

SAN JOSE'S PARKING GUIDANCE SYSTEM

From Concept to Design

Mark E. Spencer

INTRODUCTION

San Jose, California is the 11th largest city in the United States, with a population quickly approaching 1 million people. As the capital of Silicon Valley, downtown San Jose continues to grow as a major destination center. Also, a new City Hall complex will be completed within five years. As a result of the continued growth, in a downtown that experiences heavy demands of tourist and visitor traffic, parking has routinely been identified as a top priority. A Parking Guidance System is one tool that will help manage the growth in downtown traffic and parking demand in San Jose.

Many of the existing public and private parking facilities are close to capacity during the weekday, with downtown workers occupying many of the spaces. A Parking Guidance System can help manage the transportation system by directing motorists from the freeway system to the garage entrances. With a Parking Guidance System, the primary method of disseminating information is through dynamic message signs that display real-time parking availability information. Parking Guidance System signs can be tied to specific land uses, areas or parking facilities to guide drivers to their destinations. A Parking Guidance System will allow better use of existing and planned parking facilities, and help reduce driver frustration.

Thousands of visitors are also attracted annually to sporting and other activities. Within downtown San Jose there are numerous parking garages and lots, several of which are owned by the city. With the high volume of traffic, including many people unfamiliar with the street system and parking facilities, there is a need to efficiently guide motorists to available parking spaces.

To address this need, a Parking Guidance System (PGS) concept plan was developed to direct motorists to city and privately owned parking garages. The system will inform drivers of parking locations and availability, using electronic message signs located at key locations on major streets and freeway exit ramps. By providing them with timely and accurate information, drivers can make informed decisions about where they wish to park, and thus use parking facilities more efficiently. Another benefit of a Parking Guidance System is the reduction in excess circulation of motorists looking for a parking space, and the corresponding improvement in air quality.

PARKING FACILITIES

Over fifty public and private parking facilities were initially considered for the PGS based on their occupancy profile, size, proximity to major land use generators, revenue control equipment, and operating practices. To maximize the benefits and financial

investment of a PGS, the focus was on large parking facilities that generally have daytime parking spaces available in downtown or have evening parking capacity for major event traffic. Using an evaluation criteria matrix (Table 1), it was determined that eleven city and fifteen privately-owned parking facilities should be included in the PGS, including three San Jose State University parking facilities. The final number of parking facilities is currently being negotiated, based on the willingness of facility owners and operators to participate in the system.

Revenue Control. The revenue control system at each garage is the mechanism that counts entering/exiting vehicles, as well as conducts and reports financial transactions. Garage occupancy is generally tracked by loop detectors embedded in the pavement near the entrance and exit gates or by transaction records. When a vehicle drives across the detector, the vehicle is counted as entering or leaving the garage. Some garages operate independently while others are connected to a central PGS computer.

PGS Garage Equipment. The PGS design calls for each garage to have a computer that tracks the number of vehicles in the facility and then sends the information to the central PGS computer. The garage computer will have a terminal that allows the attendants to regularly correct counting errors that may occur over time.

Field testing confirmed that the accuracy of occupancy data collected at individual parking garages varies depending on the detection method and the age and type of the revenue control equipment. To lessen the chance of a potential inaccuracy, two methods to establish direct connections are being considered: one method is a direct link between the revenue control system and the PGS computer, and the other method is a direct connection between the PGS computer and the garage gates.

The accuracy of the data is a critical point in the system design. The information relayed to motorists must be reliable, or the PGS will not have credibility.

For older revenue control systems, parking garage gates can be used to count vehicles. The gate system involves the ticket issuing process, inductive loops in the driveway, the ticket spitter mechanism, and the gate itself. Parking gate systems can be more accurate than just inductive loops by themselves or other detector systems. Using the gates also provides a method for easily separating the number of vehicles driving in and out of the garage, including any reversible lanes. The gate opening and closing process sends an electrical pulse to the computer in the garage. The garage computer then tracks the number of vehicles and sends the information to the PGS central computer.

Newer revenue control systems can be directly connected to the PGS via a software interface. The interface permits the PGS to track the number of vehicles in the facility based on data from the revenue control system. This type of connection requires that the revenue control system software and the PGS software are in a compatible Windows format. Figure 1 illustrates the decision process for selection of the appropriate interface between the PGS and each facility.

Table 1: San Jose Parking Guidance System Shortlist

Facility Name	Size	Rate Structure? / 2-ways?	Revenue Control	Location
	Details	Details	Details	Details
Convention Center Garage	1,222 spaces 994 spaces available to public; 228 spaces operated by Hilton Hotel	Monthly: \$60 monthly Transient: \$5 prepay, \$3 after 6, \$7 exhibitor pass	Yes Federal APD SCAN system in place	150 W San Carlos 2 levels underground
Second/San Carlos Garage	544 spaces	Monthly: \$75 non-reserved; \$150 reserved Transient: \$0.75/half hour for first hour, \$0.50/half hour thereafter, \$9.50 daily max	Yes Federal APD SCAN system in place 2 Fed APD pay-on-foot machines Automated cashier payment system	280 S. Second Street 5 levels above ground
Market/San Pedro Garage	1,390 spaces 1,193 spaces allocated to monthly tenants, 197 spaces to transient parkers.	Monthly: \$75 non-reserved Transient: \$0.75/half hour for first hour, \$0.50/half hour thereafter, \$9.50 daily max	Yes Federal APD SCAN system in place Fed APD fee computers	45 N. Market Street 6 levels above ground
Third Street Garage	856 spaces 736 spaces allocated to monthly tenants and 120 spaces allocated to transient parkers.	Monthly: \$75 non-reserved Transient: \$0.50/half hour, \$9.00 daily max	Yes Federal APD SCAN system in place	95 N. Third Street 5 levels above ground, 1 below ground
4th/San Fernando Garage (future)	800 spaces	Same as other City facilities	Yes To be determined when constructed	Northeast corner of 4th & San Fernando Streets
SoFA Garage (future)	800 spaces	Same as other City facilities	Yes To be determined when constructed	West side of south 2nd Street between San Carlos and San Salvador Streets

Table 1: San Jose Parking Guidance System Shortlist (continued)

Facility Name	Size	Rate Structure? / 2-ways?	Revenue Control	Location
	Details	Details	Details	Details
Civic Center Garage (future)	300 spaces	Same as other City facilities	Yes To be determined when constructed	West side of south 6th Street between Santa Clara and San Fernando Streets
Civic Center Garage II (future)	1350 spaces	Same as other City facilities	Yes To be determined when constructed	West side of north 6th Street between Santa Clara and St. John Streets
Civic Center Garage III (future)	600 spaces	Same as other City facilities	Yes To be determined when constructed	TBA
Comerica Garage	1,176 spaces 623 monthly spaces 555 transient spaces	Monthly: \$96/month; \$20 county, \$30 city employee Transient: \$2.25/hr, \$19 daily max; \$5 arena event	Yes Amano System Automatic ticket spitters Gates with attended booth	333 W. Santa Clara
Gibson Speno Garage	794 spaces 750 monthly spaces 44 visitor spaces	Monthly: \$100/month; \$145 reserved Transient: \$1/20 min; \$15/daily max; \$3 special event	Yes Automatic ticket spitters Gates with attended booth	60 S. Market Street 1 level underground 5 levels above ground
Adobe Garages	1800 spaces	Monthly: n/a Transient: \$1.25/20 min; \$20 daily max; \$6 after 6 pm		303 Almaden Boulevard 6 levels
Opus Garage (future private)	805 spaces			

Table 1: San Jose Parking Guidance System Shortlist (continued)

Facility Name	Size	Rate Structure? / 2-ways?	Revenue Control	Location
	Details	Details	Details	Details
Riverpark Towers Garage	1,388 spaces 850 monthly tenants 10 reserved spaces	Monthly: \$95/month; \$150 reserved Transient: \$1/20 min; \$15 daily max; \$5 after 6 pm	Yes Booth with attendant Federal APD gates	333 W. San Carlos Garage 5 levels above ground; 2 levels underground
Park Center Plaza I Garage	1,090 spaces monthly tenants & transient parkers approximately 300 visitor spaces self-parking & complimentary valet	Monthly: \$125 tower, \$150 main, \$250 reserved Transient: \$1.25/20 min; \$20 daily max; \$6 after 5 pm	Yes Datapark equipment Installed 1 year ago	100 Park Center Garage 5 levels above ground; 2 levels underground
Park Center Plaza III Garage	1320 Serves 410,000 sf of office space Mostly monthly tenants w/ some visitors	Monthly: \$75 monthly, \$110 reserved Transient: \$0.75/20 min; \$12.75 daily max; \$7 after 5 pm	Yes Attendants & key cards Machine-readable tickets	W. San Fernando Garage 5 levels above ground; 1/2 open, 1/2 covered
Crowne Plaza Hotel Garage	267 spaces 130 monthly spaces 137 spaces for visitors & hotel guests	Monthly: \$90/month Transient: \$1/20 min; \$15/day; \$6 event & visitor	Yes Automatic ticket spitters Gates with attended booth	82 Almaden Boulevard 3 levels above ground
Arena Parking Lots A, B, C	1,436 spaces	\$10 event	No Attendant on duty during events	San Jose Arena 525 Santa Clara
Water Company	913 spaces 2 different lots			Santa Clara/Delmas
10th/San Fernando Garage (SJSU)	1,950 spaces 30 short-term spaces Valid SJSU permits only	Weekly: \$5.40 Regular Semester: \$81 Summer Session \$54, Winter Session \$16 Annual Employee Pass: \$216	No Loop detectors at entrances & exits Loops installed June 1995	10th Street/San Fernando

Table 1: San Jose Parking Guidance System Shortlist (continued)

Facility Name	Size	Rate Structure? / 2-ways?	Revenue Control	Location
	Details	Details	Details	Details
4th/San Carlos Garage (SJSU)	1,132 spaces 2 short-term spaces Valid SJSU permits only	Weekly: \$5.40 Regular Semester: \$81 Summer Session \$54, Winter Session \$16 Annual Employee Pass: \$216	No Loop detectors at entrances & exits Loops installed June 1995	4th Street/San Carlos
7th/San Salvador Garage (SJSU)	2,008 spaces 10 short-term spaces Valid SJSU permits only	Daily \$2, Weekly \$5.40 Regular Semester: \$81 Summer Session \$54, Winter Session \$16 Annual Employee Pass: \$216	Ventek self-park system, April 1998 Loop detectors at entrances & exits Loops installed June 1995	7th Street/San Salvador

Table 1: San Jose Parking Guidance System Shortlist (continued)

Facility Name	7 days/24 hrs?	Long term vs. Short term	Facility Utilization Profile	Validation Program
	Details	Details	Details	Details
Convention Center Garage	Sunday: 7 am to 7 pm Mon-Thurs: 6 am to 10 pm Friday: 6 am to 1 am Saturday: 7 am to 1 am	Monthly: 355/month Transient:	Peak occupancy 61% - 10 am to Noon, 57% - Noon to 2 pm, 50% - 7 to 9 pm, 60% - 9 to 11 pm.* Transient parkers are predominantly visitors for special events at the Convention Center, Public Library, Tech. Center, & Hilton Hotel	
Second/San Carlos Garage	Mon-Fri: 7 am to 10 pm Sat-Sun: free parking After 6pm: free parking	Monthly: 346/month Transient:	Peak occupancy 78% - 10 am to 2 pm, 30% - 7 to 9 pm, 40% - 9 to 11 pm.* Transient parkers are primarily visitors to nearby Federal & State government offices, downtown cinemas, Technology Museum, & retail businesses.	Free parking after 6 pm & on weekends Parking can be validated by nearby businesses, shops, restaurants
Market/San Pedro Garage	Mon-Fri: 7 am to 8 pm Sat-Sun: free parking After 6pm: free parking	Monthly: 2,068/month Transient:	Peak occupancy 65% - 10 am to Noon, 74% - Noon to 2 pm, 60% - 7 to 9 pm, 75% - 9 to 11 pm.* Transient parkers are primarily patrons of nearby dining and entertainment establishments and San Jose Arena.	Free parking after 6 pm & on weekends Parking can be validated by nearby businesses, shops, restaurants
Third Street Garage	Mon-Fri: 6 am to 8 pm Sat-Sun: free parking After 6pm: free parking	Monthly: 1,085/month Transient:	Peak occupancy 99% - 10 am to 2 pm, 20% - 7 to 9 pm, 40% - 9 to 11 pm.* Transient parkers are primarily visitors to adjacent Horizon Center buildings and other nearby office buildings.	Free parking after 6 pm & on weekends Parking can be validated by nearby businesses, shops, restaurants
4th/San Fernando Garage (future)	To be determined. Similar to hours at other City facilities	50% Monthly 50% Transit		
SoFA Garage (future)	To be determined. Similar to hours at other City facilities			

Table 1: San Jose Parking Guidance System Shortlist (continued)

Facility Name	7 days/24 hrs?	Long term vs. Short term	Facility Utilization Profile	Validation Program
	Details	Details	Details	Details
Civic Center Garage (future)	To be determined. Similar to hours at other City facilities			
Civic Center Garage II (future)	To be determined. Similar to hours at other City facilities			
Civic Center Garage III (future)	To be determined. Similar to hours at other City facilities			
Comerica Garage	Mon-Fri: 6:30 am to 7 pm Sat & Sun: Closed Open evenings for special events	Monthly: 623/month Transient: 555 spaces	Hardly ever full	
Gibson Speno Garage	Sun-Thur: 7 am - 11 pm Fri: 7 am - 3 am Sat: 7am - 3 pm	Monthly: 750/month Visitors:	Lot full by 9 am. Plenty of parking after 6 pm. Visitors are at times turned away during the day. No waiting list for monthly parking.	City of San Jose AMPCO validations
Adobe Garages	Yes Booth with attended gate			
Opus Garage (future private)				

Table 1: San Jose Parking Guidance System Shortlist (continued)

Facility Name	7 days/24 hrs?	Long term vs. Short term	Facility Utilization Profile	Validation Program
	Details	Details	Details	Details
Riverpark Towers Garage	Mon-Fri: 6 am - 12 am Sat: 8 am - 12 am Sun: 8 am - 9 pm	Monthly: 850 monthly; no waiting list Visitors: 250/day	Lot doesn't fill, transient parkers aren't turned away. Transients include patrons of Center for Performing Arts	
Park Center Plaza I Garage	Mon-Fri: 7 am - 11 pm Sat-Sun: 12 pm - 8:30 pm	Monthly: No waiting list Visitors: 300 spaces available; occasionally full	Peak occupancy 98% - 10 am to Noon, 95% - Noon to 2 pm, 60% - 7 to 9 pm, 75% - 9 to 11 pm.* Often full by noon, located near convention center. Serves patrons to special events at Tech Center (\$4 rate). Occasionally turns away transient parkers.	Validation books for tenants to give to clients
Park Center Plaza III Garage	Mon-Fri: 7 am - 9 pm 24-hr access with key cards for tenants Event parking for San Jose Arena	Monthly: 1100/month; occasional waiting list Visitors: 150/day	Located 2-3 blocks from Arena, averages 200-300 parkers for arena events. Visitors aren't turned away during day.	None
Crowne Plaza Hotel Garage		Monthly: 130/month; no waiting list Visitors:	Garage fills by 9:30 am. Evening parking for hotel events. Arena parking available after 6 pm. Visitors are turned away during the day.	Hotel Validations
Arena Parking Lots A, B, C	Open only during events		100% occupied during sold out events	
Water Company			20% full evenings, 30% full Saturday eves.	
10th/San Fernando Garage (SJSU)	Mon-Fri: 5:30 am - 11 pm Sat-Sun: 7 am - 11 pm No access or exit after hours		Valid SJSU permits only, violators ticketed by SJSU parking enforcement. Peak occupancy is less than 75% & occurs betwn 8 am & 3 pm. Space turnover is approximately 2.7 vehicles per day.	

Table 1: San Jose Parking Guidance System Shortlist (continued)

Facility Name	7 days/24 hrs?	Long term vs. Short term	Facility Utilization Profile	Validation Program
	Details	Details	Details	Details
4th/San Carlos Garage (SJSU)	24 hours per day, weekdays & weekends Closed on university holidays		Valid SJSU permits only, violators ticketed by SJSU parking enforcement. Peak occupancy is more than 95% & occurs between 9 am & 2 pm. Turnover is approximately 2.7 vehicles per day.	
7th/San Salvador Garage (SJSU)	24 hours per day Open all times	Daily: 1,000/day	Valid SJSU permits only, violators ticketed by SJSU parking enforcement. Peak occupancy is less than 75% & occurs between 8 am & 4 pm. Turnover is approximately 2.7 vehicles per day.	

SIGNAGE

Existing Guide Signs. There is a mixture of directional guide signs located throughout the downtown area, including destination and parking signs. These portable parking signs have standard white lettering on a blue background. They include the international parking symbol, the name of the garage, and an arrow indicating the direction to the facility. While the signs provide a consistent shape and style, their street level location makes it difficult to distinguish them from other signs and street hardware.

In addition to the static parking signs, there are also nine Changeable Message Signs (CMS) around the San Jose Arena that assist drivers seeking event parking. These signs are not used on a daily basis, but do provide an opportunity when considering more comprehensive parking management systems such as a PGS.

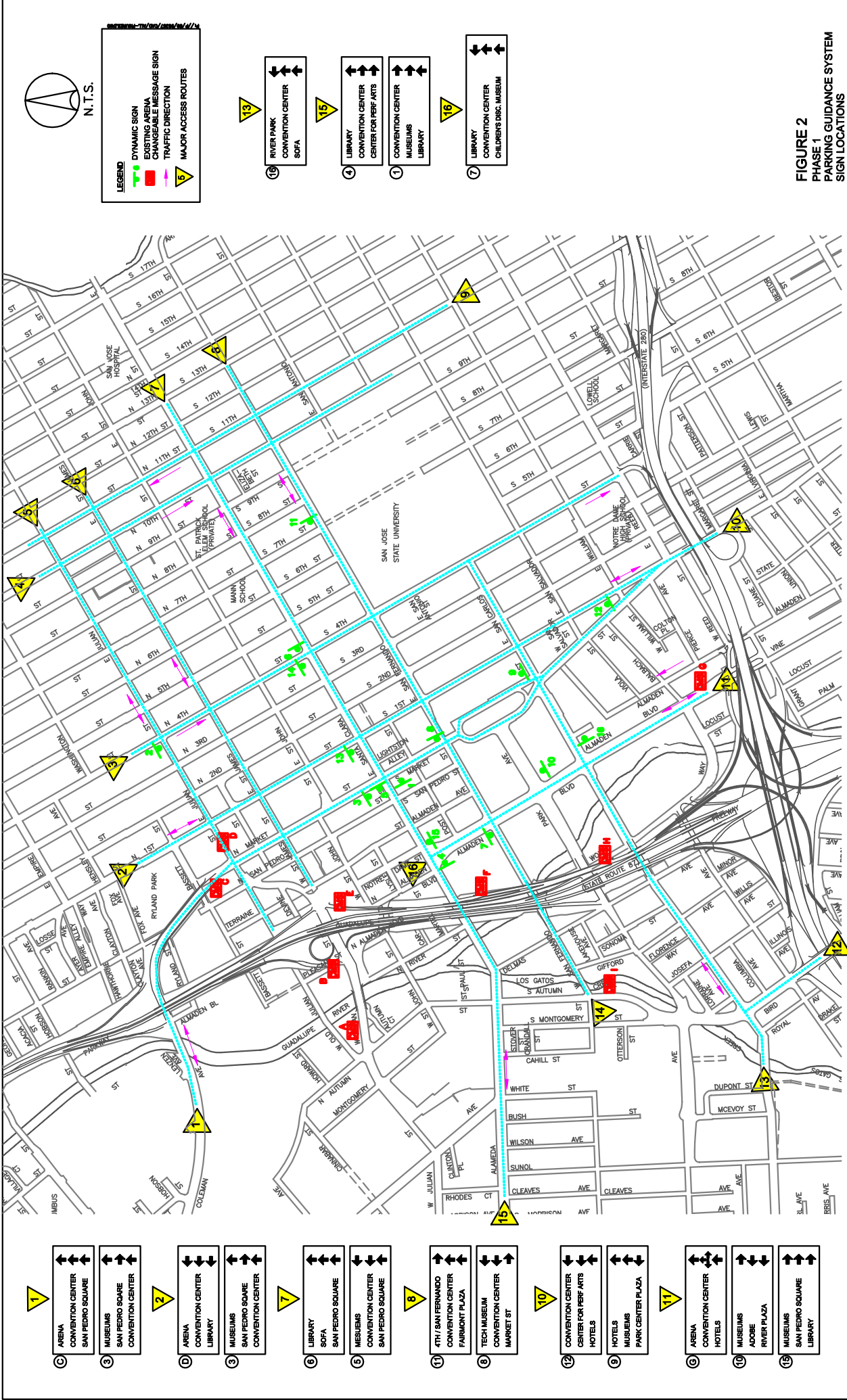
PGS Field Signs. One of the most important principles in guiding motorists to parking facilities is consistent, clear and legible signing. From the time that drivers enter the downtown area and see the first sign, until they reach the parking garage, they should see signs that are the same general shape, design, and color. A mix of electronic and static signs should convey parking information and direction. Electronic signs provide the real-time parking information about spaces available, while the static signs assist the motorist in finding the parking garage. The signage should provide the driver with sufficient advance notice that a decision point is approaching, but drivers should not be overloaded with so many signs that the desired message gets lost in the maze.

Dynamic Message Signs. Dynamic Message Signs (DMS) are a combination of conventional static signing with a small electronic sign insert. The electronic part of the sign uses technology similar to large freeway message signs, except on a much smaller scale. In San Jose, the sign panel at the top will be static and include the City's logo.

Figure 2 illustrates the sign locations and suggested messages. The figure also shows how the signs are grouped together by access route. The sign locations and message content are undergoing review by various city departments so that they are consistent with other programs currently underway in downtown San Jose.

A total of 24 DMS signs are planned. Installation of the signs (and related equipment) is anticipated to occur in two phases. Phase one will focus on the downtown core and Convention Center area, and include fifteen (15) dynamic message signs. Phase 2 will focus on the new Civic Center area and San Jose State University, and include an additional nine (9) DMS. In addition, the existing San Jose Arena CMS may also be utilized on an as-needed basis.

As shown in Figure 3, two or three panels in the middle will display available parking spaces, and the lower panel will be a single-line changeable message sign (CMS). The design of the PGS sign is undergoing review by various city departments so that it is consistent with other signage programs currently underway.



- 7
ARENA
CONVENTION CENTER
SAN PEDRO SQUARE
- 8
MUSEUMS
SAN PEDRO SQUARE
CONVENTION CENTER
- 9
ARENA
CONVENTION CENTER
LIBRARY
- 10
MUSEUMS
SAN PEDRO SQUARE
CONVENTION CENTER
- 11
LIBRARY
SOFA
SAN PEDRO SQUARE
- 12
MUSEUMS
CONVENTION CENTER
SAN PEDRO SQUARE
- 13
4TH / SAN FERNANDO
CONVENTION CENTER
FAIRMONT PLAZA
- 14
TECH MUSEUM
CONVENTION CENTER
MARKET ST
- 15
CONVENTION CENTER
CENTER FOR PERFORMING ARTS
HOTELS
- 16
HOTELS
MUSEUMS
PARK CENTER PLAZA
- 17
ARENA
CONVENTION CENTER
HOTELS
- 18
MUSEUMS
ADORE
RIVER PLAZA
- 19
MUSEUMS
SAN PEDRO SQUARE
LIBRARY

LEGEND

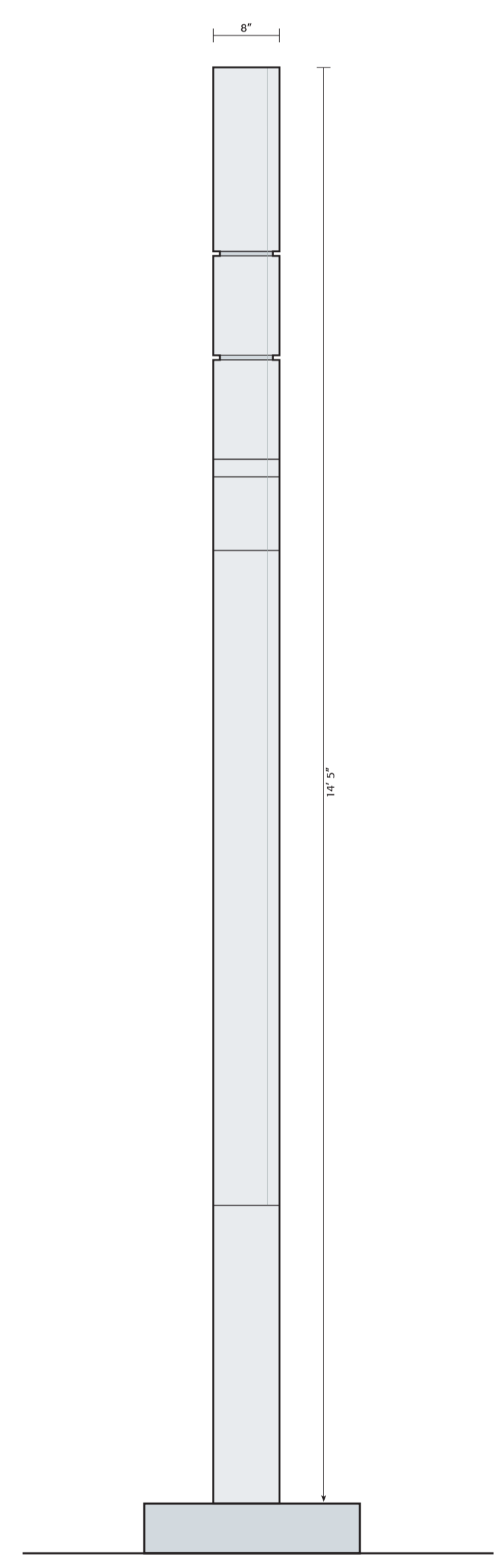
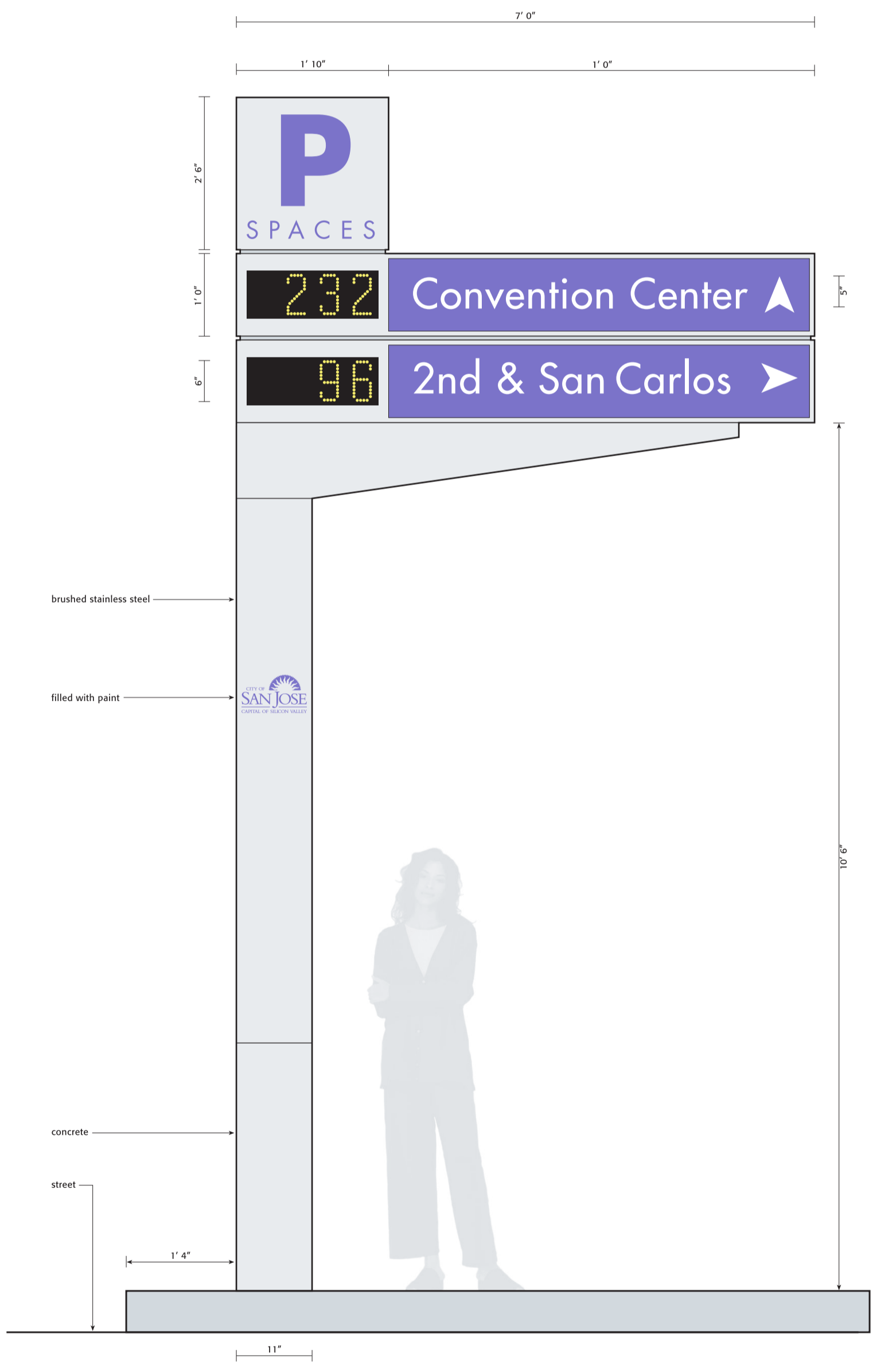
- DYNAMIC SIGN
- EXISTING ARENA
- CHANGEABLE MESSAGE SIGN
- TRAFFIC DIRECTION
- MAJOR ACCESS ROUTES

13
RIVER PARK
CONVENTION CENTER
SOFA

14
LIBRARY
CONVENTION CENTER
CENTER FOR PERFORMING ARTS
MUSEUMS
LIBRARY

15
LIBRARY
CONVENTION CENTER
CHILDREN'S DISC. MUSEUM

FIGURE 2
PHASE 1
PARKING GUIDANCE SYSTEM
SIGN LOCATIONS



Static Guide Signs. Thirty-nine (39) additional static-only signs are also planned for the San Jose PGS program. Static guide signs are the final element that the motorist will see, following the signs located at the downtown gateways and then the signs at major decision points. They will provide drivers with additional directional guidance to the parking facilities. A standard logo on a colored sign is being designed to reinforce the driver's pathway for use throughout the study area. The participating parking facilities will also have the standard parking sign displayed at their parking facility's entrance. The sign will carry the same name as the one displayed on the dynamic parking guidance signs. Also, all PGS static signs will include the international parking symbol displayed in white on a blue background.

SYSTEM ARCHITECTURE

All communication will be brought back to the City of San Jose Traffic Management Center (known as Signal Central), located in the office of the City's Department of Transportation. A typical PGS computer includes a central processing unit, graphics terminal, printer, and software that allow for central control and management of the system. To facilitate staff coordination, the central PGS computer will also be located in his facility, although not directly linked to the City's Traffic Control System (due to NTCIP compliance issues).

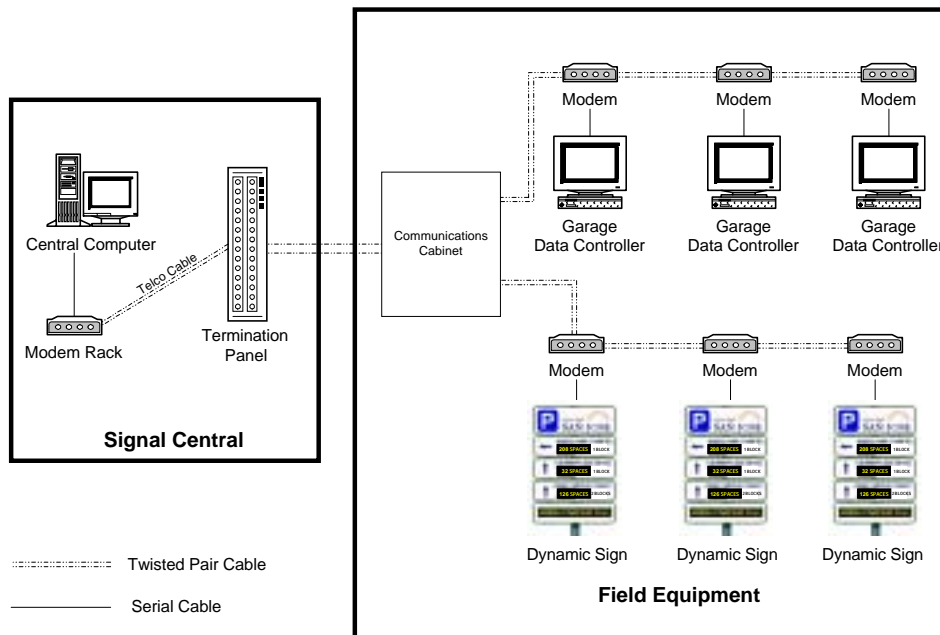
Parking count information from each garage will be collected in the central computer at Signal Central and then displayed on dynamic message signs on the street.

Additionally, the occupancy of each garage could also be provided as an output to an Internet Web page or to other Silicon Valley agencies such as Caltrans and Santa Clara County. The data could also be used in a Highway Advisory Telephone (HAT) system, where drivers can call into an automated phone system that provides real-time information about the status of the garages.

Figure 4 shows the proposed PGS system architecture. Dynamic Message Signs and parking garage PGS equipment will be connected to the central computer in the Traffic Management Center. The control of the DMS and garage computers will be via the existing traffic signal twisted wire pair (TWP) network. One of the initial steps in the feasibility analysis was to determine the communications system capacity in downtown San Jose. Multiple signs and garages can be operated on a single TWP cable. Based on PGS system requirements and the availability of TWP in the city signal network, four TWP cables are likely to be needed to transmit all PGS data into the central computer. The cables will be connected to a multiple serial interface card in the computer.

The design of the system also calls for system redundancy. Therefore, for backup links, wireless communications can be used. A non-licensed, low-power microwave with a directional antenna is planned for the wireless links.

Figure 4 – San Jose PGS System Architecture



SYSTEM COSTS

Planning level cost estimates have been developed for the PGS. The rough estimates are based on information available from vendors and other similar systems. Exact costs will depend on the vendor selected to provide the equipment, the interface method between the PGS and the garages, and the communication system. Based on these assumptions, the total Phase 1 cost estimate is \$2.8 million. The cost elements and breakdown are presented in Table 2. Phase 2 will require an additional \$1.3 million, bringing the total PGS cost estimate to \$4.1 million.

SYSTEM BENEFITS

Many benefits are expected from the deployment of a Parking Guidance System in San Jose. They include:

- More efficient use of existing parking spaces which reduces the need to construct new parking facilities.
- Assistance to the driver in finding the nearest available short-term parking garage.
- Provides an aid to orient persons unfamiliar to the area.
- Informs the traveler of the amount and location of available short term parking spaces.
- Reduces the amount of time motorists spend searching for available parking facilities.
- Reduces congestion and air pollution by lowering the number of drivers searching for a parking space.

- Increases garage occupancy, thus permitting an amortization of costs in a relatively short period of time.

NEXT STEPS

In September 2000 the City of San Jose Department of Streets and Traffic in cooperation with the Redevelopment Agency staff completed an evaluation of the feasibility and concept plan of a PGS for downtown San Jose. Design of the first phase began in late 2000 and will continue through 2001. Construction and implementation is scheduled to begin in late 2001 and extend to mid-2002.

With the support of city officials and downtown stakeholders, funding has been set aside for the design and initial implementation of the program. Following deployment, San Jose's PGS will be one of the largest applications of real-time parking management in North America.

Table 2 – Cost Estimate
City of San Jose Parking Guidance System
Phase 1 - Preliminary Cost Estimate

Item Description	Unit	Qty	Unit Cost	Total Cost
<i>Equipment and Installation</i>				
1 Dynamic Message Signs	EA	42	\$ 7,000.00	\$ 294,000.00
2 7' x 8' LED Full Matrix Sign	EA	1	\$ 150,000.00	\$ 150,000.00
3 Full Matrix Sign	EA	14	\$ 20,000.00	\$ 280,000.00
4 Static Guide Signs	EA	117	\$ 800.00	\$ 93,600.00
5 Garage Connection	EA	20	\$ 10,000.00	\$ 200,000.00
6 DMS Connection	EA	14	\$ 5,000.00	\$ 70,000.00
7 Electrical Service Connection	EA	15	\$ 10,000.00	\$ 150,000.00
8 Conduit	LF	7530	\$ 25.00	\$ 188,250.00
9 Twisted Pair Cable	LF	8595	\$ 2.00	\$ 17,190.00
10 Garage Data Controller	EA	20	\$ 8,000.00	\$ 160,000.00
11 Central Computer	EA	1	\$ 25,000.00	\$ 25,000.00
12 Central Software	EA	1	\$ 50,000.00	\$ 50,000.00
13 Central Com. Modifications	LS	1	\$ 25,000.00	\$ 25,000.00
			<i>Subtotal:</i>	\$ 1,703,040.00
<i>Design and Testing</i>				
14 Detailed Design	20%			\$ 340,608.00
15 Contingency	25%			\$ 425,760.00
16 Testing	15%			\$ 255,456.00
			<i>Subtotal:</i>	\$ 1,021,824.00
<i>Operations and Maintenance</i>				
17 Spare Parts	5%			\$ 40,880.00
18 Maintenance Support (Year 1)				\$ 50,000.00
			<i>Subtotal:</i>	\$ 90,880.00
			TOTAL:	\$ 2,815,744.00

ACKNOWLEDGMENTS

The author of this paper acknowledges the contributions made by several people. Frank Hernandez of the City of San Jose Department of Transportation is the City's Project Manager for the Parking Guidance System. Jim Ortbal is a Deputy Director of the City of San Jose Department of Transportation. Key consultant team members include Kevin Fehon, Atul Patel and Shirley Chan of DKS Associates, and Daniel Brame and James West of Kimley-Horn & Associates. All project team members have provided technical expertise for the PGS Concept Plan and the PS&E. Mr. Hernandez and Mr. Brame also contributed to the reviewing and editing of this paper.

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