be equipped with zoom capability. CCTV with PTZ cameras typically require one unit per location, and have the capability to change view angles as well as zoom into potential incidents. Both types of camera are capable of scanning images at full motion (30 or more frames per second) or at slow scan (10 to 15 fps).

- **CCTV with PTZ:** CCTV cameras with PTZ (also called surveillance cameras) are recommended for installation at strategic and key intersections in the City of Santee. PTZ control will allow system operators to focus in and see traffic movement, provide incident verification, and potentially record live scenes, either digitally on a TMC server or as recorded video, for planning studies. In areas in which privacy concerns might be an issue, PTZ stops can be placed in order to limit the viewing angles. **Figure 3.1** presents a typical CCTV camera and **Figure 3.2** presents a sample of video from a CCTV camera.

- **Fixed View (FV) Cameras:** FV Cameras operate in a similar fashion to CCTV cameras as described above, albeit without the capability to pan, tilt, or zoom. They are typically deployed in areas where the need to see visually adjacent areas is not needed. For example, a FV camera would be focused at a parking garage entry/exit ramp or intersection approach. Although they can be used as roadway monitoring cameras, the use of FV cameras is typically associated with security and/or video detection installations. In case of vehicle detection, these cameras will have dual functionality. Generally, video detection cameras are more long-term cost-efficient at four-legged major intersections in comparison with traditional inductive loop detectors. It should be noted that FV cameras are lower in cost (although only marginally), because the equipment which allows for variation in the field of view is not installed. FV cameras are usually only recommended for installation in association with dynamic message signs (DMS) for message verification, and as mentioned, as part of a video detection system installation, where the cameras can provide limited supplemental surveillance in addition to providing video detection.

Figure 3.1: Typical Arterial CCTV PTZ Camera Installation

Figure 3.2: Video Surveillance from CCTV Camera

Both camera types can either be color or monochrome. Color images provide the greatest visual information, and are the preferred choice of camera for traffic surveillance. However, during low light or night conditions, the ability to discriminate color diminishes significantly. Nighttime video images can be improved by placing the cameras in areas with high levels of illumination. Some CCTV cameras can provide both color imaging for daytime viewing and black and white imaging for nighttime video surveillance.

- **Web Cameras**: In addition to CCTV with PTZ and FV cameras, web-cams are also becoming more prevalent within the transportation industry. These cameras are much smaller in size and produce compressed video output. Typically, web-cams are used to produce video images with a direct feed into Internet Web Pages for public consumption. Web cams are usually fixed view styled cameras, work best when the transmission bandwidth is limited to transmitting still or slow scan (less than 15 frames per second), and are typically used as an alternative to FV CCTV. One type of application that is emerging is to attach a web-cam to a DMS to verify the message displayed.

3.3 Advanced Traveler Information Systems (ATIS)

Advanced Traveler Information Systems (ATIS) disseminate transportation-related information to the traveling public. The method of dissemination can range across several different media including both agency-owned devices (e.g., Dynamic Message Signs (DMS), agency web page, etc.) as well as privately operated services (i.e., radio reports, private web sites, news media, etc.). The information is typically distributed in one of two ways; pre-trip information or en-route information. Pre-trip traveler information is meant to capture people prior to beginning their trip (either locally or regionally). This is usually done through the use of media outlets (local news, public access cable TV), kiosks, or the Internet. Once the traveler has begun their journey, information received en-route can be given through any number of devices including several different roadside elements (e.g., DMS, telephone services such as 511®, etc.) as well as through in-vehicle media services (e.g., radio, navigation systems). Some of the key ATIS elements that may be applicable to a city such as Santee are the items summarized below.

3.3.1 Dynamic Message Signs (DMS) and Trailblazers

DMS offer a valuable technique to provide motorists with real-time traffic information and, if desired, alternate route selection advisories in advance of key decision points along the freeways and along a primary arterial corridor, or when using portable DMS for parking/traffic management in support of special events. DMS can provide timely, accurate and reliable en-route information to motorists when installed at critical locations and when properly operated and maintained. Recently, agencies have begun using DMS to broadcast AMBER ALERTS, providing motorists with information regarding child abductions. DMS can be fixed installations (permanent DMS) as presented in **Figure 3.3**, or portable DMS, as presented in **Figure 3.3**.

Permanent DMS that are placed along arterials are typically 5 ft x 10 ft in size and mounted approximately 18 feet high (based on Caltrans specification that provides for truck clearance). Portable DMS are typically 2 to 2 ½ ft. x 4 ft., and include a generator (battery or diesel fuel) for power. Portable DMS may also include solar panels to charge batteries and may include a cell phone to change pre-programmed messages from a remote location (e.g., TMC). Communication to the fixed signs can be done via dial-up, twisted pair cable, wireless or fiber optic connections from a central location (e.g., TMC).

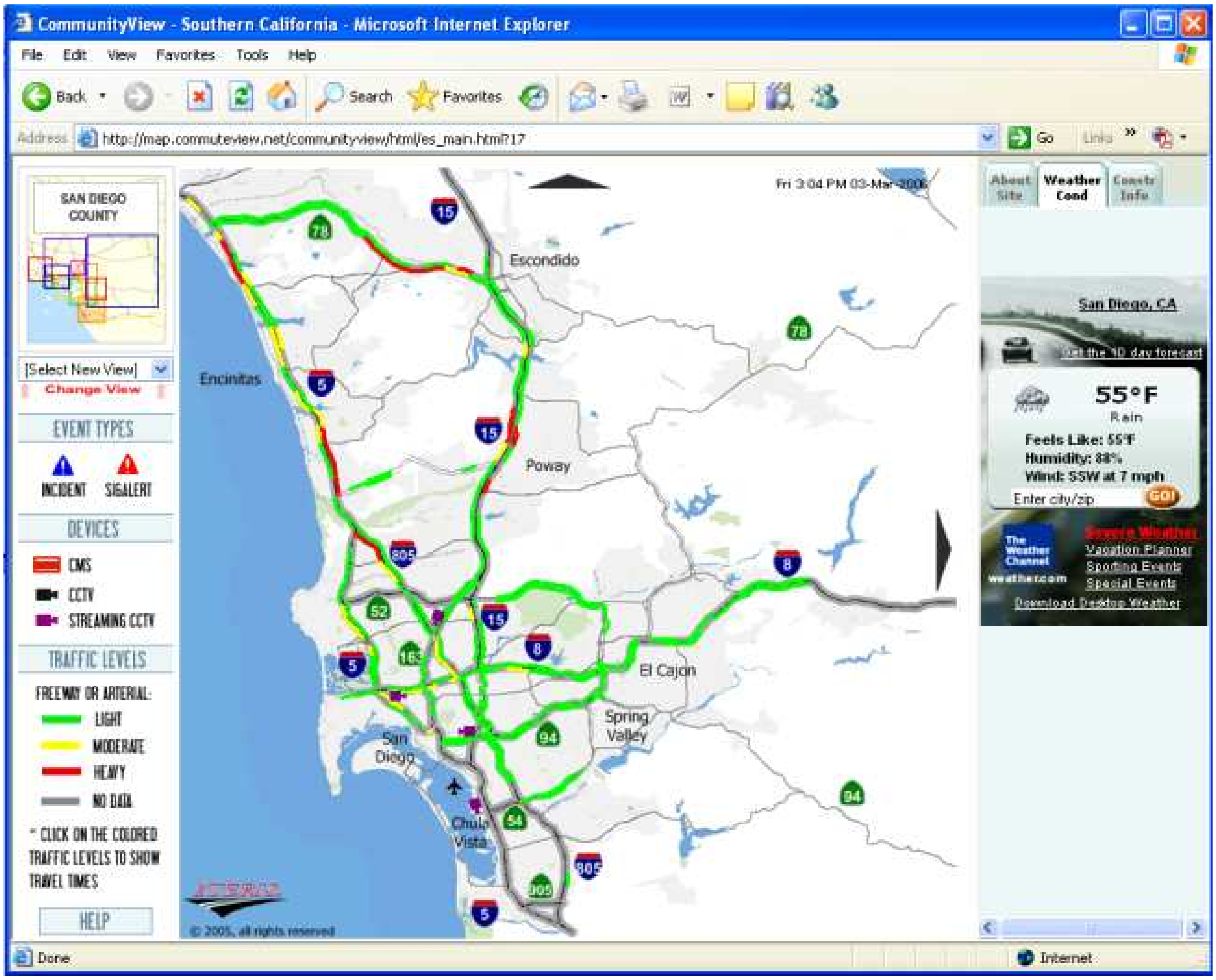
The purpose of Dynamic Trailblazer signs (**Figure 3.3**) is to guide vehicles along a diversionary route during an incident or special event based on a pre-identified routing. The process of re-routing the traffic should be coordinated between the dynamic message sign (DMS) and Dynamic Trailblazer elements of the system. Traffic re-routing should occur when an incident is detected on the freeways. Re-routing should occur simultaneously on arterial roadways during the incident to provide drivers with alternative surface routes to avoid the incident. For static signs, the standard wooden post support structure, or 3- to 4-inch steel pole installation would be used.

Figure 3.3: Permanent DMS, Portable DMS and Trailblazer

3.3.2 Web Page

This type of service will provide traffic-related information over the Internet, either over the City's web page or a private web page (http://map.commuteview.net). The information provided most frequently includes a color-coded speed map of the primary corridor freeway/arterial system, video feeds from CCTV cameras, and links to other transportation services, such as local transit agencies. Specialized information provides may include average speeds, travel times, and incident information. The City's system could automatically generate all the required traffic related pages, and make them available to the City's web server for dissemination on the City's main web site. In this manner, dissemination of this content will be controlled and maintained by City of Santee's IS department on the City's web server. This web server will already contain all the appropriate security (firewall) to prevent unauthorized access. An example of a traffic web page developed by Iteris, Inc. (San Diego region) is provided in **Figure 3.4**.

Figure 3.4: Sample Traffic Web Page



3.3.3 Media Services

Media Services refers to the use of television and radio, to broadcast local traffic information to Santee and surrounding area residents. For these services, local traffic information from Santee's system is provided to third party broadcasters for dissemination to the general public.

In the case of Community Access Television (CATV), Santee currently broadcasts City information to its residents via the City's cable provider. The City could provide an additional signal feed for broadcasting live traffic information at peak traffic hours on its local Public Access channel (Channel 23). This broadcast could include a graphical map representation of current traffic conditions including freeway speeds and arterial traffic volumes for the area. Additionally, incident data and selected CCTV camera images of local and freeway traffic could be displayed. The CATV signal format for this video feed will be provided as an NTSC signal, a one-way video feed that does not pose a security risk to the City's system. An example of a CATV image (City of El Segundo developed by Iteris, Inc.) is provided in **Figure 3.5**.

Once broadcasters receive this data content, they in-turn may display it directly as-is or they may add their own value to the information (analysis, additional public information, advertisement, etc.) and disseminate the information through their own private channels (i.e., radio, television, etc.), or share it with other providers. Typically, the interpretation of data is done prior to distribution to a particular media service. If video is transmitted, then media service will broadcast its interpretation of the image.

Currently, SANDAG is in negotiations to deploy an ATIS system in the region. One of the elements included in this deployment is a CATV service that would provide residents with live traffic information.

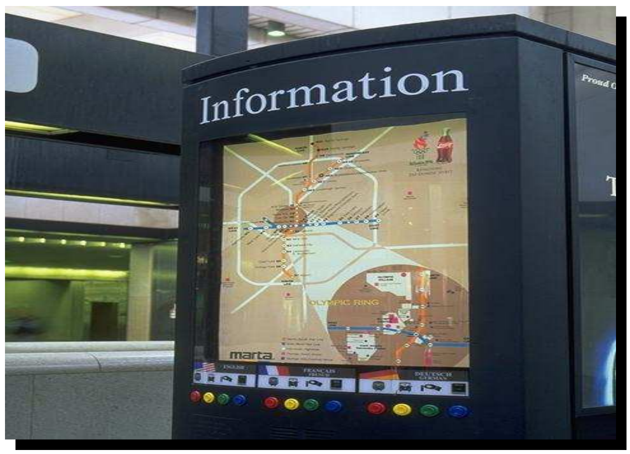
Figure 3.5: Sample CATV Video Image

3.3.4 Information Displays

This type of service, typically provided through the use of kiosks placed at strategic locations, provides travelers with a reliable source of pre-trip traffic and traveler information. For example, information displays could be deployed at modal transfer locations (transit centers, rail centers), as well as the City Hall lobby, so that travelers can visually receive information relative to traffic conditions on roadways in the City as well as freeways in the area. Information displays can take many different shapes. They can be as simple as small scrolling LED bar signs, large electronic boards containing several lines of text, large projection monitors which depict roadway congestion information, or kiosks. A kiosk could include a graphical user interface (GUI) that provides touch screen interaction by the user. Access to this data will allow travelers to make informed decisions with regard to travel route, time and mode prior to their departure.

Kiosks quite frequently also contain or provide links to other services and databases, such as transit schedules and phone numbers to local business. An example of a transit center kiosk is illustrated in **Figure 3.6**.

Figure 3.6: Transit Center Kiosk



It should be noted that all these ATIS elements are typically deployed in large cities over a large geographical area. Their effectiveness and cost benefit ratio are not well established for a city the size of Santee. Therefore it is recommended that feasibility studies are conducted before these devices are deployed in the City. In order to be effective, these elements must be deployed as part of a regional strategy. Cooperation with other agencies such as Caltrans and transit agencies is essential for the success of such projects.

3.4 Advanced Public Transportation System (APTS)

APTS-related ITS solutions enhance the transit alternative compared to single-occupancy driving. The expectation is that by using advanced technology, transit providers could respond to the primary concerns voiced by transit users. Transit would achieve enhanced reliability, efficiency, and greater assurance of passenger safety. There are several ways that ITS can be applied to the transit category of transportation elements to improve operational efficiency, increase customer satisfaction, and enhance transit safety. In addition, with the expansion of the Trolley network and increased traffic, the interaction of light rail vehicles with motor vehicles will increase in importance. As such, monitoring each preemption of the intersection and providing the appropriate signaling will grow in importance. The provision of the appropriate traffic signal controllers with associated communication network will allow for the better monitoring of such crossings.

Some of the potential solutions are described below:

- Small changeable message signs posting accurate predictions for next arriving bus at bus shelters

- Bus detection for priority at traffic signals, or for dedicated bypass lane access

The following are several, specific, transit-related ITS project concepts. Each of these should result in improved transit service, either in terms of customer satisfaction, operational management, or cost effectiveness. Similar in cost magnitude to traffic signal re-timing efforts (i.e., relatively low-cost, as compared to infrastructure- or system-related improvements), Transit ITS has the capability to pay great dividends in operational effectiveness for a rather modest capital outlay. Such projects will have much larger-than-average benefit / cost ratios.

'Next Arriving Bus' Signage: For a passenger waiting curbside for a bus, minutes seem to turn into hours because of uncertainty of when (or if) the next bus/shuttle will be arriving. Compounding this perception is the belief that the last bus passed by only a minute or so earlier, and therefore "who knows" when the next one will come. A service provided by *NextBus* Information Services, or similar, can eliminate this uncertainty, posting accurate anticipated arrival times; "next bus will arrive in x minutes" on continually-updated changeable message sign displays (similar to scrolling LED signs). This service tracks buses with GPS transponders, and uses a proprietary algorithm to calculate the arrival forecasts. The next bus arrival information is disseminated wirelessly to these transit displays, and also over the Internet to web browsers and web-capable cell phones. It should be noted that these devices are owned and operated by transit systems. However, opportunities exist for the City to work with transit agencies in order to provide reliable and efficient transit services that benefit the residents of Santee.

Traffic Signal Priority for Transit Vehicles: Transit vehicles encounter traffic congestion during both peak hours and off-peak hours. At some of the critical intersections, it has been observed that long queues cause additional transit time. This variability leads to customer mistrust of the service as a reliable and convenient way to travel, which can lead to loss of ridership. Bus signal priority technology improves transit operations by reducing trip time and delays. As buses approach a traffic light, a signal is sent to the intersection controller requesting for priority based on specific, user defined requirements (e.g. the bus is behind schedule by more than a certain number of seconds). Within limits potentially set to match the actual traffic at each intersection, the green time for the transit vehicle approach can be shifted or extended. If developed properly, signal priority will allow the transit vehicles to be granted priority service at selected intersection and the long queues restricting the bus's progress could be flushed through the troublesome signalized intersection(s). This would result in far less schedule disruption due to traffic congestion, and the reliability (and customer satisfaction) of this service would improve.

3.5 System Integration

System integration is likely the most important component of any ITS deployment, because without it both the system manager and users will typically only receive a portion of the intended and desired system-wide benefits. System integration brings the "pieces of the puzzle" together to form a composite picture of the current conditions, and disseminates that information to the proper recipient. There are two separate layers of integration; system and regional levels. Although system integration is an important element of the overall system, it is the one piece which the motoring public cannot truly see since it focuses on making things work together.

3.5.1 System Level Integration

This type of integration includes taking data prepared by one ITS element or subsystem, and converting that data into information through methods such as data smoothing, synthesizing, etc. Once this process is complete, the information is then transferred to another subsystem for use, such as broadcasting it to the public through either pre-trip or en-route traveler information methods. The process of successfully and automatically moving the data/information from one subsystem to another is commonly referred to as system integration. For this to occur, the data must be prepared using a methodology understood by another subsystem with little or no errors within the process.

3.5.2 Regional Level Integration

This type of integration is similar to system level integration, although on a much larger scale and sometimes with reduced detail. One element of regional integration can be seen through the SANDAG Regional Architecture process and the on-going area activities with Caltrans. The Caltrans TMC serves as a data hub for collecting and distributing traffic data in San Diego County. Local agencies can implement an Intertie, or center-to-center (C2C) communication link, between the local TMC and the Caltrans' (or regional) TMC for the exchange of traffic data (congestion, incidents, CCTV surveillance video). The City could provide roadway congestion information to Caltrans for area-wide dissemination. The City of Santee now becomes part of a much larger system giving the ability to disseminate their information to a much broader audience. Conversely, the City will be able to obtain data from other agencies.

4.0 COMMUNICATION SYSTEM

The primary goal of the City's communication system is to provide connectivity between the traffic signal controllers in the field and the TMC, and to support the deployment of ITS elements described in Section 3. This will then allow the City to meet the following needs:

- Implement signal timing plans in real time around the City
- Observe the video detection system from the TMC
- View traffic operation through the use of CCTV surveillance camera system
- Facilitate the communication Intertie with other agencies

In order to provide a system that will satisfy the above needs, the City's communication system should have sufficient bandwidth network to support the needs of live video and data as well as future ITS applications and system expansion. The following sections present a summary of the requirements for such network.

4.1 Communication System Requirements

The City of Santee's communication system should, at a minimum, meet the following requirements:

Existing Communication System – The proposed communication system should integrate into the City's existing communication system. It should utilize the existing communication resources to the maximum extent possible.

Reliability/Redundancy – The City's communication system should provide sufficient redundancy and automatic recovery capabilities from cable cut or a communication hub or point of data concentration failure. The communication system should be fault tolerant, self-healing, and route redundant, requiring the implementation of a fiber optic ring comprised of multiple communication hubs. The TMC can serve as one of these hubs.

Scalability and Ease of Installation – The communication system should provide a smooth migration path for future expansion, and support the implementation of additional ITS elements in future projects, such as new signalized intersections, CCTV cameras or video detection. In addition, the communication system should readily provide an incremental increase or decrease in size with limited cost and reduced risk due to the need to add or remove equipment as becomes necessary. Modular communication equipment and maximizing the use of available bandwidth can best allow for future growth.

Security – With the increasing number of hackers and viruses, security measures should be one of the primary concerns of the communication system. Passwords, firewall, routers, and administrative privileges are means to prevent the network from unauthorized access and reduce exposure to hacking and viruses.

Ease of Operations– The communication system should require minimum training and provide some degree of automation, such as dynamic bandwidth assignment, network failure alert, etc., to allow the traffic engineer to focus on higher priority during the operation of the system.

Ease of Integration – Integration refers to interoperability or the ability to seamlessly access data across different hardware and software platforms. In other words, it means the ease to work with other products. The communication equipment specified in the design should be able to integrate with both legacy equipment and other newer technologies.

Ease of Maintenance – Maintenance activities of the communication equipment may involve problem diagnostics, network recovery, hardware, firmware and software upgrades, performance monitoring, and system tune-up performance. Modular and hot swappable equipment should be used to simplify maintenance. Modular and hot swappable devices are economical because they eliminate the necessity for replacing entire boards at the system level. Upgrading can be done with any number of units at a time, from an individual module to all the modules in a system.

Availability of Environmentally Hardened Equipment – Field equipment should be able to work under the temperature ranges specified by NEMA. The lack of environmentally hardened equipment may impede the use of certain types of technology or equipment from certain vendors.

IP Addressability – Internet Protocol (IP) is a set of rules that specifies the format of data and procedures to provide a connectionless, node-to-node data packet delivery service and routing. IP addressability is a necessary requirement to have an IP based communication system. It is one of the NTCIP Transport-level protocols, and it can be used for Center-to-Field and Center-to-Center communication. It should be pointed out that IP and Ethernet are different types of protocol, which operate in different levels of the NTCIP framework. IP is a Transport Level protocol, which is used to find a route for the data packet and get it to the other end. Ethernet is one level lower, at a Sub-network Level, and is a protocol, which manages a specific physical medium, such as copper wire and fiber. IP and Ethernet protocols are quite often used together (for example, in most offices' local area computer networks), although each one can be used with a different protocol in the other layer.

The relationship between IP and Ethernet is very simple – Ethernet can utilize the IP protocol to send data across a LAN or the Internet. However, there is no connection between the Ethernet address and the Internet address. An Ethernet address is a device identifier built-in by the equipment manufacturer, which uniquely identifies one element from all other elements on the network. Ethernet equipment manufacturers have to register with a central authority so that their numbers do not overlap those of any other manufacturer.

An IP address is an identifier for a device on a Transmission Control Protocol / Internet Protocol (TCP/IP) network. Networks using the TCP/IP protocol route messages based on the IP address of the destination. Therefore, if an element has to be visible on both LAN and the Internet, that element has to have a table of what Ethernet address corresponds to what Internet address.

The City of Santee's communication system should eventually be an Ethernet-based utilizing IP protocol for data transmission.

Bandwidth Requirements – Some of the ITS field elements require the transmission of data only, such as the traffic signal controllers, while other ITS field elements require the transmission of video and data, such as CCTV cameras. The communication system for

Santee must be capable of providing data bandwidth for various ITS needs, which include CCTV camera video and data control, traffic signal controller date, and video detection.

The bandwidth requirements for data are generally low, while video transmission requires the most bandwidth and typically governs when determining the bandwidth requirements. The high bandwidth requirement for video signal transmission can be reduced by digitally transmitting the video signals by encoding, which means compression and conversion to a streaming format.

Standard and Protocol Requirements – The communication system shall meet the industry standards and protocols to the maximum extend possible. Standards define how system components interconnect with each other and the system. They also determine the interaction of these system components within an overall architecture. Communication standards for ITS are industry-consensus standards that specify how different ITS elements interconnect, communicate, and operate within a consistent framework. The framework is known as the National ITS Architecture. By specifying how systems and components interconnect, the standards promote interoperability.

Protocols are formal rules describing the format and transmission of data. The ITS element at each end of the communication link must use the same protocol to communicate. When designing the communication system, the following standard and protocol requirements should be considered:

Open Standard – Open standard provides the benefit of reducing cost, risk, and complexity. A communication technology using proprietary equipment will increase the procurement cost. An open system typically has fewer incompatibility issues and provides a simpler solution.

NTCIP – The National Transportation Communications for ITS Protocol (NTCIP) is an open standard which consists of a set of data element definitions for devices and systems and a set of rules for communication between these devices and systems. It has been adopted by the Federal Highway Administration (FHWA) to insure that inter-network connectivity is done through industry standard interfaces. NTCIP standards reduce the need for reliance on specific equipment vendors and customized one-of-a-kind product.

The primary purpose of NTCIP is to handle communication needs in two key areas: (1) Center to Field communication and (2) Center to Center communication. Using NTCIP, one requirement in designing center-to-field communication systems is that the data transmission time and the response time of the end equipment should be within the tolerances needed to allow all devices to communicate within the required time frame. Therefore, the maximum number of devices that can be put on one communication channel will depend on the transmission rate, the end equipment response time, and the quantity of information to be sent.

For center-to-center communication, the main focus of NTCIP is to achieve interoperability and standardization in center-to-center communication between different centers or systems. One approach to achieve this objective is to specify a standard architecture for the region. Another approach is to develop a software application to interface between the different centers or systems.

4.2 Communication Media

Numerous communication media are available for use in the transportation industry. The City of Santee currently has used twisted pair copper and fiber optics for interconnecting traffic signals and wireless transmission to ITS CCTV camera. These two wireline means are the primary choice for data and video transmission within the City for the future also. In addition, remotely located traffic signals and ITS field elements are envisioned to be connected to the center via broadband wireless communication in the future. The following sections discuss major characteristics of these communication media.

4.2.1 Wire Line Communication

Wire line communication refers to the use of wires or cables for connection purposes in a communications system. These cables or services can be agency-owned or leased. The major land-line communications mediums used in ITS applications and most applicable to the City of Santee include:

- Fiber Optics
- Twisted Copper Pair
- Leased Line
- Web-based

Fiber Optics – Fiber optic communication relies on the propagation of light through glass strands to transmit voice and data in an analog or digital format. Although fiber is slightly more difficult to work with than copper during initial installation, the maintenance required with fiber is less during the life of the system. It is historically more expensive than twisted pairs but current cost evaluations have shown a dramatic decrease in the cost of fiber optic infrastructures as the majority of cost is now associated with labor, not material. Due to the more competitive prices in the fiber industry, the need for greater bandwidth (Gigabit Ethernet) that is available with fiber, and the added reliability typically inherent with fiber optic infrastructures, the use of fiber optics is commonplace in today’s ITS arena.

Twisted Copper Pairs – Twisted pair copper cable is the most basic method used to establish communication for ITS. The cost for these components is reasonable, and their universal application makes this method the standard by which other communication methods are judged. Bandwidth is generally 1200 to 9600 bits per second for copper based signal system and ITS infrastructures, but the trend is moving toward 19.2k bits per second in support of new NTCIP protocols. Copper is well-suited for low-bandwidth data delivery such as for traffic signal controllers. More recently, new technology has been developed (i.e. Mil-Lektron, DSL) that allows the transmission of low-quality video over twisted pair.

Leased Line - A private, 3rd party communications network owner is able to provide a range of options for the leasing of dedicated data communication needs. Leasing is available from Local Exchange Carriers (LEC), long distance carriers such as AT&T, cable TV providers, and metropolitan area network providers. Each of these vendors operates under tariffs filed and approved by state regulatory agencies. Authorized tariff charges will normally include a one-time charge for installation and hookup, a monthly charge for line and system use, and subsequent line conditioning costs. The following are the most commonly used services:

- **56K Frame Relay Service:** this is an always-on connection between two facilities that provides a fixed 56 Kbps of bandwidth.

- **T1 and T3:** they are identical to the 56K frame relay service except that the bandwidth is 1.544 Mbps and 44.736 Mbps.

The telephone company or service provider typically maintains the equipment. It supports data, voice, and full motion TV applications.

Web-based - Web-based technology uses a video streaming and storage server to distribute real-time data, audio and video via public switched telephone lines, private telephone lines, DSL, Local Area Network (LAN), Wide Area Network (WAN), the Internet, etc. The video streaming and storage server supports Transmission Control Protocol/Internet Protocol (TCP/IP) and TCP/IP-based service protocols and is directly connected to communication devices such as modems or communication hubs. Video image data is compressed for efficient data transmission.

4.2.2 Wireless Communication

Wireless applications can be divided into two categories: fixed point-to-point and mobile (where typically the transmitter is moving). Fixed applications are the traditional and most common use of wireless video systems. The primary advantage of using wireless technology is that it does not require the installation of physical cable or the conduit infrastructure. The following forms of wireless communication technologies are commonly considered in ITS applications and are most applicable to the City of Santee.:

- Microwave
- Spread Spectrum
- Broadband Wireless Data Network

Microwave – The use of microwave frequencies to establish point-to-point communication without installing wires is common in the traffic industry. Microwave frequencies are generally above about 10 GHz and generally, though not always, must be licensed for use by the Federal Communications Commission. Microwaves require a direct line of sight between transceivers and are limited in range by atmospheric absorption; their range is dependent on frequency and signal strength and varies from approximately one to 10 miles. Microwave equipment can transmit data at a rate of up to 155 Mbps.

Spread Spectrum - Spread spectrum radio (SSR) uses radio broadcast power of less than 1 watt to broadcast information over a frequency band wider than the minimum bandwidth required transmitting the information. Spread spectrum currently uses the 902 to 928 MHz band, which has been allocated by the FCC for unlicensed use by amateur radio systems, digital portable telephones, and other low-powered devices.

The benefit of spread spectrum is that it is less susceptible, but not immune, to radio interference compared to other radio communication systems. Instead of transmitting at full power on a single channel, spread spectrum users transmit for very short periods on many different channels. The method is inherently resistant to noise, but the low power levels used mean that line-of-sight is necessary. SSR is sensitive to line-of-sight antenna propagation. Although the line-of-sight requirement is not as critical as that of microwave (narrow beams), antenna alignment is an issue. There is some risk that the unlicensed radio spectrum bands allocated to SSR will become overcrowded causing interruption to service in the future. SSR does not require installation of a communication conduit and cable infrastructure but it cannot transmit full motion video signals.

Broadband Wireless Data Network - Broadband Wireless Data Network is a wireless communications system, which provides users with wide-area, high-speed, bi-directional wireless networking for the transmission of both data and video signals. It could take the form of a subscriber service on a public network, typically from a wireless communications service provider such as Verizon, NexTel or Cingular. Or it could take the form of a private network, utilizing IP based, Ethernet radio technology, such as the Motorola Canopy product, or the Proxim Tsunami product.

This technology supports high-speed Internet/Intranet access and dedicated digital services, video teleconferencing, video on-demand, interactive video, and telephony.

5.0 OPTIONS ANALYSIS AND DEPLOYMENT STRATEGIES

The ability to show the successes and benefits to the City and its residents is critical to the continuation of a deployment plan. The systematic deployment and integration of the recommended operational and ITS improvements and supporting communication system in an overall program will allow for the utilization and realization of benefits of initial deployment efforts before the system is fully built out.

The focus of this section is to identify, develop and analyze candidate projects and strategies to improve traffic mobility within the City of Santee roadway network.

5.1 Vision

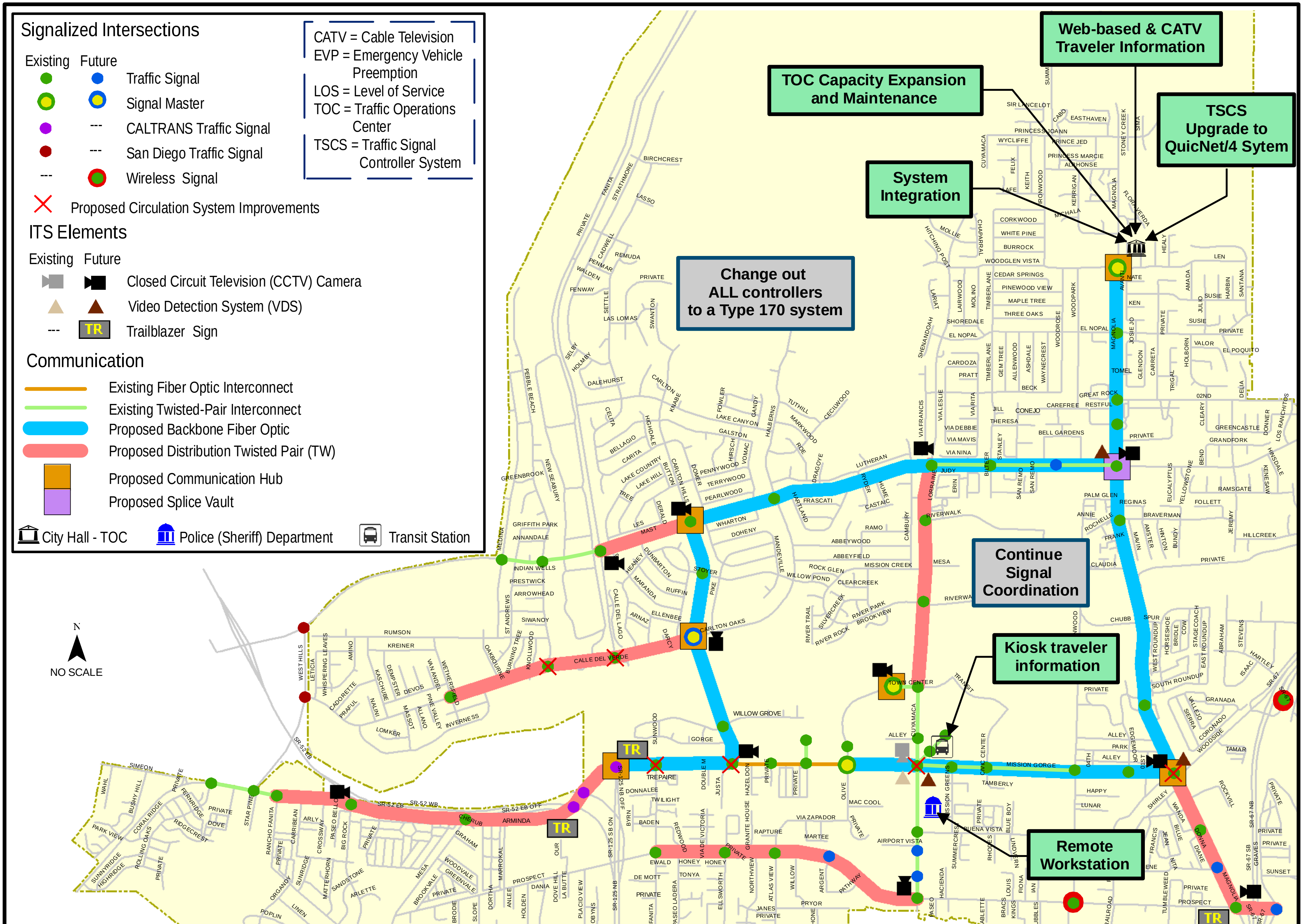
The vision of the City of Santee Technological Improvement Master Plan is to employ operational improvements and ITS strategies to meet the City's transportation system needs identified in Section 4 and to realize the following benefits:

- Greater efficiencies from the transportation system;
- Increased roadway safety;
- Improved traffic signal operations;
- Improved interagency/inter-jurisdictional public communications and coordination;
- Accommodate increased travel through the region;
- Accommodate the anticipated changes in traffic volumes resulting from increased land development.
- Improved incident response and scene management;
- Expanded traveler information dissemination;
- Enhanced convenience, effectiveness and interconnectivity of transit operations;
- Support economic development;

Through the analysis of the existing and future capacity constraints in the City's transportation infrastructure, a list of operational and ITS strategies were developed and summarized in the previous sections to meet the City's existing and future transportation system needs as shown in **Table 3.1**, found in Section 3. These operational and ITS strategies are the basis for the development of projects and programs summarized in this section. The proposed projects and programs are prioritized below as strategies and provide the following improvement categories:

1. Operational Improvements
2. ATMS Improvements
3. Communication System Improvements
4. System Integration Improvements
5. ATIS Improvements

It should be noted that the following strategies and programs are only suggestions that should be considered for implementation. The City of Santee is the ultimate decision maker as to when and where the proposed improvements are deployed. These strategies and programs may be modified to meet specific funding requirements, area growth patterns, and capital improvement projects. It is envisioned that with the implementation and deployment of these projects, the City will have adequate transportation system capacity to handle the traffic circulation within the city. **Figure 5.1** presents the ITS and supporting communication vision of the City. The vision has been formed to satisfy the existing and anticipated future needs and contains all possible recommended improvements, which are contained in the improvement categories. The deployment and implementation duration of each project may affect the implementation order and process. Due to the number of projects and differences in cost and duration, several phases of implementation may be necessary to complete the vision. The implementation cost and schedule are presented in Section 6 of this document.



Meyer, Mohaddes Associates
a business unit of Iteris, Inc.

City of Santee Transportation Improvement Master Plan - Vision

Figure 5.1

5.2 Deployment Strategy

The following provides a brief analysis of the options in each improvement category, their requirements, as well as a brief description of the expected benefits of the proposed strategies for the City of Santee. Section 6.0 of the report will detail an implementation of short, intermediate, and long range projects.

The strategies and programs that can begin immediately and be implemented within five years should be top priority. The immediate projects should also provide infrastructure for some of the projects in the long run. While the full functionality of a proposed improvement may not be realized for several years, it is important to phase the implementation so that the benefits provided can be realized throughout the development process. The objective is to apply proven, practical, and most effective technologies to help solve current issues, demonstrate their effectiveness, and build on existing applications that have shown success.

ITS technologies have advanced significantly over the past few years. ITS is currently a major focus of national and international entities, and even greater changes can be expected in the years ahead. As technologies advance, new techniques concerning traffic operations and management, traveler information dissemination, and incident management activities can be evaluated for inclusion within the City. The most appropriate approaches will be incorporated as they are proven.

5.2.1 Operational Improvements

S1. Continued Signal Coordination Improvements

During the next five years, the City of Santee should continue to implement and if necessary re-optimizing signal timing plans along its priority corridors.

The City recently completed signal timing optimization analysis along Mission Gorge Road and other major arterials in the City. Coordinating with Caltrans to synchronize Caltrans owned intersections along Mission Gorge Road with the City's intersections will result in a more effective corridor.

It is envisioned that the signal timing plans will require significant revisions in the year 2011 when 50% of the Village at Fanita is completed and occupied; and SR-52 is extended to connect to SR-67. This strategy will primarily impact the traffic operation on Cuyamaca Street, Mast Boulevard, Mission Gorge Road and Carlton Hills Boulevard. During the same period, the Riverview Office Park will be completed and occupied. This strategy will impact the traffic operation on Cuyamaca Street, Magnolia Avenue, and Mission Gorge Road.

The signal optimization process includes the preparation of optimized signal timing plans, focusing on the analysis of subsystem identification and multi-jurisdictional interfaces along the arterial priority corridors. It is important that these signal timing improvements be done across jurisdictional boundaries to provide uninterrupted traffic flow through various jurisdictions. In addition, special event signal timing plans should be prepared.

In order to ensure the signalized intersections are operating properly and the coordination is still applicable to the changing traffic patterns, it is important to continue developing updated signal coordination plans every two to three years after the initial improvements. Updating the signal coordination plans would involve collecting new counts and revisiting and/or re-optimizing the most current existing signal coordination plans during the identified time periods to best fit the new traffic volumes and patterns.

Strategy Benefit: During the state funded Fuel Efficient Traffic Signal Management (FETSIM) Program, between 1983 and 1993, signal timing optimization and coordination projects were carried out throughout the State of California. Retiming of coordinated signal systems, approximately 163 projects, resulted in an average 7.7% reduction in travel time, 13.8% reduction in delays, 12.5% reduction in stops and 7.8% decline in fuel use. Based on the 2003 U.S. Department of Transportation ITS Benefits and Costs report, implementation of signal coordination along 76 corridors in California cities found an 11.4% travel time reduction, 24.9% delay reduction, and 27% reduction in stops. The report also noted that modeling results after the implementation of coordinated signal control in four U.S. localities found reductions in fuel use ranging from a 2% savings in Phoenix, Arizona, to a 12% decline in Richmond, Virginia.

S2. Circulation System Improvements

The critical intersection enhancements should be applied prior to or concurrently with the signal coordination improvements. The following figure (**Figure 5.2**) and table (**Table 5.2**) presents the 10 critical intersections and improvements observed in the field. It should be noted that additional improvements may be implemented as mitigation measures due to the Fanita Ranch and Riverview Office Park developments and other future developments as identified in the general plan circulation element.

Figure 5.2: Critical Intersection Improvements

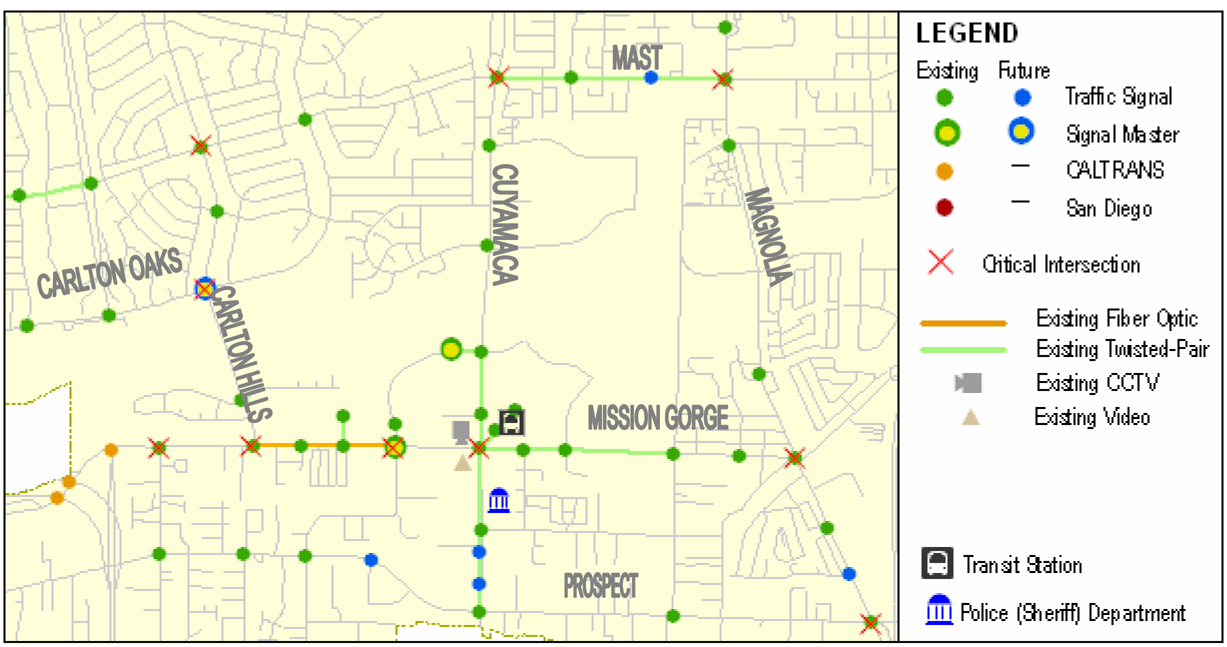


Table 5.1: Proposed Critical Intersection Improvements

INTERSECTION	PROPOSED ENHANCEMENT
	Signal Modifications
Mission Gorge Rd & Magnolia Ave	• Relocate advance loop detection for the westbound traffic
Mission Gorge Rd & Cuyamaca St	• Upgrade signal/trolley equipment
Mission Gorge Rd & Fanita Dr	• Relocate advance loop detection for the northbound traffic
Mission Gorge Rd & Town Center Pkwy.	• Relocate advance loop detection for the northbound traffic
Magnolia Ave & Prospect Ave	• Install Caltrans compliant 170 signal controller and cabinet
Mast Blvd & Cuyamaca St	• Relocate advance loop detection for westbound traffic
Mast Blvd & Carlton Hills Blvd	• Relocate advance loop detection for westbound traffic

Strategy Benefit: It generally involves relatively minor modifications to the signalized intersections to enhance safety, improve the service level of operation, and provide greater optimized coordination between the signals.

5.2.2 ATMS Improvements

S3. Traffic Control System Upgrade

In San Diego County, the City of Santee is the only agency currently running NEMA Econolite ASC/2 controllers. The City has shown interest in upgrading all its signal controllers to be compatible with the rest of San Diego County. Upgrading the City to a Type 170/BI Tran QuicNet/4 system will also allow the City to benefit from the RAMS project, whose purpose is to interconnect among jurisdictions within the San Diego region so as to provide the capabilities for viewing and possibly controlling of devices across jurisdictional boundaries.

This strategy can be deployed in stages, the City can deploy a pilot project first and based on the cost evaluations of the pilot project, the City may choose to upgrade the new control system for the entire city. The traffic signal system upgrade will be comprised of the traffic control software system (TCS) and the traffic signal controllers. The traffic control software system for the City will provide centralized monitoring, management, and control of the traffic signal controller at signalized intersections supported by the City's communication interconnect. The TCS and traffic signal controller solution that best meets the City's needs for managing and expanding its signalized network should be reliable and cost effective. The traffic signal system should also be flexible to allow future expansion in the number of signalized intersections, and the implementation of other ITS elements such as a CCTV video surveillance system.

The existing Traffic Signal Priority (TSP) system, currently using NEMA controllers, should also be upgraded as the controllers in the Trolley Square and along Cuyamaca Street are being replaced with 170 or, if necessary, 2070 controllers. Implementation of an upgraded trolley priority system using the latest technology and existing trolley detectors may better facilitate trolley operation on Cuyamaca Street, especially after majority of the city signals begin operating under QuicNet.

In order to further improve the response time to traffic operation problems, it will be beneficial to develop an integrated system between the Sheriff and TMC entities. This could be done through improvements in the communication system and deployment of Intertie (center to center communication link) between the TMC signal control system and a dedicated workstation at the Sheriff Station on Cuyamaca Street (**Figure 5.2**). The potential improvement includes the deployment of a dedicated computer workstation at the Sheriff Station with connection to central control.

Strategy Benefit: The immediate benefit of upgrading to a Type 170 QuicNet/4 system is its consistency with the rest of the San Diego region resulting in fewer discrepancies during cross-jurisdictional coordination and interconnectivity. A remote traffic control workstation may produce a more consistent, unified response to a situation, which increases the overall effectiveness of the transportation resources.

S4. Installation of Closed Circuit Television (CCTV) Cameras

The City has installed one CCTV monitoring camera at Mission Gorge Road and Cuyamaca Street. This strategy will focus on expanding the City's video surveillance capabilities with the deployment of a CCTV system at several of the remaining critical intersections. Based on the projected average daily traffic (ADT) and future developments, the intersections where CCTV camera installation is recommended are identified in two groups: group one for first stage installation, and group two for future consideration (**Figure 5.3**, next page). The exact location and placement of the cameras should be identified during the design phase of the project.

Group One – first stage installation:

- Mission Gorge Road and Fanita Drive
- Mission Gorge Road and Magnolia Avenue
- Magnolia Avenue and Prospect Avenue
- Mast Boulevard and Carlton Hills Boulevard
- Mast Boulevard and Magnolia Avenue

Group Two – future consideration:

- Mast Boulevard and Fanita Parkway
- Mast Boulevard and Cuyamaca Street
- Mission Gorge Road and Carlton Hills Boulevard
- Cuyamaca Street and Prospect Avenue
- Carlton Hills Boulevard and Carlton Oaks Drive

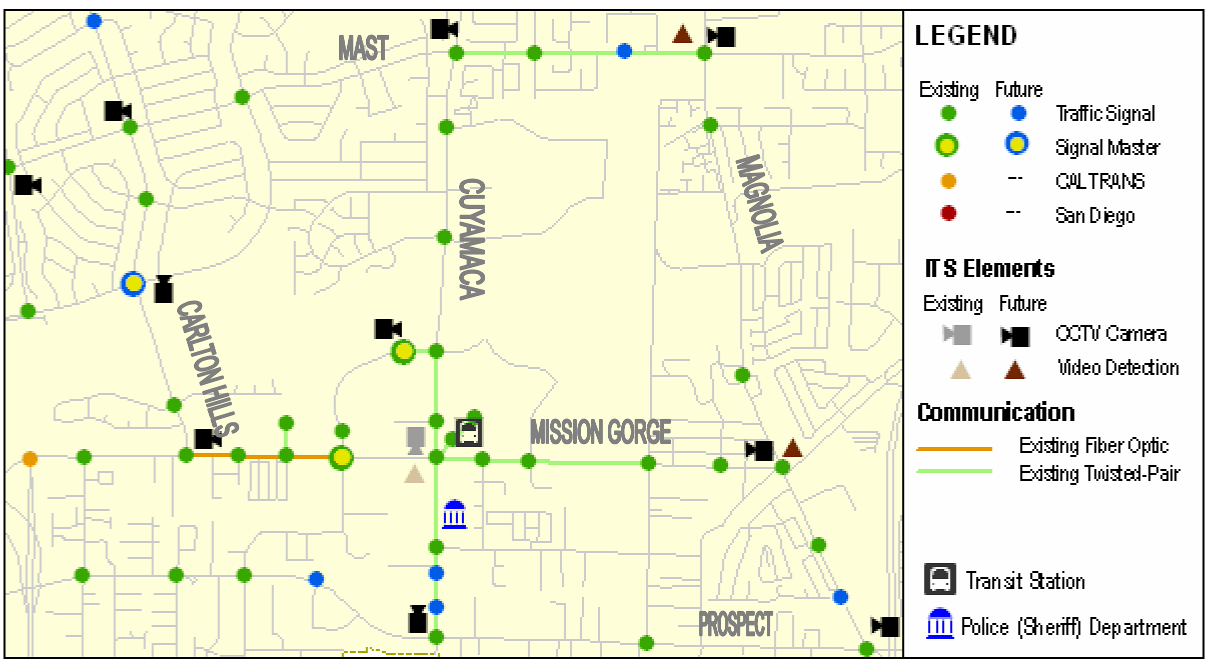
There are several camera manufacturers that have experience deploying CCTV systems for transportation surveillance purposes. Cohu, a San Diego based firm is extremely experienced with surveillance cameras, especially for wide area networking. Cohu i-Series cameras are the latest in dome CCTV cameras that support IP-based communications. Cohu MPEG encoders digitize the video signal from camera using MPEG-2 or MPEG-4 compression technology. Video can be viewed over a local LAN or the Internet using a video player. By using MPEG video, the compression efficiency is 10 to 30 times higher than M-JPEG making it very network friendly.

It is recommended that the City develop this strategy in parallel with or following other projects, such as the communication system. A digital, Ethernet/IP over fiber system is recommended for deployment. This project will assist the operators in the traffic management center and its remote workstations in monitoring traffic without having to go out to the field.

Strategy Benefit: CCTV traffic signal camera benefits:

- *Visually assess traffic flow;*
- *Help emergency response teams;*
- *Observe roads without "on-sight" manpower;*
- *Observe road conditions remotely;*
- *Efficient traffic flow means better fuel economy, and less pollution;*
- *Maximize road usage with optimal traffic flow is cost effective.*

Figure 5.3: Advanced Transportation Management Systems (ATMS) Improvements



S5. Deployment of Video Detection at Major Intersections

Selection of video detection technologies and the development of an installation and implementation plan should be included in this strategy. The locations that may need video detection cover the following sites (**Figure 5.3**):

- Mission Gorge Road and Magnolia Avenue
- Mast Boulevard and Magnolia Avenue

Though two existing video detection cameras are currently in place for the northbound and southbound directions at Mission Gorge Road and Cuyamaca Street to detect trolley traffic, it is recommended that two additional cameras be installed for the eastbound and westbound direction as well. Mission Gorge Road and Magnolia Avenue ranks as the top intersection with the worst level of service, for both the AM and PM peaks. Mast Boulevard and Magnolia Avenue is the closest critical intersection to City Hall, which also has a high school located on the northeast corner.

Strategy Benefit: Replacing loop detection with video detection reduces the delay caused by broken loops and reduces the signal maintenance costs. When supported by fiber optic communications, the video detection data (video and detection zones) can be managed from the TMC (See P8). Additionally, the video transmitted to the TMC can be used as supplemental surveillance video where CCTV cameras are not deployed.

S6. City of Santee TMC Capacity Expansion and Maintenance

In general, a Traffic Management Center (TMC) is a control center where traffic conditions are monitored; and traffic management strategies are devised, initiated, and monitored with the goal of achieving optimum arterial roadway network performance. Ideally, it should provide traffic management with the capability to interface with the field equipment and the traffic control system as well as monitor traffic flow. The City of Santee would like to utilize a TMC to provide a base of traffic operations and a communication hub between field elements, partner agencies, and other stakeholders. At a minimum, from the City's TMC, City staff will be able to perform the following functions:

- Monitor and control signalized intersections, CCTV cameras, video detection system, and other ITS elements within the project area;
- Upload and download traffic signal timing parameters;
- Interface with partner agencies and share information across jurisdictional boundaries in anticipation of incidents affecting the area's mobility;
- Develop traffic strategies and response plans for recurrent congestion, incidents, special events, and emergencies.

In addition, some basic TMC functions should be designated and built, including:

- TMC Security system or functionality, including card swipe entrance control and logon and user account design;
- Incident monitoring, reporting and verification;
- Construction/maintenance report;
- Roadway network measures of effectiveness (MOE) report on a real time basis based on travel time or intersection delay;
- Signal Measures of Effectiveness (MOE) report on a real time basis based on intersection delay;
- Status of field device and hardware as well as TMC software system.

The space requirement of a TMC is determined by its functionality. Based on a review of the system objectives and the City's current traffic operations, the City TMC layout should consist of the following areas:

1. Operations Theater – this is the area for day-to-day operations.
2. Equipment Room – this is the area for equipment storage.
3. Optional: Conference Room – this is the area for meetings and discussions.

These three rooms should be separated for the following reasons:

- The TMC equipment will generate heat and noise. A separate equipment room will provide a more comfortable working environment for traffic management staff. Additionally, the equipment room should utilize a separate climate control to keep the room cooler.
- The installation of additional equipment in the TMC can be done more easily in a separate equipment room.
- Communication equipment is very delicate and should be isolated from non-maintenance staff. A separate equipment room offers extra security for this equipment.
- High quality ceiling treatments and anti-static computer room carpet tile are desirable.
- A separate conference room will provide an area for devising traffic strategies and meetings without disturbing the normal traffic operations and emergencies. Adjoining conference rooms can also be used to house additional staff, should the need arise during special events, incidents, or emergency situations.

With the increase in development and traffic there will also be an increase in signals and the need for additional staff to maintain the signals. The operational and maintenance of TMC, therefore, is a great factor that needs to be carefully evaluated and budgeted for. Another remote workstation may be evaluated.

Strategy Benefit: The goal of the City TMC is to integrate all of the above ITS strategies into the TMC and to expand control and monitoring capabilities to encompass deployed and future ITS field elements.

5.2.3 ATIS Improvements

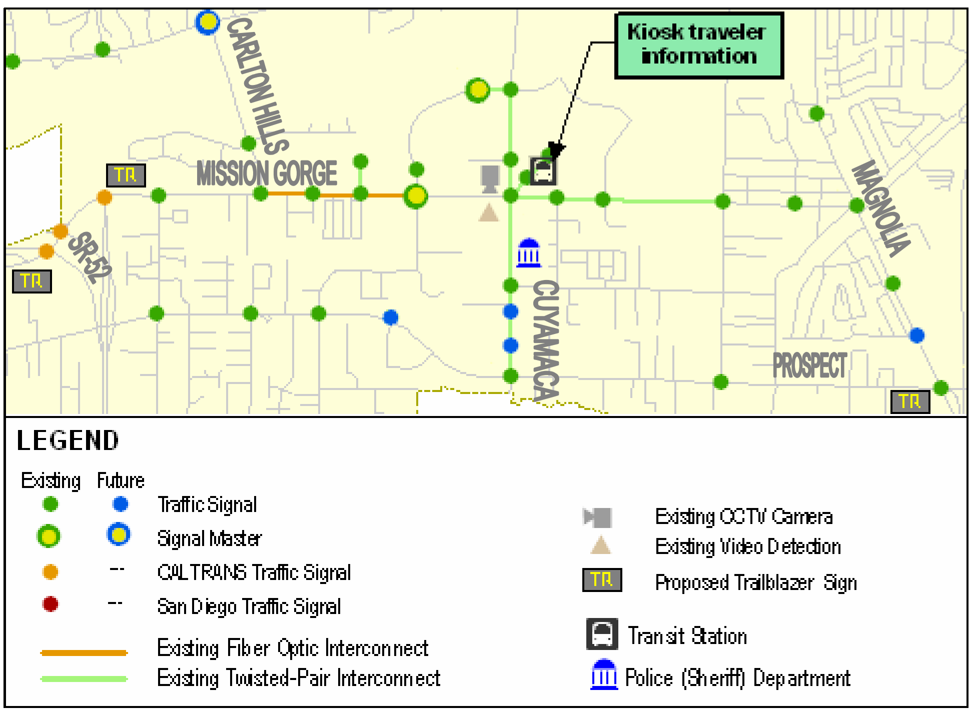
S7. Web-based Traveler Information Dissemination Deployment of traveler information kiosks at strategic locations, and Community Access Television (CATV) traveler information dissemination

Three components may be considered in this project :
- Web site
- Kiosk
- CATV

Web-based traveler information service can provide traffic-related information to the general public over the Internet. The information provided may include a color-coded speed map of the primary corridor freeway/arterial system, video feeds from CCTV cameras, and links to other transportation services, such as local transit agencies (Trolley system, bus, etc). Pre-trip traveler information is designed to capture people prior to beginning their trip (either locally or regionally). Real-time traffic information provided from web-based information sources via Internet has proved itself one of the most effective means for the public to prepare their pre-trip route plans. The information Kiosk and CATV traveler information dissemination provide other components of this project. In order to be effective, these elements must be deployed as part of a regional strategy. Cooperation with other agencies such as Caltrans and transit agencies is essential for the success of such projects. The need and feasibility must be assessed before such projects are carried out.

Strategy Benefit: The 2003 U.S. Department of Transportation study examined the benefits of Pre-trip Information in San Francisco, California. The study showed that while market penetration was low, 45% of San Francisco travelers receiving information from the Travel Advisory Telephone System changed their travel plans and 81% of travelers receiving specific route information from the TravInfo Internet site changed their travel behavior. Also, a simulation study of the Washington, DC, metropolitan area found that individuals using traveler information services could improve their on-time reliability while reducing the risk of running late. Individuals using traveler information improved their on-time reliability by 5-16 percentage points.

Figure 5.4: Advanced Traveler Information Systems (ATIS) Improvements



S8. Deployment of Trailblazer Sign

There are four signals in the City that leads to a freeway; the following Trailblazer signs should be placed to guide traffic in and out of Santee (**Figure 5.4**):

- Mission Gorge Road: East and West of SR 52/SR 125
- Magnolia Avenue: South of Prospect to SR 67

Strategy Benefit: Trailblazer signs are useful in preventing back-ups on the surface streets when there are unforeseen incidents on the freeways.

5.2.4 System Integration Improvements

S9. Integration

This component involves the development of software and procurement of hardware for the integrated workstation. Each integrated workstation will be a PC-based computer running on a common operating environment and interface. It will consist of a Graphical User Interface (GUI), a map display engine (connection to the existing Citywide GIS map), numerous device control modules (as ITS field elements are implemented), a data acquisition service, a data exchange service, a system management service and a report service. In addition, database and application servers may need to be setup to support the operations of these workstations.

Different components of the integrated workstation that are envisioned:

Graphical User Interface (GUI) – An interface for issuing commands to access the various functionality of the TMC, such as to display graphics and CCTV images on the video wall

Map Display Engine – A framework of map display interface, which can be built upon, and filled in with various customized functions, e.g. display real-time traffic progression status, location of CCTV, show DMS messages, etc.

CCTV Control Module – Allows operators to perform camera pan, tilt, zoom, focus, iris control, switch, and select function. It also allows remote viewing of video images and remote control of the cameras from the TMC.

DMS Control Module – Provides access to the DMS message library. Operators can manage (display, send, modify, remove, cancel, update, and configure) DMS messages and DMS data by the DMS control module via the GUI.

Data Acquisition Service (DAS) – Necessary so that the Santee workstation can interface and communicate with the City's existing Econolite Zone Monitor IV traffic control system.

Data Exchange Service (DES) – Enables the TMC to receive data from external agencies and coordinate traffic operations with them.

System Management Service (SMS) – A very important component of the integrated workstations because it is a measure for system security. This functionality enables the TMC to manage the data flow between various components of the system.

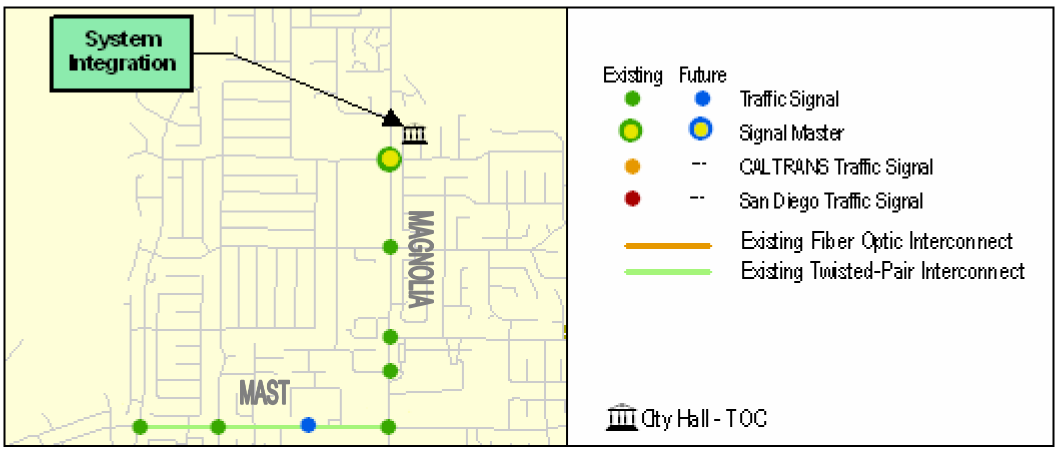
Report Service – Generates various reports against the System database for traffic analysis, device configuration, system management, and record keeping.

Servers – Required supporting the map display engine, DAS, DES, system management service and report service. The servers comprise the majority of the processing power and computing resources in the overall system.

*Strategy Benefit: The proposed integrated workstation (**Figure 5.5**), which could be integrated into the future City TMC, will provide the following improvements:*

- *Enhance the ease of use of the TMC with a single user interface. The integrated workstation eliminates the need to operate multiple devices, such as the touch screen panel and the DMS control, and cross-train operators on each different system.*
- *Provide a one-stop-for-all control module for all City of Santee ITS elements.*
- *Act as the central point for all information flow, which in turn facilitate information exchange and control sharing.*
- *Improve the operator's response and accuracy to incident management.*
- *Serve as the permanent workstation for the future TMC.*
- *Allow people with little knowledge of the future Santee TMC to provide emergency operations during emergencies and special events.*
- *Educate the public about traffic and incident management with the user-friendly GUI.*
- *Provide a common interface of potential transit-highway and transportation-public safety integration.*

Figure 5.5: System Integration Improvements



<u>5.2.5 Communication System Improvements</u>

S10. Communication Implementation

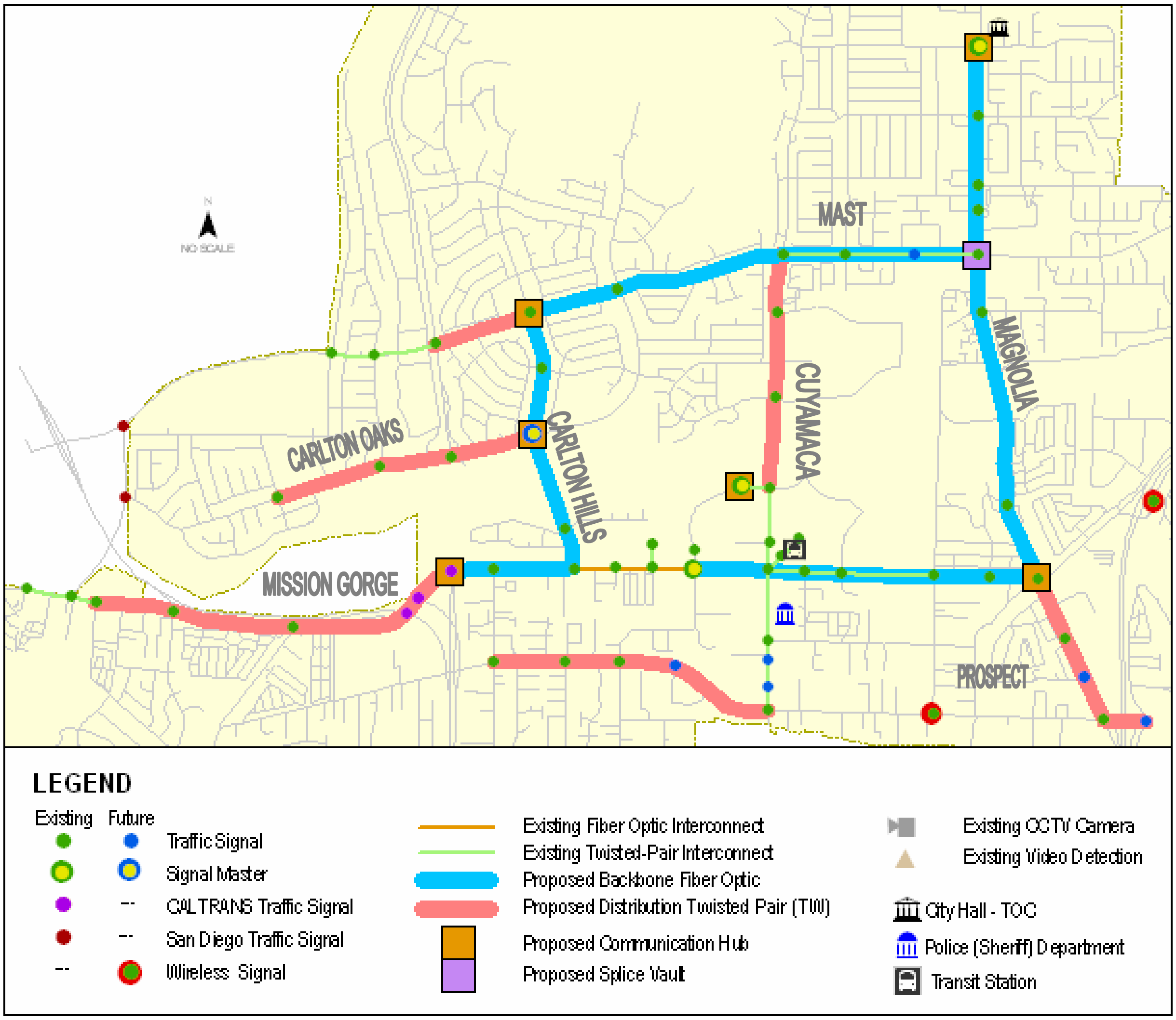
Interconnecting all the existing signals, excluding Caltrans and City of San Diego owned signals, can be achieved as shown in **Figure 5.6**. The main connectivity between the signals is fiber or twisted pair. For remote signals, a wireless connection is the most cost effective solution. The two signals, which should be communicating via a wireless connection, are as follows:

- Prospect Avenue and Cottonwood Avenue
- Woodside Avenue and Davidann Road

Because communication is the core element to all projects, it may be more effective to split communication implementation into different phases in order to gradually integrate all other projects. There are existing interconnects along Mission Gorge Road, Cuyamaca Street, and Mast Boulevard. Gap closures along those corridors would provide an immediate improvement, which will allow for implementation of the other improvements, such as CCTV cameras.

Strategy Benefit: The installation of the communication system will allow other projects to operate at a more optimal level and allow for additional capacity to monitor traffic conditions from a remote location, such as the TMC or the Police (Sheriff) Department. Having direct access to city-wide traffic signals also reduces the number of on-site signal timing modifications and maintenance.

Figure 5.6: Communication System Improvements



5.3 Summary of Project Benefits

It is envisioned that when the proposed improvements are completed, the projects will collectively reduce the city-wide travel time; shorten the travel time along Prime arterials; reduce response time; improve intersection levels of service; provide opportunity for real time surveillance of traffic flow and for verifying incidents.

Each strategy incrementally contributes to the overall operation improvements. **Table 5.2** summarizes the general improvements per proposed strategy.

Table 5.2: Project Benefits Summary

PROJECTS		BENEFITS							
		Reduction in Travel Time	Reduction in delay	Reduction in stops	Reduce collisions	Decline in fuel use	Improve level of service	Enhance safety	Increase response time
Operational Improvements									
S1	Continued Signal Coordination Improvements	■	■	■	■	■	■	■	■
S2	Critical Intersection Improvements	■	■	■	■	■	■	■	
ATMS Improvements									
S3	Traffic control system upgrade	■	■	■			■		■
S4	Installation of Closed Circuit Television (CCTV) Cameras							■	■
S5	Deployment of Video Detection at Major Intersections		■						
S6	City of Santee TMC Capacity Expansion and Maintenance						■		■
ATIS Improvements									
S7	Web-based , Kiosks, and CATV traveler information	■	■	■		■			■
S8	Trailblazer	■	■	■					■
System Integration Improvements									
S9	Integration	■	■	■	■	■	■	■	■
Communication Systems Improvements									
S10	Communication Implementation	■	■	■		■	■	■	■

■ = Improve from 5-10%   *Source: 2003 U.S. Department of Transportation ITS Benefit and Costs Report*

6. IMPLEMENTATION STRATEGY

6.1 Phasing Summary

Implementation of the different strategies discussed in Section 5 has been distributed into a series of short, intermediate, and long term projects. These projects could be deployed individually or packaged together depending on availability of funds. The cost of some projects includes design, construction, and construction management costs. Design and construction management costs are estimated to be approximately 10-15% of the construction cost. Note that the estimated costs may vary depending on the implementation schedule due to changes in labor and material costs.

6.1.1 Short Term Projects

Projects with relatively low cost improvements that can be implemented in a short period of time are short term projects, which typically occur in the first two years. In general, little or no construction is necessary to deploy the short term projects. The short tem projects are selected among the Operational Improvements of the improvement categories only.

Operational Improvements

P1. Reinstallation of Advance Loop Detection at Critical Intersections

Description: Out of the ten critical intersections that were investigated for low cost improvements, there were five intersections, listed in the **Table 6.1**, whose advance loop detectors were either too far from or in the dilemma zone. This project involves the design and construction of the advance vehicle detection systems at those five intersections. The detection system may be the relocation of the existing inductive loop detectors or the deployment of video detection system to replace the inductive loop system.

Table 6.1: Advance Loop Detection Relocation Intersections

INTERSECTION	Signal Modifications
Mission Gorge Rd & Magnolia Ave	Relocate advance loop detection for the westbound traffic
Mission Gorge Rd & Fanita Dr	Relocate advance loop detection for the northbound traffic
Mission Gorge Rd & Town Center Pkwy.	Relocate advance loop detection for the northbound traffic
Mast Blvd & Cuyamaca St	Relocate advance loop detection for westbound traffic
Mast Blvd & Carlton Hills Blvd	Relocate advance loop detection for westbound traffic

Cost: $ 52,000

P2. Installation of Protected/Permissive Left-Turn Signals at Other Locations

Description: If the City is satisfied with the results of the pilot protected/permissive left-turn implementations, continued implementation city wide would occur during this project. Additional locations will be considered as they are identified by City staff.

<u>*Cost:*</u> $ TBD

P3. Continued Signal Coordination Improvements
<u>*Description:*</u> The last time the City had a Traffic Engineering consultant firm develop new coordination plans were in 2003. Protected/permissive left-turn operated intersections differ from typical exclusive left-turn operation and the relocation of advance loop detection will also change the operation of the intersections. Furthermore, it is recommended that coordination plans be re-evaluated every two to three years. Therefore, the existing coordination plans will need to be re-visited after the short term operational improvements. This project will prepare timing plans for signal coordination along the priority corridors within the City, totaling approximately 50 intersections. It also field reviews the traffic signals along the corridors for potential minor modifications to provide an optimum synchronized system.

<u>*Cost:*</u> $100,000

<u>6.1.2 Intermediate Projects</u>

Intermediate projects are a continuation from the short term projects and the deployment and implementation of these projects will assist in the long term projects. These projects typically occur two years after the beginning of this Master Plan, or near the end of the short term projects. The length of time required to complete all projects proposed for the intermediate term would usually take approximately two to three years. These projects are selected among the Operational, ATMS and Communication Improvements of the improvement categories.

Operation Improvements

P4. Continued Signal Coordination Improvements
<u>*Description:*</u> After the completion of all intermediate projects, two to three years after the previous signal coordination improvement, traffic condition may change due to land use changes in the surrounding areas. Coordination plans would need to be reviewed and/or revised again to accommodate the changes in traffic and signal operation. The same 50 updated intersections in Project 3 (P3) should go through similar field reviews and the appropriate modifications.

<u>*Cost:*</u> $ 100,000

ATMS Improvements

P5. Traffic Control System (TCS) Upgrade
<u>*Description:*</u> It is recommended that in order to properly upgrade to the QuicNet/4 software or the latest version of QuicNet compatible with QuicNet/4 and 170 controllers, a pilot project at two major corridors be the first phase. The two corridors, which intersect at the center of the City, are:

- Mission Gorge Road corridor
- Cuyamaca Street corridor

Once the QuicNet/4 software and controllers are deployed, the City will have two separate systems to monitor and maintain. The City will be able to better coordinate with the San Diego region in regards to the RAMS project and other future interconnectivity. The scope of the project will be an evaluation of the existing traffic controller cabinets, controller units, and communication along these two corridors, upgrading the controllers to type 170 or 2070 controllers and deployment of the latest version of the QuicNet (central and local) system in coordination with the RAMS project. It is anticipated that a total of 19 signals (3 of which are Caltrans own and operated signals) along Mission Gorge Road and 9 (excluding the intersection of Mission Gorge Road at Cuyamaca Street) along Cuyamaca Street will be connected and controlled with the new system. This project may be implemented together with Project 7 (P7) in the Communication System Improvements project described below. Some modification to the system detections might be required for proper operation of the traffic responsive mode of QuicNet system.

In conjunction with the controller upgrades, implementation of a Transit Signal Priority (TSP) system using the latest technology and existing trolley detectors is also recommended.

Cost: $ 782,500

P6. Deployment of Video Detection at Major Intersections
Description: Concurrent with paving projects, which may sometimes damage loop detectors, it would be beneficial to deploy video detection cameras at the two suggested locations, listed below.

- Mission Gorge Road & Magnolia Avenue – all approaches
- Mast Boulevard & Magnolia Avenue – all approaches

Mounting of the cameras require field review and four cameras per intersections might not be enough to accommodate all movements, especially since both intersections are relatively wide.

Cost: $ 83,200

Communication System Improvements

P7. Install Communication along Gaps in the Traffic Signal System
Description: Closing the interconnect gap along the entire corridors of Mission Gorge Road and Cuyamaca Street should occur prior to or concurrent with the TCS upgrade. Closing the communication gap along Magnolia Avenue between the Traffic Management Center, at City Hall, and Mast Boulevard would be beneficial in obtaining direct access to the signals being upgraded during the intermediate term. This project may occur in conjunction with the replacement of the existing controllers (P5).

The existing communication along Mission Gorge Road and Cuyamaca Street is typically twisted pair backbone. The recommendation is to use a combination of fiber and twisted pair interconnect. There are three Caltrans intersections along Mission Gorge Road, which has approximately 1.82 miles interconnect gap. There is existing twisted pair communication south of Town Center Parkway on Cuyamaca Street, leaving 0.85 miles of interconnect gap along Cuyamaca Street north of Town Center Parkway to Mast Boulevard. It is approximately 0.75 miles from Mast Boulevard and Magnolia Avenue to the TMC in City Hall.

It is recommended that the communication implemented during this project be IP-based to better utilize the functionalities offered by the upgrade.

Cost: $ 967,200

6.1.3 Long Term Projects

During the completion of the short term and intermediate projects, the long term projects should be ready for deployment. Some long term projects may occur right after the first phase of construction, where others will take years to implement. However, based on funding, priority, and reactions from previous projects, the long term projects may or may not be deployed as planned.

Operation Improvements

P8. Critical Intersection Improvements

Description: As development occurs, the City may determine that additional improvements at the critical intersections are necessary. Some Capital Improvement Projects already include widening and additional lanes (found in **Appendix B**); however, there are some intersections along the prime arterials that may need further analysis for additional improvements – such as signal modifications, geometry enhancements, and operation improvements. Because these types of improvements are all interconnected with signal coordination and communication enhancements, it is recommended that the additional improvements be implemented concurrently.

Due to the controller replacements in Project 5 (P5) and communication gap closures in Project 7 (P7), it is also recommended that the Trolley equipment along Cuyamaca Street and Mission Gorge Road be upgraded.

Cost: $ TBD

P9. Continued Signal Coordination Improvements

Description: Every two to three years after coordination plans have been modified it is recommended that the plans be reviewed again, mainly since there are so many projects continuously being implemented citywide, affecting the estimated 50 intersections in projects 3 and 5. Also, after the completion of a major project that greatly influences the flow of traffic or signal operation the coordination plans along affected corridors should be re-evaluated to properly assist the change.

Cost: $ 100,000

P10. Remote Traffic Control Workstation at Sheriff's Department

Description: After the first phase of the TCS upgrade (P5), a remote workstation at the Sheriff Department, located on Cuyamaca Street just south of Mission Gorge Road, should be deployed to communicate with the new system. It would also be beneficial to have a remote workstation during the expansion of the TMC. It is recommended that this workstation have access to both traffic control systems. This could be done through improvements in the communication system and deployment of Intertie (center to center communication link) between the TMC signal control system and dedicated workstation. The improvement includes the deployment of a dedicated computer workstation at the Sheriff Station with connection to central control. This connection can initially be made via a leased dedicated T1 line. For cost purposes, an estimated $250/month to lease a T1 line for an additional 3 years after deployment has been assumed.

Cost: $ 64,000

ATMS Improvements

P11. Continued Traffic Signal Control System Upgrade

Description: Once the first two corridors are upgraded and fully functional, other major corridors, especially those intersecting Mission Gorge Road or Cuyamaca Street, should begin their controller replacement. The QuicNet/4 system is already installed and the City would already be familiar with the new program and controllers from the first implementation (P5). There are approximately 50 intersections along the major corridors in the City of Santee; therefore, the remaining 25 intersections will require new controllers.

The existing cabinets at some locations may need to be replaced to accommodate the new controllers. Field verification is required to assure that cabinets are a sufficient size and type for the Type 170 controllers. If a replacement of cabinets is also required, more extensive field work is recommended to locate the best possible placement of the cabinets.

Deployment of the remaining communication system (Project 17) should occur simultaneously.

Cost: $ 360,000

P12. Installation of CCTV Cameras at Critical Intersections

Description: During or after the controller upgrade, installation of the proposed CCTV monitoring cameras should also be deployed. Locations for the CCTV cameras are as follows:

Group One – first stage installation:

- Mission Gorge Road and Fanita Drive
- Mission Gorge Road and Magnolia Avenue
- Magnolia Avenue and Prospect Avenue
- Mast Boulevard and Carlton Hills Boulevard
- Mast Boulevard and Magnolia Avenue

Group Two – future consideration:

- Mast Boulevard and Fanita Parkway
- Mast Boulevard and Cuyamaca Street
- Mission Gorge Road and Carlton Hills Boulevard
- Cuyamaca Street and Prospect Avenue
- Carlton Hills Boulevard and Carlton Oaks Drive

As mentioned in Section 5, a digital Ethernet/IP over fiber or twisted pair system is recommended for this deployment. The placement of the cameras will require extra field observation for optimal visibility and mounting.

<u>*Cost:*</u> $ 390,000

P13. City of Santee TMC Capacity Expansion

<u>*Description:*</u> Depending on the progress of ATIS, ATMS, and communication improvements, the TMC is recommended to be upgraded once a large portion of the enhancements and upgrades has occurred. Therefore, once the TMC is completed, the final implementations and deployments will be supported by a larger and more advanced central system.

<u>*Cost*</u>: $ 390,000

ATIS Improvements

P14. Web-based Traveler Information Dissemination

<u>*Description:*</u> With all the new developments, especially the extension of SR 52, the community may benefit from a web-based traveler information guide. This project is recommended to begin as soon as majority of the intermediate projects are completed. A guide to the public, especially one that keeps everyone informed of the changes and provides alternate routes, will give the City a better insight of how each deployment has impacted the community.

<u>*Cost:*</u> $ 60,000

P15. Deployment of Trailblazer Sign

<u>*Description:*</u> Once communication along Mission Gorge Road and Magnolia Avenue has been established, deployment of Trailblazer sign should begin. The following Trailblazer signs should be placed to guide traffic in and out of Santee:

- Mission Gorge Road: East and West of SR 52/SR 125
- Magnolia Avenue: South of Prospect to SR 67

The location of each Trailblazer sign will require some field investigations and interconnect. Implementation of each sign may also occur in conjunction with other projects, such as lane widening CIP projects.

<u>*Cost*</u>: $ 78,000

System Integration Improvements

P16. System Integration

<u>*Description:*</u> During the planning stages of the TMC expansion and system upgrade, system integration should be a large factor in the final design. This project involves the development of software and procurement of hardware for the integrated workstation. Each integrated workstation will be a PC-based computer running on a common operating environment and interface. It will consist of a Graphical User Interface (GUI), a map display engine (connection to the existing Citywide GIS map), numerous device control modules (as ITS field elements are

implemented), a data acquisition service, a data exchange service, a system management service and a report service. In addition, numerous database and application servers will be setup to support the operations of these workstations

Cost: $ 390,000

Communication System Improvements

P17. Continue to Install Signal Interconnect System
Description: Major corridors, totaling approximately 6.48 miles, which still require interconnect include:

- Mast Boulevard
- Carlton Oaks Drive
- Prospect Avenue
- Carlton Hills Boulevard
- Magnolia Avenue

Communication is the initial step to an improved signal; therefore, controller replacement, video detection, and/or other operation improvements should be deployed as each intersection along the corridors listed above are connected to the system. Existing interconnects along Mission Gorge Road (0.59 miles) that is currently twisted pair should also be upgraded to fiber. It is recommended that both the intersections of Prospect Avenue at Cottonwood Avenue and the intersection of Woodside Avenue at Davidann Road be connected via wireless communication.

Cost: $ 2,006,550

P18. Roadway Improvements
Description: Based on the CIP projects in Section 2.8 and additional improvements, as City Staff sees necessary, some roadway improvements include, but are not limited to:

- Widening of Mission Gorge Road between SR 125 and Carlton Hills Boulevard
- Widening of Cuyamaca Street
- Olive Lane Improvements
- Extension of Mast Boulevard to Riverford Road
- Extension of Magnolia Avenue to connect to Cuyamaca Street

Cost: $ TBD

6.1.4 Project Summary

Below, in **Table 6.2**, is a summary of all the recommended short term, intermediate, and long term projects.

Table 6.2: Summary of Recommended Projects

PROJECTS		COST
SHORT-TERM PROJECTS		
P1: Reinstallation of Advance Loop Detection at Critical Intersections		**$ 52,000.00**
	Description: This project involves the design and construction of the advance vehicle detection systems at five intersections.	

PROJECTS	COST
P2: Installation of Protected/Permissive Left-Turn at other locations	**$ TBD**
Description: Additional locations will be considered as they are identified by City staff.	
P3: Continued Signal Coordination Improvements	**$ 100,000.00**
Description: This project will prepare timing plans for signal coordination along the priority corridors.	
5% Contingency for Operation & Maintenance (Short-Term Projects)	*$ 7,500.00*
INTERMEDIATE PROJECTS	
P4: Continued Signal Coordination Improvements	**$ 100,000.00**
Description: Two to three years after the previous signal coordination improvement, plans would need to be revised again to accommodate the changes in traffic and signal operation.	
P5: Traffic Control System (TCS) Upgrade	**$ 782,500.00**
Description: This pilot project includes the installation of the BI Tran QuicNet/4 software and hardware and the replacement of the existing controllers with Type 170 controllers at two major corridors (Mission Gorge Road and Cuyamaca Street) and TSP at 5 intersections near trolley line.	
P6: Deployment of Video Detection at Major Intersections	**$ 83,000.00**
Description: Concurrent with paving projects, this project will install video detection cameras for all approaches at two locations – Magnolia Avenue at Mast Boulevard and Mission Gorge Road.	
P7: Install Communication along Gaps in the Traffic Signal System	**$ 967,000.00**
Description: This project recommends closing the interconnect gap along the entire corridors of Mission Gorge Road and Cuyamaca Street concurrent with or before the TSC upgrade. As well as installing interconnect along Magnolia Avenue from Mast Boulevard to the TMC.	
5% Contingency for Operation & Maintenance (Intermediate Projects)	*$ 96,500.00*
LONG-TERM PROJECTS	
P8: Critical Intersection Improvements	**$ TBD**
Description: As development occurs, potential improvements critical intersections should be implemented, which include operation improvements, signal modifications, and geometric enhancements as directed by City staff.	
P9: Continued Signal Coordination Improvements	**$ 100,000.00**
Description: Every 2 to 3 years after coordination plans have been modified it is recommended that the plans be reviewed again, especially since projects are being implemented citywide.	
P10: Remote Traffic Control Workstation at Sheriff's Department	**$ 64,000.00**
Description: After the TCS upgrades on Cuyamaca Street, a new remote workstation, via a telephone line, at the Sheriff Department should be communicating via the new system.	
P11: Continued Traffic Signal Control System Upgrade	**$ 360,000.00**
Description: Once the first two corridors are upgraded and fully functional, major corridors intersecting Mission Gorge Road or Cuyamaca Street, should begin their controller replacement.	
P12: Installation of CCTV Cameras at Critical Intersections	**$ 390,000.00**
Description: During or after the controller upgrade, installation of the proposed CCTV monitoring cameras should also be deployed. There are a total of 10 recommended CCTV camera locations.	
P13: City of Santee TMC Capacity Expansion	**$ 390,000.00**
Description: Depending on the progress of ATIS, ATMS, and communication improvements, the TMC is recommended to be upgraded once a large portion of the enhancements has occurred.	
P14: Web-based Traveler Information Dissemination	**$ 60,000.00**
Description: With all the new developments, especially the extension of SR 52, the community will greatly benefit from a web-based traveler information guide.	
P15: Deployment of Trailblazer Signs	**$ 78,000.00**
Description: Trailblazer signs should be placed along Mission Gorge Road (East and West of SR 52/SR 125) and Magnolia Avenue (South of Prospect to SR 67) to guide traffic in and out of Santee.	
P16: System Integration	**$ 390,000.00**
Description: During the planning stages of the TMC expansion, system integration should be a large	

PROJECTS		COST
	factor in the final design.	
P17: Continue to Install Signal Interconnect System		**$2,006,500.00**
	Description: Major corridors, which still require interconnect include Mast Boulevard, Carlton Oaks Drive, Prospect Avenue, Carlton Hills Boulevard, and Magnolia Avenue. Modes of communication consist of fiber, twisted pair, and wireless.	
P18: Roadway Improvements		**$ TBD**
	Description: Widening of lanes, extension of corridor, and other roadway improvements.	
Contingency for Operation & Maintenance (Long-Term Projects)		*$ 192,000.00*
TOTAL (Short-Term, Intermediate, and Long-Term Projects)*		***$ 6,219,500.00***

***** Total cost does not include projects whose costs remain to be determined (TBD).

The development of operations and maintenance (O&M) policies and procedures and their associated costs is an important strategy to ensure that the implemented projects will be fully and efficiently operated for the life of the improvements. An O&M plan, even a brief one, should be developed and refined at each stage of implementation. This plan should address both the deployed (field and central) elements and the components of the communication system. It should address staffing requirements for operation and for maintenance and also the opportunities for sharing of duties and responsibilities between them.

Many of the proposed Santee projects probably will not require additional staff for operations and maintenance beyond the current levels. It is anticipated, however, that several of the intermediate and long-term traffic signal upgrade projects will require additional operating staff and additional annual cost of maintenance. Added staffing resources of approximately ½ time of a full time engineer (about 4 hours per day) may be needed to operate and trouble shoot the upgraded and expanded traffic management system. For a city having approximately 100 signals, a minimum of 2 fulltime staff are normally required for operations and a crew of about 5 maintenance technicians required for overall maintenance of the traffic signal system. For City of Santee budgeting purposes, it is initially suggested that approximately 5% be added to the cost of each project for operations and another 5% for the maintenance cost during the useful life of the project. A more detailed estimation of resources and costs should be prepared when the initial set of ITS improvements are tentatively selected.

6.2 Staged Implementation

Implementation of the 19 projects discussed in Section 6.1 will vary based on available funding, community needs, resources, and response to the first phase implementations.

6.2.1 Construction Packaging

Each project may be implemented as a package with other relevant projects, with future CIP projects, or individually. The decision to group projects or keep them separate will be dependent on available funding. Whether projects remain as individual or packaged projects, such as controller upgrade and interconnect system, the implementation should occur concurrently.

6.2.2 Implementation Costs

A conceptual cost implementation schedule is shown below in **Table 6.3**.

Table 6.3 Conceptual Deployment Schedule and High Level Cost Estimates

STRATEGIES	SHORT TERM		INTERMEDIATE			LONG TERM[2]					TOTAL PER PROJECT
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Operational Improvements											
S1 Continued Signal Coordination Improvements		*Project 3* $100,000			*Project 4* $100,000			*Project 9* $100,000			*$ 300,000*
S2 Critical Intersection Improvements	*Project 1* $52,000	*Project 2* TBD				*Project 8* TBD					*$ 52,000[4]*
ATMS Improvements											
S3 Traffic Control System Upgrade			*Project 5* $782,500[1]			*Project 11* $360,000	*Project 10* $55,000	$3,000[3]	$3,000[3]	$3,000[3]	*$ 1,206,500*
S4 Installation of Closed Circuit Television (CCTV) Cameras							*Project 12* $390,000				*$ 390,000*
S5 Deployment of Video Detection at Major Intersections				*Project 6* $83,200							*$ 83,200*
S6 City of Santee TMC Capacity Expansion and Maintenance							*Project 13* $130,000	$130,000	$130,000		*$ 390,000*
ATIS Improvements											
S7 Web-based , Kiosks, and CATV traveler information						*Project 14* $60,000					*$ 60,000*
S8 Trailblazer							*Project 15* $78,000				*$ 78,000*
System Integration Improvements											
S9 Integration							*Project 16* $130,000	$130,000	$130,000		*$ 390,000*
Communication Systems Improvements											
S10 Communication Implementation			*Project 7* $967,200			*Project 17* $1,003,275	$1,003,275			*Project 18* TBD	*$ 2,973,750[4]*
TOTAL PER YEAR =	*$52,000*	*$100,000*	*$1,749,700*	*$83,200*	*$100,000*	*$1,423,275*	*$1,786,275*	*$363,000*	*$263,000*	*$3,000*	$ 5,923,450
5% Contingency for Operation & Mainteance =	$2,600	$5,000	$87,485	$4,160	$5,000	$71,164	$89,314	$18,150	$13,150	$150	$ 296,173
TOTAL PER TERM =	***$159,600***		***$2,029,545***			***$4,030,478***					***$ 6,219,623[4]***

NOTES:

S = Strategy; P = Project; TBD = To Be Determined

[1] Includes local and central upgrade

[2] Long term project implementation may vary based on available funds

[3] $250/month to lease a phone line

[4] Does not include projects whose cost are TBD

6.3 Funding Sources

As the regional planning agency for transportation, SANDAG allocates millions of dollars each year in local, state, and federal funds for the region's transportation network. SANDAG develops the Regional Transportation Plan to implement a long-range vision for buses, the Trolley, rail, highways, major streets, bicycle travel, walking, goods movement, and airport services. The following describes some specific revenues for state highway, local street, and road projects. Funding sources should be revisited and identified periodically to be able to secure appropriate opportunities for funding the City of Santee's projects.

State Transportation Improvement Program (STIP) and State Highway Operation and Protection Program (SHOPP): The CTC programs the STIP and SHOPP on a statewide basis. The program funding is based upon reasonably expected state and federal revenues, as identified in the 2006 STIP Fund Estimate that was adopted by the CTC on September 2005. The STIP- and SHOPP-funded projects programmed are based upon the recommended funding amounts. The final approved funding, as adopted by CTC at its April 2006 meeting, is incorporated into the final 2006 RTIP.

Regional STP (RSTP): Federal RSTP funds are apportioned by Caltrans to various areas of the state, including the San Diego region. RSTP funding levels are based on estimates provided by Caltrans. RSTP funds have been programmed to EAP projects, as well as toward other eligible projects.

Congestion Mitigation and Air Quality (CMAQ) Program: Federal CMAQ funds also are apportioned by Caltrans to the San Diego region. Eligible EAP and other projects include CMAQ funds.

Borders and Corridors Program: SAFETEA-LU changed the distribution of this program to a formula-based program at the national level. The funds are allocated to the state which develops the project eligibility and funding. In addition to addressing these issues, SB 1282 exempts these federal funds from being included in the transportation funds subject to the distribution and fair share formulas (the current method for STIP-RIP distribution).

Traffic Congestion Relief Program (TCRP): In FY 2001, the Governor of California initiated a new funding program (TCRP) in an effort to relieve congestion statewide. The TCRP was created as a result of a budget surplus; however, with the continuing budget deficit, TCRP allocations haven been sporadic. TCRP funds are based on the priority list of TCRP allocations.

Highway Bridge Program (HBP)/Hazard Elimination Safety including Safe Routes to Schools (HES/SR2S): These programs are administered by Caltrans at the statewide level. Funding levels for the HBP program are based upon Caltrans' recommended list of projects. SANDAG will program the HES/SR2S programs as soon as they become available from Caltrans. SANDAG maintains a lump sum listing for each program as provided by Caltrans. Caltrans has committed to updating the lump sum list every six months.

Demonstration/High-Priority Projects: SAFETEA-LU includes several San Diego region projects under the High-Priority Project Authorizations program.

Local Agency Funding: The local agency revenues programmed are based on reasonably expected revenues as submitted by local agencies. Included are city and county local gas tax subventions, local public funds, Prop. 42 funds, and developer funds administered by local agencies.

Local Privatization/Toll Revenues: The 2006 RTIP includes two local privatization/toll revenue funding: (1) the SR 125 private toll road project from SR 905 to SR 54 (authorized by AB 680) – the project and the privatization funding programmed are based upon the most recent information provided by California Transportation Ventures (CTV) and Caltrans; and (2) the SR 241 Foothill Corridor toll road.

FTA Urbanized Area Formula (Section 5307) Capital Program: The FTA Section 5307 program is a formula-funding program to fund ongoing preventive maintenance, bus acquisition programs, the regional vanpool program, office and shop equipment, and other capital projects. The revenues are based on SAFETEA-LU through FY 2009 then escalated by four percent to 2011 (the escalation rate is based on an average growth over the SAFETEA-LU period).

FTA Formula (Section 5310) Capital Program: This program is administered by Caltrans, and the funds are allocated each year by the California Transportation Commission (CTC). Recipients are nonprofit organizations serving the elderly and the disabled community in need of vehicles and other capital items in order to provide services. No funds are shown under this category since the allocation occurs after the adoption of the FSTIP and all previous funds have been obligated. After CTC approves the funding, the project will be amended into the RTIP.

Traffic Congestion Relief Program (TCRP): The Governor of California initiated a new funding program (TCRP) in an effort to relieve congestion statewide in FY 2001. The TCRP was created as a result of a budget surplus; however, with the continuing budget deficit, the status of TCRP is uncertain. TCRP funds are based on the priority list of TCRP allocations.

Transportation Development Act (TDA): TDA funds are based on a ¼ percent state sales tax, with revenues made available primarily for transit operating and capital purposes. By law, the San Diego County Auditor’s office estimates the apportionment for the upcoming fiscal year. SANDAG prepares forecasts of TDA funds using the apportionment as the base level. The forecasts are based on a forecast of sales tax revenues estimated for the San Diego County using SANDAG’s Demographic and Economic Forecasting Model (DEFM), an econometric forecasting model which takes into consideration numerous variables, including population growth, inflation, and real income growth. Certain TDA funds are included in the ‘local’ revenue sources and in the operating costs.

TransNet Local Sales Tax Program: TransNet allocates 1/3 of the available local sales tax revenues for transit purposes. Of these funds, no more than 40 percent is available for operating and for nonrail capital purposes, and at least 60 percent is used for capital projects specified in the original ballot measure. The TransNet Extension allocates 24.6 percent to transit, of which 16 percent is allocated directly to the transit operators for operations and other capital needs. The forecasts of sales tax funds are developed using the same DEFM model discussed above. The TransNet funds include proceeds from bonds backed by the sales tax revenues. The TransNet funds revenues for transit projects are consistent with SANDAG's annual forecasts.

Other Funds: These funds include contributions from various state funding sources, local agency contributions, private sector funding, advertising income, investment earnings, passenger fare revenue, and other miscellaneous income. Revenues from these sources are generally consistent with established historical trends or are based upon funding commitments from local agencies.

Freeway Service Patrol (FSP) Program: The 2006 RTIP programs provides funding for the region's FSP program from funding provided through the state FSP Act and RSTP funds allocated by SANDAG. The FSP program costs and revenue estimates have been developed jointly by SANDAG, Caltrans, and the California Highway Patrol based upon the most current statewide FSP Act funding levels.

Regional Transportation Demand Management (TDM) Program: The Regional TDM revenues programmed are derived from multiple sources – CMAQ, TransNet, TDA, FTA Section 5307, and local/private funding.

APPENDIX A

ADVANCE DETECTOR SETBACKS

Advance Detector Setbacks

Drivers are in a "dilemma zone" if, when they see the yellow indication, they are too close to the intersection to stop, but are too far away to enter the intersection before the red indication. Empirical studies have shown the zone to begin approximately 4.5-5.0 seconds of travel time from the stop line and end approximately 2.0-2.5 seconds from the stop line. It is good safety practice to avoid terminating the green indication when vehicles are in the dilemma zone.

If advance detectors are not placed upstream of the dilemma zone, vehicles can enter the zone before the controller is aware of their presence. This can lead to yellow indications being shown to vehicles in the dilemma zone, which increases the perception/reaction demand on the driver. The increased perception/reaction demand may lead to increased number of collisions.

Design requirements of advanced detectors based on the Caltrans Manual via the Manual for Uniform Traffic Control Devices (MUTCD) 2003 California Supplement was used to calculate suggested detector setback distances from the stop line. The MUTCD 2003 California Supplement provides guidance regarding the minimum distance needed to eliminate the dilemma zone. The recommendations are illustrated in the following table:

Table A.1: Suggested Advance Detector Setbacks

Approach Speed (MPH)	MUTCD 2003 California Supplement Minimum Distance (feet)
25	105
30	140
35	185
40	230
45	285
50	345
55	405

A summary of the existing advance detector setbacks compared with the MUTCD 2003 California Supplement values can be found in **Table A.2**. All minimum advance detector setback values listed are based on the posted speed limit. Approaches that do not meet the MUTCD 2003 California Supplement minimum standards (highlighted in **Table A.2**) are more than 30 feet below the minimum, an estimated distance. Relocating detectors may not be the utmost priority for improvement, but should be considered for future improvement plans that can accommodate relocating advance loop detectors.

Table A.2: Advance Detector Summary at Critical Signalized Intersections

INTERSECTION	NB			SB			EB			WB		
	Sp	**Ex**	**CT**	**Sp**	**Ex**	**CT**	**Sp**	**Ex**	**CT**	**Sp**	**Ex**	**CT**
Mission Gorge Rd & Magnolia Ave	**45**	272	285	**45**	262	285	**40**	242	230	**45**	181	285
Mission Gorge Rd & Cuyamaca St	**35**	258	185	**45**	294	285	**40**	301	230	**40**	287	230
Mission Gorge Rd & Fanita Dr	**40**	136	230	**-**	-	-	**40**	*	230	**40**	240	230
Mission Gorge Rd & Town Center Pkwy	**35**	153	185	**35**	241	185	**40**	231	230	**35**	261	185
Mast Blvd & Magnolia Ave	**40**	234	230	**40**	330	230	**40**	237	230	**35**	240	185
Mission Gorge Rd & Carlton Hills Blvd	**-**	-	-	**35**	247	185	**40**	327	230	**35**	290	185
Magnolia Ave & Prospect Ave	**40**	240	230	**40**	*	*	**40**	214	230	**40**	*	*
Mast Blvd & Cuyamaca St	**40**	187	230	**35**	241	185	**40**	273	230	**40**	169	230
Mast Blvd & Carlton Hills Blvd	**35**	235	185	**35**	258	185	**35**	235	185	**40**	183	230
Carlton Hills Blvd & Carlton Oaks Dr	**35**	211	185	**35**	216	185	**35**	207	185	**25**	250	105

** Note: Loops were not visible in the field*

Sp: Posted speed   Ex: Existing advance detector setback   CT: Caltrans minimum recommended advance detector setback

APPENDIX B

ON-GOING PROJECTS AND CAPITAL IMPROVEMENT PROGRAM (CIP) PROJECTS

Table 12-3
Recommended Mitigation Measures
Year 2010 With SR 52 Extended to SR 67 With 50% of the Project Traffic

Intersection	Peak Hour	Without Project		With Project		Mitigated		Recommended Mitigation Measures
		Delay [a]	LOS [b]	Delay [a]	LOS [b]	Delay [a]	LOS [b]	
6. Woodglen Vista Dr/Cuyamaca St	AM PM	19.8 66.7	C F	46.2 >100.0	E F	21.1 24.7	C C	Install a traffic signal with the following geometry: **SB Cuyamaca St**: One Left-turn lane, one Through lane and one shared Through/Right lane **WB Woodglen Vista Dr**: One Left-turn lane and one shared Through/Right lane **NB Cuyamaca St**: – One Left-turn lane, one Through lane and one shared Through/Right lane **EB Woodglen Vista Dr**: – One Left-turn lane and one shared Through/Right lane
8. El Nopal/Cuyamaca St	AM PM	34.5 43.0	D E	>100.0 >100.0	F F	16.7 18.5	C C	Install a traffic signal with the following geometry: **SB Cuyamaca St**: One Left-turn lane, one Through lane and one shared Through/Right lane **WB El Nopal**: One Left-turn lane and one shared Through/Right lane **NB Cuyamaca St**: – One Left-turn lane, one Through lane and one shared Through/Right lane **EB El Nopal**: – One Left-turn lane and one shared Through/Right lane
11. Mast Blvd/SR 52 EB Ramp	AM PM	12.9 >100.0	B F	13.4 >100.0	B F	26.5 19.4	C B	Install a traffic signal with north/south (Mast Blvd) split phasing and provide the following geometry: **WB Mast Blvd**: One Left-Turn lane and one shared Left/Through lane **WB On-Ramp**: No change **EB Mast Blvd**: No change **EB Off-Ramp**: Two Left-turn lanes and one shared Through/Right lane
12. Mast Blvd/SR 52 WB Ramp	PM	53.2	F	83.3	F	12.9	B	Install a traffic signal and provide the following geometry: **WB Mast Blvd**: Two Right-Turn lanes and two Through lanes **WB Off-Ramp**: No change **EB Mast Blvd**: One Left-turn lane and two Through lanes **EB On-Ramp**: No change

Table 12-3
Recommended Mitigation Measures
Year 2010 With SR 52 Extended to SR 67 With 50% of the Project Traffic

Intersection	Peak Hour	Without Project		With Project		Mitigated		Recommended Mitigation Measures
		Delay [a]	LOS [b]	Delay [a]	LOS [b]	Delay [a]	LOS [b]	
23. Carlton Oaks Dr/Carlton Hills Blvd	AM	72.0	E	90.5	F	40.3	D	Provide the following intersection geometry: **SB Carlton Hills Blvd**: No Change **WB Carlton Oaks Dr:** Dual Left-turn lanes, One Through lane and one Right-turn lane **NB Carlton Hills Blvd**: No Change **EB Carlton Oaks Dr**: Right-turn overlap phasing
34. Mission Gorge Rd/Cuyamaca St	PM	73.4	E	78.0	E	64.7 [c]	E [c]	Provide a Right-turn lane on **NB** Cuyamaca Street
38. Woodside Ave/SR 67Off-Ramp	AM	54.8	F	54.9	F	45.7	D	Provide the following intersection geometry: **SB SR 67 Off Ramp:** No change **WB Woodside Ave South:** One Left-turn lane and one shared Left/Through lane **NB Woodside Ave:** Dual Left-turn lanes and one Right lane **EB Woodside Ave North:** No change

Footnotes:

a. Average intersection delay in seconds

b. Level of service

c. The impact is not fully mitigated to LOS D or better but is mitigated to below a level of significance (lower than the "without" project condition)

STREET NAME	LIMITS	DESCRIPTION	COST	STATUS
Cuyamaca St	River Park Dr - Mission Creek Dr	Widening, pedestrian and bike improvements	$ 2,262,600	CIP 07-03, Begin design
Cuyamaca St	River Park Dr - Town Center Pkwy	Sidewalk	$ 186,000	CIP 07-04
Cuyamaca St	Mesa Av - Mast Bl	Widening, pedestrian and bike improvements	$ 378,300	CIP 00-04, Completed
Magnolia Av	Chubb Ln - San Diego River	Sidewalk	$ 396,100	CIP 06-10, Contract awarded
Magnolia Av	Park Av - Chubb Ln	Sidewalk	$ 143,100	CIP FY07-08
Mission Gorge Rd	SR 125 - Carlton Hills	Widening	$ 9,447,300	CIP 07-08
Olive Ln	Mission Gorge - Via Zapador	Improve to 4 lane collector	$ 4,584,000	CIP 07-10
Prospect Av	Interchange with SR 67	Ramp improvements	$ 5,300,000	CIP 07-13
Woodside Av & Shadow Hill Rd		Intersection improvements	$ 180,000	CIP 07-11
Prospect Av		Widening and undergrounding	$ 20,075,000	Future CIP
Buena Vista Av	Cottonwood Av - Railroad Av	Widening	$ 422,200	Future CIP
Civic Center Dr.	B St - Town Center Pkwy	Widening	$ 2,625,000	Future CIP
Cottonwood Av	Park Av - Mast Bl	Widening	$ 12,768,000	Future CIP
Cuyamaca St	Mast Bl - Lafe Dr	Widening	$ 1,821,900	Future CIP
Cuyamaca St	Town Center Pkway - Mesa Av	Widening	$ 9,226,300	Future CIP
Fanita Dr	Prospect Av - Mission Gorge Rd	Widening	$ 1,273,600	Future CIP
Fanita Dr	Southern City Limit - Prospect Av	Widening	$ 22,938,200	Future CIP
Graves Av	Pepper Dr - Prospect Av	Widening	$ 1,341,600	Future CIP
Graves Av	Prospect Av - Northerly End	Widening	$ 207,300	Future CIP
Lake Canyon Dr	Fanita Dr - Settle Rd	Widening	$ 527,600	Future CIP
Magnolia Av	Mission Gorge Rd - Chubb Ln	Widening	$ 3,395,300	Future CIP
Mast Bl	Los Ranchitos Rd - Eastern City Limit	Widening	$ 3,601,800	Future CIP
Mesa Rd	Southern City Limit - Prospect Av	Widening	$ 1,269,300	Future CIP
Mesa Rd	Prospect Av - Mission Gorge Rd	Widening	$ 294,200	Future CIP
Prospect Av	Mesa Rd - Cuyamaca St	Widening	$ 30,071,200	Future CIP
Railroad Av	Mission Gorge Rd - Prospect Av	Widening	$ 2,525,400	Future CIP
Town Center Pkwy	B St - Cottonwood Av	Widening	$ 5,775,000	Future CIP
Town Center Pkwy	Cottonwood Av - Magnolia Av	Widening	$ 2,625,000	Future CIP
Magnolia Av & Mission Gorge Rd		Intersection improvements	$ 3,309,200	Future CIP

STREET NAME	LIMITS	DESCRIPTION	COST	STATUS
Mission Gorge Rd & Cottonwood Av		Intersection improvements	$ 335,600	Future CIP
Mission Gorge Rd & Cuyamaca St		Intersection improvements	$ 382,000	Future CIP
Mission Gorge Rd & Fanita Dr		Intersection improvements	$ 338,100	Future CIP
Magnolia Av & Prospect Av		Intersection improvements	$ 338,000	Future CIP
Carlton Hills Bl	Gorge Av - San Diego River	Median improvements	$ 820,000	Future CIP
Cuyamaca St	San Diego River - 950' south	Median improvements	$ 546,000	Future CIP
Magnolia Av	Chubb Ln - Braverman Dr	Median improvements	$ 1,200,000	Future CIP
Magnolia Av	Kerrigan St - 2nd St	Median improvements	$ 1,880,000	Future CIP
Mast Bl	Fanita Pkwy - Carlton Hills Bl	Median improvements	$ 1,100,000	Future CIP
Mast Bl	Magnolia Av - Los Ranchitos Rd	Median improvements	$ 1,857,000	Future CIP
Mast Bl	Cuyamaca St - Magnolia Av	Median improvements	$ 983,000	Future CIP
Mission Gorge Rd	Civic Center Dr - Magnolia Av	Median improvements	$ 1,857,000	Future CIP
Woodside Av	Magnolia Av - SR 67	Median improvements	$ 1,311,000	Future CIP
Cuyamaca St	Northerly terminus to southerly boundary of Fanita Ranch	Street extension	Dev. Funded	To be constructed with development
Magnolia Av	Princess JoAnn - Cuyamaca St	Street extension	Dev. Funded	To be constructed with development

APPENDIX C

COST ESTIMATES

PROJECTS		Unit	Quantity	Unit Price	Total Cost
P1: Reinstallation of Advance Loop Detection at Critical Intersections					
	Relocation of advance loop detectors at critical intersections (per approach)	EA	5	$ 8,000.00	$ 40,000.00
	Design and Construction Management			30%	$ 12,000.00
P2: Installation of Protected/Permissive Left-Turn at Other Locations					
	Prot/Perm Left-Turn operation as directed by City Staff		TBD	TBD	TBD
P3: Continued Signal Coordination Improvements					
	New/Modify intersection coordination plans	EA	50	$ 2,000.00	$ 100,000.00
P4: Continued Signal Coordination Improvements					
	New/Modify intersection coordination plans	EA	50	$ 2,000.00	$ 100,000.00
P5: Traffic Control System (TCS) Upgrade					
	Upgrade to BI Tran QuicNet/4 System	EA	1	$ 200,000.00	$ 200,000.00
	Replace intersection controller with Type 170	EA	25	$ 16,000.00	$ 400,000.00
	Trolley priority operation at intersection(s) near trolley line	EA	5	$ 25,000.00	$ 125,000.00
	Design and Construction Management			30%	$ 217,500.00
	Contingencies		1	$ 100,000.00	$ 100,000.00
P6: Deployment of Video Detection at Major Intersections					
	Install video detection at Mission Gorge Rd & Magnolia Ave	EA	4	$ 8,000.00	$ 32,000.00
	Install video detection at Mast Blvd & Magnolia Ave	EA	4	$ 8,000.00	$ 32,000.00
	Design and Construction Management			30%	$ 19,200.00
P7: Install Communication along Gaps in the Traffic Signal System					
	Fiber Optic along gap of Mission Gorge Road	MI	0.45	$ 250,000.00	$ 112,500.00
	Twisted Pair along gap of Mission Gorge Road and Cuyamaca Street	MI	2.22	$ 200,000.00	$ 444,000.00
	Fiber Optic along Magnolia Avenue from Mast Blvd to City Hall	MI	0.75	$ 250,000.00	$ 187,500.00
	Design and Construction Management			30%	$ 223,200.00
P8: Critical Intersection Improvements					
	Trolley equipment upgrade, operational improvements, signal modification, etc.		TBD	TBD	TBD
P9: Continued Signal Coordination Improvements					
	New/Modify intersection coordination plans	EA	50	$ 2,000.00	$ 100,000.00
P10: Remote Traffic Control Workstation at Sheriff's Department					
	Install Traffic Control Workstation	EA	1	$ 40,000.00	$ 40,000.00
	Lease phone line	YR	4	$ 3,000.00	$ 12,000.00
	Design and Construction Management			30%	$ 12,000.00
P11: Continued Traffic Signal Control System Upgrade					
	Replace intersection controller with Type 170	EA	25	$ 16,000.00	$ 400,000.00
	Design and Construction Management			30%	$ 120,000.00
	Contingencies		1	$ 100,000.00	$ 100,000.00
P12: Installation of CCTV Cameras at Critical Intersections					
	Install CCTV camera at critical intersections	EA	10	$ 30,000.00	$ 300,000.00
	Design and Construction Management			30%	$ 90,000.00
P13: City of Santee TMC Capacity Expansion					
	Additional rooms	EA	3	$ 100,000.00	$ 300,000.00
	Design and Construction Management			30%	$ 90,000.00
P14: Web-based Traveler Information Dissemination					
	Web-based traveler guide	EA	1	$ 60,000.00	$ 60,000.00
P15: Deployment of Trailblazer Signs					
	Install Trailblazer sign at Mission Gorge Road & SR 52/SR 125	EA	2	$ 20,000.00	$ 40,000.00
	Install Trailblazer sign at Magnolia Avenue & Prospect Ave	EA	1	$ 20,000.00	$ 20,000.00
	Design and Construction Management			30%	$ 18,000.00
P16: System Integration					
	Upgrade Software	EA	1	$ 150,000.00	$ 150,000.00
	Upgrade Hardware	EA	1	$ 150,000.00	$ 150,000.00
	Design and Construction Management			30%	$ 90,000.00
P17: Continue to Install Signal Interconnect System					
	Replace existing twisted pair with Fiber Optic along Mission Gorge Road	MI	0.59	$ 250,000.00	$ 147,500.00
	Install Fiber Optic along the remaining major corridors in Santee	MI	6.48	$ 200,000.00	$ 1,296,000.00
	Install wireless communication	EA	2	$ 50,000.00	$ 100,000.00
	Design and Construction Management			30%	$ 463,050.00
P18: Roadway Improvements					
	Widening, extension, and other improvements		TBD	TBD	TBD
				SUB-TOTAL	*$ 6,443,450.00*
				5% Contingency for Operations & Maintenance	*$ 322,172.50*
TOTAL (Short-Term, Intermediate, and Long-Term Projects)*					***$ 6,765,622.50***

***** Does not include projects whose cost is to be determined (TBD)