Addendum

OAKLAND ZOO IN KNOWLAND PARK MASTER PLAN MITIGATED NEGATIVE DECLARATION

Administrative Draft #1

Oakland Zoo East Bay Zoological Society

August 2009

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Prepared by:
PLACEMAKERS

in association with

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Environmental Collaborative
Environmental Vision
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Questa

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GENERAL PROJECT INFORMATION

PURPOSE

This Addendum analyzes Project changes to the Oakland Zoo in Knowland Park Master Plan under the existing Oakland Zoo in Knowland Park Master Plan Mitigated Negative Declaration (MND) and provides additional supporting information for Aesthetics, Air Quality, Biological Resources, Geology and Soils, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Mineral Resources, Noise, Fire Protection and Transportation and Traffic.

SUBJECT

Addendum to the Oakland Zoo in Knowland Park Master Plan Mitigated Negative Declaration (SCH# [City to provide]) adopted [City to provide] .

CASE NUMBER

City of Oakland [City to provide]

LEAD AGENCY

City of Oakland
Community and Economic Development Agency (CEDA)
250 Frank H. Ogawa Plaza, Suite 3315
Oakland, California 94612

PROJECT TITLE

Addendum to the Oakland Zoo in Knowland Park Master Plan Mitigated Negative Declaration.

PROJECT LOCATION

The Project site is within the Oakland Zoo in Knowland Park located in south Oakland east of Interstate 580 and adjacent to Anthony Chabot Regional Park (see **Figure 2-1** Project Location Map). The Park totals approximately 525 acres of which 42 acres comprise the Zoo.

MND ADDENDUM PROJECT DESCRIPTION

The proposed Project would consist of the following changes to the California 1820 Exhibit, renamed California!: replace the Loop Road and Shuttle Bus System with a Gondola Transportation System; eliminate the Canyon and River Exhibits; eliminate the Off-site Breeding Area; construct a new Veterinary Medical Hospital; construct

an Overnight Camping Area; modify the perimeter fence line to minimize incursion into wildlife habitat to the north and northwest; provide an emergency vehicle access road; and provide public access to the two knolls on the east side of California!

PREVIOUS ENVIRONMENTAL REVIEW

The MND for the Oakland Zoo in Knowland Park Master Plan was adopted by the Oakland City Council in 1998 (SCH#_____). The MND is available at the Planning Division office or at the following website link:

_____[City to provide link]

DETERMINATION

The City of Oakland has made the following determination leading to the preparation of this Addendum rather than a Subsequent Negative Declaration.

APPLICABLE	NOT APPLICABLE	STATEMENT
	√	Substantial changes are proposed in the project which will require major revisions of the previous Negative Declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects.
	√	Substantial changes occur with respect to the circumstances under which the project is undertaken which will require major revisions of the previous Negative Declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects.
		New information of substantial importance, which was not known at and could not have been known with the exercise of reasonable diligence at the time the previous Negative Declaration was adopted, show any of the following:
	√	The project will have one or more significant effects not discussed in the previous Negative Declaration.
	√	Significant effects previously examined will be substantially more severe than shown in the previous Negative Declaration.
	√	Mitigation measures or alternatives previously found not to be feasible would in fact be feasible and would substantially reduce one or more significant effects of the project, but the project proponents decline to adopt the mitigation measure or alternative.
	√	Mitigation measures or alternatives which are considerably different from those analyzed in the previous Negative Declaration would substantially reduce one or more significant effects on the environment, but the project proponents decline to adopt the mitigation measure or alternative.

APPLICABLE	NOT APPLICABLE	STATEMENT
	√	If any of the above items are applicable to the current situation, the City must find that a Subsequent Negative Declaration should be prepared.
√		If some changes or additions to the original Negative Declaration are necessary but none of the above items that would warrant preparation of a Subsequent Negative Declaration are applicable, an Addendum should be prepare pursuant to CEQA Guidelines Section 15164

The City of Oakland recognizes that this MND Addendum incorporates information obtained and produced after the MND was adopted and that this Addendum contains additions, clarifications and other minor modifications. The City has reviewed this Addendum as well as the MND and has concluded that this Addendum does not add significant new information to the MND that would require preparation of a Subsequent Negative Declaration under CEQA. The new information added to the MND with this Addendum does not involve a new significant environmental impact, a substantial increase in the severity of a previously identified environmental impact, or a feasible mitigation measure or alternative considerably different from others previously analyzed that the Project sponsor declines to adopt and that would clearly lessen the significant environmental impacts of the Project. There is no information to indicate that the MND was inadequate or inconclusive, or that the public was deprived of a meaningful opportunity to review and comment on the MND.

Based on the above, the City finds that the additions, clarifications and minor modifications to the MND presented in this Addendum do not individually or collectively constitute cause to prepare a Subsequent Negative Declaration und CEQA Guidelines Section 15162.

Approved by: _____ Date: _____

Dan Lindheim
Director of Community and Economic Development Agency
City of Oakland

CHAPTER 1

INTRODUCTION

1.1 PURPOSE OF THE ADDENDUM

This document is an Addendum to the Oakland Zoo in Knowland Park Master Plan Mitigated Negative Declaration (the MND), which was adopted by the Oakland City Council on _____ 1998 [City to provide date]. This Addendum assesses proposed changes to the Oakland Zoo Master Plan and updates certain information contained in the MND. The Project changes and the additions, clarifications and minor modifications addressed in this Addendum do not change any of the original conclusions of the MND and, under CEQA, Public Resources Code § 21166 and CEQA Guidelines § 15164, do not implicate any of the circumstances that would require preparation of a subsequent negative declaration or EIR.

1.2 ADDENDUM SCOPE

TOPICS COVERED IN THE ADDENDUM

The proposed Master Plan changes could require updated information, clarification, and modified analysis for the following environmental topics:

- **Aesthetics:** The Project would substitute a gondola transportation system for the previously approved loop road and shuttle bus system. The gondola includes eight support structures, gondola cars, and cables. The potential visual impacts associated with the gondola and other proposed Project changes will be addressed.

- **Air Quality:** This section will be require updated to address current requirements for analyzing greenhouse gas emissions.

- **Biological Resources:** This section requires updating to address changes in the site plan for the California 1820 exhibit, renamed California! and proposed changes to the final perimeter fence location.

- **Geology and Soils:** The proposed Master Plan changes include a new and relocated Veterinary Medical Hospital and a Gondola Transportation System. Geotechnical information for the Project site will be updated to reflect these changes.

- **Hazards and Hazardous Materials:** This section will discuss the regulatory requirements applicable to the potential hazardous medical material storage at the new Veterinary Hospital.

- **Hydrology and Water Quality:** This section will evaluate the proposed Master Plan changes related to hydrology and water quality issues.

- **Land Use/Planning:** This section will evaluate the proposed Master Plan changes related to land use/planning issues.

- **Noise:** This section will evaluate the proposed Master Plan changes requiring updates to the noise analysis.

- **Fire Protection Services:** The discussion of the provision of fire protection services will be updated to address the proposed Project changes.

- **Recreation:** The proposed modifications to the final perimeter fence location, including a new public access trail, will be discussed.

- **Transportation/Traffic:** The traffic analysis will be updated to reflect current conditions and information about projected future conditions.

TOPICS REQUIRING NO ADDITIONAL DISCUSSION

- **Cultural Resources:** The proposed Master Plan changes would not change any of the information or conclusions in the MND related to cultural resources.

- **Mineral Resources:** The Oakland Zoo contains no known mineral resources.

- **Population and Housing:** Neither the approved Master Plan nor the proposed Master Plan changes would affect population conditions or the housing supply.

- **Public Services:** The proposed Master Plan changes would not alter the analysis or conclusions of the MND regarding police protection, schools and other public facilities.

- **Utilities and Service System:** The proposed Master Plan changes would not alter the analysis or conclusions of the MND regarding wastewater, potable water and solid waste.

1.3 ADDENDUM ORGANIZATION

This Addendum is organized as follows:

General Project Information: This section provides a summary of the environmental review process for the Project and documents the City's determination to proceed with an Addendum to the MND.

Introduction: This section describes the purpose and scope of the Addendum.

Project Description: This section describes in detail the proposed changes to the 1998 approved Master Plan.

Environmental Topics Requiring Updated Discussion Due to Proposed Master Plan Changes: This analysis provides an update of existing site conditions, an update of applicable policies and regulations, and an assessment of the proposed Master Plan changes. For each environmental topic, the Addendum summarizes the conclusions presented in the MND and evaluates the proposed Master Plan changes in light of the information contained in the MND and other information now available. The Addendum concludes that the proposed Master Plan changes are within the scope of the MND analysis and conclusions and would not result in any new significant environmental effects.

CHAPTER 2

PROJECT DESCRIPTION

2.1 BACKGROUND

PREVIOUS MASTER PLAN APPROVAL

In 1997 the Oakland Zoo submitted an application to the City for a major conditional use permit for the Oakland Zoo in Knowland Park Master Plan (Master Plan) intended to allow development of certain improvements and programs at the Zoo over a period of twenty years (Zoning Case No. CM97-25). On April 16, 1997, the Oakland City Planning Commission adopted a Mitigated Negative Declaration for the Master Plan and approved part of the Master Plan. On June 4, 1997, the City Planning Commission approved the remainder of the Master Plan. On December 15, 1998, the City Council adopted Resolution No. 74736 C.M.S. upholding the City Planning Commission's June 4, 1997 decision approving the California 1820 Exhibit portion of the major conditional use permit, subject to certain conditions of approval. The conditions of approval reflected the terms of a Memorandum of Understanding entered into by the Zoo and various neighbors regarding several land use issues, including the location of the perimeter fence.

FINAL FENCE LOCATION APPROVAL AND PROPOSED MASTER PLAN MODIFICATION

In 2009 the Zoo has applied for two approvals. First, pursuant to the provisions of Master Plan Condition of Approval No. 11, the Zoo has applied to the Zoning Administrator for approval of the precise location of the previously approved perimeter fence. The perimeter fence will be an eight-foot high black cyclone fence that will be approximately 6,860 linear feet. Second, the Zoo has applied for approval of certain modifications to the Master Plan, including revisions to the California 1820 area that reduce the overall development and relocation of the veterinary hospital to a site previously approved for the California 1820 River

Exhibit. This Addendum updates the information contained in the MND in light of the proposed Master Plan modifications.

2.2 SETTING

The Oakland Zoo in Knowland Park (Park) is located in south Oakland, east of Interstate 580 and adjacent to Anthony Chabot Regional Park (see **Figure 2-1**). The Park totals approximately 525 acres of which approximately 45 acres comprise the Zoo. The remaining 480 acres contains public trails and fire roads.

The immediate residential neighborhood surrounding the Zoo was built out when the Master Plan was approved and has changed little over the past ten years. However, subsequent to approval of the Master Plan, two large development projects were proposed in southeast Oakland: Leona Quarry and Oak Knoll. The Leona Quarry project was approved in 2004 and consists of 477 single-family and multi-family residential units to be constructed in two phases. The site is the former Leona Quarry and is located about 2.5 miles northwest of the Zoo. The first phase of construction has been completed and includes 427 residential units. The Oak Knoll project is a mixed-use project to be developed at the 183-acre decommissioned Naval Medical Center, which is located about 1.3 miles north of the Zoo. The Oak Knoll project proposes 960 single- and multi-family residential units, local-serving commercial development and parks and open space.

2.3 APPROVED MASTER PLAN ELEMENTS

The Master Plan provides the guiding vision for the Zoo over a 20-year period. (The Zoo is now at the mid-point of the 20-year process.) The guiding vision is to:

- Make optimum use of the unique combination of historic and native Californian landscapes in Knowland Park.

- Balance fiscal prudence and bold new ideas, building an achievable vision of the future for the Oakland Zoo in Knowland Park to make the zoo and park one of the outstanding facilities of its kind in the world.

The Master Plan addressed three unique landscape environments at the Zoo: the Historic Park Landscape and Arboretum, the Zoological Park, and the area designated for the new California 1820. The Master Plan identified a variety of elements to be built in each of these areas. The Master Plan improvements for each landscape environment are summarized below. **Table 2-1** identifies the specific elements described in the Master Plan and shows their status. **Figure 2-2** shows the approved Master Plan map. The status of each landscape environment is discussed below.

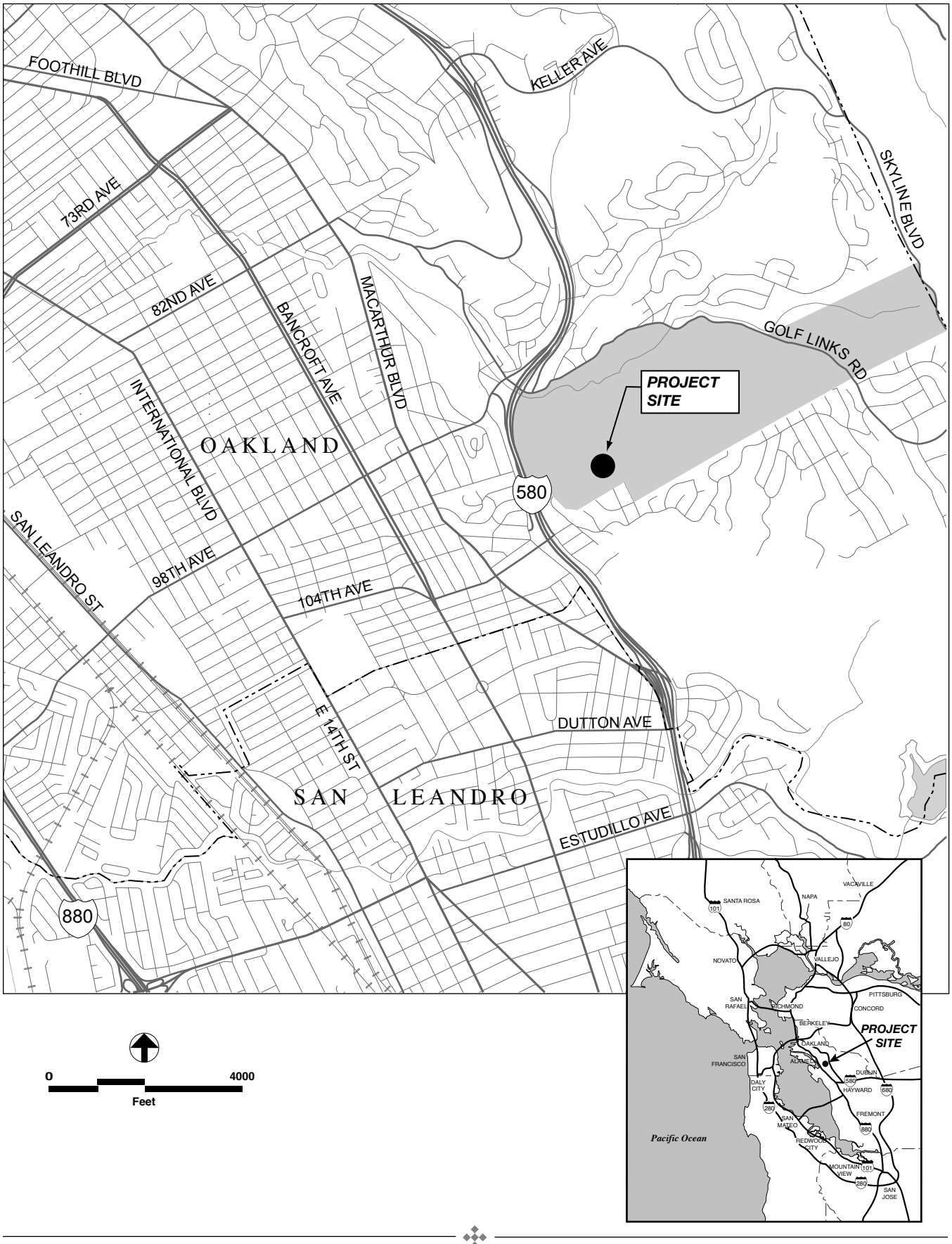


Figure 2-1
Project Location Map

TABLE 2-1: MASTER PLAN STATUS

Element	Status
Arboretum	
Center for Science and Environmental Education	Completed in 1999.
Three new picnic shelters	Eliminated from Master Plan
Removal of exiting restrooms from riparian corridor.	Completed in 2000
Arroyo Viejo Creek restoration	Completed in 2007
Widen existing one-way access road to 30 feet to accommodate two-way traffic and bicycle/pedestrian lane.	Completed 2000
Pedestrian hiking trail connecting meadow with Upper Knowland Park	Eliminated from Master Plan
New plantings installed as Arboretum ages	On-going
Zoo	
African Savanna: new trail extending from existing elephant exhibit to center of Zoo; new exhibits along this trail include warthog, green monkeys, hyena; overlooks to view lions, impala, grater kudu and baboon exhibits.	Exhibits completed 1998 New trail eliminated from Master Plan
African Village: new restroom; food service and cultural hut adjacent to existing elephant exhibit.	Completed 1998
Tropical Rainforest: new dense plantings for existing exhibits along trails; interactive displays/interpretive exhibits.	On-going
Improved Safari Restaurant and gift center.	Completed 2001
Improved main entrance including landscaping, new ticket booth, signage and banners.	Completed 2001
New squirrel monkey and tiger exhibits	Completed 2002
Rides renovation	Completed 2003
Wall along southerly boundary across main parking area to screen parking from adjacent residences and provide a sound barrier. A landscaped buffer replaced the wall in response to neighborhood request as specified in MOU.	Completed 2004
Children's Zoo improvements and upgrades	Completed 2005
Improved secondary entrance including landscaping, new ticket booth, signage and banners.	Completed 2005
Replaced paving in existing overflow parking lots.	Completed 2007
Snow Building: improvements including upgraded kitchen and restroom facilities.	Completed 2008
Australian Walk About: new home for existing wallabies, wallaroos, large flightless emus.	Completion Spring 2009
Other improvements and upgrades to Zoo.	On-going

TABLE 2-1: MASTER PLAN STATUS (continued)

Element	Status
California 1820	
Canyon Exhibit: featuring golden eagle, jaguar, bald eagle, white tailed deer, bobcat, great horned owl, walk-through aviary and California reptile.	This element is proposed for elimination from the Master Plan. The exhibit is approximately 9 acres in size
River Exhibit: featuring river otter, great blue heron, sandhill crane and other animal species.	This element is proposed for elimination from the Master Plan. The exhibit is approximately 3.7 acres in size.
Oak Woodland Exhibit: featuring American bison, cougar, barn owl and grey wolf.	This element remains.
California Interpretive Center – viewing platform and interpretive exhibits.	This element remains.
Off-site breeding area	No set implementation date.
Paving existing fire road.	Completion in 2009.
Loop road and shuttle bus system.	This element is proposed for elimination from the Master Plan. The loop road comprises approximately 5.7acres.
Perimeter fence.	Fall 2009

Arboretum

The Center for Science and Environmental Education is completed and offers a variety of educational programs for children and adults. Restrooms located within the riparian corridor were removed to facilitate the Arroyo Viejo Creek restoration element, which has been completed. The Arroyo Viejo Creek restoration element included the repair of in-stream locations, bank erosion and stability, removal of all non-native vegetation and re-planting of the entire corridor with native riparian plants. Arroyo Viejo Creek is used as an outdoor lab, offering educational opportunities to teach students about watersheds, environmental stewardship and science. Of necessity, the restoration efforts will be on-going to remove non-native plants, install native plants and maintain trails. New plantings have been installed and will continue to be installed over time as the Arboretum ages. The one-way access road from the Arboretum to the Zoo has been widened to 30-feet to accommodate two-way traffic and a bicycle/pedestrian lane, which has improved circulation. The picnic shelters and new restroom included in the original Master Plan were not constructed and the Zoo does not plan to construct these facilities, thereby increasing the amount of open space in the Arboretum.

Zoological Park

The majority of the elements approved in the Master Plan have been completed, including the various animal exhibits, as well as improvements to the Children's Zoo, Snow Building, Safari Restaurant and gift center. The rides have been renovated. The main and secondary entrances have been improved and the overflow

SOURCE: Amphion Environmental, Inc.

Figure 2-2
Approved Master Plan

parking lot, located to the north of the main parking lot, was re-paved in 2007, which has improved parking and circulation conditions at the Zoo. The overflow parking lot was in poor condition – pavement was worn and cracked and there was no storm drain system. The absence of storm drains resulted in stormwater sheeting across the parking lot with most of the runoff draining into the Zoo although some runoff drained to the slope above adjacent homes located to the southeast. Improvements to the overflow parking lot included repaving, curbing, lighting and storm drain inlets.

A proposed wall along the southerly boundary of the Zoo (adjacent to the main parking lot) was not constructed at the request of the neighbors and was replaced with a landscaped buffer approved by the neighbors. The prior Master Plan approval allows for other improvements and upgrades that are on-going to maintain the health and safety of the animals including exhibit enhancements, visitor access/flow and public safety. A trail that was included in the approved Master Plan and would have extended from the African Savanna to the center of the Zoo has not been constructed and the Zoo no longer plans to construct this trail.

California 1820

An area known as California 1820 encompassing a variety of activities and improvements was approved as part of the original Master Plan approval. This element of the Master Plan has not been implemented and is the primary focus of the modifications to the Master Plan. The original Master Plan called for locating California 1820 primarily in Upper Knowland Park on approximately 25 acres of undeveloped land. The central theme focused on regional extinction, featuring native California species present prior to the Gold Rush. Five ecological units would be highlighted by the exhibits: grassland, chaparral, oak woodland, riparian and canyon. The exhibits proposed in the original Master Plan included a River Exhibit, Grizzly Bear Exhibit, Canyon Exhibit, and Oak Woodland Exhibit. Other features included an off-site breeding area, California Interpretive Center, a loop road and shuttle bus system and paving the existing fire road.

Final Location of Fence

Additionally, the approved Master Plan allowed installation of an eight-foot high black cyclone perimeter fence around the entire California 1820 area. The Zoo's original proposal for the location of the fence was modified during the approval of the Master Plan in response to neighbor concerns. The modification to the fence location is documented in the MOU and the approved Master Plan conditions of approval. The fence is shown in **Figure 2-2**. To maintain the Zoo's accreditation, the perimeter fence is required by the Association of Zoos and Aquariums. The perimeter fence is also required by the United States Department of Agriculture for the license to exhibit animals. All perimeter fences are required to be separate from all exhibit fencing. Construction of the perimeter fence is planned to begin in Spring 2009.

2.4 PROPOSED CHANGES TO MASTER PLAN

The Master Plan acknowledges that plans change over time, particularly with a 20-year planning horizon. Since approval of the Master Plan ten years ago, the Zoo has decided to revise its plans for the California 1820 area, renamed California! The revisions would include:

1) substitution of an electric gondola people-moving system to replace the loop road and shuttle bus system;

2) relocation of the interpretive center;

3) elimination of two major areas of animal exhibits (Canyon and River Exhibits) and visitor facilities;

4) relocation and replacement of the existing Veterinary Medical Hospital on the site of the previously approved River Exhibit area;

5) construction of an overnight camping area;

6) modifications to the final location of the perimeter fence;

7) provision of an emergency vehicle access road; and

8) provision of a public access path.

Figure 2-3 shows the proposed changes to the Master Plan map. The proposed changes would reduce the area of land disturbance previously approved under the Master Plan by approximately 3.44 acres (see **Table 2-2**). A comparison between the approved California 1820 project area and the proposed California! project area is presented in **Figure 2-4**. **Figure 2-5** shows the extent of physical disturbance that would be expected with development of California! The proposed changes to the Master Plan are described below.

FORMER RIVER EXHIBIT/PROPOSED VETERINARY MEDICAL HOSPITAL

The originally approved River Exhibit covered approximately 3.7 acres. The proposed Veterinary Medical Hospital would be located on approximately one acre of this site. The hospital would be one and one-half levels and range in height from 14 to 29 feet, with the elevator overrun extending to 30 feet six inches in height; total 17,065 square feet; and have a 13,765 square-foot footprint.

Hospital building materials include a mix of concrete masonry units, stained wood siding, and painted metal doors and window frames. The roof would be built with asphalt/composite shingles. The outdoor animal areas would consist of a translucent polycarbonate panel system supported by wood frame structures. Earth tone colors

SOURCE: PJA Architects + Landscape Architects

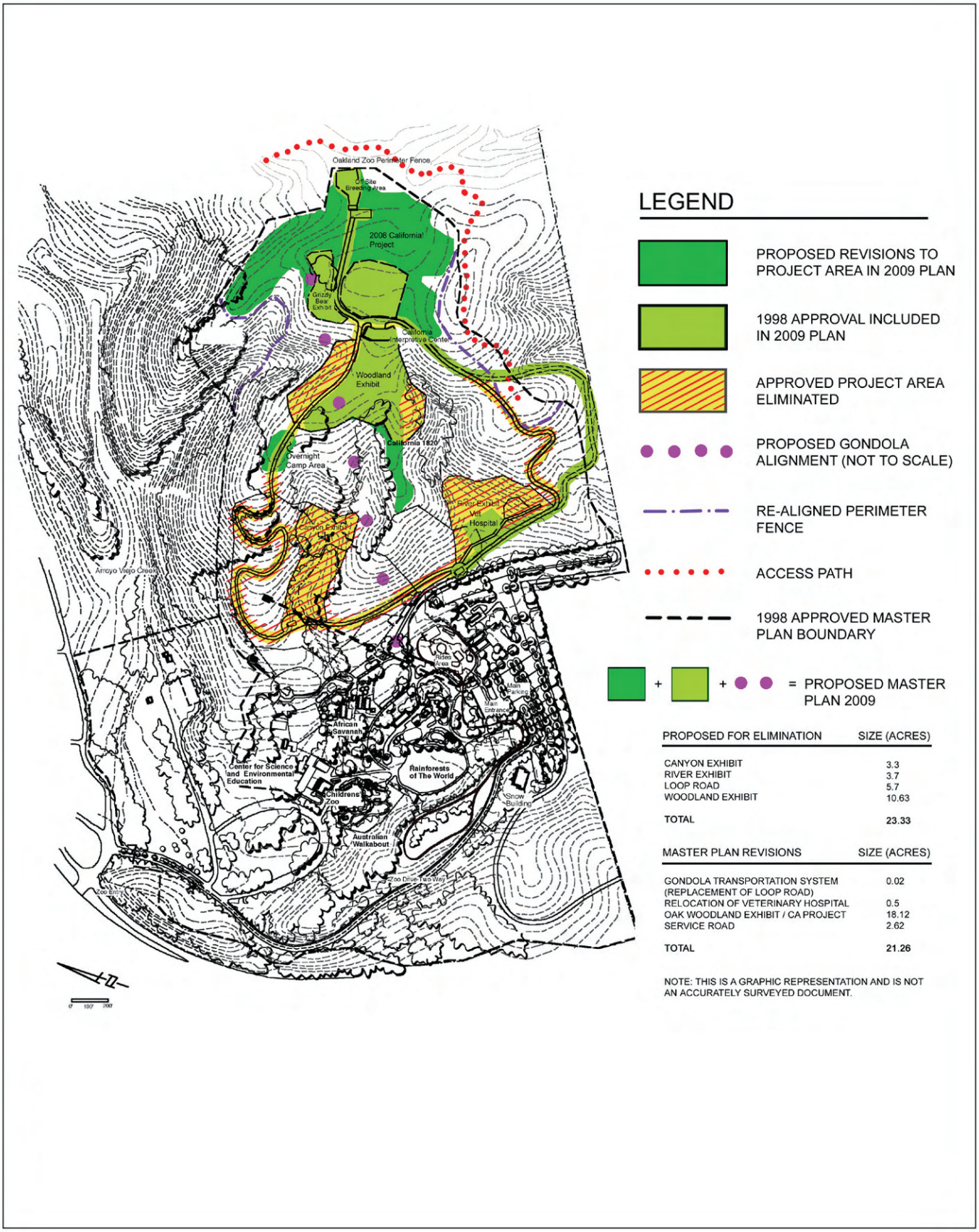
Figure 2-3
Proposed Master Plan Changes

TABLE 2-2: COMPARISON OF APPROVED CALIFORNIA 1820 AND PROPOSED CHANGES TO CALIFORNIA 1820 RENAMED CALIFORNIA!

Approved California 1820 Element of Master Plan	Acreage	Proposed Changes to Approved California 1820 Element of Master Plan (Renamed CA!)	Acreage
Canyon Exhibit	3.3	Canyon Exhibit eliminated	0
River Exhibit	3.7	Veterinary Medical Hospital	1.0
Woodland Exhibit	10.63	Woodland Exhibit	18.12
California Interpretive Center	0.23	California Interpretive Center	0.23
Off-site Breeding Area	0.54	Off-site Breeding Area eliminated	0
Paving Existing Maintenance Road	1.79	Paving Existing Maintenance Road	1.79
Loop Road and Shuttle Bus System	5.7	Gondola Transportation System	0.02
Perimeter Fence	1.5	Perimeter Fence	1.5
		Emergency Vehicle Access Road	0.67
		Public Access Path	0.26
		Overnight Camping Area	0.36
Total	27.39	**Total**	23.95

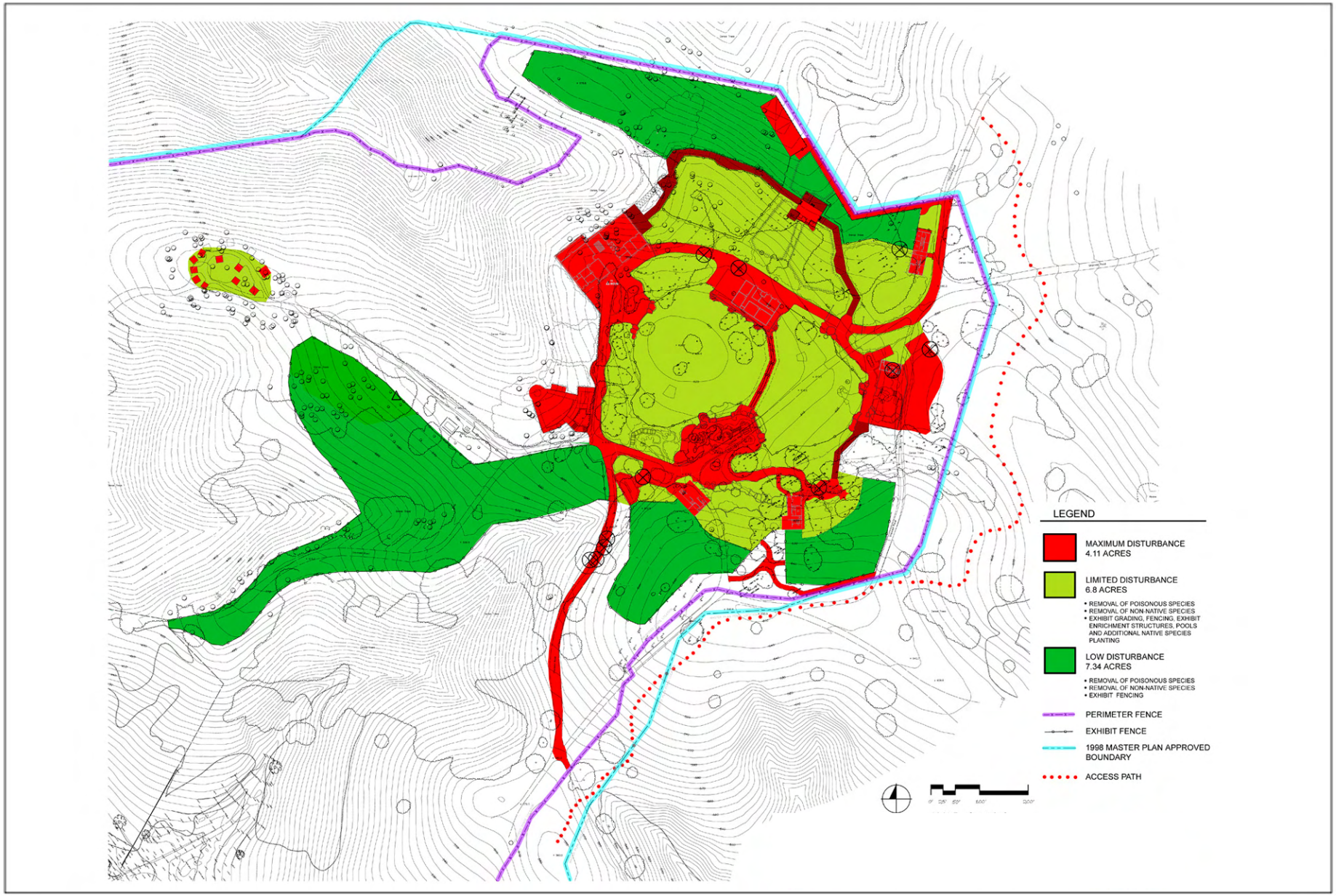
will be used for the building. Two split mechanical units – one ten-ton unit and one 15-ton external condensing unit – will be mounted on the ground on the northwest corner of the building. An emergency back-up generator is also planned. Native trees would be planted to screen the hospital from the parking lot and disturbed slope areas would be revegetated with native grasses and low growing native plants.

The new Veterinary Medical Hospital will become a model veterinary care center for best practices in animal care by incorporating green and sustainable construction. The facility projects to be the first LEED certified facility of its kind in the state of California and will be designed with multiple energy saving and water conservation features, will incorporate sustainable building materials and will create a healthy indoor environment, both for Zoo staff and the rehabilitating animal occupants. The Veterinary Medical Hospital will enable teaching opportunities with the University of California at Davis School of Veterinary Medicine, participation in the International Species Information System and partnership opportunities for other facilities and institutions in Northern California. The current hospital was built in 1960 when the Zoo had one part-time veterinarian. Now the Zoo is home to more than 650 animals



SOURCE: PJA Architects + Landscape Architects

Figure 2-4
Site Comparison Diagram



SOURCE: PJA Architects + Landscape Architects

Figure 2-5
Site Impact Diagram

and the professional staff includes two full-time veterinarians and two technicians. As the Zoo continues to grow with new exhibits and animals, the scope of veterinary services will increase. The proposed Veterinary Medical Hospital will provide for standard diagnosis, treatment, housing and quarantine for most sizes and species of animals. One new staff person would be added with the operation of the new facility. It is a critical component for maintain the Zoo's dedication to best practices in animal management. **Figure 2-6** and **Figures 2-7a** and **2-7b** show the site plan and building elevations. With elimination of the River Exhibit, approximately 2.7 acres will remain undisturbed open space.

FORMER CANYON EXHIBIT/PROPOSED OPEN SPACE

The originally approved Canyon Exhibit covered approximately nine acres. Under the proposed modifications to the Master Plan, these nine acres will remain undisturbed open space.

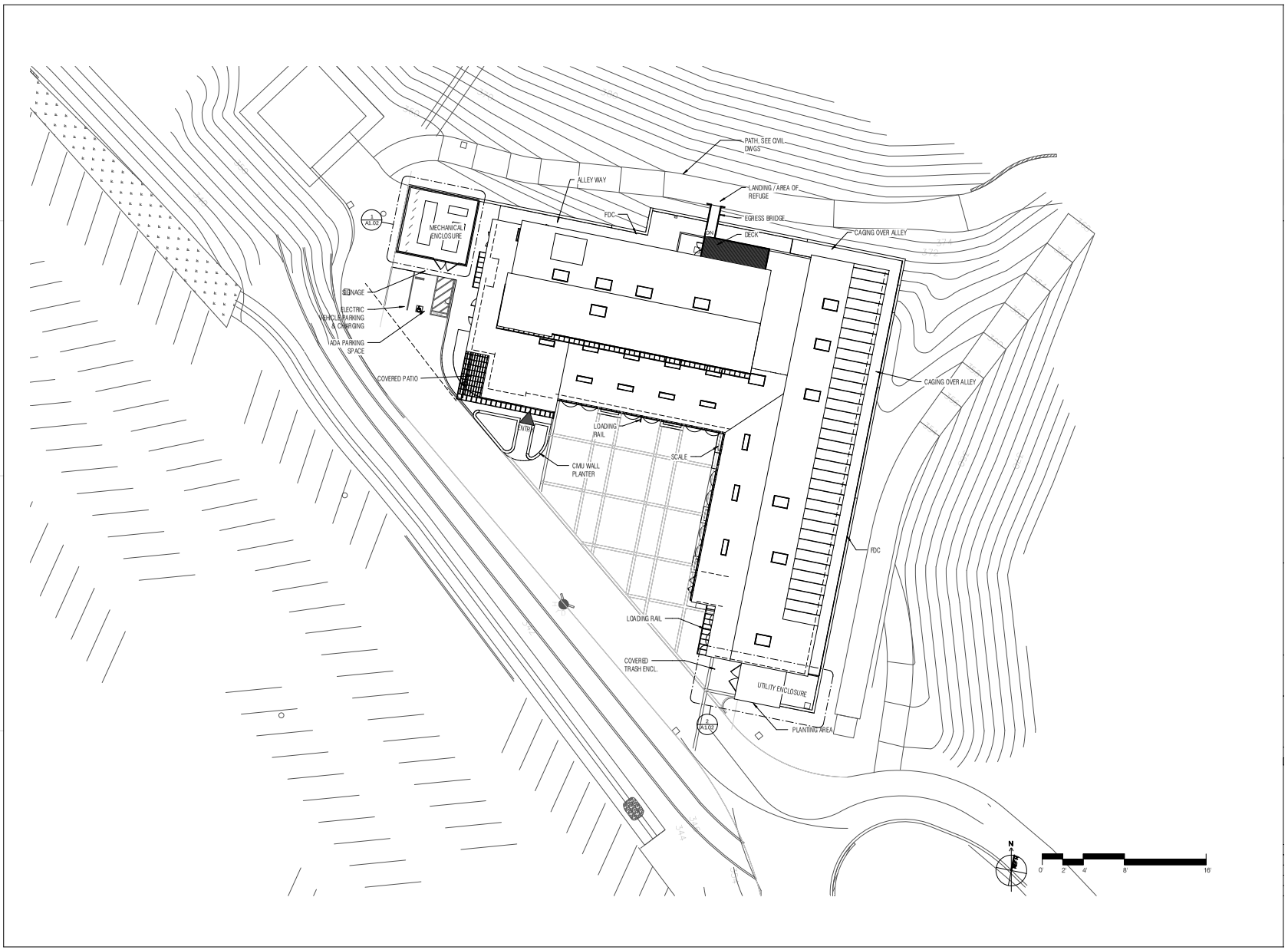
FORMER LOOP ROAD AND SHUTTLE BUS SYSTEM/PROPOSED GONDOLA TRANSPORTATION SYSTEM

The originally approved Loop Road covered approximately 5.7 acres. Due to the steepness of the terrain, construction of the loop road would require significant grading and retaining walls.

The proposed Gondola Transportation System consists of: eight support structures, seven of the structures would range in height from 22 to 39 feet and one structure located in a ravine would be 62 feet in height; a cable system; a lower terminal located in the Zoo near the camel exhibit; and an upper terminal located at the California Interpretive Center. The eight support structures would each have a base that would be a maximum of 12 feet by 12 feet in size. The support structures and cars would be matte-finish and forest green color. The lower portions of the support structures would be screened with tall plantings. **Figure 2-8** shows a typical gondola car.

FORMER CALIFORNIA 1820/PROPOSED CALIFORNIA!

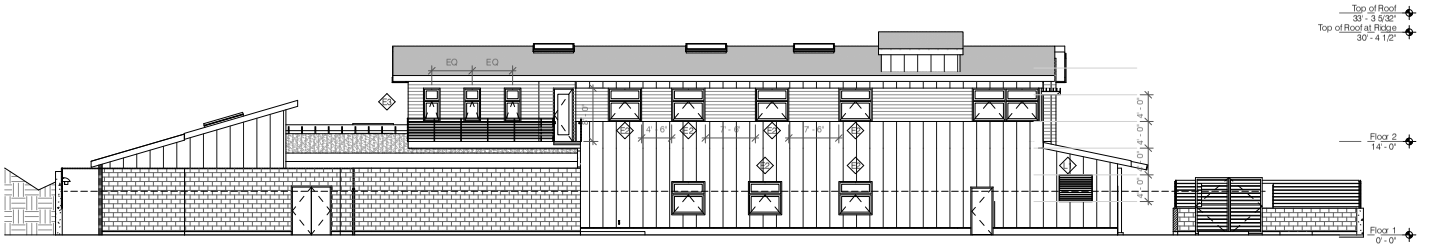
The approved California 1820 has been renamed California! and includes the changes described above and relocation of the Interpretive Center. The Interpretive Center has been moved several hundred feet northwest of its original location and sited to allow existing topography to reduce visibility. Other key aspects of the originally approved exhibit will remain. Exhibits of animals native to California have not changed: tule elk, grizzly bear, bison, eagle, black bear, cougar, jaguar, wolf and California waterfowl. Botanical displays and cultural displays of native California people also will remain as originally approved.



SOURCE: Noll & Tam Architects and Planners

Figure 2-6
Veterinary Medical Hospital Site Plan

1 A3.01 SOUTH ELEVATION
1/8" = 1'-0"



2 A3.01 NORTH ELEVATION
1/8" = 1'-0"

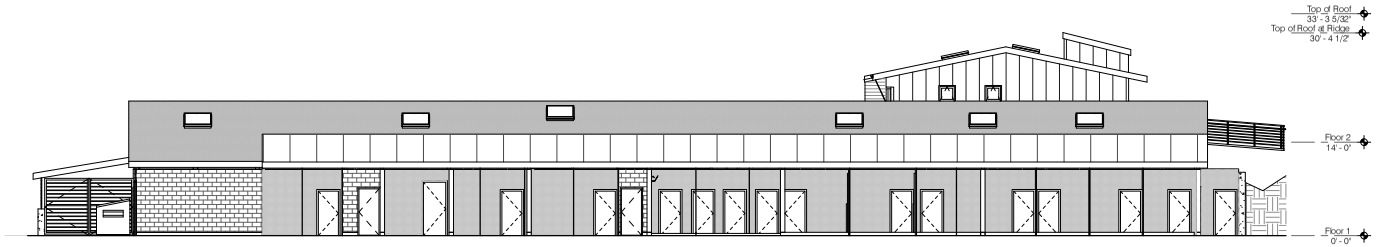
KENOTE LEGEND

1 ASPHALT SHINGLE ROOF ASSEMBLY	9 PRE-FINISHED METAL DOWNSPOUT	17 EXPOSED ROOF FRAMING TRELLIS
2 BUILT UP ASPHALT ROOF ASSEMBLY	10 PRE-FINISHED METAL GUTTER/FLASHING	18 WOOD AND STEEL RAILING
3 POLYCARBONATE TRANSLUCENT ROOF ASSEMBLY	11 WOOD AND STEEL SHADING FIXTURE	19 WOOD AND STEEL FENCE
4 INSULATED CMU WALL	12 PAINTED METAL DOOR AND FRAME	20 WOOD AND STEEL TRELLIS
5 CMU WALL	13 VENTILATION LOUVER	21 BUILDING SIGNAGE
6 CEMENTITIOUS PANEL WALL ASSEMBLY	14 ALUMINUM RIBBON WINDOW SYSTEM	22 TIMBER POST
7 UNIT SKYLIGHT	15 ALUMINUM STOREFRONT SYSTEM	
8 WOOD SIDING WALL ASSEMBLY	16 ALUMINUM WINDOW	

SOURCE: Noll & Tam Architects and Planners

Figure 2-7a
Veterinary Medical Hospital – South and North Elevations

1 A3.02 WEST ELEVATION
1/8" = 1'-0"



2 A3.02 EAST ELEVATION
1/8" = 1'-0"

KENOTE LEGEND

1 ASPHALT SHINGLE ROOF ASSEMBLY	9 PRE-RINISHED METAL DOWNSPOUT	17 EXPOSED ROOF FRAMING TRELLIS
2 BUILT UP ASPHALT ROOF ASSEMBLY	10 PRE-RINISHED METAL GUTTER/FLASHING	18 WOOD AND STEEL RAILING
3 POLYCARBONATE TRANSLUCENT ROOF ASSEMBLY	11 WOOD AND STEEL SHADING FIXTURE	19 WOOD AND STEEL FENCE
4 INSULATED CMU WALL	12 PAINTED METAL DOOR AND FRAME	20 WOOD AND STEEL TRELLIS
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6 CEMENTITIOUS PANEL WALL ASSEMBLY	14 ALUMINUM RIBBON WINDOW SYSTEM	22 TIMBER POST
7 UNIT SKYLIGHT	15 ALUMINUM STOREFRONT SYSTEM	
8 WOOD SIDING WALL ASSEMBLY	16 ALUMINUM WINDOW	

SOURCE: Noll & Tam Architects and Planners

Figure 2-7b
Veterinary Medical Hospital – West and East Elevations

SOURCE: CWA Construction SA/Corp

Figure 2-8
Typical Gondola Car

OVERNIGHT CAMPING AREA

A secluded overnight camping area is proposed west of California! It would consist of eleven fixed platform tents and a composting toilet system on approximately 0.36 acre. The overnight camping area would be located in a wooded setting, remote and invisible from surrounding viewpoints. Camping activities are for youth groups and family groups attended and facilitated by Oakland Zoo staff.

PERIMETER FENCE MODIFICATIONS

Portions of the perimeter fence are proposed for modification to reduce potential impacts to wildlife habitat and improve public access. At the northwest portion of the perimeter fence, near the Wolf Exhibit, the fence would be pulled back to the oak trees to minimize incursion in the chaparral. Additionally, the fence would be located to avoid removal of oak trees. At the southeast portion of the perimeter fence, near the Black Bear and Mountain Lion Exhibits, the fence would be pulled back to allow for the proposed public access path. The entire length of the perimeter fence would be designed to allow for passage of small animals along the base of the fence approximately every 300 feet.

EMERGENCY VEHICLE ACCESS ROAD

The Oakland Fire Department has requested provision of an emergency vehicle access road from Snowdown Avenue to California! The road would utilize existing fire roads to minimize disturbance to grassland areas. The road would be 16 to 20 in width and about 1,450 feet long. The road would either be gravel or paved.

PUBLIC ACCESS PATH

A public access path would be provided to allow public access to two knolls located to the southeast of California! which offer panoramic views of San Francisco Bay. The public access path would commence at the existing fire road located to the northeast of California! and would generally follow the perimeter fence, terminating at the knoll below the knoll named "heart attack hill by the neighbors.

CHAPTER 3

ENVIRONMENTAL TOPICS REQUIRING UPDATED DISCUSSION DUE TO PROPOSED MASTER PLAN CHANGES

The proposed changes to the Master Plan could affect the conclusions of the MND for Aesthetics; Air Quality; Biological Resources; Geology and Soils; Hazards and Hazardous Materials; Hydrology and Water Quality; Land Use, Recreation and Planning; Noise; Fire Protection; and Transportation and Traffic. A discussion of each of the affected environmental topics follows.

3.1 AESTHETICS

This section evaluates whether any of the Project changes would result in new aesthetic impacts not identified in the MND or a substantial increase in the severity of the previously identified aesthetic impacts. This section also discusses any pertinent new information or changes in the Project circumstances that could result in new or a substantial increase in impacts. This analysis relies on the City's current draft of the *CEQA Thresholds/Criteria Significance Guidelines* (City of Oakland 2008a). Additionally, this section reviews the previously adopted mitigation measures, updates these mitigation measures as necessary, or replaces the mitigation measures with the applicable provisions of the City's *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval* (2008b).

METHODOLOGY

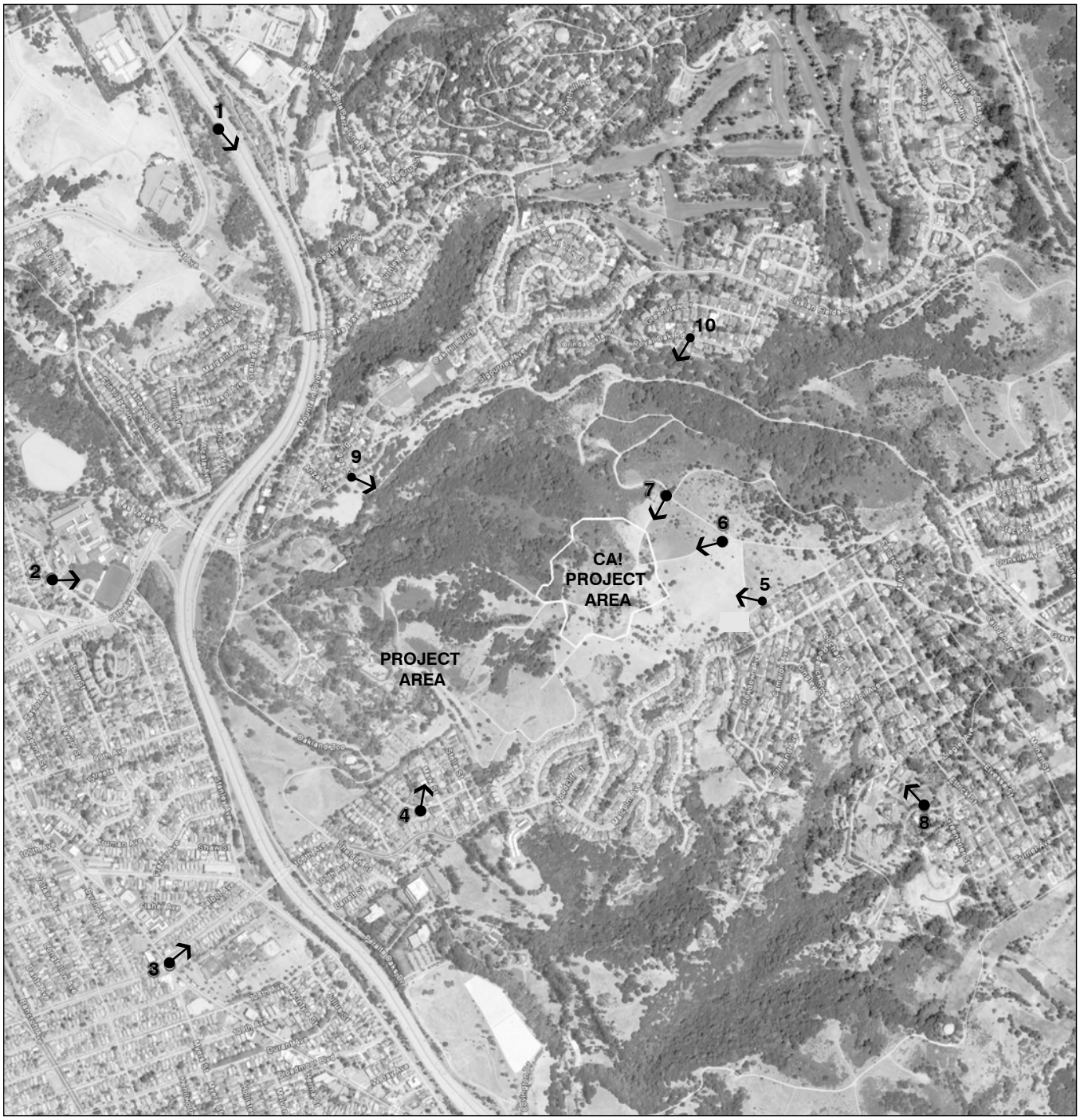
To identify potential viewpoints from which the proposed Project could be visible, a windshield survey was conducted in the Project area in March 2009. Particular attention was paid to public areas such as Interstate 580, busy roadways, Knowland Park and surrounding residential areas. Ten potential viewpoints were identified during the windshield survey as potentially offering views of the Project site and photographs were taken. The ten viewpoints are listed below:

1. Interstate 580 southbound looking south
2. Bishop O'Dowd High School looking southeast
3. 106th Avenue at MacArthur Boulevard looking northeast
4. Hood Street near Mark Street looking north
5. Knowland Park trail looking west
6. Knowland Park trail looking west
7. Knowland Park trail looking southwest
8. Bemis Street looking northwest
9. Royal Oak Road looking south
10. Golf Links Road looking southeast

Figure 3.1-1 shows the location of the ten viewpoints. The candidate photos are provided in **Appendix A**.

In coordination with City of Oakland staff, five viewpoints were selected for visual simulation:

- Interstate 580 southbound looking south
- Hood Street near Mark Street looking north
- Knowland Park trail looking west
- Royal Oak Road looking south
- Golf Links Road looking southeast



SOURCE: Environmental vision

Figure 3.1-1
Photo Viewpoint Locations

Visual simulations for the selected five viewpoints include a view of existing conditions (March 2009), a view of the proposed Project at completion and a view of the Project at seven years with mature landscaping.

EXISTING CONDITIONS

The proposed Project site encompasses a portion of Knowland Park which is characterized by grasslands, chaparral and oak woodlands. Fire roads and informal trails of barren earth traverse the area. Project site topography is hilly with elevations ranging from about 350 feet to about 650 feet. The Project site is undeveloped with the exception of a cellular phone tower located in the northwestern portion of the proposed California! site, near the location of the proposed Amphitheater.

SIGNIFICANCE CRITERIA

a: Would the project have a substantial adverse effect on a scenic vista?

The proposed Project would shift the location of California! (formerly California 1820) from what was analyzed in the MND and two new elements not evaluated in the MND: Gondola Transportation System and the relocated Veterinary Medical Hospital.

Currently, upper portions of Knowland Park are visible from Interstate 580, a designated scenic highway (City of Oakland 1974) and comprise background views of the ridgeline. [Note: the figure numbers and titles for all visual simulations are incorrect - they were inadvertently reversed and will be corrected for submittal of Administrative Draft #2. In the discussion below, please disregard the figure titles.]**Figure 3.1-3** shows views of the upper portions of Knowland Park when driving south on Interstate 580. The upper photo shows the site as it currently exists. Two tall eucalyptus trees (about 50 feet in height) are a prominent feature on the ridgeline extending well above the oak woodlands which cover the hillsides. The ridgeline forms the background view with the forested hillsides and urban development comprising the middle-ground and the Interstate 580 roadway the foreground. The lower photo shows a visual simulation with the proposed Project. In this view, the two eucalyptus trees are gone and the westerly facades of the Interpretive Center, located in California! are visible. The building roofline extends slightly above the ridgeline but does not represent a significant visual disruption of the ridgeline. In this view, the proposed Project would appear as a component of the background views available from Interstate 580 and would be observed briefly when traveling on Interstate 580. **Figure 3.1-2** shows the view of the site as it currently exists (upper photo) and a view of the Project with the proposed landscaping after seven years of growth (lower photo). The landscaping would partially screen the lower portions of the Interpretive Center and a cluster of planted trees [confirm type for submittal of Administrative Draft #2.]to the south of the Interpretive

Existing view from I-580 looking south

Visual simulation of proposed project after construction

SOURCE: Environmental Vision

Figure 3.1-3
Viewpoint 1: Visual Simulation from I-580 Looking South –
Landscaping at Seven Year Maturity

Existing view from I-580 looking south

Visual simulation of proposed project

SOURCE: Environmental Vision

Figure 3.1-2
Viewpoint 1: Visual Simulation from I-580 Looking South –
Project Completion

Center would be visible extending above the ridgeline. Project visibility from Interstate 580 would be minimal and would not have a substantial adverse effect on a scenic vista.

Figure 3.1-5 shows a view of the proposed Project site from Hood Street, a residential street located to the southeast of the site. The upper photo shows the site as it currently exists. Background views are of hillsides comprising a portion of Knowland Park and show grasslands, oak woodlands and a fire road. Middle ground and foreground views are of single-family residences and landscaping. The lower photo shows a segment of the Gondola Transportation System, at the far left of the photo, the upper portion of the children's play structure [confirm this is the play structure for submittal of Administrative Draft #2.] located in California! and a very small portion of the Veterinary Medical Hospital roof is visible behind existing trees. Seven of the gondola support structures would range in height from 22 to 39 feet and one structure located in a ravine would be 62 feet in height. The gondola support structures would run parallel with the existing fire road and would not extend above the top of oak woodlands which appear along the ridgeline in background views. While the Gondola Transportation System would be visible from Hood Street and nearby residences, it would not obstruct views of the hillsides. The children's play structure would extend above the top of the oak woodlands and would be visible in background views although it is partially screened by existing trees and vegetation. While the play structure would extend above the ridgeline, it would not represent an intrusive element on the ridgeline. Views of the Veterinary Medical Hospital roof are barely perceptible and would not obstruct views of the hillsides. **Figure 3.1-4** shows the view as it currently exists (upper photo) and a view of the Project with the proposed landscaping after seven years of growth (lower photo). The proposed landscaping is not noticeable in this view. Project visibility from Hood Street would be limited and would not obstruct views of the hillside and would not have a substantial adverse effect on a scenic vista.

Figure 3.1-7 shows a view of the proposed Project from a public trail in Knowland Park. The upper photo shows the site as it currently exists. Background views offer a panoramic view of San Francisco Bay, the Marin Headlands, and the Oakland and San Francisco skylines. Middle ground views are of oak woodlands, grasslands and trails and foreground views are of grasslands. The lower photo shows a section of the Perimeter Fence and portions of California!, including animal exhibits and the Interpretive Center, appearing in the middle ground view, which would reduce the extent of visible open grasslands. Animal exhibit fencing would extend above the tree tops but would not obstruct the panoramic view of San Francisco Bay and urban skylines. The Interpretive Center would extend slightly above the tree tops but again would not obstruct panoramic views. **Figure 3.1-6** shows the view as it currently exists (upper photo) and a view of the Project with the proposed landscaping after seven years of growth (lower photo). The proposed landscaping would provide limited screening of California! in this

Existing view from Hood Street looking north

Visual simulation of proposed project

SOURCE: Environmental Vision

Figure 3.1-5
Viewpoint 4: Visual Simulation from Hood Street Looking North – Landscaping at Seven Year Maturity

Existing view from Hood Street looking north

Visual simulation of proposed project

SOURCE: Environmental Vision

Figure 3.1-4
Viewpoint 4: Visual Simulation from Hood Street Looking North – Project Completion

Existing view from Knowland Park trail looking west

Visual simulation of proposed project after construction

SOURCE: Environmental Vision

Figure 3.1-7
Viewpoint 5: Visual Simulation from Knowland Park Trail Looking West – Landscaping at Seven Year Maturity

Existing view from Knowland Park trail looking west

Visual simulation of proposed project

SOURCE: Environmental Vision

Figure 3.1-6
Viewpoint 5: Visual Simulation from Knowland Park Trail Looking West – Project Completion

view. With mature landscaping, Project visibility from this public trail would continue to be noticeable in middle ground views. While the proposed Project would represent a noticeable change in middle ground views, it would not obstruct panoramic views and would not have a substantial adverse effect on a scenic vista.

Figure 3.1-9 shows a view of the proposed Project from Royal Oak Road which is located to the west of the Project site. The upper photo shows the site as it currently exists. Background views are of the sky, forested land (including the two eucalyptus trees shown in **Figure 3.1-3**) comprises the middle ground view and single-family residences dominate foreground views. The lower photo shows a portion of the Interpretive Center roof slightly extending above the tree tops as well as the upper portion of one of the animal exhibits; and the two eucalyptus trees are gone. **Figure 3.1-8** shows the view as it currently exists (upper photo) and a view of the Project with the proposed landscaping after seven years of growth (lower photo). The proposed landscaping is not visible in this view. The proposed Project would result in minimal encroachment into the horizon and would not have a substantial effect on a scenic vista.

Figure 3.1-11 shows a view of the proposed Project from Golf Links Road which is located to the northwest of the Project site and is well travelled. The upper photo shows the site as it currently exists. Background views are of the sky and ridgeline, forested land comprises the middle ground views (including one of the tall eucalyptus trees) and the roadway and roadway vegetation are in the foreground. The lower photo shows the westerly and southerly facades of the Interpretive Center and one of the gondola support structures, and the tall eucalyptus tree is gone. The Interpretive Center appears as a dominant element on the ridgeline although the proposed use of natural colors would blend with the landscape and soften its appearance. The gondola support structure is visible but is not a dominant vertical element on the ridgeline as existing trees form a backdrop and are as taller as or taller than the support structure. **Figure 3.1-10** shows the view as it currently exists (upper photo) and a view of the Project with the proposed landscaping at seven years maturity, which would screen much of the westerly building façade from view. The proposed Project would result in a noticeable change along the ridgeline, but would not have a substantial effect on a scenic vista.

b: Would the project substantially damage scenic resources, including, but not limited to trees, rock outcroppings, and historic buildings within a state or locally designated scenic highway?

As discussed above, the Oakland Zoo and Knowland Park are within the view corridor of Interstate 580 a designated scenic highway. Project development would not substantially damage scenic views of the ridgeline and hillsides available from Interstate 580 as discussed in **Significance Criterion a** above. The proposed Project would avoid

Existing view from Royal Oak Road looking south

Visual simulation of proposed project after construction

SOURCE: Environmental Vision

Figure 3.1-9
Viewpoint 9: Visual Simulation from Royal Oak Road Looking South – Landscaping at Seven Year Maturity

Existing view from Royal Oak Road looking south

Visual simulation of proposed project

SOURCE: Environmental Vision

Figure 3.1-8
Viewpoint 9: Visual Simulation from Royal Oak Road Looking South – Project Completion

Existing view from Golf Links Road looking southeast

Visual simulation of proposed project after construction

SOURCE: Environmental Vision

Figure 3.1-11
Viewpoint 10: Visual Simulation from Golf Links Road Looking Southeast – Landscaping at Seven Year Maturity

Existing view from Golf Links Road looking southeast

Visual simulation of proposed project

SOURCE: Environmental Vision

Figure 3.1-10
Viewpoint 10: Visual Simulation from Golf Links Road Looking Southeast – Project Completion

rock outcroppings present on-site and there are no historic buildings present on the Project site. The proposed Project would result in a reduction in the number of protected trees identified for removal in the MND. The proposed Project would not substantially damage scenic resources.

c: Would the project substantially degrade the existing visual character or quality of the site and its surroundings?

The proposed Project would alter the visual character of the site, however, as discussed in **Significance Criteria a** and **b**, it would not substantially degrade the visual character or the Project site or the surrounding area. Visual impacts would be similar to those addressed in the MND and would continue to be less-than-significant.

d: Would the project create a new source of substantial light and glare which would substantially and adversely affect day or nighttime views in the area?

Light and glare impacts would continue to be less-than-significant as identified in the MND. The proposed Project would include limited night lighting for safety and security purposes at the Veterinary Medical Hospital and California! The animal exhibits would not include night lighting. Lighting would be designed to provide the minimum illumination needed to achieve safety and security objectives and would be directed downward and shielded to focus illumination on the desired areas and minimize light trespass.

The gondola cars would be a green matte finish intended to blend into the landscape; and the gondola support structures would be matte finished with minimal potential for glare. Animal exhibits would utilize existing vegetation and landscaping would be installed to screen the exhibit areas minimizing the potential for glare. Window glazing for the Veterinary Medical Hospital and California Interpretive Center would be non-reflective glass.

MITIGATION MEASURES

The proposed Project would not result in significant new visual impacts. In addition, the Project will be subject to the City's Standard Conditions of Approval #18, #45, #46, #47, which will further reduce the potential for any significant impacts.

REFERENCES

City of Oakland. 1974. *Oakland General Plan, Scenic Highways Element*. September 1974.

City of Oakland. 2008a. *CEQA Thresholds/Criteria Significance Guidelines, Aesthetics, Shadow and Wind*. July 15, 2008.

City of Oakland. 2008b. *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval.*

3.2 AIR QUALITY

This section evaluates whether any of the Project changes would result in new aesthetic impacts not identified in the MND or a substantial increase in the severity of the previously identified aesthetic impacts. This section also discusses any pertinent new information or changes in the Project circumstances that could result in new or a substantial increase in impacts. This analysis relies on the City's current draft of the *CEQA Thresholds/Criteria Significance Guidelines* (City of Oakland 2008a). Additionally, this section reviews the previously adopted mitigation measures, updates these mitigation measures as necessary, or replaces the mitigation measures with the applicable provisions of the City's *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval* (2008b).

SIGNIFICANCE CRITERIA

Greenhouse Gas Emissions and Global Climate Change

[Note: I don't have the updated standard language for GHG and climate change (my version is dated 7-15-08) please provide. Must all standard language applicable to Initial Studies/MND be included here?)

MITIGATION MEASURES

The proposed Project would not result in significant new air quality impacts. In addition, the Project will be subject to the City's Standard Conditions of Approval addressing greenhouse gas emissions and global climate change, which will further reduce the potential for any significant impacts.

REFERENCES

City of Oakland. 2008a. *CEQA Thresholds/Criteria Significance Guidelines, Aesthetics, Shadow and Wind.* July 15, 2008.

City of Oakland. 2008b. *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval.*

3.3 BIOLOGICAL RESOURCES

This section evaluates whether any of the Project changes would result in new biological resources impacts not identified in the MND or a substantial increase in the severity of the previously identified potential impacts on biological resources. This section also discusses any pertinent new information or changes in the Project circumstances that could result in new or a substantial increase in the severity of identified impacts. This analysis relies on the City's current draft of the *CEQA Thresholds/Criteria of Significance Guidelines* (City of Oakland 2008a). Additionally, this section reviews updated regulatory requirements pertaining to special-status species and sensitive natural communities, as well as the City's Creek Protection Ordinance and Tree Protection Ordinance adopted since the 1998 Project approval. Finally, the section reviews the previously adopted mitigation measures, updates these mitigation measures as necessary, or replaces the mitigation measures with the applicable provisions of the City's *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval* (City of Oakland 2008b).

METHODOLOGY

Biological resources associated with the Project site were identified through a review of available background information, field reconnaissance surveys, and conduct of updated detailed surveys. Extensive field surveys and resource mapping was performed in advance of and subsequent to preparation of the MND. This included preparation of a *Biotic Resources Survey* (Cheung Environmental Consulting, 1996), conduct of protocol surveys for the State and federally-threatened Alameda whipsnake (*Masticophis lateralis euryxanthus*) in 1998 and 1999 (Swaim Biological, Inc., 2009), and preparation of a *Tree Survey* (Cheung Environmental Consulting, 1997). The *Biotic Resources Survey* (BRS) described and mapped existing natural communities on the site, summarized the results of systematic surveys for special-status plants, provided information on the potential for occurrence of special-status animals, and made conclusions on the significance of potential impacts of improvements proposed as part of the original Master Plan on sensitive resources and wildlife habitat. A copy of the survey report for Alameda whipsnake is contained in **Appendix B**.

During preparation of this Addendum, available documentation was reviewed to provide updated information on general resources in the area, presence of sensitive natural communities, and the distribution and habitat requirements of special-status species which have been recorded from or are suspected to occur in the Project vicinity. In addition to the BRS and other detailed studies conducted on the site and vicinity, a review of the occurrence records of the California Natural Diversity Data

Base of the California Department of Fish and Game was completed. Field reconnaissance surveys were conducted by James Martin, Principal of Environmental Collaborative, on May 7 and 19, and June 18 and 29, 2009 to confirm the vegetation and wildlife resources, presence of any sensitive natural communities, potential for jurisdictional waters, and suitability of the site to support populations of special-status species. Supplemental detailed surveys for special-status plant species were conducted by Dianne Lake, Consulting Botanist, with field surveys conducted on May 19, 21, 26, and 29, and June 29, 2009.

Mr. Martin also provided input into the adjusted alignment of the Perimeter Fence, modifications to animal enclosures in California!, and the alignment of the proposed Public Access Path along the eastern edge of the site as part of refinement of the proposed Project, with the goal of minimizing further impacts to sensitive biological resources. A *Habitat Evaluation* (Swaim Biological, Inc., 2009a) was prepared to further evaluate potential effects of the revised Master Plan on Alameda whipsnake, and provide a comparison to the potential impacts associated with the original Master Plan. Finally, an *Alameda Whipsnake Conceptual Mitigation Plan* (Swaim Biological, Inc, 2009b) was then prepared to define minimum mitigation for this species if not detected during supplemental protocol surveys to be conducted in 2009 and 2010 to confirm absence, as well as more rigorous compensatory mitigation if this species is encountered on the site. Copies of the *Habitat Evaluation* and the *Alameda Whipsnake Conceptual Mitigation Plan* are contained in **Appendix C** and **Appendix D**, respectively.

SIGNIFICANCE CRITERIA

a: Would the project have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate sensitive or special status species in local or regional plans, policies or regulations, or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service?

As discussed in the MND, the biological resources associated with the Project site were evaluated in a *Biotic Resources Survey* (Cheung Environmental Consulting, 1996) (BRS). The BRS described and mapped existing natural communities on the site, summarized the results of systematic surveys for special-status plants, provided information on the potential for occurrence of special-status animals, and made conclusions on the significance of potential impacts of improvements proposed as part of the Master Plan on sensitive resources and wildlife habitat. Based on the BRS, the MND determined that the project had the potential to significantly impact one special status plant species, robust monardella (*Mondardella villosa ssp. globosa*), two occurrences of which were documented on site during the systematic surveys in 1995.

Although no special status wildlife species had been observed on site, the MND determined that the project could have a potentially significant impact on Alameda whipsnake (*Masticophis lateralis euryxanthus*), Cooper's hawk (*Accipiter cooperi*), sharp-shinned hawk (*Accipiter striatus*) and San Francisco lacewing (*Nothochysa Californica*). Mitigation measures were included in the project and the MND determined that these measures would mitigate the impacts to special-status species to a less-than-significant level.

In general, the proposed Project would continue to have similar impacts on biological resources including special status species, although proposed changes to the Master Plan have generally reduced potentially significant impacts. These refinements include: eliminating the original shuttle bus system which would have created a new loop road across the hillsides and required substantial grading and tree removal to accommodate; providing visitor access to California! by a gondola that would pass over rather than through dense woodland and chaparral vegetation; elimination of the River Exhibit and replacement with the Veterinary Medical Hospital at a substantial reduction in the amount of grading in the vicinity; elimination of a new hiking trail from the California 1820 to Arroyo Viejo which would have passed through chaparral, woodland, and riparian habitat; and adjustments to the alignment of the Perimeter Fence so that less acreage is contained within California! and removal of chaparral habitat in the northwestern portion is minimized. Some aspects of the proposed changes to the Master Plan actually expand proposed exhibits and visitor uses into locations where no improvements were proposed previously, such as the expanded exhibit areas in California! and the Overnight Camping Area. However, collectively the amount of affected habitat and associated vegetation removal and habitat disturbance has been substantially reduced.

Table 3.3-1 provides a summary of the comparison between the approved Master Plan and proposed Project and the amount of vegetative cover affected under both scenarios. As summarized in the MND, California 1820 would have directly impacted 36.3 acres of habitat in exhibit areas, plus an additional 9.0 acres of habitat associated with construction of the proposed loop road. In addition, the proposed loop road would have affected an additional 58 acres of habitat by enclosing it in the loop roadway system, with shuttle vehicles running frequently along the route during the daytime. The shuttle bus system would have created an impediment to movement by smaller terrestrial species into the habitat surrounded by the loop road. As currently proposed, the existing maintenance road on the east side of California! would be widened and paved, but would be used only for controlled maintenance access.

TABLE 3.3-1: ESTIMATED VEGETATION IMPACTS COMPARISON BETWEEN APPROVED MASTER PLAN AND PROPOSED PROJECT

California 1820 (1998)	CC	DSS	CBS	FBS	GSL	OW	Rock	Totals	BOD	ORN
Bison	3.6	0.0	0.7	0.0	3.5	0.0	0.0	**7.8**		
Breeding	0.0	0.0	0.0	0.0	0.0	0.8	0.0	**0.8**		
Wolf	0.0	0.4	1.4	0.2	1.5	0.2	0.0	**3.7**		
River (included vet hospital)	0.0	0.2	0.3	5.6	5.0	0.5	0.0	**11.6**		
Canyon	0.0	0.0	0.0	4.2	0.9	7.3	0.0	**12.4**		
									9.0	0.2
Total Exhibit Acreage	3.6	0.6	2.4	10.0	10.9	8.8	0.0	**36.3**		
							0.0			
Enclosed by shuttle but outside exhibits	0.0	1.3	5.8	4.0	18.9	28.0	0.0	**58.0**		
Totals 1998	**3.6**	**1.9**	**8.2**	**14.0**	**29.8**	**36.8**	**0.0**	**94.3**		

California!	CC	DSS	CBS	FBS	GSL	OW	Rock	Totals		
Permanent + Limited Dist	0.24	0.0	4.25	0.17	3.79	0.89	0.0	**9.34**	1.53	0.02
Low Disturbance	0.32	0.0	2.82	0.0	3.17	1.15	0.0	**7.46**	0.54	0.0
Veterinary Medical Hospital	0.0	0.0	0.0	0.5	0.13	0.0	0.0	**0.63**	0.33	0.0
Maintenance Road	0.0	0.0	0.0	0.0	0.2	0.0	0.0	**0.2**	.59	0.2
Total Project Acreage	**0.56**	**0.0**	**7.07**	**0.67**	**7.29**	**2.04**	**0.0**	**17.63**	**1.4**	
Temporary Impacts										
Veterinary Medical Hospital	0.0	0.0	0.03	0.48	0.24	0.0	0.0	**0.58**	0.0	0.0
Maintenance Road	0.0	0.01	0.04	0.0	0.71	0.0	0.0	**0.76**	0.95	0.07
EVA Road	0.0	0.0	0.0	0.0	0.13	0.0	0.0	**0.13**	0.63	0.0
Joint Trench	0.0	0.0	0.3	0.48	0.24	0.0	0.0	**3.8**	0.58	0.0
Total Acreage	**0.0**	**0.01**	**0.37**	**0.96**	**1.32**	**0.0**	**0.0**	**5.27**	**2.16**	**0.7**

Vegetation/Cover Types Notes:

CC (Chamise Chaparral)
DSS (Diablan Sage Scrub)
CBS (Coyote Brush Scrub)
FBS (French Broom Scrub)
GLS (Grassland, Native and Non-native combined)
OW (Oak Woodland)
Rock (Rock Outcrops)
BOD (Barren or Disturbed)
ORN (Ornamental)

The following discussion analyzes the potential impacts to special-status species associated with the proposed Project.

Special-Status Species

Special-status species[1] are plants and animals that are legally protected under State and/or federal Endangered Species Acts or other regulations, as well as other

[1] Special status species include: designated rare, threatened, or endangered and candidate species for listing by the California Department of Fish and Game (CDFG); designated threatened or endangered and candidate species for listing by the U.S. Fish and Wildlife Service (USFWS); species considered rare or endangered under the conditions of Section 15380 of the CEQA Guidelines, such as those plant species identified on Lists 1A, 1B and 2 in the *Inventory of Rare and Endangered Plants of California* by the California Native Plant Society (CNPS); and possibly other species which are considered sensitive or of special concern due to limited distribution or lack of adequate information to permit listing or rejection for state or federal status, such as those included on list 3 in the CNPS *Inventory* or identified as animal "California Species of Special Concern" (SSC) by the CDFG.

species that are considered rare enough by the scientific community and trust agencies to warrant special consideration, particularly with regard to protect of isolated populations, nesting or denning locations, communal roosts, and other essential habitat. Available information on special-status species was reviewed during preparation of this Addendum, including their current status which could have changed since the MND was certified in 1998. This included the results of a habitat suitability analysis of the site, supplemental surveys for special-status plants conducted in 2009, and a habitat evaluation for Alameda whipsnake, which was a focus of the analysis in the MND. The following provides the results of that updated review and conclusions regarding potential for occurrence of special-status species and potential impacts of the revised Project.

Special-Status Plant Species

Systematic rare plant surveys were conducted on the site in 1995 as part of the BRS for the Master Plan. Given the length of time since the initial field surveys and fact that some aspects of the revised Project had changed, supplemental surveys of the site were conducted on May 19, 21, 26, and 29, and June 29, 2009. No special-status plant species were encountered on the site during supplemental surveys conducted in 2009, and the only species detected during systematic surveys conducted in 1995 consisted of two occurrences of robust monardella (*Monardella villosa* ssp. *globosa*). Robust monardella has no legal protective status under the Endangered Species Acts, but is maintained on List 1B (rare or endangered in California and elsewhere) of the *Inventory of Rare and Endangered Plant Species* (California Native Plant Society, 2001), and as such would warrant protection as part of CEQA review. However, no occurrences of robust monardella were located during the 2009 survey effort, and this species is no longer believed to be present on the site. It is uncertain why these occurrences of robust monardella are no longer present, possibly due to natural causes associated with shading by invasive French broom, intensive grazing by goats used by the Oakland Fire Department to reduce fuel loads for fire prevention, or some other factors. Consequently, the protective measures called for in Mitigation Measures 14a and 14b from the MND, which called for rerouting the loop road and revising the boundary of the Bison Exhibit are no longer applicable.

The potential for occurrence of any other populations of special-status plant species on the site is considered very remote, given the negative findings of surveys conducted in 2009 and 1995, with the exception of the now extirpated occurrences of robust monardella. However, the supplemental survey effort in 2009 wasn't initiated until fairly late in the spring blooming season and several species with potential to occur in similar habitat would have been largely indistinguishable from the surrounding grassland cover by May. In addition, some aspects of the proposed

Project have been refined since the supplemental surveys were initiated in 2009, including an expansion of the Wolf Enclosure area, adjustments to the alignment of the Perimeter Fence, and provisions for a new Public Access Path along the eastern edge of the site outside the Perimeter Fence. Although the likelihood of encountering any new populations of special-status plant species is considered very remote, supplemental detailed surveys will be required to confirm absence or presence. Should the supplemental surveys reveal the presence of a special-status plant species on the California! site, the areas shall be avoided and protected with a buffer consistent with the approach to mitigation specified under Mitigation Measures 14a and 14b in the MND for the robust monardella previously found on the site.

Special-Status Animal Species

The BRS and MND provide a discussion of the potential effects of the Project on special-status animal species suspected to possibly occur on the site. This included information on 27 special-status animal species, including four mammals, 12 birds, two reptiles, two amphibians, and seven invertebrates. Essential habitat for most of these species was determined to be absent on the site, with the exception of possible nesting habitat for Cooper's hawk (*Accipiter cooperii*) and sharp-shinned hawk (*Accipiter striatus*), possible use of woodland by the San Francisco lacewing (*Nothochrysa californica*), and the potential for occurrence of Alameda whipsnake (AWS) in areas of chaparral and other suitable habitat. San Francisco lacewing is no longer a federal Candidate Species of Concern, although this species may warrant consideration under CEQA review as called for under Section 15380 of the CEQA Guidelines. Cooper's hawk and sharp-shinned hawk are both considered SSC by the CDFG. No nests of any raptors were detected during field surveys conducted as part of the BRS. However, the woodlands provide suitable nesting habitat for hawks and other raptors, and the grassland and areas of open scrub and woodland provide suitable foraging habitat for raptors and other bird species. Raptor nests in active use are protected under State Fish and Game Code and nests in active use by most bird species are protected under the federal Migratory Bird Treaty Act.

As is discussed above, the proposed Project would have less impact on the existing natural habitat found on the site, including potential foraging habitat for special-status birds as well as special-status invertebrates. Additionally, as discussed below under **Significance Criterion f**, the revised Project would reduce the number of trees impacted and therefore reduce the potential for disrupting suitable habitat for specialstatus bird species if they were to nest on the site in the future. Mitigation Measure 14i in the MND addressed potential impacts on nesting Cooper's hawks and Mitigation Measure 14j addressed potential impacts on San Francisco lacewings. There remains a potential for occurrence of other nesting birds on the site that

would also be protected under the federal Migratory Bird Treaty Act and possibly the State Fish and Game Code. However, the City's Conditions of Approval & Uniformly Applied Development Standards regarding protection of possible nesting habitat and the requirement that a preconstruction survey be conducted if vegetation removal and construction is to be initiated during the breeding/nesting season (from March 15 through August 15) would serve to mitigate potential impacts on bird species of concern to less-than-significant levels. San Francisco lacewing is no longer a federal Candidate Species of Concern, but the dust control measures called for in Mitigation Measure 14j from the MND would continue to provide protection for this and other insects and other wildlife on the site, and this would be a less-than-significant impact.

A major focus of the BRS and the MND was the potential for occurrence of AWS on the site. The MND basically assumed that AWS was most likely present on the site, that impacts would potentially be significant, and developed broad mitigation measures to address these impacts. Following adoption of the MND, protocol surveys were conducted by Swaim Biological, Inc, in 1998 and 1999 (Swaim Biological, Inc., 2009). No AWS were found on the site as part of the protocol surveys, and separate surveys conducted for the East Bay Regional Park District in 2003 and 2004 along Skyline Boulevard in Anthony Chabot Regional Park also produced negative results, providing an indication that this species is most likely not be present in Knowland Park and the likelihood of colonizing the site is remote (see Results of Trapping Survey in **Appendix B**). However, the Zoo survey results are now over ten years old and the USFWS protocols have since become more rigorous. In addition, revisions to the proposed Project would result in impacts to some areas not previously trapped. Supplemental protocol surveys for AWS will be conducted in 2009 and 2010 at the sites of California! and the Overnight Camping Area to provide confirmation on presence or absence of this species.

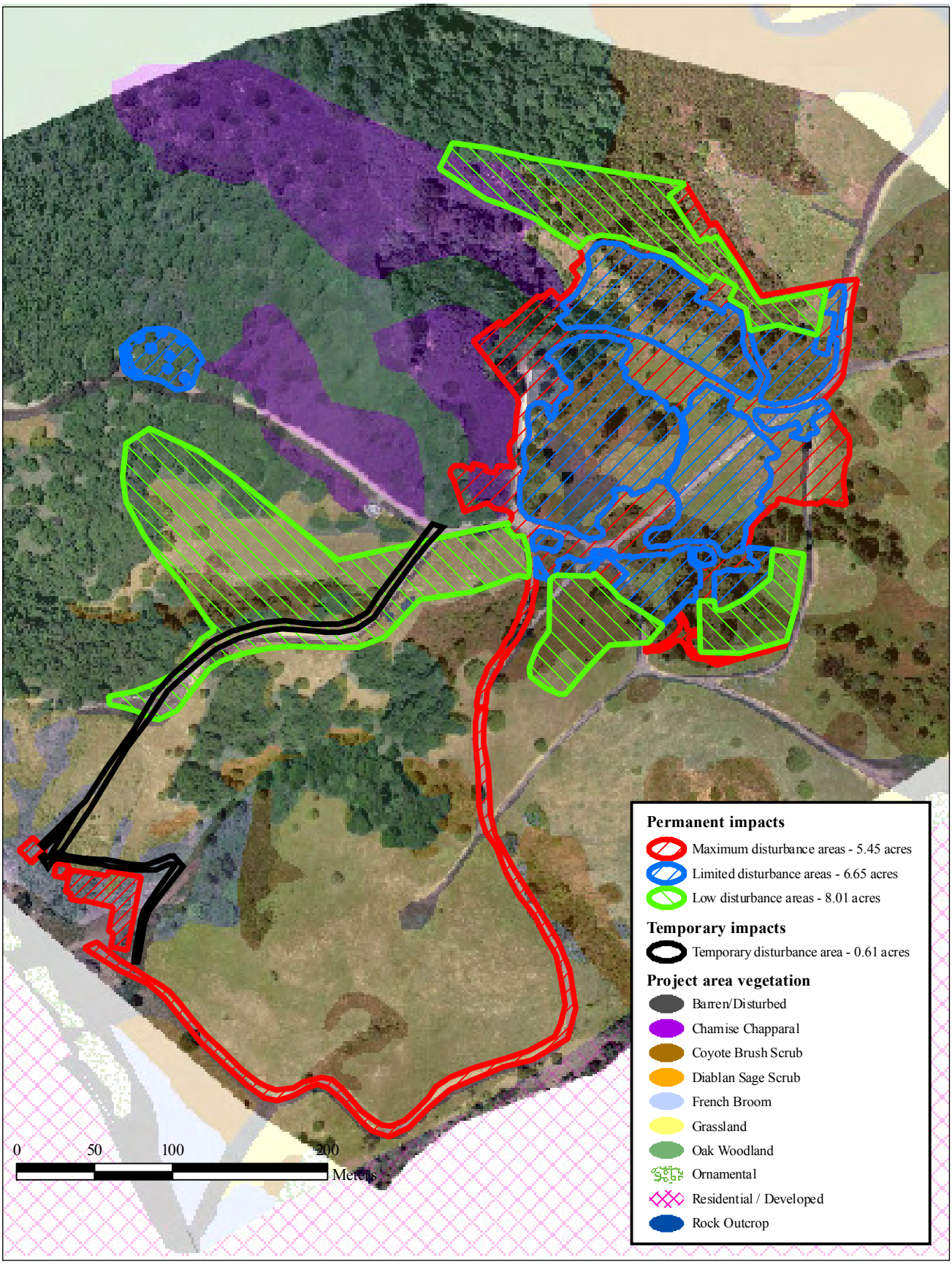
A *Habitat Evaluation* (Swaim Biological, Inc., 2009a) was prepared to further evaluate potential effects of the proposed changes to the Master Plan on Alameda whipsnake, and provide a comparison to the potential impacts associated with the Master Plan (**Appendix C**). **Table 3-1** provides a comparison in changes to existing vegetative cover between the California 1820 and California! The proposed Project would affect an estimated 17.63 acres of habitat would be affected. An estimated 5.27 acres would be temporarily disturbed. Collectively, this represents a reduction in anticipated loss and disturbance of existing vegetation and habitat by approximately 13.4 acres.

Figure 3.3-1 shows the existing vegetation cover and the extent of habitat disturbance associated with the proposed changes to the Master Plan. This figure identifies three possible levels of disturbance in the Master Plan area, based on construction and long-term use activities as determined by the Zoo's consulting landscape architect. These consist of areas considered permanently disturbed (i.e. occupied by structures, roadways, pathways, etc.), those areas with limited disturbance (i.e. visitor use and day-time exhibit areas), and those areas with low disturbance (i.e. non-display exhibit areas and larger animal enclosures). Tree removal and native vegetation clearing would be avoided or minimized within most of these zones to the degree possible, with greater flexibility possible in the limited and low disturbance zones. However, long-term use by some species, such as foraging and trampling in the Bison Exhibit, would eventually reduce ground covers and could eventually eliminate most of the grassland from the enclosure areas. For the purposes of this assessment, Project-related areas of disturbance were considered similar in their degree of long-term impacts on vegetative cover and wildlife habitat. Again, the proposed changes to the Master Plan would result in a substantial reduction in the acreage of affected habitat by an estimated 13.4 acres. Therefore, potential impacts to AWS associated with the revised Project are less than that evaluated in the MND.

As recognized in the MND, impacts to any occupied AWS habitat would be considered a significant impact and the MND assumed that the species was present. If supplemental surveys establish the absence of AWS on the site, measures necessary to ensure no incidental take would occur during construction in the unlikely event of that an individual is in fact present on site but was somehow undetected during the protocol surveys. If AWS are determined to be present, additional measures would be implemented to avoid, minimize and mitigate impacts as required under the MND and under the applicable Conditions of Approval. Mitigation Measures 14c through 14h in the MND pertain to AWS, assuming the species is present on the site and that avoidance measures are warranted. Swaim Biological, Inc. has prepared a *Conceptual Mitigation Plan* (CMP) addressing potential impacts on AWS (Swaim Biological, Inc., 2009b) which updates and clarifies the mitigation measures to be implemented (**Appendix D**).

b: Would the project have a substantial adverse impact on any riparian habitat or other sensitive natural community identified in local or regional plans, policies or regulations, or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service?

The MND discussed potential impacts to sensitive communities such as grassland, riparian, woodland and chaparral community types and recognized that such impacts



SOURCE: Swaim Biological Inc.

Figure 3.3-1
Vegetation Cover and Disturbance Areas Map

were potentially significant. The MND included measures to mitigate these impacts to a less-than-significant level, including implementation of a Habitat Enhancement Plan, a Tree Protection and Revegetation Plan, preservation and management of scrub and/or chaparral habitat if AWS is present on site, and invasive species controls. These measures were found to reduce the impact to sensitive communities to a less-than-significant level.

UPDATED REGULATORY SETTING - SENSITIVE NATURAL COMMUNITIES

The following discussion provides an update on the regulatory setting regarding special-status species, summarizes the condition of existing resources on the site, and analyzes the potential for the revised Project to impact riparian habitat or other sensitive natural communities. Information on State legislation intended to protect oak woodland resources, and the local ordinance enacted to protect native trees is also summarized below.

California Natural Diversity Data Base

The California Natural Diversity Data Base (CNDDB) is a branch of the CDFG, and provides information on special-status species and sensitive natural communities. This includes an inventory of sensitive natural communities considered to have a high inventory priority in the State. The vegetation classification system used by CNDDB has changed since 1998, from a habitat based system to a floristically based system. While the classification system is still being refined by the CNDDB,[2] it provides greater definition for which natural communities are considered sensitive and have a high inventory priority that should be recognized during CEQA review. This includes use of a ranking system to provide an indication of rarity, based on NatureServe's standard heritage program methodology.

Ranking of the various vegetation types according to their rarity and treat is an important part of the current classification system used by the CNDDB. In the latest version of the *List of California Vegetation Alliances* (CNDDB, 2007), the alliances are ranked using a system derived from NatureServe's standard heritage

[2] The purpose of the CNDDB natural community inventory was originally to identify and determine the significance and rarity of the various vegetation types in the State. The classification system for "natural communities" currently used by CNDDB is being refined and has undergone substantial changes in the past five to ten years. It is based on the system described in the *Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995), a floristically based system that uses two units of classification, called the alliance and the association as described in *National Vegetation Classification* (Grossman, et al., 1998). Because the classification for natural communities in California is incomplete, the detail in the finest resolution of the hierarchy, the association, is not uniform. Associations are defined quantitatively by a classification procedure that compares the component species in related vegetation sampling plots. Although it is just now being used in a broad scale, this quantitative vegetation classification and systematic mapping method will allow conservationists and resource managers a greater understanding of natural ecosystems, their abundance, and their relative security.

program methodology.[3] Each community type is ranked with a Global (G) and a State (S) code of 1, 2, 3, 4, or 5, with a 1 representing the most sensitive and 5 representing relatively common types. If an alliance is marked with a 1 though 3 code on the State or Global level, this means that all of the associations within it will also be considered of high inventory priority. If marked as G4 or G5, these alliances are generally considered common enough to not be of concern.

Oak Woodland Legislation

Although not all oak woodlands are considered sensitive natural community types or have a high inventory priority with the CNDDB, they are generally considered to provide important wildlife habitat and their continued loss and conversion is of concern to CDFG. The Oak Woodlands Conservation Act was approved in 2004 and added Section 21083.4 to the Public Resources Code to clarify the importance of oak woodland conservation in the State. Under the provisions of the Oak Woodlands Conservation Act, a county shall determine whether a project within its jurisdiction may result in the conversion of oak woodlands that would have a significant effect on the environment. If the county determines that there would be a significant effect on oak woodlands, the county shall require one or more mitigation alternatives. These include conserving oak woodlands through the use of conservation easements; planting an appropriate number of replacement trees and providing for their monitoring and maintenance for a seven year period; restoring former oak woodlands; contributing to the Oak Woodlands Conservation Fund, as established under Section 1363(a) of the Fish and Game Code, for the purpose of purchasing oak woodlands conservation easements; or some other appropriate mitigation developed by the county.

EXISTING CONDITIONS AND POTENTIAL IMPACTS

Sensitive natural community types on the site include native grasslands, riparian habitat along the Arroyo Viejo, and some vegetation associations in the chaparral cover. The BRA and MND provides information on each of these community types. Given the changes proposed as part of the revised Project, particularly the removal of the hiking trail from California 1820 to the Arroyo Viejo, no direct impacts on riparian habitat are currently anticipated. The MND contained no mitigation measures specifically pertaining to riparian habitat, but the broader vegetation management recommendations for invasive species removal and native

[3] NatureServe is an international, non-profit conservation organization providing scientific data used to assist in resource planning and conservation. The List of California Vegetation Alliances is structured differently than previous lists in that it emphasizes the relationship of California alliances with the current National Vegetation Classification System. The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by a letter reflecting the appropriate geographic scale of the assessment (G = Global, S = State).

enhancement plantings called for in Mitigation Measure 13a would still be applicable to the revised Project.

The associations of oak woodland on the site aren't recognized as a sensitive natural community type with a high inventory priority by the CNDDB, but they are recognized under State law and trees meeting the definition of "protected tree" are regulated under the City's Tree Protection Ordinance, as discussed further under **Significance Criterion f**. The proposed Project has been refined to deliberately avoid potential impacts on most of the oak woodlands on the site, and compliance with the City's Tree Protection ordinance would also serve to meet the intent of the resource protections called for in Section 21083.4 to the Public Resources Code.

The following provides an expanded discussion of the native grassland and chaparral natural communities on the site, which would still be affected by the proposed Project.

Native Grassland

As discussed in the BRS, much of the remaining grasslands on portions of the site support a high percentage of native species. An estimated 7.6 acres of grassland cover occurs within the limits of proposed improvements and exhibit areas under the revised Project, and most of these were mapped as native grasslands in the BRS in 1995. The condition of the remaining native grasslands on the site have been degraded by historic grazing activities in the past, on-going intensive grazing by goats for fire fuel load reduction, and the spread of French broom and other invasive species, but areas dominated by native grassland species continue to represent a sensitive resource. These stands of native grassland on the site can be best characterized as Valley Needlegrass Grasslands under the *Preliminary Description of Terrestrial Natural Communities* (Holland, 1986) and the *List of Terrestrial Natural Communities* (CDFG, 2003), or as alliances dominated by *Nassella pulchra* and *Danthonia californica* based on classification of the *Manual of California Vegetation* (Sawyer et. al., 1995). Under both of these classification systems, the native grasslands are considered sensitive natural community types with a high inventory priority by the CNDDB. Both *Nassella pulchra* and *Danthonia californica* alliances are rated G4S3 in the *List of California Vegetation Alliances* (CDFG, 2007), meaning they have a high inventory ranking in the State.

The proposed Project would reduce the amount of disturbance which would occur in the grassland found on the Project site. Loss or further degradation to the remaining grasslands would occur as a result of construction of roadways, pathways, new structures, and fencing, as well as from grazing and trampling by confined animals in the exhibit enclosures. As is shown on **Table 3-1**, the approved Master

Plan would have resulted in 10.9 acres of potential impacts to grassland as a result of construction and use of the exhibit areas. Under the proposed Project, 7.29 acres of grassland would be impacted, resulting in an estimated reduction of approximately 3.61 acres of grassland habitat. Mitigation Measure 13a in the MND calls for implementation of a Habitat Enhancement Plan that would "enhance" native grasslands among other habitat types in the California 1820 Exhibit area and Upper Knowland Park and remove invasive species. But the focus for this effort was on removal of invasive species with no specific goals for how much habitat was to be protected and managed. Recreating native grassland habitat is a difficult task, and preserving areas of existing native grassland through proper management and invasive species control are more realistic goals for a plan of this type.

Chaparral

Chamise (*Adenostoma fasciculatum*) forms the dominant species in most of the chaparral habitat on the site. While chaparral is generally not considered a sensitive natural community, several associations of the chamise-dominated alliances are considered to have a high inventory priority as indicated in the *Preliminary Description of Terrestrial Natural Communities* (CDFG, 2003). This includes the chamise association with bush monkeyflower (*Mimulus aurantiacus*) which is found on the site in the dense stands of chaparral. No attempt was made to map out the specific associations with bush monkeyflower as this species is broadly distributed in the chaparral and nearby coastal scrub.

The proposed Project would reduce potential impacts on chamise chaparral and related scrub communities. Under the approved Master Plan, 3.6 acres of chamise chaparral would have been impacted. The proposed Project would reduce the total acreage of potential impact on this natural community type to 0.56 acre (see **Table 3-1**). Most of this direct impact is associated with construction of the proposed amphitheater, which was not a component of California 1820 and is proposed to be located in an area of dense chaparral and young coast live oaks. Installation of the Perimeter Fence would also affect chaparral, although considerable adjustments have been made to the original alignment deliberately to avoid incursion into these habitat types. Additionally, the final alignment of the Perimeter Fencing in the northwestern portion of the site would be field adjusted to further reduce incursion into chamise chaparral habitat. The MND required that potential impacts on chamise chaparral and other natural communities be mitigated by implementing a Habitat Enhancement Plan as well as the measures described above under potential impacts on AWS. These measures would be sufficient to reduce the potential impacts of the proposed Project on the chamise chaparral natural community to a less-than-significant level.

c: Would the project have a substantial adverse effect on federally protected wetlands (as defined by Section 404 of the Clean Water Act) or state protected wetlands, through direct removal, filling, hydrological interruption, or other means?

Although definitions vary to some degree, wetlands are generally considered to be areas that are periodically or permanently inundated by surface or ground water, and support vegetation adapted to life in saturated soil. Wetlands are recognized as important features on a regional and national level due to their high inherent value to fish and wildlife, use as storage areas for storm and flood waters, and water recharge, filtration and purification functions. The CDFG, U.S. Army Corps of Engineers (Corps), and the Regional Water Quality Control Board (RWQCB) have jurisdiction over modifications to wetlands and other "waters of the United States."[4]

A preliminary wetland assessment was conducted as part of the field reconnaissance surveys in 2009 to confirm the extent of potential jurisdictional wetlands and unvegetated other waters in the vicinity of the site. Based on the results of the assessment, no wetlands occur within the limits of proposed improvements associated with the revised Master Plan, although two seep areas occur just outside the alignment of the Perimeter Fence. Potential jurisdictional features are generally limited to unvegetated ephemeral drainages, as indicated in **Figure 3.3-3**.[this figure will be provided with submittal of Administrative Draft #2.] These drainages contain no wetland vegetation and are generally indistinguishable from the surrounding vegetative cover. As shown in **Figure 3.3-3**, they consist of narrow, incised channels of from one to two feet in width which convey surface water during and immediately after rainfall events generating surface runoff. Most of these drainages are hydrologically connected to downstream waters, such as Arroyo Viejo to the north. However, the drainage upslope of the proposed Veterinary Medical Hospital ends where the ravine opens up, and surface flows apparently disperses as sheet flow across the vicinity of the proposed new hospital structure before being intercepted by the existing fire road and then flowing into a drainage ditch and culvert system along the northern edge of the visitor parking lot.

No significant direct impacts to wetlands and waters are anticipated with the proposed changes to the Master Plan. No potential wetlands or creeks would be directly affected by the proposed Project, as indicated in **Figure 3.3-3**. There

[4] Jurisdiction of the Corps is established through provisions of Section 404 of the Clean Water Act, which prohibits the discharge of dredged or fill material without a permit. The RWQCB jurisdiction is established through Section 401 of the Clean Water Act, which requires certification or waiver to control discharges in water quality. The RWQCB also has jurisdiction over hydrologically isolated waters under the State Porter-Cologne Act, including features no longer regulated under the Corps. Jurisdictional authority of the CDFG over wetland areas is established under Section 1600 of the State Fish and Game Code, which pertains to activities that would disrupt the natural flow or alter the channel, bed or bank of any lake, river or stream.

remains a possibility that installation of the Perimeter Fence segment over Arroyo Viejo could result in disturbance to the bank of this perennial stream, which is a regulated waters under jurisdiction of the Corps, RWQCB, and CDFG. However, a Creek Protection Permit would be required if this segment of the Perimeter Fence was ever installed, which would require preparation of a Creek Protection Plan that would adequately address all direct and indirect potential impacts to this feature. Implementation of the City's Standard Conditions of Approval & Uniformly Applied Development Standards related to Creek Protection would ensure that indirect impacts to these features are adequately avoided and potential impacts to creeks and wetlands would be less-than-significant.

d: Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?

The MND determined that construction of the proposed paved loop road under the approved Master Plan could interfere with diurnal movements of wildlife species in the Project area, including deer and several reptile species. Additionally, construction of the Perimeter Fence could impede movement by larger terrestrial species. The proposed Project has substantially reduced these potential impacts on wildlife habitat and movement opportunities. The total acreage of directly affected habitat would be reduced from 36.3 acres to 17.63 acres; and 5.27 acres of temporarily disturbed habitat. An additional 58 acres that would have been separated by the proposed loop road under the approved Master Plan would no longer be surrounded by an actively used roadway with the proposed Project. The proposed gondola used to transport visitors to California! would pass over the top of the existing woodland, chaparral, and grassland habitat, which would still be accessible to smaller, ground mobile terrestrial species.

Modification made as part of the proposed Project serve to minimize the effect of the Perimeter Fence on existing habitat and wildlife movement. As discussed in the Project Description, the design of the Perimeter Fence would include wildlife friendly undercrossings spaced at approximately 300-foot intervals that would allow for passage of most terrestrial wildlife species with the exception of deer. And the alignment of the Perimeter Fence has been pulled back in the northwestern portion of California! to minimize disturbance to existing chamise chaparral cover. As a result, over five acres of chaparral and woodland habitat that would have previously been contained within the Perimeter Fence now remain as part of the larger natural open space area outside the revised fence alignment. Native wildlife would continue to have unimpeded access along the northern slopes of Knowland Park. The proposed Project would have a less-than-significant impact on wildlife movement in the vicinity.

e: Would the project fundamentally conflict with any applicable habitat conservation plan or natural community conservation plan.

There are no applicable habitat conservation plan or natural community conservation plans covering the project site. Accordingly, the revised Project will have no such impact.

f: Would the project fundamentally conflict with the City of Oakland Tree Preservation Ordinance (Oakland Municipal Code (OMC) Chapter 12.36) by removal of protected trees under certain circumstances? Factors to be considered in determining significance include: The number, type, size, location and condition of (a) the protected trees to be removed and/or impacted by construction and (b) the protected trees to remain, with special consideration given to native trees.

Title 12, Chapter 12.36 of the City of Oakland Municipal Code identifies protected trees that require a permit for removal. According to the ordinance, a tree removal permit must be obtained to remove a "protected tree". A protected tree consists of any coast live oak measuring 4 inches in diameter at breast height (dbh) or any other tree species measuring 9 inches dbh or larger, except non-native eucalyptus and Monterey pine (*Pinus radiata*). Monterey pine trees shall be protected only on city property and in development-related situations where more than five Monterey pine trees per acre are proposed to be removed. Except as noted in the ordinance, eucalyptus and Monterey pine are not protected by the ordinance. Replacement tree plantings are typically required where native tree species are removed. Adequate protection shall also be provided during the construction period for any trees which are to remain in the vicinity of proposed development. The City of Oakland has developed Conditions of Approval & Uniformly Applied Development Standards typically applied to projects affecting tree resources.

The MND determined that tree removal associated with implementation of the approved Master Plan would be a potentially significant impact. Based on a *Tree Survey* (Cheung Environmental Consulting 1997) completed for the Project, it was determined that approximately 98 protected trees (73 native and 25 non-native) would be removed as a result of development of the California 1820 Exhibit and 67 non-native trees would be removed to develop the Center for Science and Environmental Education. The MND recognized that the City's Tree Preservation Ordinance would govern removal of the trees and required that a Tree Protection and Revegatation Plan be prepared to protect, replace, and preserve trees on the project site.

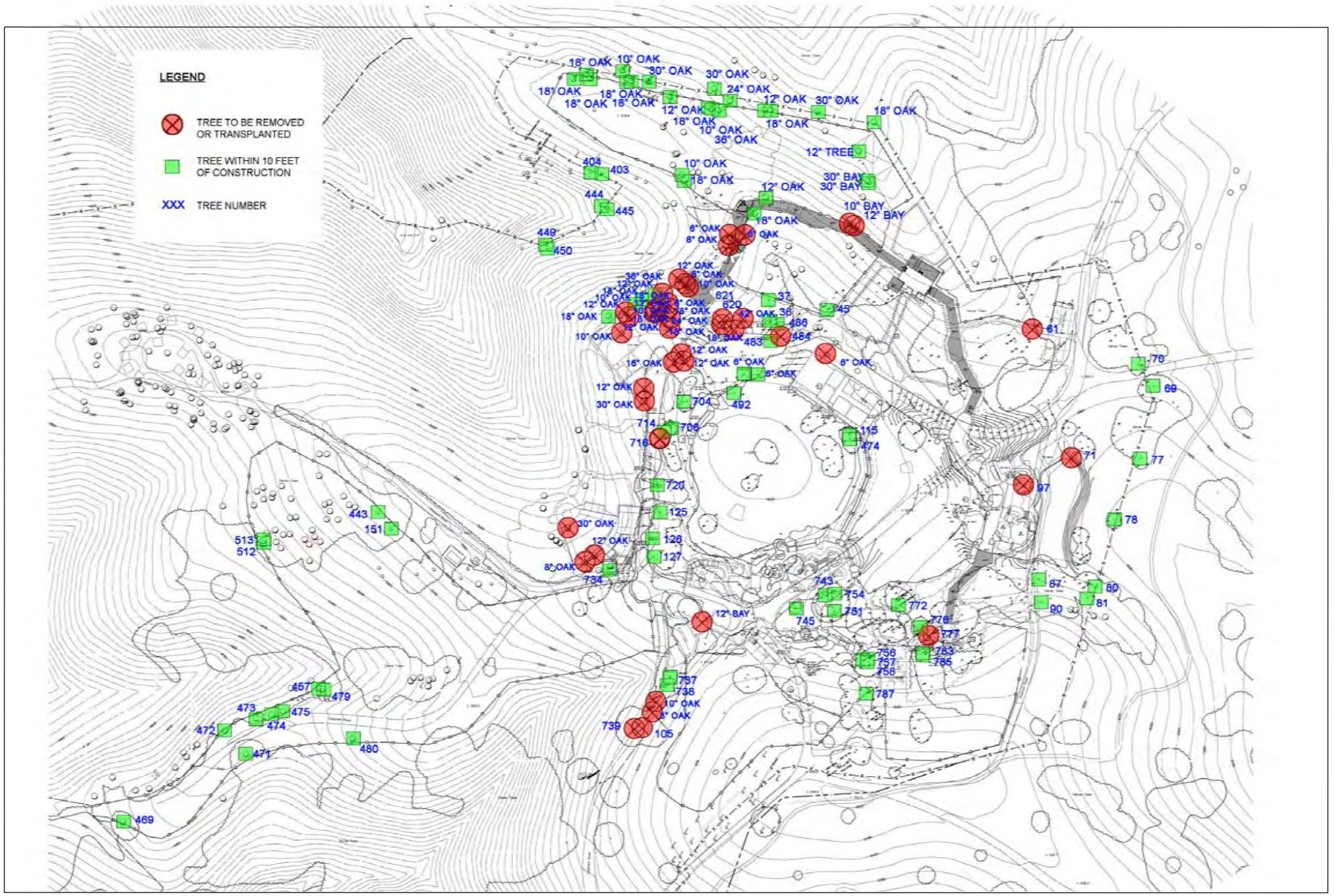
To assess the proposed Project's potential impacts on trees, the Project's civil engineer updated the survey, including areas not previously mapped (Aliquot, 2009).

Previously unsurveyed trees were mapped, and information on trunk diameter and species were recorded, based on the standards for protected trees as defined in the City's Tree Protection Ordinance. This updated tree data together with mapping from the original *Tree* Survey, was then used by the Project's landscape architect to prepare the California! Tree Diagram (PJA, 2009), shown in **Figure 3.3-2** identifies trees to be removed or transplanted, trees within ten feet of anticipated construction, and trees more than ten feet from proposed improvements. Most of the trees in the vicinity of proposed construction are coast live oaks with trunk diameters ranging from four to forty eight inches.

The proposed Project would result in the removal or transplantation of a total of 38 protected trees, and another 87 trees would be located within ten feet of construction. One of the objectives of the proposed Project is to minimize tree removal through further refinement of Project improvements and to make field adjustments to the final alignment of the Perimeter Fence and the animal exhibit enclosure fences to avoid removal of individual trees, wherever feasible. This goal seems achievable, and replacement plantings would be provided as part of site landscaping and as required to provide compliance with the City's Tree Protection Ordinance.

The proposed Project would result in substantially less impacts to protected, from 73 native trees under the Master Plan to fewer than 38 with the proposed Project. Most of the trees proposed for removal under the approved Master Plan were associated with the dense woodlands along the southwestern edge of the site where extensive grading would have been required to accommodate the Shuttle Road, which is no longer proposed as part of the Project. The proposed Gondola Transportation System has been designed to avoid any tree removal, with the alignment passing over the large stand of woodland and chaparral cover along the alignment. Some future trimming of oaks under the gondola alignment may be required to maintain adequate clearance, but the system has been designed to provide a minimum clearance of ten feet over the tops of these mature trees where they would be closest to the Gondola Transportation System. Because the trees are mature any future trimming should be minimal and should not adversely affect the long-term health of these trees.

The proposed Project's impacts to trees would be mitigated through implementation of the Tree Protection and Revegetation Plan required in Mitigation Measure 13b of the MND and compliance with the City's Tree Protection Ordinance and Conditions of Approval.



SOURCE: PJA Architects+Landscape Architects

Figure 3.3-2
California! Tree Diagram

g. Would the project fundamentally conflict with the City of Oakland Creek Protection Ordinance (OMC Chapter 13.16) intended to protect biological resources? Although there are no specific, numeric/quantitative criteria to assess impacts, factors to be considered in determining significance include whether there is substantial degradation of riparian or aquatic habitat through: (a) discharging a substantial amount of pollutant into a creek; (b) significantly modifying the natural flow of the water; (c) depositing substantial amounts of new material into a creek or causing substantial bank erosion or instability; or (d) adversely impacting the riparian corridor by significantly altering vegetation or wildlife habitat?

Title 13, Chapter 13.16 of the City of Oakland Municipal Code establishes a number of guidelines to protect Oakland's creeks by reducing and controlling stormwater pollution, preserving and enhancing creekside vegetation and wildlife, and controlling erosion and sedimentation. The ordinance includes specific measures applicable to parking lots, gas stations, industrial and commercial activities, as well as to properties that contain creeks or other watercourses. According to the ordinance, "a creek is a watercourse that is a naturally occurring swale or depression, or engineered channel that carries fresh or estuarine water either seasonally or year round." The ordinance includes permitting guidelines for development and construction projects taking place in or near creeks, and requires that a Creek Protection Plan be prepared in advance of issuance of a Creek Protection Permit. The City of Oakland has developed Conditions of Approval & Uniformly Applied Development Standards (City of Oakland, 2008) typically applied to projects affecting tree resources.

As discussed above under **Significance Criterion c**, all of the ephemeral drainage features on the site appear to qualify as a "creek" under the City's Creek Protection Ordinance. The ordinance includes permitting guidelines for development and construction projects taking place in or near creeks, and requires that a Creek Protection Plan be prepared in advance of issuance of a Creek Protection Permit. The City's Conditions of Approval & Uniformly Applied Development Standards are typically applied as development standards for projects affecting creek resources. **Figure 3.3-3** [this figure to be provided with submittal of Administrative Draft #2] shows the assumed Creek Protection Zone delineated by the Zoo's civil engineer around each of the creeks on the site, mapped in accordance with the Creek Protection Ordinance.

No significant direct impacts to wetlands and waters are anticipated with the proposed changes to the Master Plan. No potential wetlands or creeks would be directly affected by the proposed Project, as indicated in **Figure 3.3-3**. There remains a possibility that installation of the Perimeter Fence segment over Arroyo Viejo could result in disturbance to the bank of this perennial stream. However, a

INSERT FIGURE 3.3-3

[this figure to be provided with submittal of Administrative Draft #2]

Creek Protection Permit would be required if this segment of the Perimeter Fence was ever installed, which would require preparation of a Creek Protection Plan that would adequately address all direct and indirect potential impacts to this feature. Improvements associated with the proposed Veterinary Medical Hospital would be located over 100 feet downstream from the current terminus of the small ephemeral drainage channel to the north. And the alignment of the Perimeter Fence has been intentionally adjusted in the proposed Project to avoid the ephemeral drainages that occur to the southwest, southeastern and northwest of the site. Implementation of the City's Conditions of Approval, would ensure that indirect impacts to these features are adequately avoided and potential impacts to creeks and wetlands would be less-than-significant.

MITIGATION MEASURES

The proposed Project would not result in significant new biological impacts. In addition, the Project will be subject to the City's Standard Conditions of Approval #44 - #51 which will further reduce the potential for any impacts.

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Swaim Biological, Inc., 2009, *Results of a Trapping Survey for the Alameda Whipsnake (Masticophis lateralis euryxanthus) at the Proposed California Expansion Project Area of the Oakland Zoo, City of Oakland, Alameda County, California*, prepared for Ms. Patricia Jeffery, Placemakers, June 8.

Swaim Biological, Inc. 2009a, *Alameda Whipsnake Habitat Evaluation*, July 24.

Swaim Biological, Inc., 2009b, Alameda Whipsnake Conceptual Mitigation Plan, July 24.

3.4 GEOLOGY AND SOILS

This section evaluates whether any of the Project changes would result in new geology and soils impacts not identified in the MND or a substantial increase in the severity of the previously identified aesthetic impacts. This section also discusses any pertinent new information or changes in the Project circumstances that could result in new or a substantial increase in impacts. This analysis relies on the City's current draft of the *CEQA Thresholds/Criteria Significance Guidelines* (City of Oakland 2008a). Additionally, this section reviews the previously adopted mitigation measures, updates these mitigation measures as necessary, or replaces the mitigation measures with the applicable provisions of the City's *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval* (2008b).

SIGNIFICANCE CRITERIA

a: Would the project expose people or structures to substantial risk of loss, injury or death as identified in subsections i –iv?

The proposed Project is not located within an Alquist-Priolo Earthquake Fault Zone but would be subject to seismic ground shaking as it is about 13 miles from the Hayward Fault (Harza 1994). A geotechnical investigation for the proposed Veterinary Medical Hospital (Jensen-Van Lienden Associates, Inc. 2008) has been prepared in compliance with Mitigation Measure 1c. A geotechnical investigation for California! will be prepared as required by Mitigation Measure 1c. The proposed Project would not result in new significant geology and soils impacts.

MITIGATION MEASURES

The proposed Project would not result in significant new geology and soils impacts. In addition, the Project will be subject to the City's Standard Conditions of Approval #58 which will further reduce the potential for any significant impacts.

REFERENCES

Harza Consulting Engineers and Scientists. 1994. *Fault Rupture Hazard and Geotechnical Investigation for Environmental Education Center and Building Additions Oakland Zoo, Oakland California.* April 29, 1994.

Jensen-Van Lienden Associates, Inc. 2008. *Geotechnical Engineering Study Veterinary Hospital – Oakland, CA*. May 9, 2008.

City of Oakland. 2008a. *CEQA Thresholds/Criteria Significance Guidelines, Aesthetics, Shadow and Wind.* July 15, 2008.

City of Oakland. 2008b. *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval.*

3.5 HAZARDS AND HAZARDOUS MATERIALS

This section evaluates whether any of the Project changes would result in new hazards and hazardous materials impacts not identified in the MND or a substantial increase in the severity of the previously identified aesthetic impacts. This section also discusses any pertinent new information or changes in the Project circumstances that could result in new or a substantial increase in impacts. This analysis relies on the City's current draft of the *CEQA Thresholds/Criteria Significance Guidelines* (City of Oakland 2008a). Additionally, this section reviews the previously adopted mitigation measures, updates these mitigation measures as necessary, or replaces the mitigation measures with the applicable provisions of the City's *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval* (2008b).

SIGNIFICANCE CRITERIA

a: Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?

The proposed Veterinary Medical Center would store limited amounts of hazardous materials associated with standard veterinary medical procedures. These hazardous materials would be stored in compliance with State and local requirements and would not result in new significant impacts.

b: Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?

Surplus hazardous materials would be disposed of in compliance with State and local requirements. There would be no new significant impacts.

h: Expose people or structures to a significant risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?

The proposed Project would not introduce a new fire risk. See **Section 3.9 Fire Protection Services**.

MITIGATION MEASURES

The proposed Project would not result in significant new visual impacts. In addition, the Project will be subject to the City's Standard Conditions of Approval #74 which will further reduce the potential for any significant impacts.

REFERENCES

City of Oakland. 2008a. *CEQA Thresholds/Criteria Significance Guidelines, Aesthetics, Shadow and Wind.* July 15, 2008.

City of Oakland. 2008b. *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval.*

3.6 HYDROLOGY AND WATER QUALITY

This section evaluates whether any of the Project changes would result in new hydrology and water quality impacts not identified in the MND or a substantial increase in the severity of the previously identified hydrology and water quality impacts. This section also discusses any pertinent new information or changes in the Project circumstances that could result in new or a substantial increase in impacts. This analysis relies on the City's current draft of the *CEQA Thresholds/Criteria of Significance Guidelines* (City of Oakland 2008a). Additionally, this section reviews the updated regulatory requirements (the MS-4 Permit and the Oakland Creek Protection Ordinance) adopted since the 1998 Project approval. Finally, the section reviews the previously adopted mitigation measures, updates these mitigation measures as necessary, or replaces the mitigation measures with the applicable provisions of the City's *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval* (City of Oakland 2008b).

SIGNIFICANCE CRITERIA

a: Would the project violate any water quality standards or waste discharge requirements?

The MND determined that the Project would not violate any water quality standards or waste discharge requirements and included mitigation measures to address the potential for any water quality impacts, including compliance with various regulatory and permitting requirements. Similarly, the proposed Project would be required to comply with all applicable water quality standards and waste discharge requirements through compliance with NPDES Permit No. CA0029831 governing stormwater discharges into the City's municipal separate storm sewer system, the City's Creek Protection Ordinance and the City's Standard Conditions of Approval. Consequently, the proposed Project changes would not result in any new or increased impacts related to water quality standards or waste discharge requirements.

b: Would the project substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level?

Neither the 1998 Project nor the proposed Project involves activities that would affect groundwater supplies or recharge.

c, d, e, and l: Would the project result in substantial erosion or siltation on- or off-site that would affect the quality of receiving waters, result in substantial flooding, create or contribute to runoff which would exceed the capacity of the existing or planned stormwater drainage system, otherwise degrade water quality, or substantially alter the drainage pattern of the site or area, including through the alteration of the course or increasing the rate of amount of flow of

a Creek, river, or stream in a manner that would resulting substantial erosion siltation or flooding or both on-or off-site?

The MND identified potential water quality impacts resulting from potential discharges into surface waters from erosion, increases in impervious surfaces, and locating the trail and picnic facilities in the vicinity of Arroyo Viejo Creek. Additionally, development of California 1820 was determined to have the potential to adversely affect the natural drainage patterns and degrade water quality in the intermittent drainages in the exhibit area. All of these potential impacts were determined to be avoided or reduced to a less than significant level through implementation of the mitigation measures.

The proposed Project changes would reduce the potential for water quality, drainage, and flooding impacts, because the overall site disturbance would be reduced from approximately 27.39 acres to approximately 23.95 acres, thereby reducing the potential for erosion, the increases in impervious surfaces, and the potential to affect natural drainage patterns on the site. The elimination of the loop road and shuttle system in the plan for the California 1820 exhibit, accounts for the significant reductions in the proposed site disturbance. Additionally, the trail and picnic facilities have been deleted from the Project.

The following discussion analyzes the potential erosion, water quality, drainage pattern alterations, and flooding impacts of the proposed Project.

Site Hydrology

A Drainage Report for the Knowland Park Zoo (Aliquot Associates, Inc., May 8, 2009, revised August 6) has been prepared for the proposed Project changes. The report included preliminary drainage design for the Veterinary Medical Hospital and proposed maintenance road to California! A conceptual design for California! itself was also included, with a figure depicting concept detention and treatment.

The proposed Project drains into various drainages. The primary drainage for the Zoo is Arroyo Viejo Creek. The Calfornia! site is located at the apex of San Leandro Creek and Arroyo Creeks. The majority of the Project site drains to subwatersheds of Arroyo Viejo and nine acres drains into a tributary of San Leandro Creek. The drainage report is primarily concerned with the impacts to the drainage system within the Zoo and the adjacent residential areas that are within two subwatersheds of Arroyo Viejo above the existing Zoo storm drainage system. Approximately 46.6 acres of watershed drain into the Zoo drainage system. There are two entry points into the drainage system which are termed the north and south entrance points. Approximately 18.9 acres drains to the north system and 27.7 acres drains to the south system. These two systems collectively drain the Zoo property and join just northwest of the Zoo at a confluence approximately 100 feet prior to the

primary outlet to Arroyo Viejo Creek along Golf Links Road. Drainage from the north system is collected and conveyed through an antiquated system of pipes and ditches contributed by the upper reaches of the Zoo property and various exhibits along its route. Both the north and south systems are insufficient to carry the 10-year flow and excess runoff forms temporary ponded areas on the property. These two drainage systems are shown on **Figure 3.6-1**.

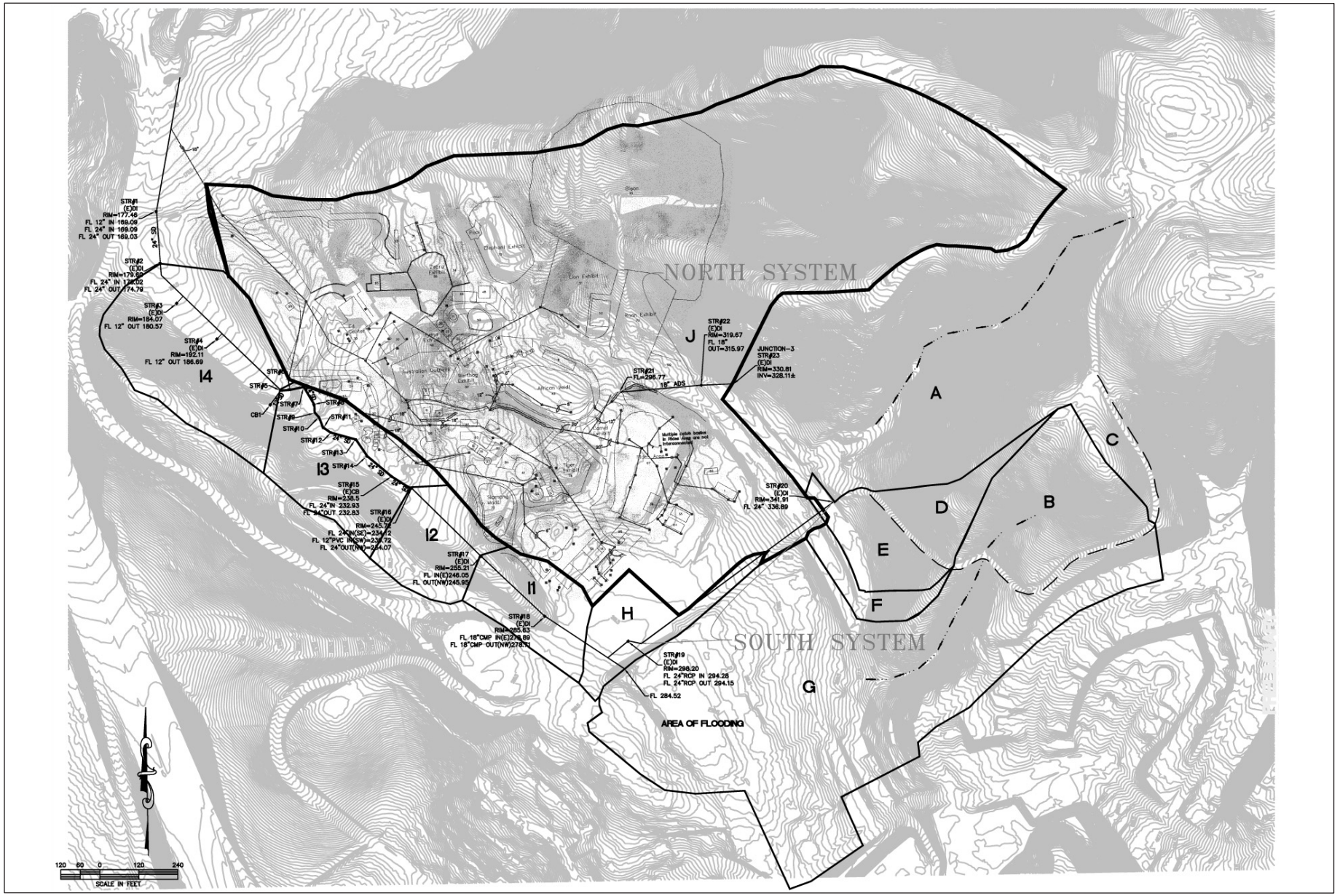
North Drainage System

The drainage report divides existing hydrologic conditions of the north system into two contributing areas: upland and downstream. The upland area, approximately 18.5 acres, encompasses the drainage area above the proposed Veterinary Medical Hospital site, a small portion of the California! site and adjacent hillsides. The other 0.4 acres is collected from impervious areas in and around the upper parking lots. The primary watershed above the Veterinary Medical Hospital site is 14.1 acres and includes portions of California! This is a defined drainage that outlets through a swale adjacent to the proposed hospital site. Currently, drainage from the swale sheet flows across the storage yard and into the overflow parking lot below where then enters either the north system or some goes to the south system. It is estimated that 90 percent of the flow goes to the north and ten percent goes the south under design conditions.

The remaining 4.4 acres of watershed area that drains to the north system includes a portion of the existing dirt fire access road leading to the proposed California! site and hillslope areas above the roadway. Sheet flow from hillslopes above the road enter the road bed and during low flows are carried along the inside edge of the road to the storage yard near the proposed Veterinary Medical Hospital site and enter the north drainage system. Under high flow scenarios, the drainage system is overwhelmed and flow crosses the dirt roadway and drains at several breach points into drainages that eventually end up in the south drainage system. Along the lower stretch of the access road, breached flows are intercepted by the existing upper parking lots below the proposed Veterinary Medical Hospital site and enter drainage facilities within the Zoo during high flows. Along the upper stretch of the road, breached or overflows drain into the rear yards of the existing neighborhood below during high flows. Minor flooding from drainage breaching the upper section of the road has been reported by adjacent residents.

South Drainage System

The contributory watershed to south system is 27.65 acres which includes the main parking areas of the Zoo property, the neighborhood to the southeast of the main parking lot, and portions of the upland along the access road to California! This



SOURCE: Aliquot

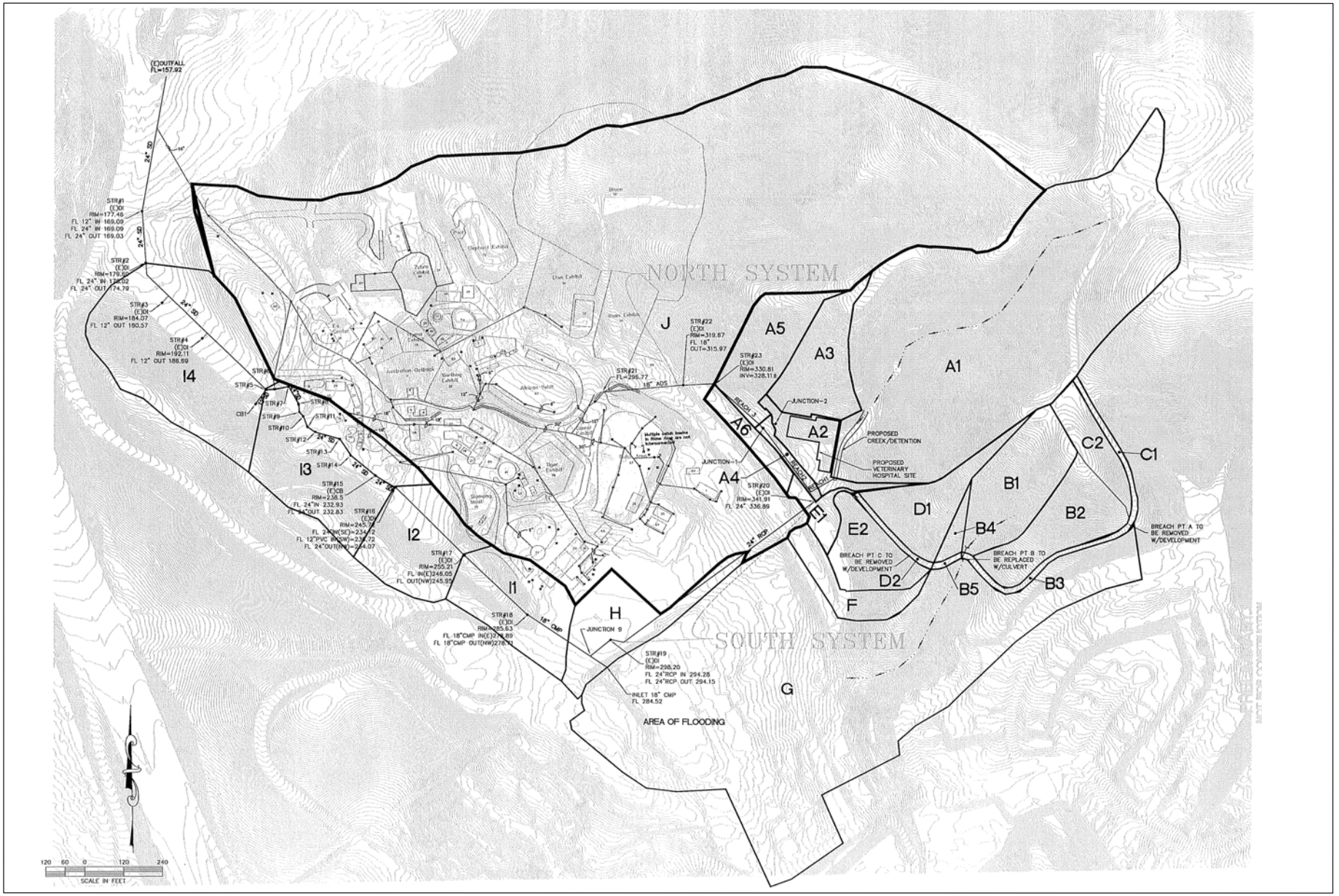
Figure 3.6-1
Drainage Area Map – Pre-Development

drainage system begins just below the Veterinary Medical Hospital site in the southern portion of the overflow parking lot. From this location, a 24-inch pipe runs westerly through the main parking lot and connects to an 18-inch pipe running north to south parallel to the Zoo's western boundary before discharging into the creek along Golf Links Road. The 18-inch pipe begins at the Zoo's southern boundary at the bottom of the slope of the main parking lot where it collects drainage from the creek the runs through the adjoining neighborhood to the southeast. Minor flooding occurs at this inlet location and the adjacent neighborhood due to an existing backwater condition (a rise in the upstream water surface elevation due to a constriction in flow, i.e. when the South pipe system is full, water backs up behind the inlet). See **Figure 3.6-2** Flow in this watershed originates above the residential areas in a defined swale/drainage above the end of Hood Street. Flows from this drainage typically are collected in the drainage and then make a sharp right turn and then enter the south drainage system through a series of catch basins linked by a 12-inch culvert. High flows in the drainage may over flow into Hood Street, travel along residential streets and eventually drain to the 18-inch pipe described above. The watershed above the Hood Street swale is approximately six acres.

Veterinary Medical Hospital and Maintenance Road

The proposed Project has been designed with a storm water management system that offsets any increases over existing conditions in runoff from the proposed Project and would reduce existing drainage issues in some portions of the adjacent residential area. This would be accomplished by upgrading the current collection and conveyance system and routing it through a series of water quality and detention structures that link into the existing Zoo drainage system. A main feature to control flows from the road and Veterinary Medical Hospital is an open storm water detention basin along the east side of the hospital. The runoff stored within and released from the basin was calculated to offset the increase in post-development flow from the following improvements:

- Increase in flow produced by the new Veterinary Medical Hospital,
- Increase in flow produced by the paving of the access maintenance road to California!, and
- Increase in flow from a 20% pavement increase in the upper Zoo parking lots below the proposed Veterinary Medical Hospital site. (The existing improvements to the parking lots are not part of the revised Master Plan but have been included in this analysis to ensure that all conditions on the site are adequately accounted for in the drainage plan.)



SOURCE: Aliquot

Figure 3.6-2
Drainage Area Map – Post-Development

All of the flow from the watershed above the Vet hospital and portions of the access roadway drainage would be collected in the detention basin. Increased flows from the paved access road will be mitigated by altering the road and hillslope drainage. Roadway and hillslope drainage will be collected and conveyed via drop inlets to and then routed to a storm drain under the road that will route all runoff to a diversion structure. This diversion structure then meters flow into the south and north drainage system by using a series of different sized pipes. Drainage from the hill slope areas, sub-basin B1 (two acres) is an exception and will be collected and conveyed to the nearest drainage swale (i.e., Hood Street) at the base of B1. **Figure 3.6-2** shows the proposed drainage layout. This drainage layout would reduce the drainage area to the Hood Street channel by two acres or 30 percent. While this may not eliminate overflows at this point, the proposed drainage layout would reduce the frequency of those overflows and would effectively reduce hillslope runoff entering the backyards of adjacent residents.

The proposed detention basin collecting flows from the roadway and upper watershed would regulate the 6-hour 15- and 100-year flow events, and the 24-hour 100-year flow event while maintaining the required two-foot freeboard for the 100-year event. While only runoff from the upland areas and the post-development paved road would be routed through the detention basin, the proposed detention basin is sized to offset the increased flows from proposed improvements of the Veterinary Medical Hospital and overflow parking lot as well. With the proposed drainage improvements there would be a slight reduction in peak storm water flows at the entrances of either the north or south drainage systems. **Table 3.6-1** presents the pre-development and post-development stormwater flows.

TABLE 3.6-1: PRE-DEVELOPMENT AND POST-DEVELOPMENT STORMWATER FLOWS

	North System		South System	
Storm	**Pre-Project (cfs)**	**Post-Project (cfs)**	**Pre-Pproject (cfs)**	**Post-Project (cfs)**
6 hr 15 yr	20.37	20.18	31.52	30.15
6 hr 100-yr	28.67	27.87	43.61	41.58
24 hr 100-yr	28.82	28.25	43.83	41.79

The proposed Veterinary Medical Hospital would be located at the site of the former River Exhibit, which was analyzed in the MND. The hospital would result in approximately one acre of development in comparison with the eliminated River Exhibit which would have resulted in approximately 3.7 acres of development. Consequently, the proposed changes to the Master Plan would not result in new or

more severe significant drainage and water quality impacts. Additionally, with implementation of the City's Standard Conditions of Approval for drainage and water quality impacts will further ensure that the potential for temporary water quality and sedimentation impacts associated with construction activities and permanent impacts associated with flooding risk and increased site run-off would be less-than-significant.

Increased Runoff

The increased flows from the proposed site improvements would be accommodated by the proposed open detention basin. Runoff from the upland drainage area and the proposed paved maintenance road would be routed through the detention basin, which is designed to be over-sized to off-set the increased run-off from the Veterinary Medical Hospital site and previously expanded upper parking lot. Also, by intercepting road drainage and routing it to the detention basin and by altering hillslope flows from their pre-development drainage paths, post-development flows to the downhill swale would not exceed pre-development flows and would generally be reduced at known problem areas.

Flooding

With the proposed drainage routing and detention system, run-off during high flows that previously entered the flooded south system would instead be re-routed to the detention basin and, ultimately, the north system. Also, the road drainage to the below-ground storm drain would prevent previously breached flows from flowing to the neighborhood below. The new roadway drainage system would effectively reduce contributory watershed to the neighborhood by nearly two acres. This would slightly reduce existing flood conditions south of the Zoo and would not worsen flooding conditions in the neighborhoods southeast of the main parking lot.

Water Quality

Construction of the proposed Veterinary Medical Hospital would not result in additional significant erosion and water quality impacts than what is identified in the MND. The proposed open detention basin would allow for settling of silts and particulates. Also the access road run-off would be conveyed beneath the road to bio-retention basin rain gardens and treated before conveyance to the detention basin. These rain gardens would be placed on the outside bend of the road where the natural topography widens.

California! The components of California! that could affect drainage impacts are the impervious areas from exhibit development, paths and roads, gondola tower foundations, and the overnight camping area. The exhibit is divided into three separate watersheds. The final design plans for California! would include the necessary facilities to ensure

that all drainage will be treated and detained to regulate flows prior to being released into their separate watersheds.

The Project designers used the City of Oakland's "Modified Triangular Hydrograph Method" and have determined preliminary storm water storage requirements for each of the watersheds to ensure that adequate space is available. The values for the 100-year storm are presented in **Table 3.6-2**.

TABLE 3.6-2: 100-YEAR STORM VALUES

Watershed	Area (acres) Impervious surfaces	Pre project Q (cfs)	Post project Q (cfs)	Storage Volume (cu.ft.)
K	1.74	5.23 cfs	6.93	1113
L	1.2	3.32 cfs	4.72	932
M	0.42	1 cfs	1.5 cfs	396

California! would also use some or all of the following storm water Best Management Practices: rain gardens, using pervious surfaces to the extent possible, green roof systems, landscaped vegetated swales and minor detention areas. Final design of these features would be completed when final improvement plans are submitted for California!

California! would represent a similar area of development to that of California 1820, but the location would be shifted to the north. The proposed changes would reduce the area of land disturbance previously approved under the Master Plan by approximately 3.44 acres. The design of California! is conceptual and the location of actual building sites and the development areas of exhibits will be precisely located in a final plan. However, California! would result in drainage impacts equal to or less than those identified in the MND. Increased runoff in California! would be handled through a multitude of proposed features including rain gardens, pervious pavement, vegetated swales and temporary detention and storage ponds. Additionally, the City's Standard Conditions of Approval for drainage and water quality will further ensure that the potential for temporary water quality and sedimentation impacts associated with construction activities and permanent impacts associated with flooding risk and increased site run-off would be less-than-significant.

Increased Runoff and Flooding

While the precise location of impervious areas have not been determined for California!, the drainage report states that "there are plenty of opportunities for implementation of standard techniques and facilities to control runoff and flooding

in accordance with regulatory requirements due to the low impact of impervious surface in the large development envelope." (Aliquot, 2009). The Gondola Transportation System's support structure foundations would create approximately 0.2 acre of development as compared with the 5.7 acre loop road previously analyzed in the MND. This small amount of impervious area would not have a significant impact on increased runoff quantities. The overnight camping area (approximately 0.36 acres) includes 11 tent cabins clustered within a loop access road constructed of pervious surface materials. The small amount of impervious area included in the overnight camping area would not have a significant impact on increased runoff quantities. The conceptual design shows runoff from the overnight camping area being routed to a bio-retention rain garden and conveyed to a spreader pipe to distribute flows to the hillslope. Where possible, pervious paving surfaces, spreader pipes, and green roofs would be implemented throughout California! to offset the increases in impervious areas.

Water Quality

Because the overall area proposed for disturbance in California! has been reduced from the approved Master Plan, no new or increased water quality impacts would occur. All post-development increase in runoff would be mitigated on-site by reducing the flows through use of some or all of the following techniques: rain gardens, pervious surfaces, run-off coefficient reduction due to landscaping plantings, cisterns, recycling of water, green roof systems and other mitigating implementation. (Aliquot, 2009).

m: Would the project fundamentally conflict with the City's Creek Protection ordinance?

The Project is required to comply with the Creek Protection ordinance. There are no significant creek resources as defined by the ordinance that would be directly impacted. Consequently, no new or more severe impacts from the proposed Project revisions would be expected. Implementation of the applicable Standard Conditions of Approval would further ensure that the potential for drainage and water quality impacts would be less-than-significant.

The changes to the location of the perimeter fence would not increase runoff, erosion, or otherwise affect the on- or off-site hydrology or water quality. Implementation of the applicable Standard Conditions of Approval would further ensure that the potential for drainage and water quality impacts would be less-than-significant.

UPDATED REGULATORY SETTING

Since approval of the Project and adoption of the MND, certain regulatory requirements have changed. The proposed Project must comply with current regulations. Presented below is a summary of those applicable regulations that have changed since the MND was adopted.

NPDES Permit Requirements

The CWA has nationally regulated the discharge of pollutants to the waters of the U.S. from any point source since 1972. In 1987, amendments to the CWA added section 402(p), which established a framework for regulating nonpoint source (NPS) storm water discharges under the National Pollutant Elimination System (NPDES). The project sponsor will be required to comply with two NPDES permit requirements, the general construction permit issued by the State Water Resources Control Board and the municipal separate storm sewer permit issued by the San Francisco Bay Regional Water Quality Control Board.

General Construction Permit

In 1999, the State Water Resources Control Board issued the NPDES General Construction Permit for Storm Water Discharges Associated with Construction Activities (Water Quality Order 99-08 DWQ). To obtain coverage under the permit, a project sponsor is required to submit a Notice of Intent (NOI) with the State Water Resource Control Board's (SWRCB) Division of Water Quality. The NOI includes general information on the types of construction activities that will occur on the site. A project sponsor is also required to submit a site-specific plan called the Stormwater Pollution Prevention Plan (SWPPP) for construction activities. The SWPPP will include a description of Best Management Practices (BMPs) to minimize the discharge of pollutants from the site during construction. It is the responsibility of the property owner to obtain coverage under the permit prior to site construction.

The NPDES General Industrial Permit Requirements apply to the discharge of storm water associated with industrial sites. The permit requires the implementation of management measures that will achieve the performance standard of best available technology (BAT) economically achievable and best conventional pollutant control technology (BCT). Under the statute, operators of new facilities must implement industrial BMPs in the project SWPPP and perform monitoring of storm water discharges and unauthorized non-storm water discharges. An annual report must be submitted to the RWQCB each July 1. Operators of new facilities must file an NOI at least 14 days prior to the beginning of operations.

Municipal Separate Storm Sewer System Permit (MS4 Permit)

To comply with the CWA regarding municipal storm water discharges, 14 cities including the City of Oakland, three county agencies, two flood control districts, the unincorporated area within Alameda County formed the Alameda Countywide Clean Water Program (ACCWP) in 1991. ACCWP holds a joint municipal NPDES permit from the San Francisco Bay RWQCB. In 2003, the San Francisco Bay RWQCB issued NPDES Permit No. CAS0029831 (Order R2-2203-0021). The permit includes a comprehensive plan to reduce the discharge of pollutants to creeks, San Francisco Bay, and the ocean to the maximum extent possible. The revised permit included requirements regarding review and approval of new development projects. The permit requires new development projects to include permanent control measures to reduce long-term impacts of land development on storm water quality and creek channels. To implement the permit requirements, the ACCWP prepared the ACCWP Stormwater Quality Management Plan for 2002-2008. As required by the permit the Alameda County Public Works Agency, developed a draft *Hydrograph Modification Management Plan* (Nov. 15, 2004)(HMP) to reduce the hydromodification impacts from stormwater discharges associated with certain development. The HMP includes design standards to ensure that covered activities do not result and prohibits covered development projects from causing an increase in the erosion potential for receiving streams. In March 2007, the RWQCB approved, as amended, the HMP and amended the NPDES Permit No. CAS0029831 to include the hydromodification requirements (Order No. R2-2007-005).

City of Oakland Creek Protection Ordinance

The City's stormwater protection ordinance is contained in Chapter 13.16 of the Oakland Municipal Code. The ordinance prohibits activities that would result in the discharge of pollutants to Oakland's waterways or damaging of the creeks, creek functions, or habitat. The ordinance aims to reduce pollutants in stormwater by regulating grading, excavation, and filling activities. The ordinance requires that all construction projects develop a site map, grading plan, and drainage plan prior to approval. The City of Oakland's stormwater ordinance was revised in 1997 to provide stronger provisions to safeguard creeks. The ordinance, now called the "Creek Protection, Stormwater Management, and Discharge Control Ordinance" includes permitting guidelines for development and construction projects taking place on creekside property. More detail regarding project conformance to the City's Creek Ordinance is provided in the **Section 3.3 Biological Resources**.

MITIGATION MEASURES

The proposed Project would not result in significant new drainage and water quality impacts. In addition, the Project will be subject to the City's Standard Conditions of Approval #34, #55, #75, #76, #77, #80, #81, #82 and #83 which will further reduce the potential for any impacts.

REFERENCES

Aliquot Associates, Inc. *Preliminary Drainage Study – Oakland Zoo Veterinary Hospital,* February 26, 2009.

Aliquot Associates, Inc. *Conceptual Design – Alt C Veterinary Hospital Site Preliminary Site Plan*, March 19, 2009.

Aliquot Associates, Inc. *Drainage Report: Knowland Park Zoo. Preliminary Design—Veterinarian Hospital. Conceptual Design—California Exhibit and Access Road.* May 8, 2009.

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Association of Bay Area Governments, Dam Failure Inundation Maps, obtained from http://www.abag.ca.gov/bayarea/eqmaps/damfailure/damfail.html on May 1, 2009.

Site Visit by Questa Engineering Staff on April 30, 2009.

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Western Regional Climate Center – Monthly Climate Summary for Oakland, CA obtained from http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca6332

3.7 LAND USE, RECREATION AND PLANNING

This section evaluates whether any of the Project changes would result in land use and recreational impacts not identified in the MND or a substantial increase in the severity of the previously identified aesthetic impacts. This section also discusses any pertinent new information or changes in the Project circumstances that could result in new or a substantial increase in impacts. This analysis relies on the City's current draft of the *CEQA Thresholds/Criteria Significance Guidelines* (City of Oakland 2008a). Additionally, this section reviews the previously adopted mitigation measures, updates these mitigation measures as necessary, or replaces the mitigation measures with the applicable provisions of the City's *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval* (2008b).

SIGNIFICANCE CRITERIA

b: Result in a fundamental conflict between adjacent or nearby land uses?

The proposed Project would continue to be consistent with the Open Space, Conservation and Recreation Element of the General Plan and would improve public access. [Note: City and Zoo to review Zoo surveys and City zoning maps to confirm public access trail is consistent with zoning.] The approved perimeter fence would cut off access to the two knolls offering panoramic views of San Francisco Bay and environs (see **Section 3.1 Aesthetics**). The proposed Project would pull back the perimeter fence along the easterly boundary of California! and provide public access to these two knolls which would improve public access in comparison with the approved Master Plan which would prevent access to these knolls.

MITIGATION MEASURES

The proposed Project would not result in significant new land use and recreation impacts.

REFERENCES

City of Oakland. 2008a. *CEQA Thresholds/Criteria Significance Guidelines, Aesthetics, Shadow and Wind.* July 15, 2008.

City of Oakland. 2008b. *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval.*

3.8 NOISE

This section evaluates whether any of the Project changes would result in new noise impacts not identified in the MND or a substantial increase in the severity of the previously identified noise impacts. This section also discusses any pertinent new information or changes in the Project circumstances that could result in new or a substantial increase in impacts. This analysis relies on the City's current draft of the *CEQA Thresholds/Criteria of Significance Guidelines* (2008a). Additionally, the section reviews the previously adopted mitigation measures, updates these mitigation measures as necessary or replaces the mitigation measures with the applicable provisions of the City's *Standard Conditions of Approval* (2008b).

METHODOLOGY

Noise Sensitive Receptors

The predominant land use surrounding the Zoo is single-family residential development. Residential development is considered a noise sensitive receptor. Most of the nearby residential development would not be adversely affected by the proposed Project due to distance and Interstate 580. However, adjacent residences to the south of the proposed Project were identified as potential noise sensitive receptors. To assess potential noise impacts to adjacent residences, six noise sensitive receptor locations were identified along the Zoo's southern property line and are shown in **Figure 3.8-1**. These six noise sensitive receptor locations will be referenced throughout this section in assessing temporary construction noise impacts and on-going operational noise impacts.

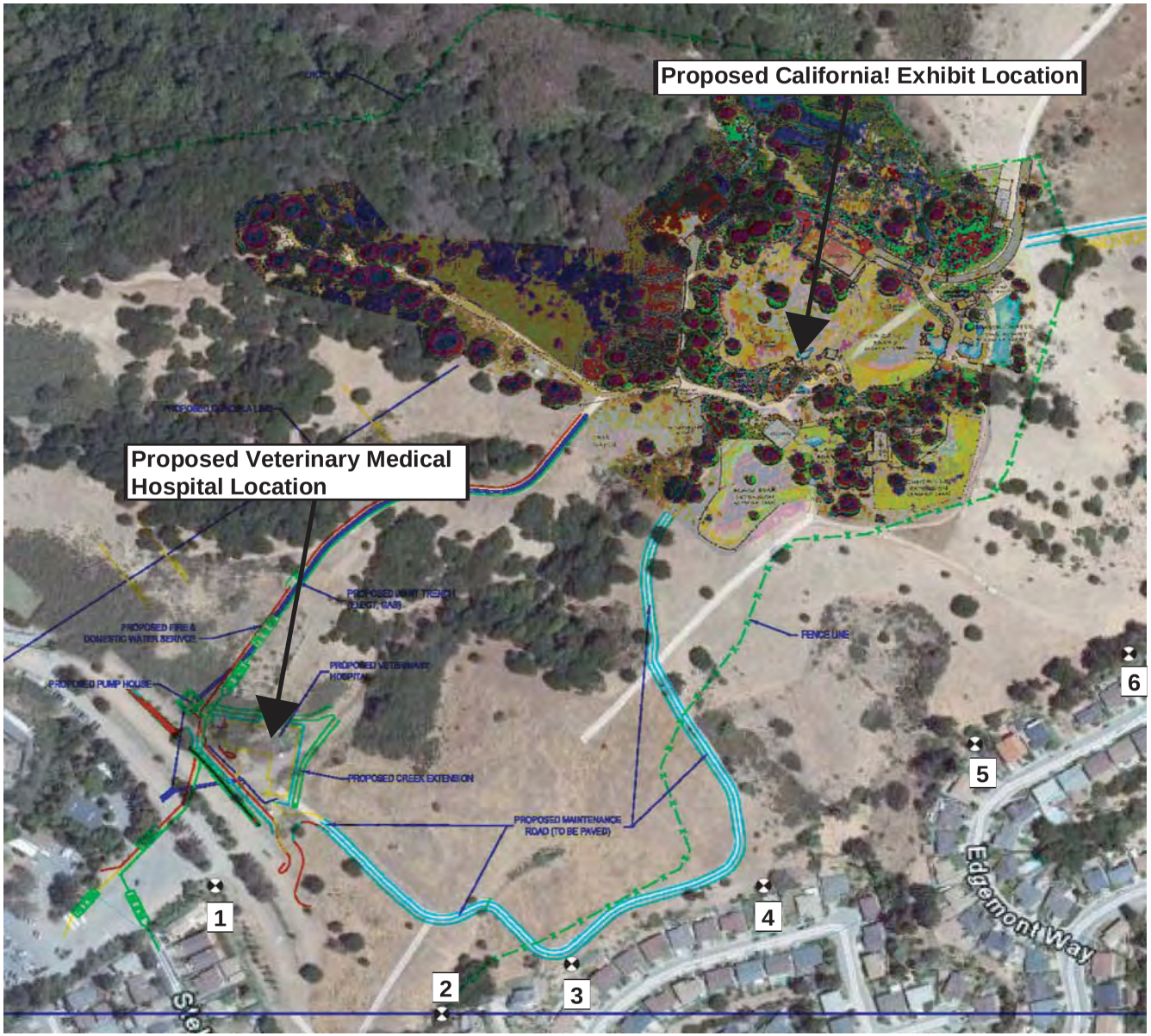
24-Hour Ambient Noise Monitoring

To document the current community ambient noise conditions at the site, three sound level meters were placed along the southern edge of the Zoo's property to record the daily background noise levels prevalent in and around the Zoo (see **Figure 3.8-2**). The three 24-hour sound level meters were programmed to record continuously throughout the day on Thursday, April 9, 2009. The sound level meters were field-calibrated prior to and following the noise measurements to ensure accuracy. The results are presented in **Table 3.8-1**.

TABLE 3.8-1: MEASURED AMBIENT NOISE LEVELS OVER 24 HOUR PERIOD

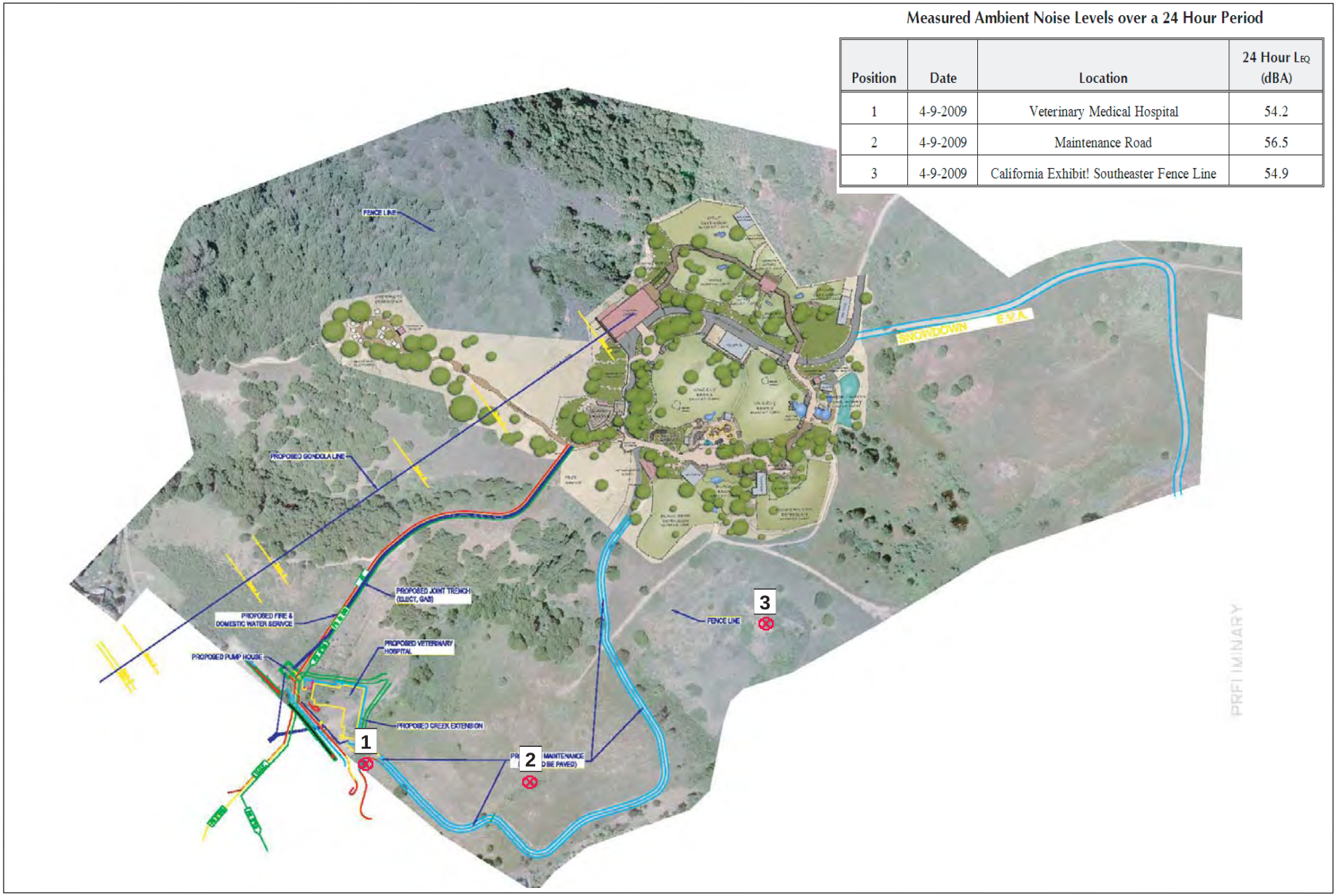
Position	Date	Location	24 Hour LEQ (dBA)
1	4-9-2009	Veterinary Medical Hospital	54.2
2	4-9-2009	Maintenance Road	56.5
3	4-9-2009	California! Southeast Fence Line	54.9

Source: LFR



SOURCE: LFR

Figure 3.8-1
Residential Receiver Locations



SOURCE: LFR

Figure 3.8-2
Ambient Noise Measurement Locations

The three 24-hour sound level measurements (L_{EQ}, A-Weighted) range from a high of 56.5 dBA L_{EQ} at Position 2 to a low of 54.2 dBA L_{EQ} at Position 1. During the on-site noise measurements, start and end times are recorded as well as any background noise sources in the area, such as motor vehicle traffic traveling on Interstate 580 and parking lot noise from activities associated with the Zoo. The 24-hour sound level measurements ran from midnight to midnight, integrating and logging data every 30 minutes. Field data gathered at the Project site included measuring or estimating distances, angles-of-view, slopes, and site elevations. This information was subsequently verified using available maps and records. All sound level measurements conducted and presented in this section are in accordance with the American National Standards Institute (ANSI SI.4-1983 - R2001) specifications for sound level meters. All instruments are maintained with the National Bureau of Standards traceable calibrations.

Modeling of the proposed Project site and surrounding environment was accomplished using Cadna (Computer Aided Noise Abatement) Ver. 3.7, which is a model-based computer program developed for predicting noise impacts in a wide variety of conditions. Cadna allows for the input of project information such as noise source data, barriers, structures, and topography to create a detailed CAD model, and uses the most up-to-date calculation standards to predict outdoor noise impacts to property lines and adjacent surrounding areas.

SIGNIFICANCE CRITERIA

Overview Potential noise impacts generated by the proposed Project include temporary noise impacts from construction activities and on-going operational noise impacts. The proposed Project must comply with the City's construction noise standards (see **Table 3.8-2**) and on-going operational noise standards (see **Table 3.8-3**).

Potentially significant impacts are defined by comparing existing and projected noise levels at the southern residential land use areas using the City's noise guidelines and a determination of whether the incremental noise increase would be noticeable to most people. A ten dBA incremental noise increase is perceived by most people to be a doubling in the loudness of sound. A five dBA increase is readily noticed by most people, while a three dBA increase in marginally noticeable to most people. For this Project, a significant impact will be defined as follows:

- A three dBA or greater increase in areas where the noise levels are currently above acceptable levels or where the acceptability thresholds are being exceeded; or
- A five dBA or greater increase even if the acceptability threshold has not been reached.

TABLE 3.8-2: CITY OF OAKLAND CONSTRUCTION NOISE STANDARDS AT RECEIVING PROPERTY LINE, dBA[1]

Receiving Land Use	Maximum Allowable Noise Level (dBA)	
	Weekdays 7 a.m.-7 p.m.	Weekends 9 a.m.-8 p.m.
Less than 10 days		
Residential	80	65
Commercial, Industrial	85	70
More than 10 Days		
Residential	65	55
Commercial, Industrial	70	60

[1] If the ambient noise level exceeds these standards, the standard shall be adjusted to equal the ambient noise level.

Source: City of Oakland, 1996b.

TABLE 3.8-3: CITY OF OAKLAND OPERATIONAL NOISE STANDARDS AT RECEIVING PROPERTY LINE, dBA[1]

Receiving Land Use	Cumulative No. of Minutes in a 1-Hr Period[2]	Maximum Allowable Noise Level (dBA)	
		Daytime 7 a.m.-10 p.m.	Nighttime 10 p.m.-7 a.m.
Residential and Civic[3]	20 (L33)	60	45
	10 (L16.7)	65	50
	5 (L8.3)	70	55
	1 (L1.7)	75	60
	0 (Lmax)	80	65
Anytime			
Commercial	20 (L33)	65	
	10 (L16.7)	70	
	5 (L8.3)	75	
	1 (L1.7)	80	
	0 (Lmax)	85	
Manufacturing, Mining, and Quarrying	20 (L33)	70	
	10 (L16.7)	75	
	5 (L8.3)	80	
	1 (L1.7)	85	
	0 (Lmax)	90	

[1] These standards are reduced 5 dBA for simple tone noise, noise consisting primarily of speech or music, or recurring impact noise. If the ambient noise level exceeds these standards, the standard shall be adjusted to equal the ambient noise level.

[2] Lx represents the noise level that is exceeded X percent of a given period. Lmax is the maximum instantaneous noise level.

[3] Legal residences, schools and childcare facilities, health care or nursing home, public open space, or similarly sensitive land uses.

Source: City of Oakland, 1996b.

a: Would the project expose persons or generate noise levels in excess of standards established in the Oakland general plan or applicable standards of other agencies (e.g. OSHA)?

The proposed Project would not generate noise levels in excess of standards established in the City's Noise Ordinance (see discussion under Criteria b and c below.

b: Would the project violate the City of Oakland Noise Ordinance (Oakland Planning Code Section 17.120.050) regarding operational noise?

As discussed in the MND, operational noise impacts would not be significant. The operational activities of the proposed Veterinary Medical Hospital, Gondola Transportation System and California! would not result in new significant noise impacts with implementation of the applicable noise Standard Conditions of Approval. These new elements were evaluated to determine if the operational noise impacts would exceed the City of Oakland Noise Ordinance limits of 60 dBA for operations between 7 a.m. and 10 p.m. The conclusions of this evaluation are presented below.

Veterinary Medical Hospital

The evaluation of operational activities for the Veterinary Medical Hospital were based on the mechanical plans dated April 16, 2009. **Table 3.8-4** summarizes the noise emission data.

TABLE 3.8-4: VETERINARY MEDICAL HOSPITAL OPERATIONAL MECHANICAL EQUIPMENT

Manufacturer	Model	Noise Emission Data
Trane	TTA180	89 dB PWL
Trane	TTA090	89 dB PWL
Generac	SD230	73 dBA SPL at 23 feet

Source: LFR

The combined mechanical equipment noise impacts from the proposed Veterinary Medical Hospital was evaluated at the six residential receiver locations placed along the projects southern property line are shown in **Table 3.8-5**.

TABLE 3.8-5: NOISE IMPACTS - VETERINARY MEDICAL HOSPITAL

Receiver	Location	Construction Noise Impacts (dBA)
1	Western Property Line	54.1
2	Southern Property Line	31.4
3	Southern Property Line	25.2
4	Southeastern Property Line	20.1
5	Southeastern Property Line	17.2
6	Southeastern Property Line	15.2

Source: LFR

The City of Oakland restricts operational impacts at residential property lines to 60 dBA L_{EQ}. As shown in **Table 3.8-5**, noise impacts would range from 15.2 dBA at Receiver 6 to 54.1 dBA at Receiver 1. Noise impacts associated with the operational activities of the proposed Veterinary Medical Hospital mechanical equipment would be below 60 dBA and would be less-than-significant. **Figure 3.8-3** presents a graphical representation of the noise impacts generated by the Veterinary Medical Hospital mechanical equipment operations.

Gondola Transportation System

The gondola terminal building would be located in the northern portion of California! The terminal building would contain all of the operational mechanical equipment associated with the Gondola Transportation System. The noise emission data is summarized in **Table 3.8-6**.

TABLE 3.8-6: GONDOLA TRANSPORTATION SYSTEM NOISE EMISSION DATA

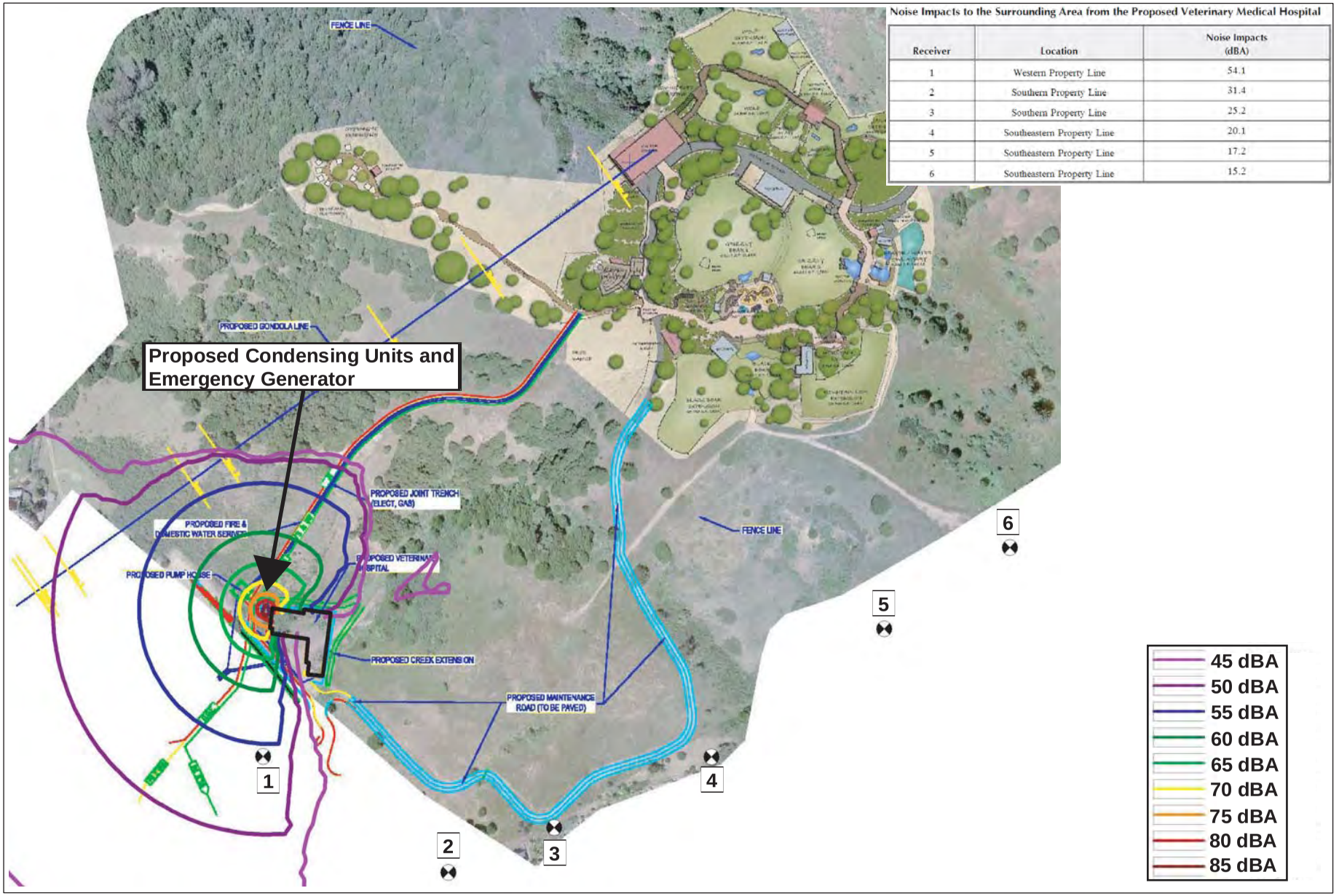
Manufacture	Mechanical Equipment Location	Sound Pressure Level at 12 meters (dBA)
Doppelmayr CTEC	Terminal Building	75.0

Source: LFR

The gondola mechanical equipment noise impacts are presented in **Table 3.8-7**. The City of Oakland restricts operational impacts at residential property lines to 60 dBA L_{EQ}. Noise impacts from the operations of the Gondola Transportation System would range from 16.9 dBA at Receiver 4 to 26.5 dBA at Receiver 6. Noise impacts associated with the operational activities of the Gondola Transportation System would be below 60 dBA L_{EQ} and are considered less-than-significant. The MND concluded operational noise impacts from the loop road and shuttle bus system would be less-than-significant. Consequently, no significant adverse noise impacts would occur with the replacement of the loop road and shuttle bus system with the proposed Gondola Transportation System. **Figure 3.8-4** presents a graphical representation of the operational noise impacts from the Gondola Transportation System's mechanical equipment.

California!

The proposed California! is located in the northeastern portion of the Oakland Zoo. The maintenance road would be used to bring supplies to California! and would result in one trip per day. Daily noise would be generated from exhibit visitors and exhibit animals. Large groups of people have a tendency to raise their voice when talking; and the human voice can be as loud as 62.0 dBA at 10 feet. The maximum occupancy for visitors at California! and animals housed in the animal exhibits are presented in **Table 3.8-8** and **Table 3.8-9** respectively.



SOURCE: LFR

Figure 3.8-3
Veterinary Medical Hospital Mechanical Equipment Operational Noise Impacts

TABLE 3.8-7: NOISE IMPACTS TO SURROUNDING AREA - GONDOLA TRANSPORTATION SYSTEM MECHANICAL EQUIPMENT AT THE TERMINAL BUILDING

Receiver	Location	Construction Noise Impacts (dBA)
1	Western Property Line	25.0
2	Southern Property Line	20.3
3	Southern Property Line	19.6
4	Southeastern Property Line	16.9
5	Southeastern Property Line	20.8
6	Southeastern Property Line	26.5

Source: LFR

TABLE 3.8-8: CALIFORNIA! VISITORS MAXIMUM DAILY OCCUPANCY

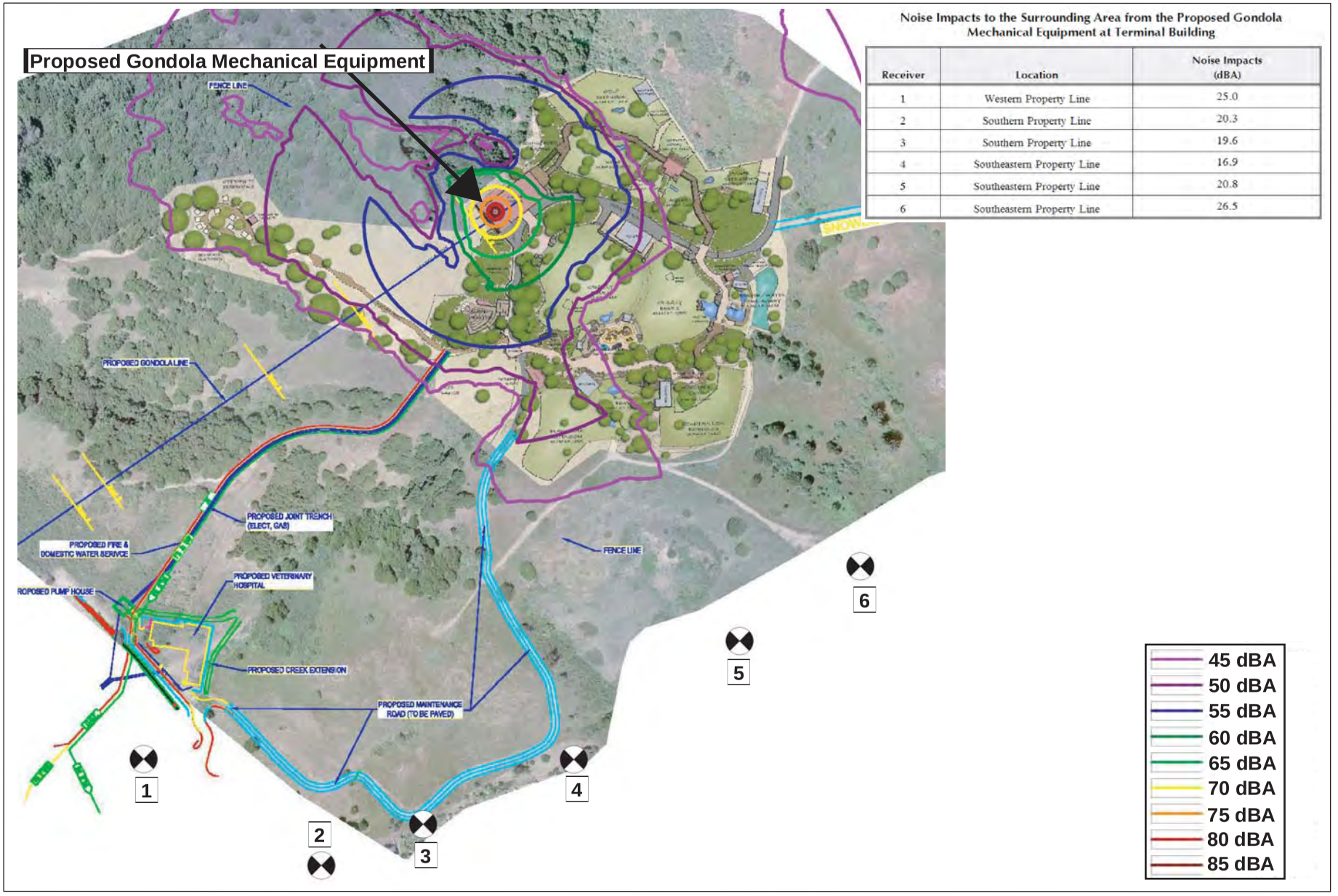
Location	Maximum Daily Occupancy (people)
California Site Attendance	395
Overnight Experience	100

Source: Oakland Zoo

TABLE 3.8-9: CALIFORNIA! ANIMALS MAXIMUM PLANNED OCCUPANCY

Species	Maximum Planned Occupancy (animals)
Grizzly Bear	4
Black Bear	5
Mountain Lion	3
Jaguar	3
Wolf	10
Eagle	2
Beaver	2
Waterfowl	10
Amphibians	2
Reptiles	2

Source: Oakland Zoo



Noise Impacts to the Surrounding Area from the Proposed Gondola Mechanical Equipment at Terminal Building

Receiver	Location	Noise Impacts (dBA)
1	Western Property Line	25.0
2	Southern Property Line	20.3
3	Southern Property Line	19.6
4	Southeastern Property Line	16.9
5	Southeastern Property Line	20.8
6	Southeastern Property Line	26.5

SOURCE: LFR

Figure 3.8-4
Gondola Transportation System Mechanical Equipment
Operational Noise Impacts

Based on the identified maximum occupancies, California! operational noise impacts were evaluated for each of the six residential receiver locations and are shown in **Table 3.8-10**.

TABLE 3.8-10: NOISE IMPACTS - CALIFORNIA! OPERATIONS

Receiver	Location	Construction Noise Impacts (dBA)
1	Western Property Line	35.7
2	Southern Property Line	38.1
3	Southern Property Line	32.3
4	Southeastern Property Line	27.7
5	Southeastern Property Line	34.3
6	Southeastern Property Line	41.5

Source: LFR

Noise impacts from the operations of California! would range from 27.7 dBA at Receiver 4 to 41.5 dBA at Receiver 6 and would be less-than-significant. The single daily service vehicle trip along the maintenance road generated by California! is also considered to generate less-than-significant noise impacts. A graphical representation of the noise impacts from California! operations are presented in **Figure 3.8-5**.

Combined Operations for Veterinary Medical Hospital, Gondola Transportation System and California!

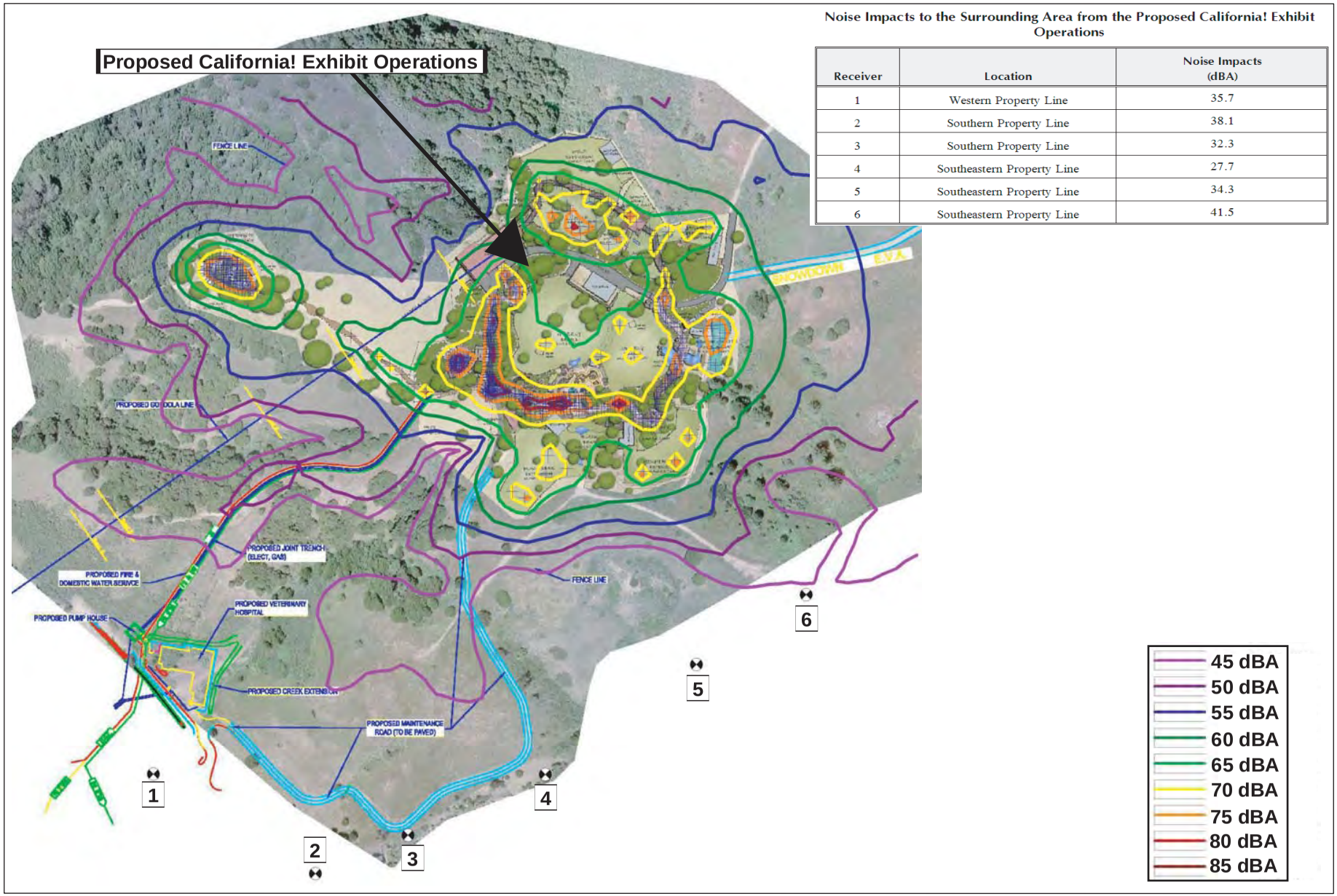
The combined daily operations of the Veterinary Medical Hospital, Gondola Transportation System and California! are summarized in **Table 3.8-11**. Noise impacts from the combined daily operations of the Veterinary Medical Hospital, Gondola Transportation System, and California! would range from 28.2 dBA at Receiver 4 to 47.5 dBA at Receiver 6. The noise impacts associated with the Project's combined operational activities would be less-than-significant.

TABLE 3.8-11: COMBINED NOISE IMPACTS -VETERINARY MEDICAL HOSPITAL, GONDOLA TRANSPORTATION SYSTEM AND CALIFORNIA!

Receiver	Location	Construction Noise Impacts (dBA)
1	Western Property Line	47.5
2	Southern Property Line	36.3
3	Southern Property Line	32.8
4	Southeastern Property Line	28.2
5	Southeastern Property Line	34.6
6	Southeastern Property Line	41.6

Source: LFR

A graphical representation of the noise impacts from the projects combined operations are presented in **Figure 3.8-6**.

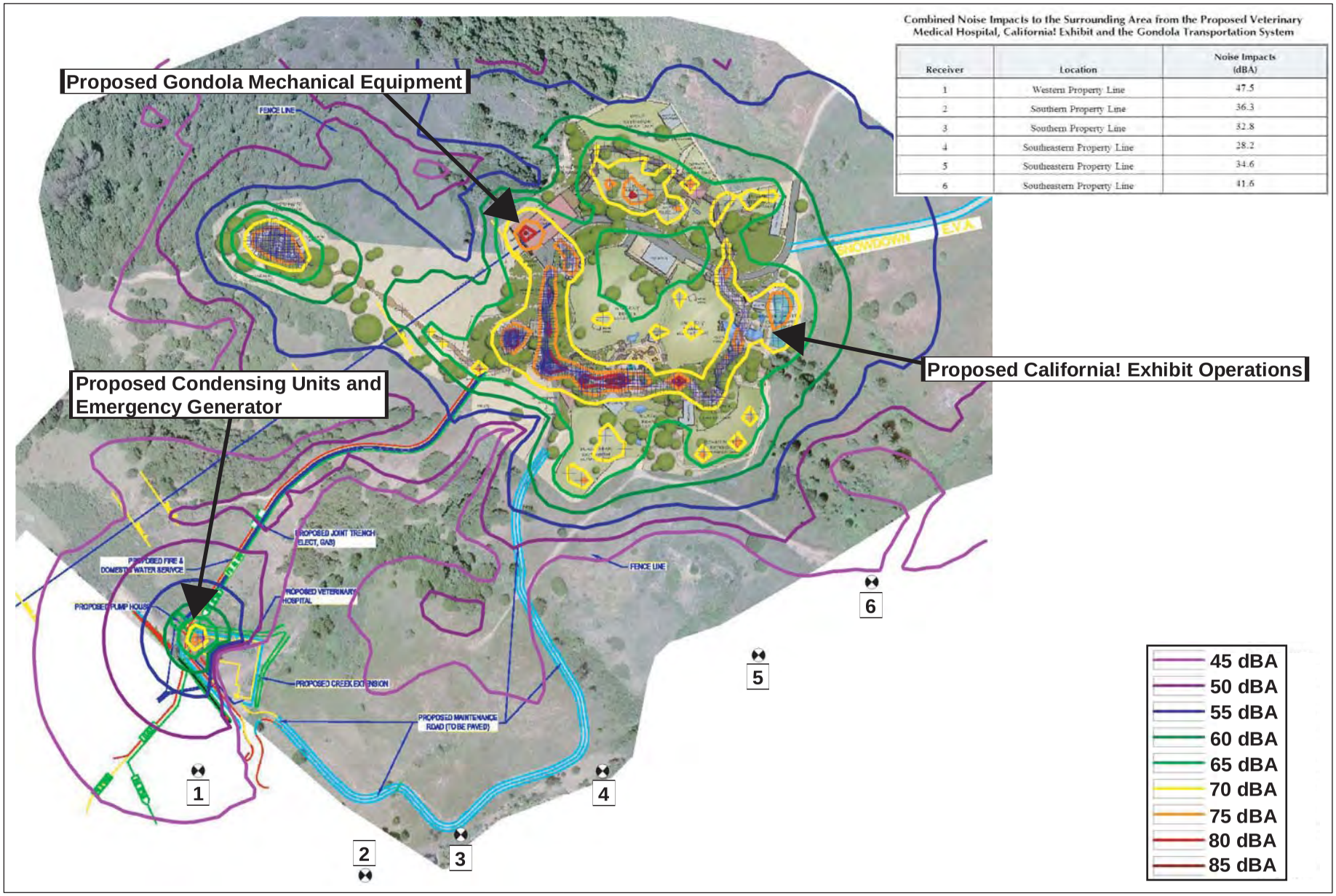


Noise Impacts to the Surrounding Area from the Proposed California! Exhibit Operations

Receiver	Location	Noise Impacts (dBA)
1	Western Property Line	35.7
2	Southern Property Line	38.1
3	Southern Property Line	32.3
4	Southeastern Property Line	27.7
5	Southeastern Property Line	34.3
6	Southeastern Property Line	41.5

SOURCE: LFR

Figure 3.8-5
California! Operational Noise Impacts at Maximum Occupancy



Combined Noise Impacts to the Surrounding Area from the Proposed Veterinary Medical Hospital, California! Exhibit and the Gondola Transportation System

Receiver	Location	Noise Impacts (dBA)
1	Western Property Line	47.5
2	Southern Property Line	36.3
3	Southern Property Line	32.8
4	Southeastern Property Line	28.2
5	Southeastern Property Line	34.6
6	Southeastern Property Line	41.6

SOURCE: LFR

Figure 3.8-6
Combined Veterinary Medical Hospital, California!
and Gondola Transportation System Operational Noise Impacts

c: Would the project violate the City of Oakland Noise Ordinance (Oakland Planning Code Section. 120.050) regarding construction noise, except if an acoustical analysis is performed?

The MND identified potentially significant construction noise impacts that would be mitigated to a less-than-significant level. The proposed Project would result in similar construction noise impacts.

The noise analysis evaluated five worst-case construction phase scenarios and is based upon the proposed equipment to be used for each phase. The evaluated phased construction scenarios are listed below.

- Veterinary Medical Hospital construction
- Maintenance road construction
- Utility/drainage trench construction
- California! construction
- Gondola Transportation System construction

Each of these construction phases is analyzed and modeled individually using Canda Noise Modeling Software. Worst-case conditions are assumed with all equipment running simultaneously, a circumstance that is not likely to occur. All sound pressure levels within the equipment noise emission database are standardized at a distance of 50 feet from the noise source. The noise evaluation for each phase is based on worst-case construction operations for a one-hour time period. The operating usage percentage is based on typical construction practices and the professional experience of LFR. The noise calculations of each phase will provide a realistic prediction of the noise impact range to be expected from a typically intermittent operation of machinery.

Veterinary Medical Hospital

The proposed construction equipment to be used in the construction of the Veterinary Medical Hospital is summarized in **Table 3.8-12**.

TABLE 3.8-12: VETERINARY HOSPITAL PROPOSED CONSTRUCTION EQUIPMENT AND SOUND PRESSURE LEVELS

Equipment	Operation Usage Percentage	Sound Pressure Level at 50 feet (dBA)
Scraper	50%	84.0
Bull Dozer	16%	82.0
Water Truck	8%	76.0
Back Hoe	50%	78.0
Excavator	50%	81.0
Compactor	33%	83.0
Front End Loader	16%	79.0
Dump Truck	50%	76.0

Source: LFR

The noise impacts from the Veterinary Medical Hospital construction activities are shown in **Table 3.8-13**.

TABLE 3.8-13: CONSTRUCTION NOISE IMPACTS - VETERINARY MEDICAL HOSPITAL

Sensitive Receptor	Location	Construction Noise Impacts (dBA)
1	Western Property Line	67.4
2	Southern Property Line	56.4
3	Southern Property Line	43.7
4	Southeastern Property Line	31.3
5	Southeastern Property Line	27.9
6	Southeastern Property Line	25.7

Source: LFR

The City of Oakland restricts construction noise impacts at residential property lines to 80 dBA L_{EQ} for construction activities that last ten days or less and 60 dBA L_{EQ} for construction activities that occur for more than ten days. Construction noise levels at the six residential receiver locations range from 25.7 dBA at Receiver 6 to 67.4 dBA at Receiver 1. With implementation of the applicable noise Standard Conditions of Approval, noise impacts would be mitigated to a less-than-significant level because it would restrict noise levels. A graphical representation of the noise impacts from the Veterinary Medical Hospital construction activities are presented in **Figure 3.8-7**.

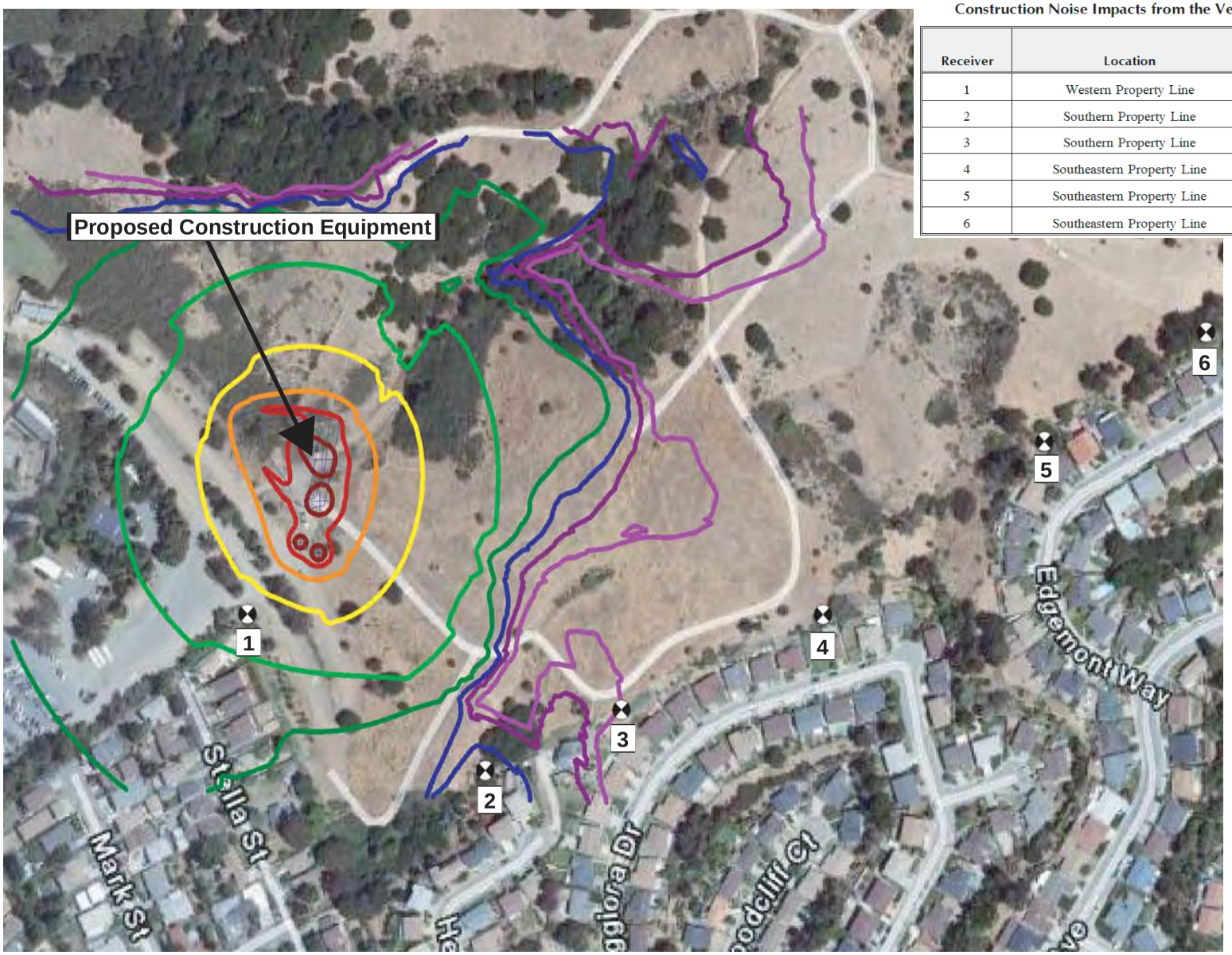
Maintenance Road

The proposed construction equipment to be used in the construction of the maintenance road is summarized in **Table 3.8-14**.

TABLE 3.8-14: MAINTENANCE ROAD PROPOSED CONSTRUCTION EQUIPMENT AND SOUND PRESSURE LEVELS

Equipment	Operation Usage Percentage	Sound Pressure Level at 50 feet (dBA)
Scraper	50%	84.0
Bull Dozer	16%	82.0
Water Truck	8%	76.0
Paver	50%	77.0
Compactor	33%	83.0
Front End Loader	16%	79.0
Dump Truck	50%	76.0

Source: LFR



Construction Noise Impacts from the Veterinary Medical Hospital

Receiver	Location	Construction Noise Impacts (dBA)
1	Western Property Line	67.4
2	Southern Property Line	56.4
3	Southern Property Line	43.7
4	Southeastern Property Line	31.3
5	Southeastern Property Line	27.9
6	Southeastern Property Line	25.7

SOURCE: LFR

Figure 3.8-7
Veterinary Medical Hospital Construction Noise Impacts

Noise impacts from the maintenance road construction activities to the six residential receiver locations are summarized in **Table 3.8-15**.

TABLE 3.8-15: CONSTRUCTION NOISE IMPACTS FROM THE MAINTENANCE ROAD

Receiver	Location	Construction Noise Impacts (dBA)
1	Western Property Line	61.0
2	Southern Property Line	65.5
3	Southern Property Line	71.2
4	Southeastern Property Line	60.6
5	Southeastern Property Line	53.9
6	Southeastern Property Line	46.8

Source: LFR

As shown in **Table 3.8-15**, the construction noise levels at the six residential receiver locations range from 46.8 dBA at Receiver 6 to 71.2 dBA at Receiver 3. The most impacted residential property lies south of the proposed maintenance road, which is represented as Receiver 3 but the noise level would be below the City's standard for construction noise such that no impacts would result. Additionally, implementation of the applicable noise Standard Conditions of Approval will further ensure that the potential for noise impacts would be less-than-significant. **Figure 3.8- 8** shows a graphical representation of the noise impacts from the maintenance road construction activities.

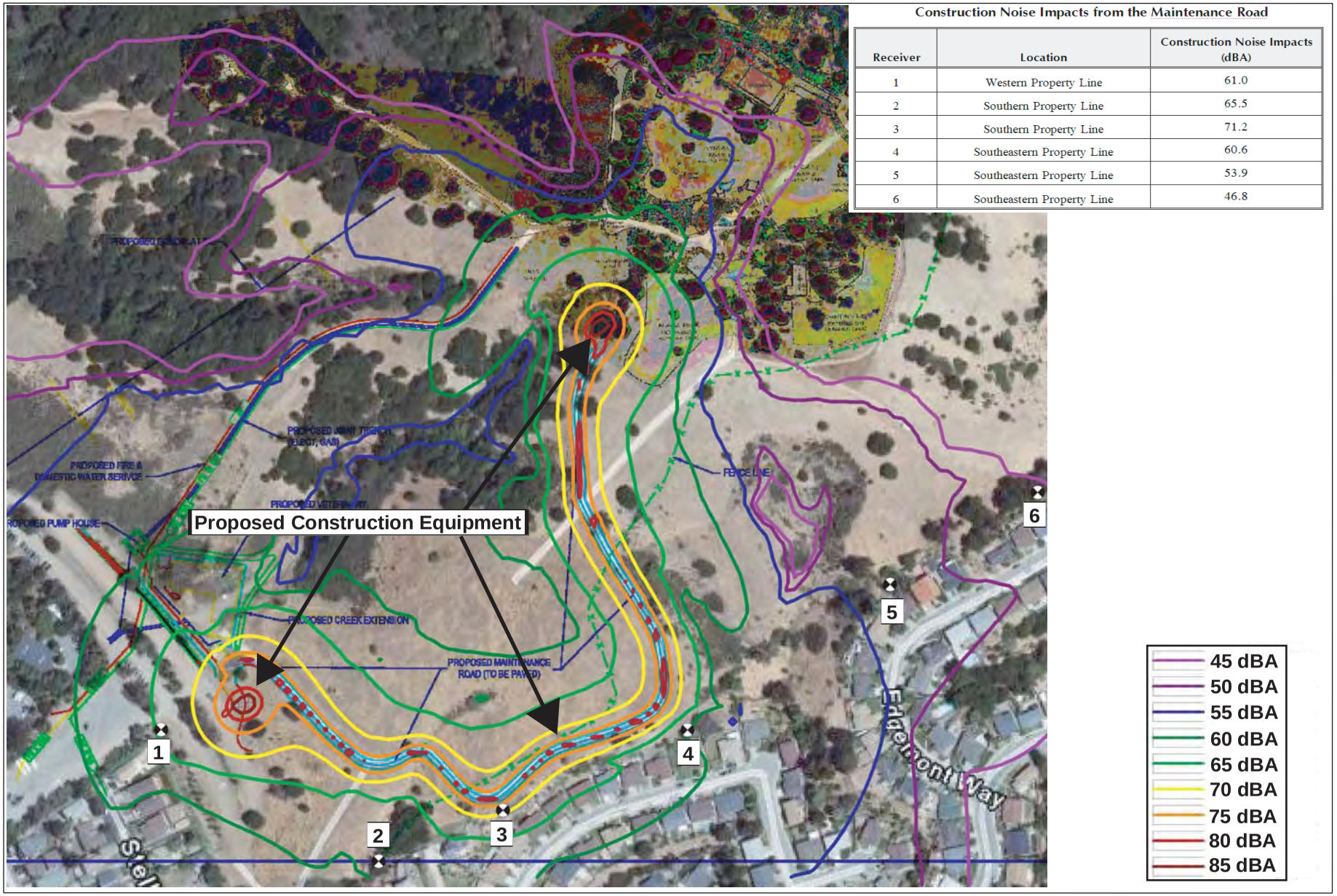
Utility Line Trench

The proposed construction equipment to be used in the construction of the utility line trench is summarized in **Table 3.8-16**.

TABLE 3.8-16: UTILITY LINE TRENCH PROPOSED CONSTRUCTION EQUIPMENT AND SOUND PRESSURE LEVELS

Equipment	Operation Usage Percentage	Sound Pressure Level at 50 feet (dBA)
Concrete Pump	16%	810
Concrete Truck	16%	79.0
Back Hoe	50%	78.0
Excavator	50%	81.0
Compactor	33%	83.0
Dump Truck	50%	76.0

Source: LFR



Construction Noise Impacts from the Maintenance Road

Receiver	Location	Construction Noise Impacts (dBA)
1	Western Property Line	61.0
2	Southern Property Line	65.5
3	Southern Property Line	71.2
4	Southeastern Property Line	60.6
5	Southeastern Property Line	53.9
6	Southeastern Property Line	46.8

SOURCE: LFR

Figure 3.8-8
Maintenance Road Construction Noise Impacts

The noise impacts from the utility line trench construction activities to the six residential receiver locations are summarized in **Table 3.8-17**.

TABLE 3.8-17: CONSTRUCTION NOISE IMPACTS – UTILITY LINE TRENCH

Receiver	Location	Construction Noise Impacts (dBA)
1	Western Property Line	63.1
2	Southern Property Line	55.2
3	Southern Property Line	46.4
4	Southeastern Property Line	28.9
5	Southeastern Property Line	29.0
6	Southeastern Property Line	26.8

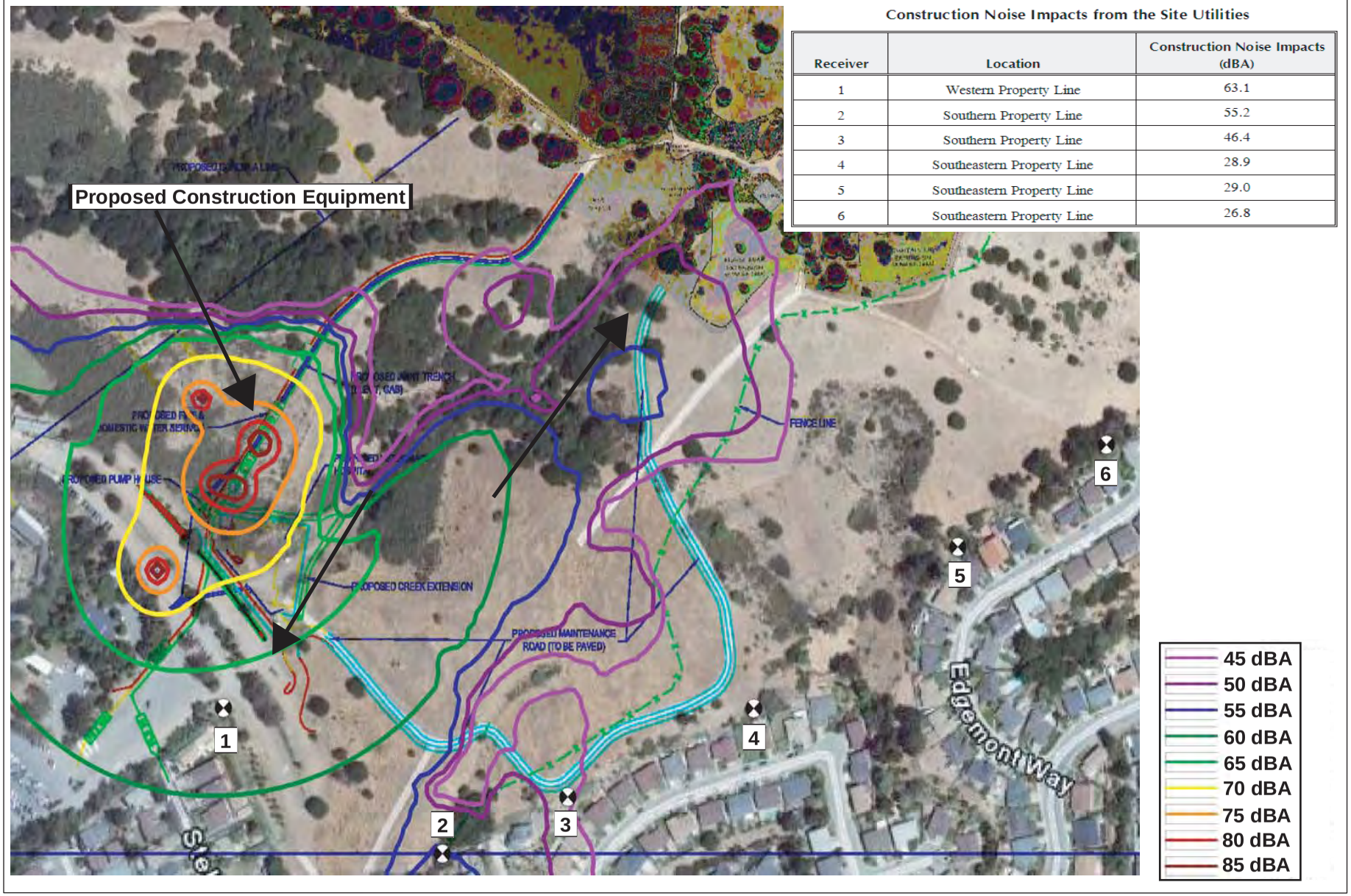
Source: LFR

Construction noise levels at the six residential receiver locations range from 26.8 dBA at Receiver 6 to 63.1 dBA at Receiver 1. The most impacted residential property lies south of the proposed utility line trench, which is represented as Receiver 1 but the noise level would be below the City's standard for noise construction such that no significant impacts would result. Additionally, implementation of the applicable noise Standard Conditions of Approval will further ensure that the potential for noise impacts would be less-than-significant. **Figure 3.8-9** shows a graphical representation of the noise impacts from the utility line trench construction activities

California!

The proposed construction equipment to be used in the construction of California! is summarized in **Table 3.8-18**. The noise impacts from the California! construction activities were evaluated at the six residential receiver locations and the noise impact calculations from the California! construction activities to the residential receivers are summarized in **Table 3.8-19**.

The City of Oakland restricts construction noise impacts at residential property lines to 80 dBA L_{EQ} for construction activities that last ten days or less and 60 dBA L_{EQ} for construction activities that occur for more than ten days. Our calculations show Construction noise levels at the six residential receiver locations range from 33.0 dBA at Receiver 4 to 45.3 dBA at Receiver 6 and are below the 60 dBA L_{EQ} standard. A graphical representation of the noise impacts from the California! construction activities is presented in **Figure 3.8-10**. Consequently, no significant adverse noise impacts would occur. Additionally, implementation of the applicable noise Standard Conditions of Approval will further ensure that the potential for noise impacts would be less-than-significant.



SOURCE: LFR

Figure 3.8-9
Utility Line Trench Construction Noise Impacts

TABLE 3.8-18: CALIFORNIA! PROPOSED CONSTRUCTION EQUIPMENT AND SOUND PRESSURE LEVELS

Equipment	Operation Usage Percentage	Sound Pressure Level at 50 feet (dBA)
Concrete Pump	16%	81.0
Concrete Truck	16%	79.0
Boom Lift	8%	81.0
Scraper	50%	84.0
Water Truck	8%	76.0
Compactor	33%	83.0
Dump Truck	50%	76.0
Front End Loader	16%	79.0
Bull Dozer	16%	82.0

Source: LFR

TABLE 3.8-19: CONSTRUCTION NOISE IMPACTS – CALIFORNIA!

Receiver	Location	Construction Noise Impacts (dBA)
1	Western Property Line	41.6
2	Southern Property Line	37.7
3	Southern Property Line	33.9
4	Southeastern Property Line	33.0
5	Southeastern Property Line	38.8
6	Southeastern Property Line	45.3

Source: LFR

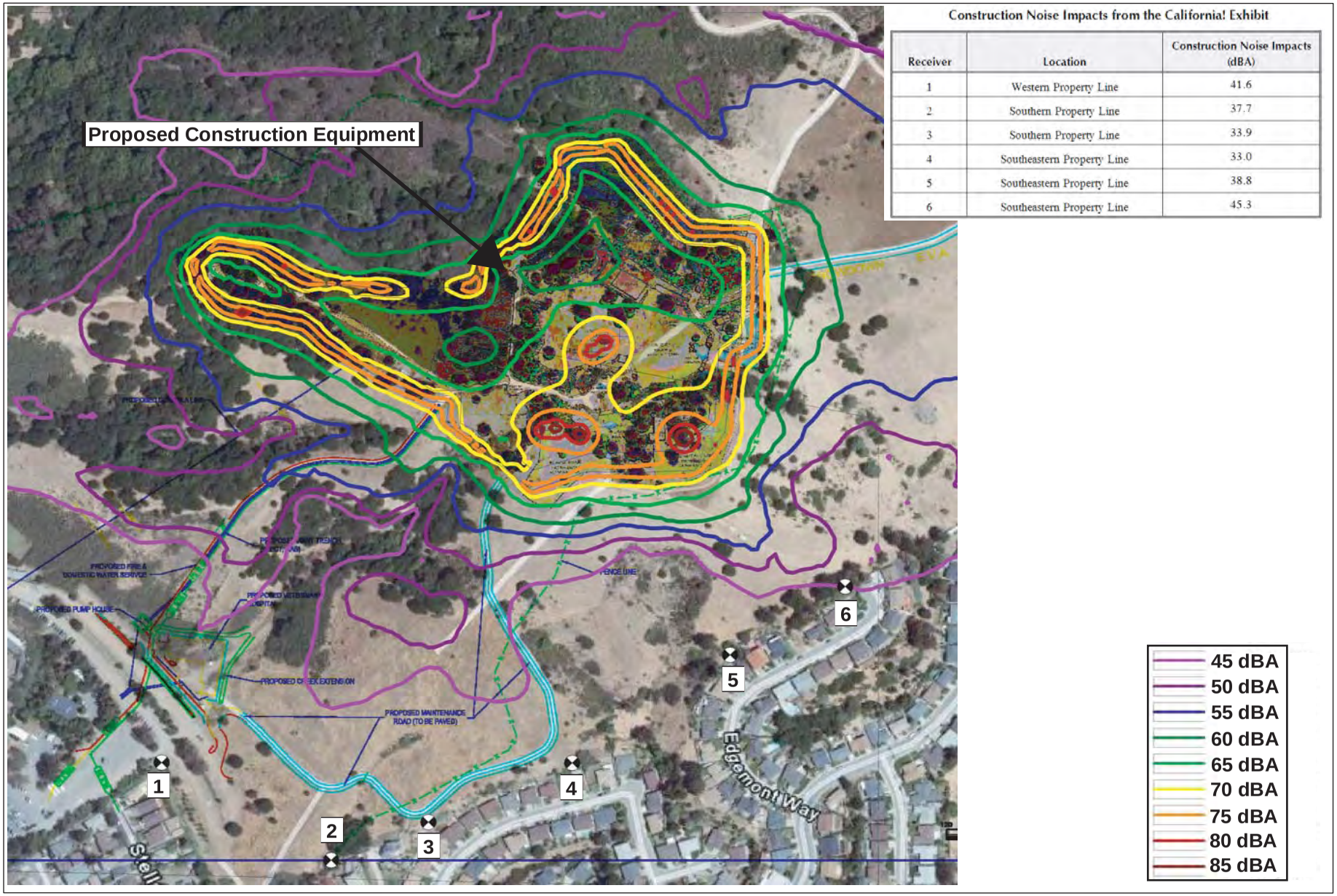
Gondola Transportation System

The proposed construction equipment to be used in the construction of the Gondola Transportation System is summarized in **Table 3.8-20**.

TABLE 3.8-20: GONDOLA TRANSPORTATION SYSTEM PROPOSED CONSTRUCTION EQUIPMENT AND SOUND PRESSURE LEVELS

Equipment	Operation Usage Percentage	Sound Pressure Level
Helicopter	25%	90.0 dBA @ 300 feet
Concrete Truck	16%	79.0 dBA @ 50 feet
Concrete Pump	16%	81.0 @ 50 feet
Bob Cat	33%	81.0 @ 50 feet

Source: LFR



SOURCE: LFR

Figure 3.8-10
California! Construction Noise Impacts

The noise impacts from the Gondola Transportation System construction activities were evaluated at the six residential receiver locations and are summarized in **Table 3.8-21**.

TABLE 3.8-21: CONSTRUCTION NOISE IMPACTS FROM THE GONDOLA EXPRESS

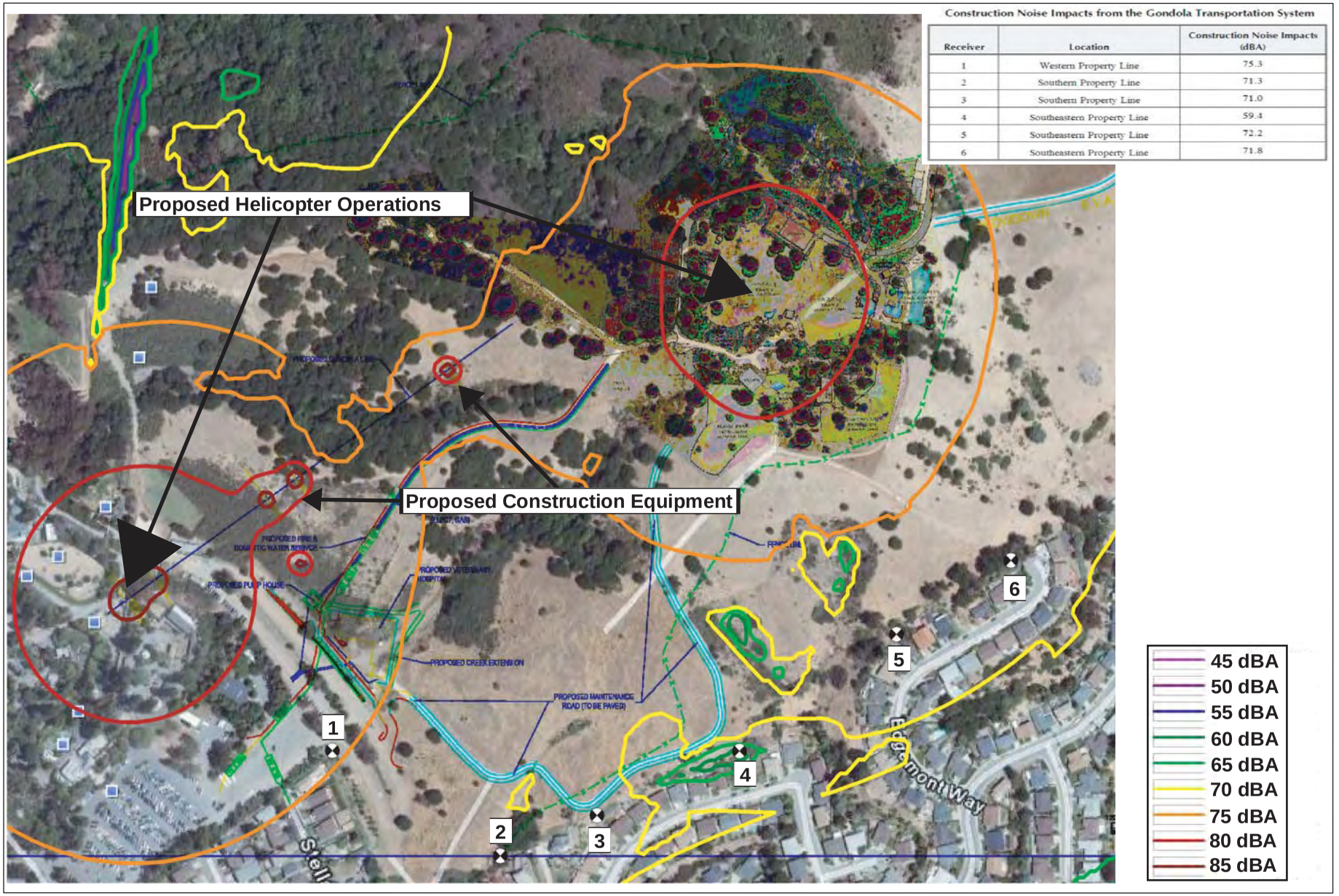
Receiver	Location	Construction Noise Impacts (dBA)
1	Western Property Line	75.3
2	Southern Property Line	71.3
3	Southern Property Line	71.0
4	Southeastern Property Line	59.4
5	Southeastern Property Line	72.2
6	Southeastern Property Line	71.8

Source: LFR

The City of Oakland restricts construction noise impacts at residential property lines to 80 dBA L_{EQ} for construction activities that last ten days or less and 60 dBA L_{EQ} for construction activities that occur for more than ten days. Our calculations show construction noise levels at the six residential receiver locations range from 59.4 dBA at Receiver 4 to 75.3 dBA at Receiver 1. Consequently, no significant adverse noise impacts would occur. Additionally, implementation of the applicable noise Standard Conditions of Approval will further ensure that the potential for noise impacts would be less-than-significant. **Figure 3.8-11** shows a graphical representation of the noise impacts from the Gondola Transportation System.

MITIGATION MEASURES

The proposed Project would not result in significant in significant new noise impacts. In addition, the Project will be subject to the City's Standard Conditions of Approval #28, #29, #30 and #32 which will further reduce the potential for any impacts.



SOURCE: LFR

Figure 3.8-11
Gondola Transportation System Construction Noise Impacts

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3.9 FIRE PROTECTION SERVICES

This section evaluates whether any of the Project changes would result in new impacts to fire protection services not identified in the MND or a substantial increase in the severity of the previously identified aesthetic impacts. This section also discusses any pertinent new information or changes in the Project circumstances that could result in new or a substantial increase in impacts. This analysis relies on the City's current draft of the *CEQA Thresholds/Criteria Significance Guidelines* (City of Oakland 2008a). Additionally, this section reviews the previously adopted mitigation measures, updates these mitigation measures as necessary, or replaces the mitigation measures with the applicable provisions of the City's *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval* (2008b).

EXISTING CONDITIONS

The Zoo and Knowland Park are located within the 2004 Wildfire Assessment District (City of Oakland 2009), which was not in existence at the time the MND was prepared and adopted. Wildland fires are of great concern in the Oakland Hills and the introduction of new development in the hilly and vegetated terrain of the Project site must be designed to provide safe and quick access to California! and the Veterinary Medical Hospital in the event of a fire or other emergency. The Zoo has met with the Fire Department (Aliquot 2008) and based on their input the Project has been designed to comply with Fire Department standards.

SIGNIFICANC CRITERIA

a: Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered government facilities, need for new or physically altered government facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for fire protection?

The proposed Project would not result in increased demand for fire protection services beyond that identified in the MND. However, with the proposed changes to the approved Master Plan it is necessary to reevaluate emergency access conditions as they relate to the proposed Project. The Veterinary Medical Hospital would be located above and adjacent to the overflow parking lot (former site of the River Exhibit). Emergency response vehicles would directly access this site via the overflow parking lot and existing maintenance road, which would be paved as part of the proposed Project.

The existing maintenance road is too steep for most emergency response vehicles to access California!, therefore the Project would provide an emergency vehicle access (EVA) road that would provide access to California! via Snowdown Avenue. The EVA road would be constructed on an existing fire road to avoid disturbance to surrounding grasslands and would either be paved or graveled. The EVA road would be designed to meet Fire Department standards. Potential impacts to fire protection services would continue to be less-than-significant as identified in the MND.

MITIGATION MEASURES

The proposed Project would not result in significant new impacts to fire protection services. In addition, the Project will be subject to the City's Standard Conditions of Approval #70, #71, and #73, which will further reduce the potential for any significant impacts.

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3.10 TRANSPORTATION AND CIRCULATION

This section evaluates whether any of the Project changes would result in new transportation and circulation impacts not identified in the MND or a substantial increase in the severity of the previously identified transportation and circulation impacts. This section also discusses any pertinent new information or changes in the Project circumstances that could result in a new or a substantial increase in impacts. This analysis relies on the City's current draft of the *CEQA Thresholds/Criteria of Significance Guidelines* (2008a). Additionally, the section reviews the previously adopted mitigation measures, updates these mitigation measures as necessary or replaces the mitigation measures with the applicable provisions of the City's *Conditions of Approval & Uniformly Applied Development Standards Imposed as Standard Conditions of Approval* (2008b).

METHODOLOGY

In consultation with the City of Oakland Transportation Services Division of the Department of Public Works, AECOM developed the framework to undertake the traffic impact analysis for the proposed Project. As shown in **Figure 3.10-1**, traffic analysis focuses on the following seven study intersections:

1. Zoo Drive / Mountain Boulevard / Golf Links Road (three-way stop control);
2. Golf Links Road / I-580 Westbound on ramp (signal control);
3. Golf Links Road / I-580 Eastbound off ramp / 98th Avenue (signal control);
4. 106th Avenue / Malcolm Avenue / Zoo Drive (one-way stop control);
5. 106th Avenue / I-580 Westbound on ramp (all-way stop control);
6. 106th Avenue / Foothill Boulevard (all-way stop control); and
7. 106th Avenue / MacArthur Boulevard (signal control).

The traffic analysis was conducted following the guidelines established by the City of Oakland. Future year traffic volume forecasts were estimated using growth rates derived from the Alameda County Congestion Management Agency's (ACCMA) travel demand forecasting model. Traffic impacts were evaluated using intersection Level of Service (LOS) calculations for the AM and PM peak hour (which occurs between the hours of 7:00 - 9:00 AM and 4:00 - 6:00 PM respectively). Evaluations were conducted for the following six scenarios, which include three baseline scenarios and three "with Project" scenarios.

- Existing Conditions (Baseline);
- Existing plus Project Conditions;
- Year 2015 Conditions (Baseline);
- Year 2015 plus Project Conditions;
- Cumulative Year 2030 Conditions (Baseline); and
- Cumulative Year 2030 plus Project Conditions.

SOURCE: AECOM

Figure 3.10-1
Project Site and Study Intersections

Data Collection

Existing turning movement counts were collected at each of the study intersections during the AM and PM peak hour during a non-holiday week (April 16, 2009). **Figure 3.10- 2** presents the existing intersection lane configurations and traffic controls. **Figure 3.10-3** presents the existing traffic volumes at the seven study intersections.

Analysis Methodology

This traffic analysis was conducted following the guidelines established by the City of Oakland, and traffic impacts were evaluated using intersection LOS calculations for the weekday AM and PM peak hours. LOS is a qualitative description of an intersection's performance based on the average delay per vehicle.

Signalized Intersections

Signalized intersection analyses are conducted using the methodology of the Transportation Research Board's 2000 Highway Capacity Manual. The operational analysis uses various intersection characteristics (e.g., traffic volumes, lane geometry, and signal phasing/timing) to estimate the average control delay experienced by motorists traveling through an intersection. Control delay, which is the portion of total delay attributed to traffic signal operation for signalized intersections, includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. The use of control delay as the basis for defining LOS differs from earlier versions of HCM methodology, which used "stopped delay" (i.e., a portion of the total control delay) to define LOS.

Unsignalized Intersections

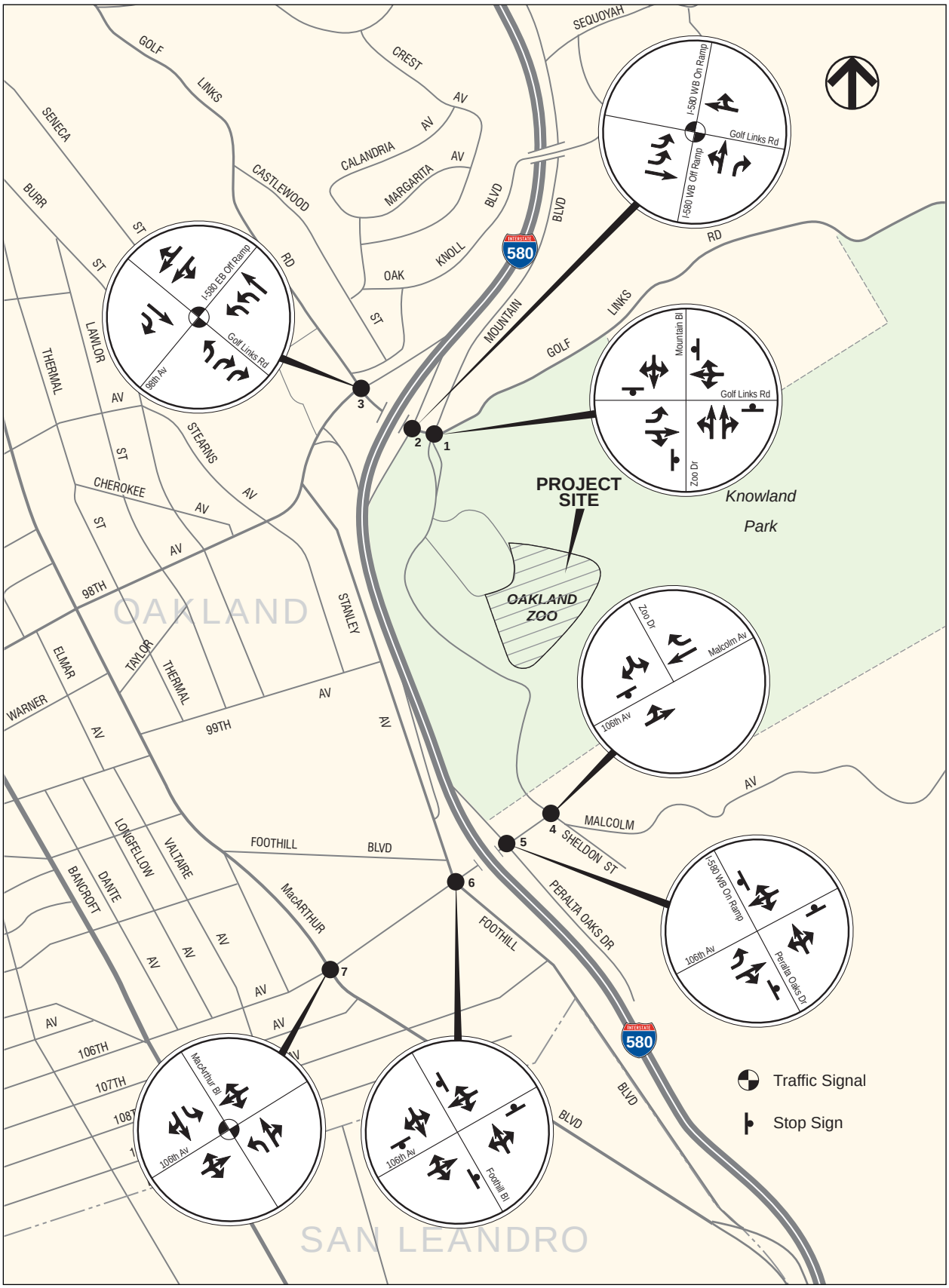
The unsignalized (all-way stop controlled and side-street stop controlled) intersection LOS calculations are also conducted using the methodology of the Transportation Research Board's *2000 Highway Capacity Manual*. With this methodology, operations are defined by the average control delay per vehicle (measured in seconds) for each stop-controlled movement. This incorporates delay associated with deceleration, acceleration, stopping, and moving up in the queue. For all-way stop-controlled intersections, delay is presented in terms of average controlled delay for all movements. For side-street stop-controlled intersections, delay is presented for the worst case stop-controlled approach.

Table 3.10-1 presents the LOS criteria for signalized and unsignalized intersections.

EXISTING CONDITIONS

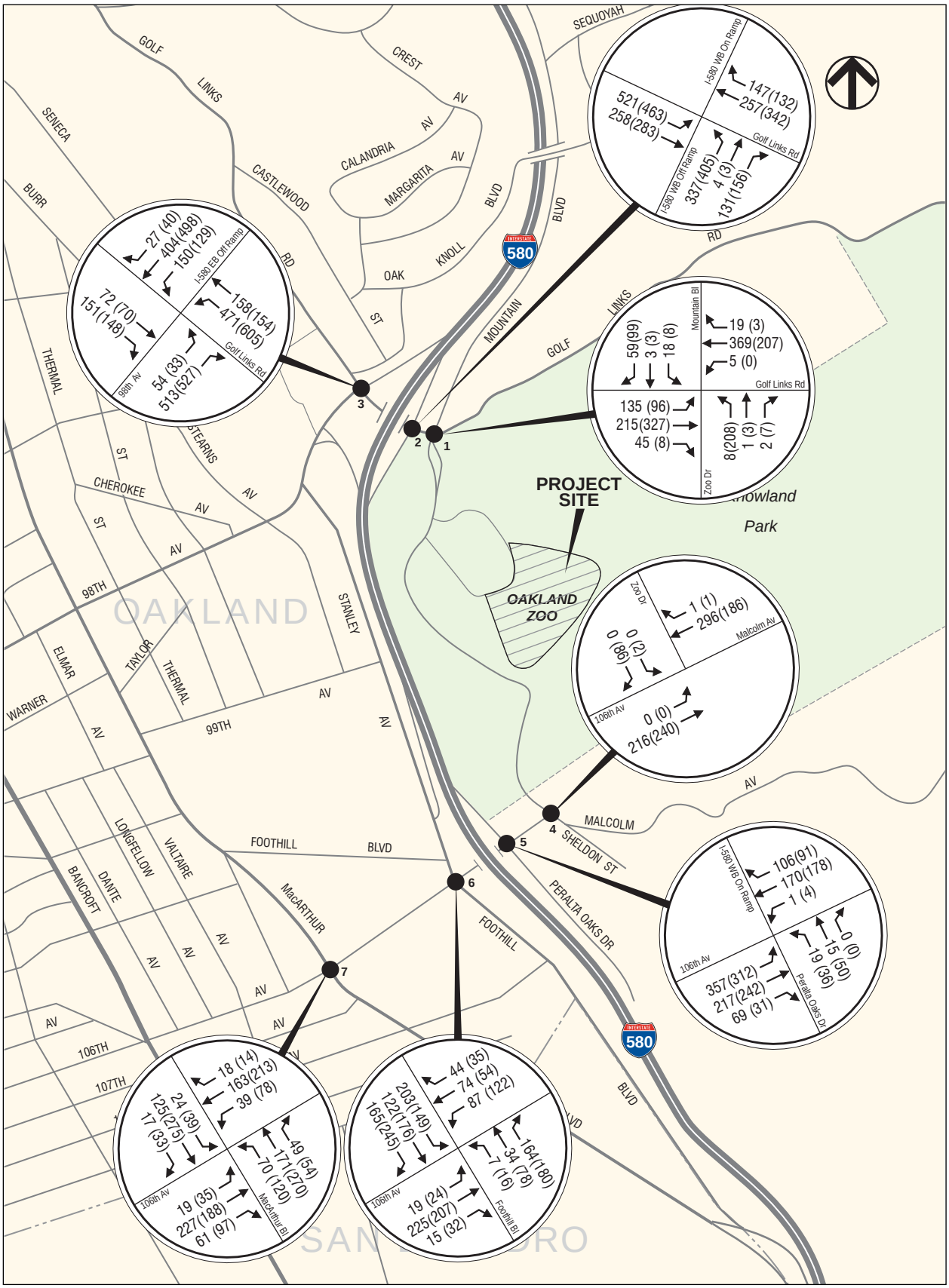
Completed Master Plan Circulation Improvements

The Zoo has completed the following access and circulation improvements since approval of the Master Plan: widened Zoo Drive to 30 feet to accommodate two-way traffic (this road was previously one-way which required Zoo traffic to exit onto Sheldon Street, then 106th Street) and a bicycle/pedestrian lane; repaved the overflow parking lot allowing for more efficient use of this parking lot; and new directional signage. These efforts have improved circulation at the Zoo.



SOURCE: AECOM

Figure 3.10-2
Existing Lane Geometry



SOURCE: AECOM

Figure 3.10-3
Existing Traffic Volumes
Weekday AM (PM) Peak Hour

TABLE 3.10-1: INTERSECTION LEVEL OF SERVICE METHODOLOGY

Level of Service	Description	Average Total Delay (seconds/vehicle)	
		Signalized Intersections	Unsignalized Intersections
A	Little or no delay	≤ 10.0	≤ 10.0
B	Short traffic delay	> 10.0 and ≤ 20.0	> 10.0 and ≤ 15.0
C	Average traffic delay	> 20.0 and ≤ 35.0	> 15.0 and ≤ 25.0
D	Long traffic delay	> 35.0 and ≤ 55.0	> 25.0 and ≤ 35.0
E	Very long traffic delay	> 55.0 and ≤ 80.0	> 35.0 and ≤ 50.0
F	Extreme traffic delay	> 80.0	> 50.0

Source: Transportation Research Board, *Highway Capacity Manual*, 2000.

Existing Traffic Operations

The operation of each intersection was analyzed using existing intersection volumes and configurations. The results are summarized in **Table 3.10-2**.

TABLE 3.10-2: INTERSECTION LOS SUMMARY – EXISTING CONDITIONS

#	Intersection	Traffic Control[1]	Peak Hour	Existing Conditions	
				LOS	Delay[2]
1	Zoo Drive / Mountain Boulevard / Golf Links Road	TWSC	AM	B	10.3
			PM	B	11.7
2	Golf Links Road / I-580 Westbound on ramp	Signal	AM	C	22.9
			PM	C	33.2
3	Golf Links Road / I-580 Eastbound off ramp / 98th Avenue	Signal	AM	C	27.8
			PM	C	29.6
4	106th Avenue / Malcolm Avenue / Zoo Drive	OWSC	AM	A	0.0
			PM	B	9.8
5	106th Avenue / I-580 Westbound on ramp	AWSC	AM	B	11.8
			PM	B	11.6
6	106th Avenue / Foothill Boulevard	AWSC	AM	C	16.8
			PM	C	20.3
7	106th Avenue / MacArthur Boulevard	Signal	AM	A	9.6
			PM	B	11.1

Notes:
[1] AWSC = All-Way Stop Controlled; OWSC = One-Way Stop Controlled; TWSC = Three-Way Stop Controlled
[2] Delay measured in seconds per vehicle.

Source: AECOM, 2009.

SIGNIFICANCE CRITERIA

Overview

An assessment of the proposed Project impacts, and the corresponding recommended improvements, were determined based on the intersection Level of Service significance criteria guidelines established by the City of Oakland are discussed below.

The Project would have a significant effect at the analysis intersections if it would cause an increase in traffic which is substantial in relation to the baseline traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads or congestion at intersections), or change the condition of an existing street (i.e., street closures, changing direction of travel) in a manner that would substantially affect access or traffic load and capacity of the street system.

None of the Project study intersections lie within the Downtown area[1]; therefore, thresholds relating to Downtown are not addressed in this analysis.

a: At a study signalized intersection which is located outside the Downtown area, the project would cause the level of Service (LOS) to degrade to worse than LOS D (i.e. E)?

The MND determined the project proposed in 1998 would not exceed the LOS thresholds at the Zoo Drive/Mountain Boulevard/Golf Links Road intersection and Golf Links Road and I-580 ramps. The proposed Project would result in a minimal increase to vehicle traffic (three vehicle trips during the AM peak hour and five vehicle trips during the PM peak hour) and would not result in significant new traffic and circulation impacts. A discussion of existing traffic operations and Project generated traffic is presented below.

Project Generated Traffic

Vehicle trip generation is shown in **Table 3.10-3**. Rates were determined using information provided in the Institute of Transportation Engineers (ITE), *Trip Generation*, Eighth Edition.

TABLE 3.10-3: PROJECT GENERATED TRIPS

Trip Generator		Inbound		Outbound		Total Trips	
		AM	**PM**	**AM**	**PM**	**AM**	**PM**
Veterinary Medical Hospital	(17,123 sq. ft.)	1	0	0	1	**1**	**1**
Overnight Camping Area	(11 tents)	1	3	1	1	**2**	**4**
Total Trips		2	3	1	2	**3**	**5**

Source: AECOM, 2009.

[1] Downtown is defined in the Land Use Transportation Element of the Oakland General Plan on page 67 as the area generally bound by West Grand Avenue to the north, Lake Merritt and Channel Park to the east, the Oakland estuary to the south and I-980/Brush Street to the west.

The proposed Veterinary Medical Hospital would employ one additional person, and will not be open to the public. The facility would generate at most one additional trip during the weekday AM and PM peak hour. The Overnight Camping Area is expected to generate two additional trips during the AM peak hour and four additional trips during the PM peak hour. The entire proposed Project is expected to generate a total of three trips during the AM peak hour and five trips during the PM peak hour.

The additional trips are layered over existing traffic counts to derive Existing plus Project traffic volumes using the Project's estimated trip distribution pattern (see **Figure 3.10-4**). Transit mode split is not factored into this distribution pattern because the proposed Project is not expected to generate enough additional transit trips to impact transit demand during the AM or PM peak hour. The distribution pattern of Project trips was developed based on information taken from the Alameda County Congestion Management Agency (ACCMA) travel demand model as well as pneumatic hose counts taken at the Zoo driveways during a non-holiday (April 20, 2009) Project-specific trip volumes are illustrated in **Figure 3.10-5** and Existing Plus Project traffic volumes are illustrated in **Figure 3.10-6**. A Level of Service comparison at each study intersection under Existing and Existing plus Project conditions during the AM and PM peak hour is shown in **Table 3.10-4**.

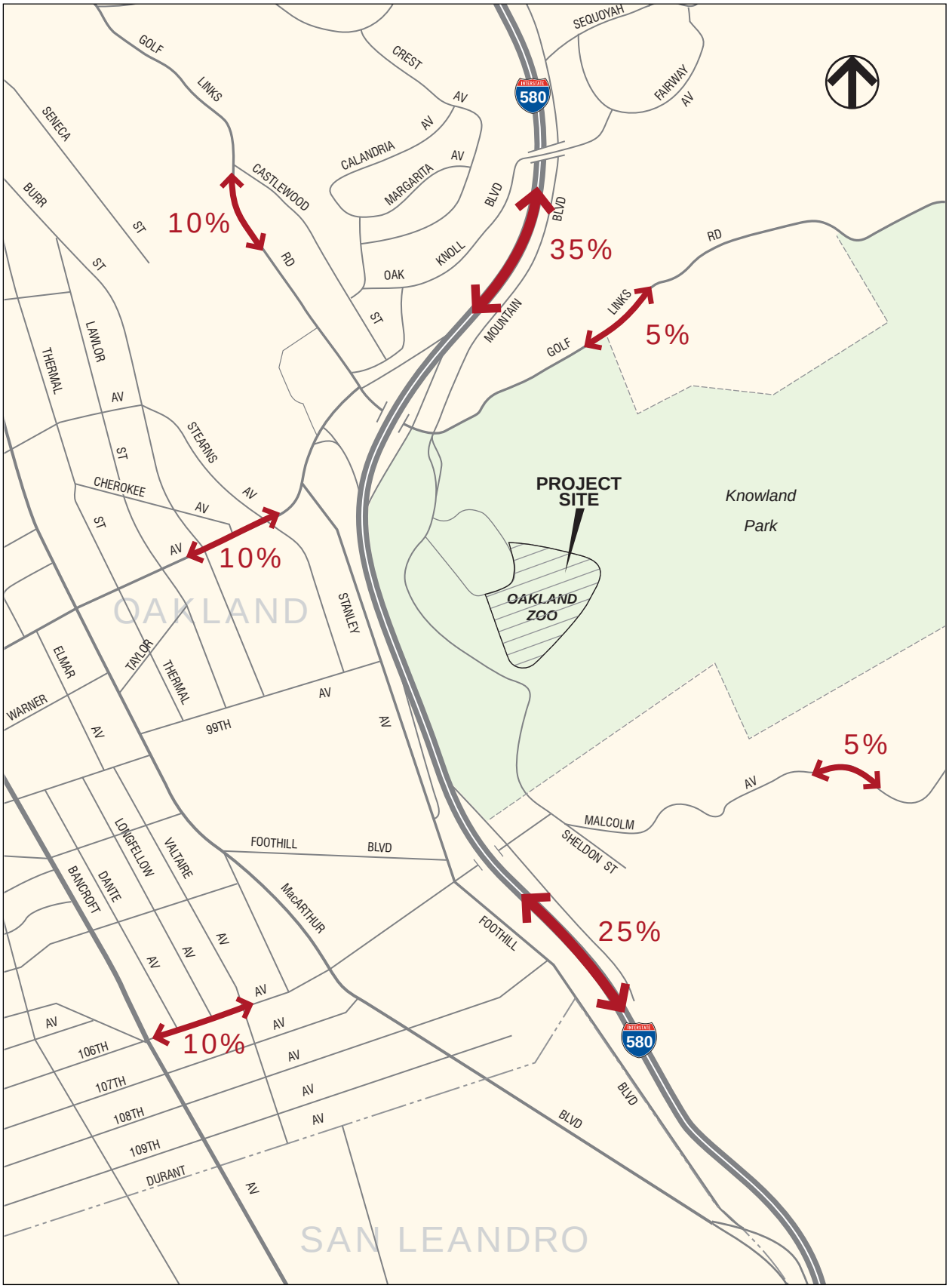
According to City of Oakland significance criteria the Project would not have a significant impact under Existing plus Project Conditions.

Construction Period Conditions

Potential short-term construction impacts generated by the proposed Project would include impacts associated with the delivery of construction materials and equipment, and removal of construction debris. During the construction period, temporary and intermittent transportation impacts would result from truck movements as well as construction worker trips to and from the Project site. The construction-related traffic would result in temporary congestion on Project area streets because of the slower movements and larger turning radii of construction trucks compared to passenger vehicles. Within the vicinity of the construction site, Zoo Drive is a 24 foot wide, two-lane roadway. The roadway configuration and width would adequately accommodate vehicles and trucks turning into and out of the Construction site. The City of Oakland's Standard Conditions of Approval #24 addressing construction traffic management will adequately mitigate construction traffic impacts.

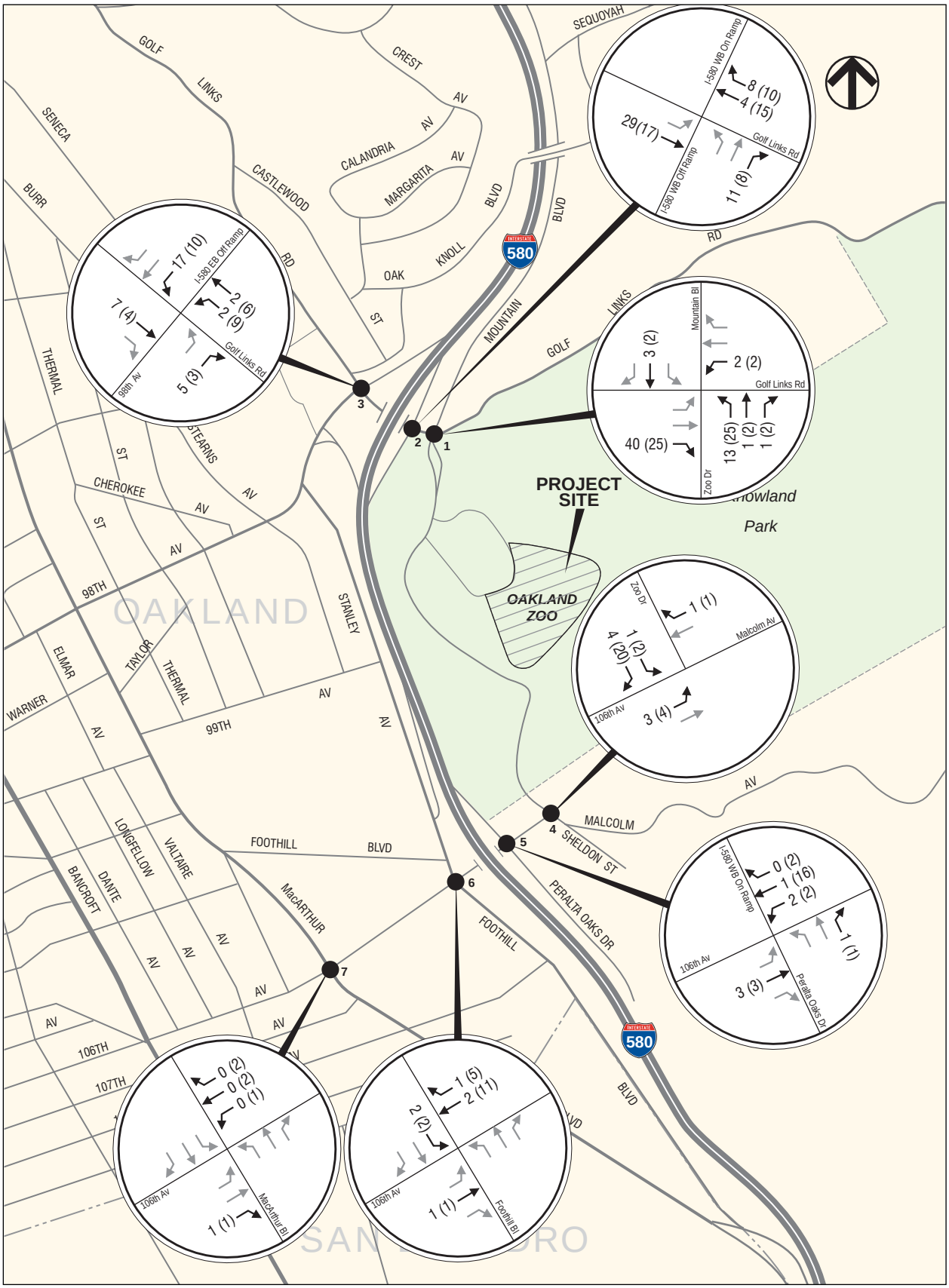
Veterinary Medical Hospital

Construction of the Veterinary Hospital is scheduled to occur over a twelve month period. During construction, the number of trucks that would come to and from the site is expected to range from 5 to 44 per day, depending on the construction



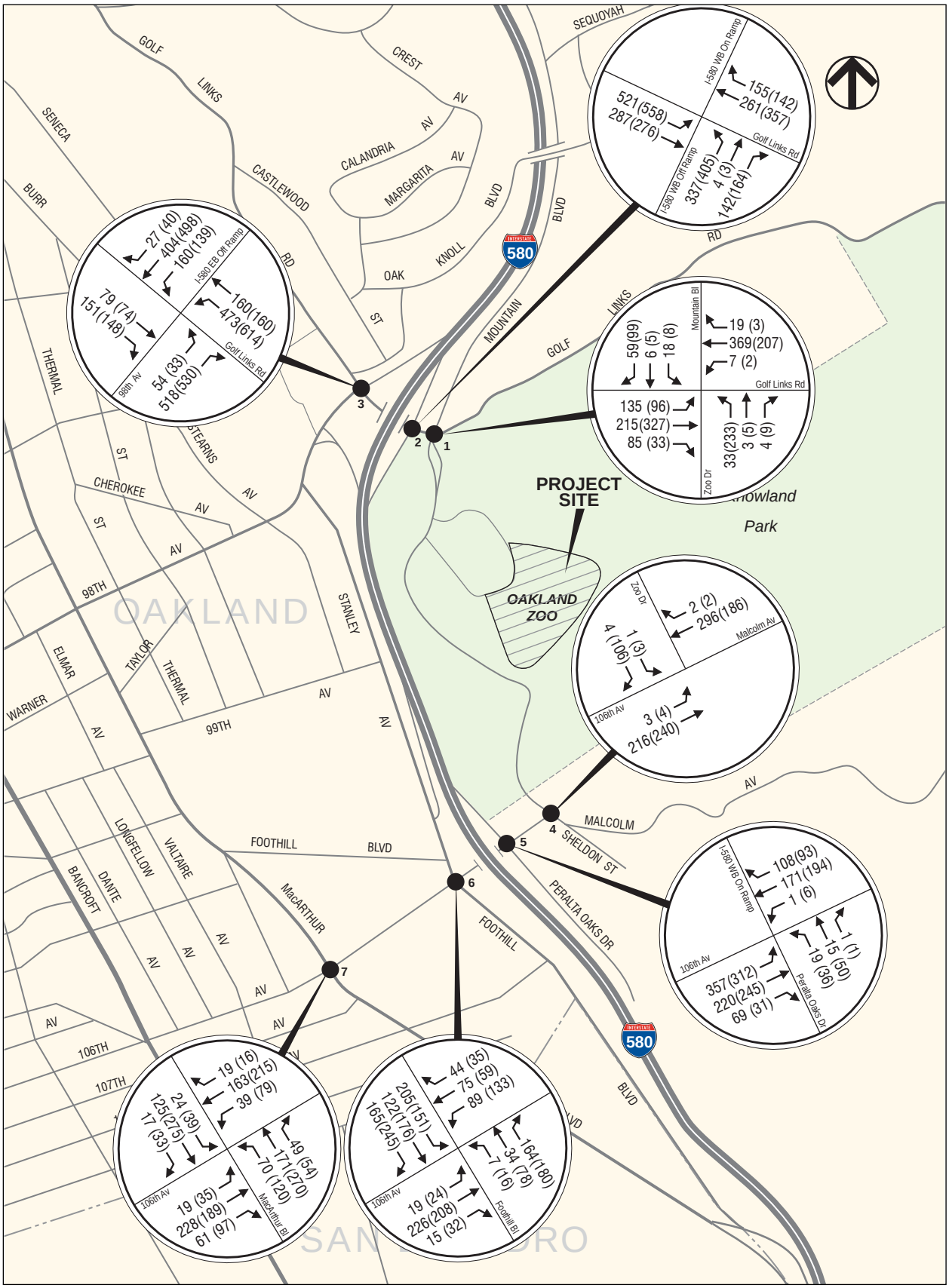
SOURCE: AECOM

Figure 3.10-4
Project Trip Distribution



SOURCE: AECOM

Figure 3.10-5
Project Traffic Volumes
Weekday AM (PM) Peak Hour



SOURCE: AECOM

Figure 3.10-6
Existing Plus Project Traffic Volumes
Weekday AM (PM) Peak Hour

TABLE 3.10-4: INTERSECTION LOS COMPARISON: EXISTING (BASELINE) AND EXISTING PLUS PROJECT CONDITIONS

#	Intersection	Traffic Control[1]	Peak Hour	Existing Conditions		Existing plus Project Conditions	
				LOS	Delay[2]	LOS	Delay[2]
1	Zoo Drive / Mountain Boulevard / Golf Links Road	TWSC	AM	B	10.3	B	10.3
			PM	B	11.7	C	15.5
2	Golf Links Road / I-580 Westbound on ramp	Signal	AM	C	22.9	C	23.9
			PM	C	33.2	C	33.3
3	Golf Links Road / I-580 Eastbound off ramp / 98th Avenue	Signal	AM	C	27.8	C	27.8
			PM	C	29.6	C	29.7
4	106th Avenue / Malcolm Avenue / Zoo Drive	OWSC	AM	A	0.0	A	9.9
			PM	A	9.8	A	9.8
5	106th Avenue / I-580 Westbound on ramp	AWSC	AM	B	11.8	B	11.8
			PM	B	11.6	B	11.6
6	106th Avenue / Foothill Boulevard	AWSC	AM	C	16.8	C	16.8
			PM	C	20.3	C	20.3
7	106th Avenue / MacArthur Boulevard	Signal	AM	A	9.6	A	9.6
			PM	B	11.1	B	11.1

Notes:
[1] AWSC = All-Way Stop Controlled; OWSC = One-Way Stop Controlled; TWSC = Three-Way Stop Controlled
[2] Delay measured in seconds per vehicle.

Source: AECOM, 2009.

phase. The majority of these trips would be made by small-medium flatbed trucks used primarily for delivery, and are expected to occur during the off-peak hours. Construction of the Veterinary Medical Hospital is expected to employ from 10 to 60 workers.

California!

Construction of California! is scheduled to occur in four sequential phases:

1. Perimeter Fence, Maintenance Road installation;

2. Animal Exhibits (Grizzly, Bison / Elk extension), Gondola Transport System, Overnight Campsite, Utility Line Trench and Pathways(partial);

3. Animal Exhibits (Wolf, Eagle, Black Bear, and Mountain Lion), Site Utilities and Pathways (partial); and,

4. Interpretive Center, Animal Exhibits (Jaguar, and Condor), Site Utilities and Pathways (complete).

During construction, the number of trucks that would come to and from the site varies depending on the phase. No trucks are expected during Phases 1 and 2, while a maximum of 81 trucks is expected during Phase 4, construction of the Visitor / Education Center, Animal Exhibits (Jaguar, and Condor), and completion of the Site Utilities and Pathways. In all phases, a majority of the trips would be made by small-medium flatbed trucks used primarily for delivery, and would be expected to occur during off-peak hours. Construction activities are expected to employ from five to 80 workers.

c : At a study signalized intersection outside the Downtown area where the level of service is LOS E, the project would cause the total intersection average vehicle delay to increase by four (4) or more seconds or degrade to worse than LOS E (i.e., F)?

All study intersections currently operate at LOS C or better and would continue to operate at LOS C or better with the proposed Project. See discussion under **Significance Criterion a** above.

d: At a study signalized intersection for all areas where the level of service is LOS E, the project would cause an increase in the average delay for any of the critical movements of six (6) seconds or more, or degrade to worse than LOS E (i.e., F)?

All study intersections currently operate at LOS C or better and would continue to operate at LOS C or better with the proposed Project. See discussion under **Criteria a** above.

e: At a study signalized intersection for all areas where the level of service is LOS F, the project would cause (a) the total intersection average vehicle delay to increase by two (2) or more seconds, or (b) an increase in average delay for any of the critical movements of four (4)seconds or more; or (c) the volume-to-capacity ("V/C") ratio exceeds three (3) percent but only if the delay values cannot be measured accurately)?

All study intersections currently operate at LOS C or better and would continue to operate at LOS C or better with the proposed Project. See discussion under **Criteria a** above.

f: At a study unsignalized intersection for all areas, the project would add ten (10) or more vehicles and after project completion satisfy the Manual on Uniform Traffic Control Devices (MUTCD) peak hour volume warrant.

The proposed Project would add eight new vehicle trips during the peak hour (three during the AM peak hour and five during PM peak hour) from what was identified in the MND. The proposed Project would satisfy the MUTCD peak hour volume warrant.

[A discussion of the California! AM and PM peak hour trips will be added in Administrative Draft #2.]

Cumulative Impacts: A project's contribution to cumulative impacts is considered "considerable" (i.e., significant) when the project exceeds at least one of the intersection-related thresholds listed above in threshold #a through #g for years 2015 and 2030.

Future Scenarios Traffic Operations

The traffic analysis was conducted following the guidelines established by the City of Oakland and using the Alameda County Congestion Management Agency (ACCMA) travel demand forecasting model. Evaluations were conducted for the following future scenarios:

- Year 2015 Conditions (Baseline);
- Year 2015 plus Project Conditions;
- Cumulative Year 2030 Conditions (Baseline); and
- Cumulative Year 2030 plus Project Conditions.

Year 2015 Conditions

Several local and regional projects have been proposed in the vicinity of the Oakland Zoo Project site that may impact traffic in the area. These projects include The Leona Quarry and Oak Knoll residential and mixed use developments. The Leona Quarry project is located about 2.5 miles northwest of the Zoo and consists of 477 single-family and multi-family residential units. The Oak Knoll project is a mixed use project to be developed at the 183-acre decommissioned Naval Medical Center located about 1.3 miles north of the Zoo. The Oak Knoll project proposes 960 single- and multi-family residential units. Forecasts for Year 2015 include an assumed annual Zoo attendance growth rate of two percent. The two percent annual growth rate represents a conservative figure for a projected annual growth rate over the next 15 years. The average attendance growth rate for other zoos located in the Western U.S. over the past ten years has been less than 1.5 percent.

By applying growth associated with the planned local and regional projects to the existing roadway network, Year 2015 traffic volumes are developed. By layering AM and PM peak hour Project-related trips (i.e., trips associated with the new projects during the given period) over Year 2015 traffic volumes, Year 2015 plus Project traffic volumes are derived. Levels of Service at each study intersection under both Year 2015 (Baseline) and Year 2015 plus Project Conditions during the AM and PM peak hour are summarized and compared in **Table 3.10-5**.

According to City of Oakland significance criteria the Project would not have a significant impact under Year 2015 plus Project Conditions.

TABLE 3.10-5: INTERSECTION LOS COMPARISON: YEAR 2015 (BASELINE) AND YEAR 2015 PLUS PROJECT CONDITIONS

#	Intersection	Traffic Control[1]	Peak Hour	Year 2015 (Baseline)		Year 2015 plus Project	
				LOS	Delay[2]	LOS	Delay[2]
1	Zoo Drive / Mountain Boulevard / Golf Links Road[3]	TWSC	AM	B	10.7	B	10.7
			PM	C	16.9	C	17.0
2	Golf Links Road / I-580 Westbound on ramp	Signal	AM	C	26.8	C	26.8
			PM	D	37.1	D	37.2
3	Golf Links Road / I-580 Eastbound off ramp / 98th Avenue	Signal	AM	C	29.3	C	29.2
			PM	C	32.1	C	32.1
4	106th Avenue / Malcolm Avenue / Zoo Drive	OWSC	AM	A	0.0	B	10.1
			PM	A	10.0	A	10.0
5	106th Avenue / I-580 Westbound on ramp	AWSC	AM	B	12.5	B	12.5
			PM	B	12.4	B	12.4
6	106th Avenue / Foothill Boulevard	AWSC	AM	C	24.3	C	24.4
			PM	C	23.9	C	24.0
7	106th Avenue / MacArthur Boulevard	Signal	AM	A	9.8	A	9.8
			PM	B	11.5	B	11.6

Notes:
[1] AWSC = All-Way Stop Controlled; OWSC = One-Way Stop Controlled; TWSC = Three-Way Stop Controlled
[2] Delay measured in seconds per vehicle.
[3] A modified HCM approach is applied at the Three-Way Stop Controlled intersection. Delay is presented for the worst stop controlled approach.

Source: AECOM, 2009.

Year 2030 Cumulative Conditions

Forecasts for Year 2030 include development from several local and regional projects that have are planned and approved in the vicinity of the Project site. Forecasts also include an assumed annual Zoo attendance growth rate of two percent. The two percent annual growth rate represents a conservative figure for a projected annual growth rate over the next 15 years. The average attendance growth rate for other zoos located in the Western U.S. over the past ten years has been less than 1.5 percent.

By applying growth associated with the planned local and regional projects to the existing roadway network, Year 2030 Cumulative traffic volumes are developed. By layering AM and PM peak hour Project-related trips over Year 2030 Cumulative traffic volumes, Year 2030 plus Project traffic volumes are derived. Levels of Service at each study intersection under Year 2030 (Baseline) and Year 2030 plus Project Conditions during the AM and PM peak hour are summarized in **Table 3.10-6**.

TABLE 3.10-6: INTERSECTION LOS COMPARISON – YEAR 2030 (BASELINE) AND YEAR 2030 PLUS PROJECT CONDITIONS

#	Intersection	Traffic Control[1]	Peak Hour	Year 2030 Cumulative (Baseline)		Year 2030 Cumulative plus Project	
				LOS	Delay[2]	LOS	Delay[2]
1	Zoo Drive / Mountain Boulevard / Golf Links Road	TWSC	AM	B	11.8	B	11.8
			PM	C	22.9	D	23.1
2	Golf Links Road / I-580 Westbound on ramp	Signal	AM	D	48.0	D	48.0
			PM	**E**	**66.0**	**E**	**66.4**
3	Golf Links Road / I-580 Eastbound off ramp / 98th Avenue	Signal	AM	D	40.5	D	40.6
			PM	D	44.0	D	44.1
4	106th Avenue / Malcolm Avenue / Zoo Drive	OWSC	AM	A	0.0	B	11.1
			PM	B	10.6	B	10.6
5	106th Avenue / I-580 Westbound on ramp	AWSC	AM	B	14.4	C	14.4
			PM	C	15.8	C	15.8
6	106th Avenue / Foothill Boulevard	AWSC	AM	**E**	**40.1**	**E**	**40.2**
			PM	**F**	**>50.0**	**F**	**>50.0**
7	106th Avenue / MacArthur Boulevard	Signal	AM	B	10.7	B	10.7
			PM	B	13.5	B	13.5

Notes:
[1] AWSC = All-Way Stop Controlled; OWSC = One-Way Stop Controlled; TWSC = Three-Way Stop Controlled
[2] Delay measured in seconds per vehicle.

Source: AECOM, 2009.

According to City of Oakland significance criteria the Project would not have a significant impact under Year 2030 plus Project Conditions.

[A discussion of how Zoo trips were accounted for in the cumulative analysis will be added in Administrative Draft #2.]

Planning-Related Non-CEQA Issues Applicable to the Proposed Project: include parking and transit.

Project Parking Demand

The Oakland Zoo currently provides 872 striped, and 300 unstriped parking spaces for staff and visitors. At Project completion, the existing total of 1172 spaces would remain, and no additional parking spaces would be provided. Observation has shown that existing supply will be enough to meet the maximum weekday AM and PM peak hour demand. There would be no significant impact.

Parking for construction workers would temporarily increase parking occupancy levels on-site. Construction workers would park in designated areas to avoid conflicts with visitor parking.

Local Transit Operations

The Oakland Zoo is currently served by AC Transit bus routes. Very few visitors arrive on public transportation and the proposed Project is not likely to increase ridership.

MITIGATION MEASURES

The proposed Project would not result in potentially significant new traffic and circulation impacts. The proposed Project would be subject to the City of Oakland Standard Conditions of Approval #24 which requires the preparation of a Construction Management Plan to mitigate temporary impacts associated with construction traffic.

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APPENDIX

A

CANDIDATE PHOTOS

1. I-580 southbound looking south

2. Bishop O'Dowd High School looking southeast

3. 106th Ave. at MacArthur Blvd. looking northeast

4. Hood St. near Mark St. looking north

5. Knowland Park trail looking west

6. Knowland Park trail looking west

7. Knowland Park trail looking southwest

8. Bemis Street looking northwest

9. Golf Links Road looking southeast

10. Royal Oak Road looking south

APPENDIX

B

RESULTS OF A TRAPPING SURVEY FOR ALAMEDA WHIPSNAKE

Results of a Trapping Survey for the Alameda Whipsnake (*Masticophis lateralis euryxanthus*) at the Proposed California Expansion Project Area of the Oakland Zoo City of Oakland, Alameda County, California

Prepared for
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1.0 INTRODUCTION

The purpose of this document is to present the results of a live trapping survey conducted f or the Alameda whipsnake (*Masticophis lateralis euryxanthus*) at the proposed California 1820Exhibit Expansion project area as proposed in the 1998 Mitigated Negative Declaration for the project. The second goal of this report is to provide information on the status of the Alameda whipsnake in the Oakland Zoo region based on more recent survey trapping survey data and to update the report based on changes being proposed to the Zoo Master Plan and the California Expansion Project In 1998 the project was called "California 1820" Currently, the project is called "California"

The project site is located just east of the existing Oakland Zoo in the City of Oakland, Alameda County (Figure 1) and lies within Knowland Park, just east of Interstate 580 at the Golf Links Road exit (Figure 2). Surveys were required in 1998due to the presence of potential whipsnake habitat in the project area.

The Alameda whipsnake is listed as a state and federally threatened species. The survey was conducted under the authority of a federal recovery permit (TE--815537) issued by the U.S. Fish and Wildlife Service (USFWS) and a Memorandum of Understanding from the California Department of Fish and Game (CDFG). The survey followed the 1998 protocol for pre-project surveys for the Alameda Whipsnake. At that time the protocol required a 90 day spring survey. Since that time the survey protocol for the species has changed and a fall component of trapping has been added.

2.0 ECOLOGY OF THE ALAMEDA WHIPSNAKE

The Alameda whipsnake is a slender, fast moving, diurnal snake with a narrow neck and relatively broad head (Stebbins 2003). The dorsal color is sooty-black with wide yellow-orange dorso-lateral stripes (Riemer 1954). The anterior portion of the stripes and ventral surface of the snake are heavily pigmented with orange-rufous coloration. Adults reach up to five feet in length. The Alameda whipsnake and the chaparral whipsnake (*Masticophis lateralis lateralis*) make up the two subspecies of the California whipsnake (*Masticophis lateralis*) (U.S. Department of Interior, 2000Adults can reach up to five feet in length (Swaim 1994).

The Alameda whipsnake uses the mosaic of habitats found in the East Bay, with the highest frequency of use in and near scrub and chaparral habitats including chamise chaparral, Diablan sage scrub, northern coyote brush scrub, and riparian scrub (Swaim 1994). Swaim (1994) also found that there was extensive use of grassland and oak woodland/savanna adjacent to chaparral and scrub communities by Alameda whipsnakes equipped with radio transmitters. The home ranges of six radio-equipped whipsnakes were centered on scrub communities. Core areas (areas of concentrated use) were on east, south, southeast, southwest-facing slopes with open or partially open canopy scrub or chaparral communities. Whipsnakes ranged into the surrounding grassland for distances of greater than 500 feet (Swaim 1994). Whipsnakes remained in the grassland for periods ranging from a few hours to several weeks at a time (Swaim 1994). Grassland habitats were used by male whipsnakes most extensively during the mating season in

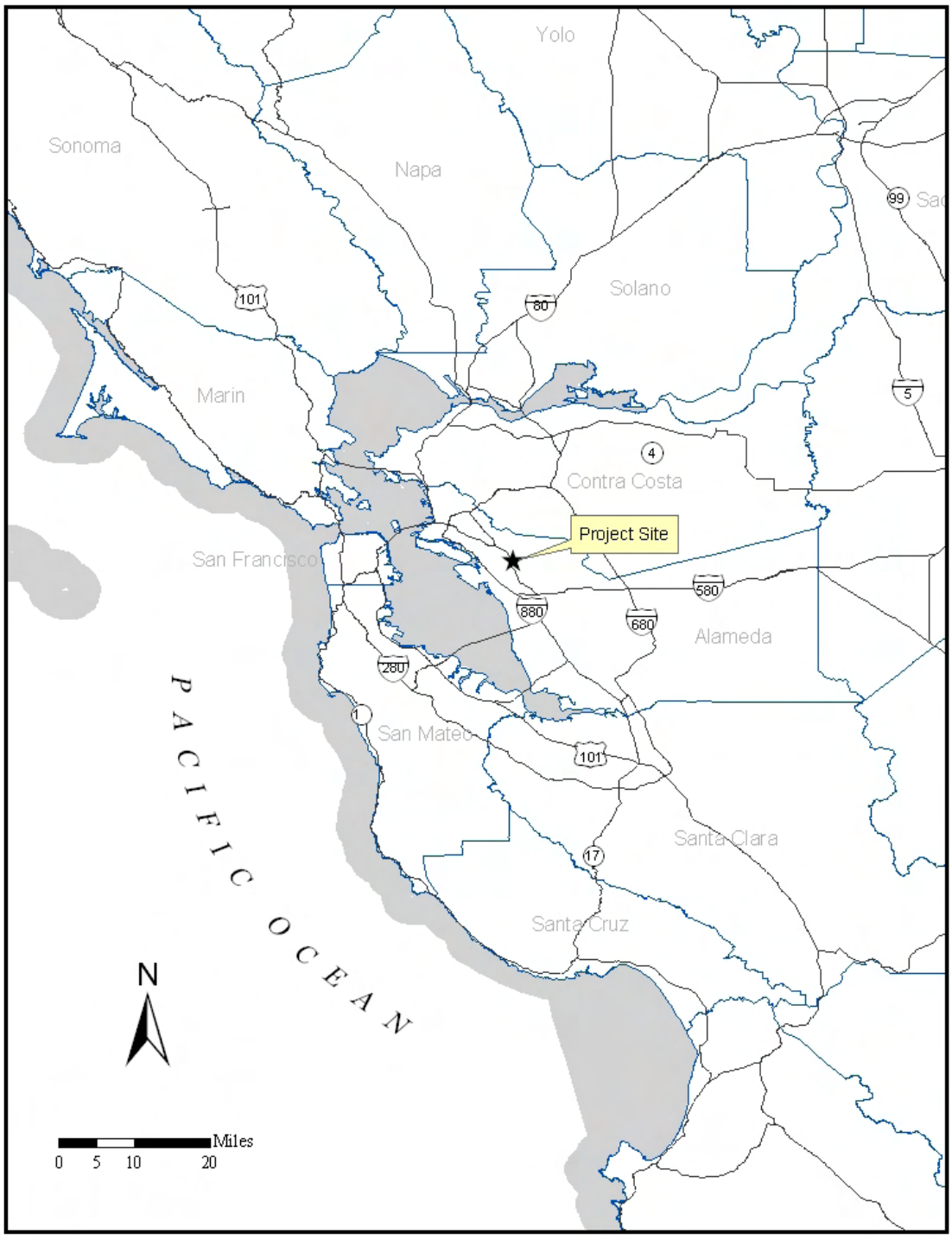


Figure 1. Regional Location Map

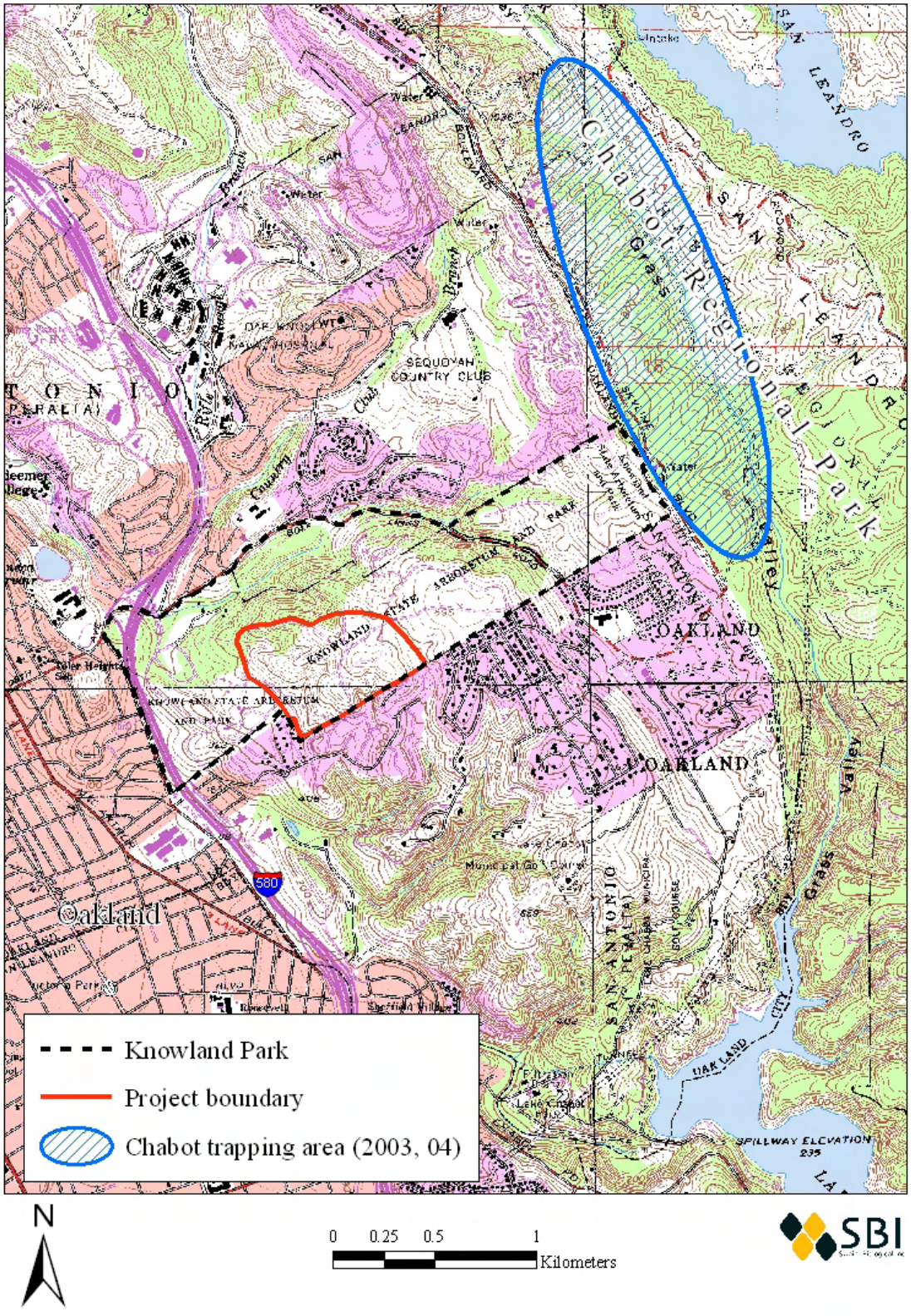


Figure 2. Study Site Location and Surrounding Area.

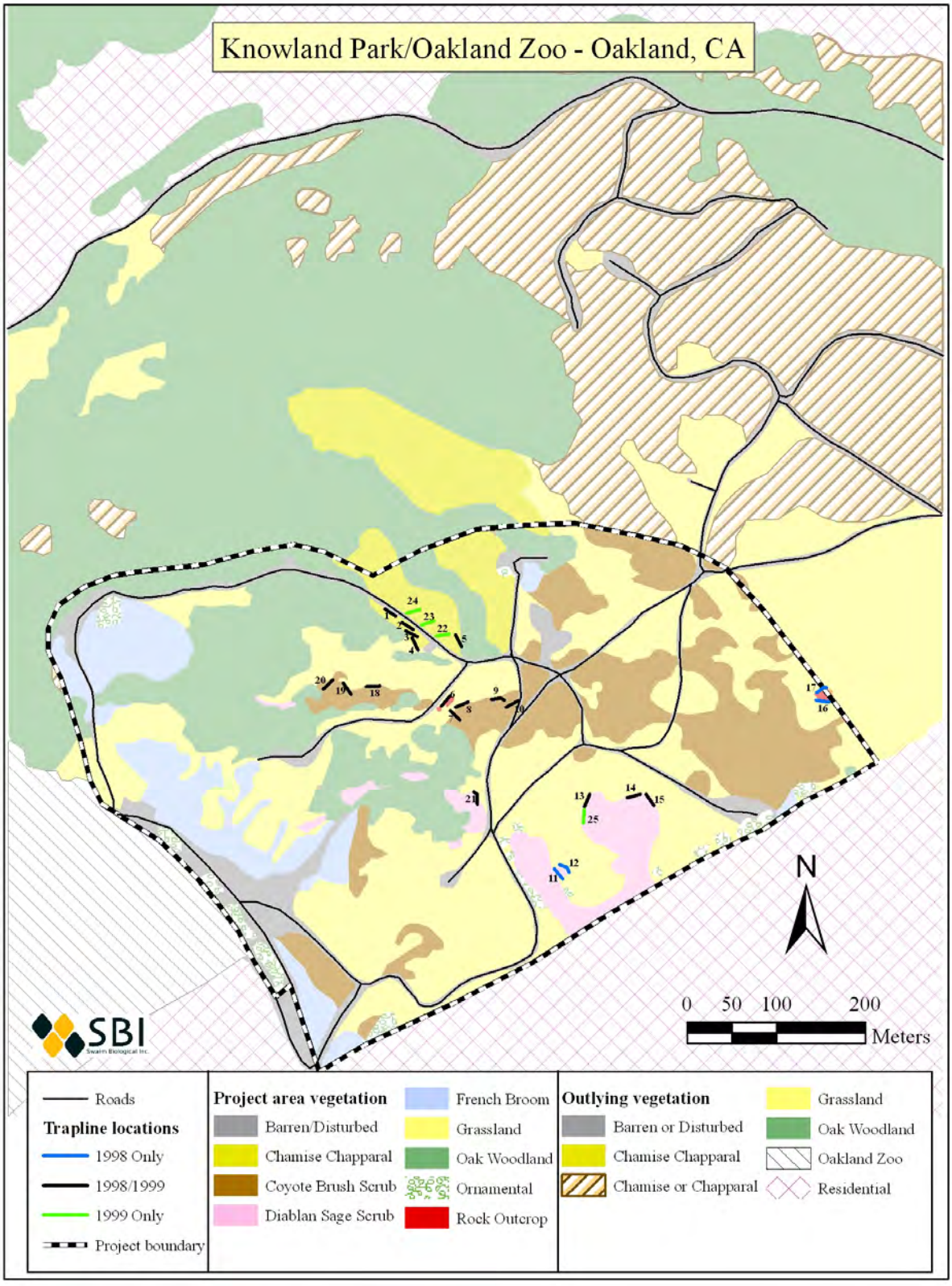


Figure 3. Vegetation Cover and Trapline Placement.

spring (Swaim 1994). Female whipsnake used grassland areas most extensively after mating, possibly in their search for suitable egg-laying sites (Swaim 1994). Anecdotal information also indicates Alameda whipsnakes can be found even greater distances from scrub and chaparral habitats (up to approximately four miles) in grassland and oak savanna (Swaim 2000a, 2000b.

Rock outcrops are also enhance the habitat for Alameda whipsnake because they provide cover and promote abundant lizard populations. However rock outcrops were not present at all study areas where whipsnakes have been documented.

Records of the Alameda whipsnake in the project vicinity include a historic locality from the City of Oakland Leona Heights Park approximately three miles northwest of the site, East Bay Municipal Utility District watershed lands approximately three miles east of the project area and a road kill specimen from Redwood Road in Castro Valley approximately three miles southeast of the project area (Figure 4).

3.0 DESCRIPTION OF THE STUDY AREA

Vegetative communities (Holland 1986) present in the study area include non-native grassland, needle grass grassland, Diablan sage scrub, french broom scrub, northern coyote brush scrub, chamise chaparral, coast-live oak woodland, barren and disturbed, and ornamental. A description of each community, summarized from previous environmental documents, is provided below. Figure 3 shows the distribution of these communities in the study area and vicinity, with the native and annual grasslands combined.

3.1 Non-native Grassland

This grassy vegetation type is dominated by introduced annual grasses and herbs. The predominant grass species are wild oats (*Avena fatua*), several species of brome (*Bromus* spp.), Italian ryegrass (*Lolium multiflorum*), farmer's foxtail (*Hordeum murinum* ssp. *leporinum*), and several species of annual fescue (*Vulpia* spp.). This natural community is being rapidly replaced by non-native French broom scrub.

3.2 Needlegrass Grassland

This herbaceous natural community contains a visible component of native perennial grasses, such as purple needlegrass (*Nasella pulchra*), narrow needlegrass (*N. lepida*), California oatgrass (*Danthonia californica*), and junegrass (*Koeleria cristata*). The native perennial grasses are generally not the dominant species, as measured by percent cover, but are usually present at densities of at least several clumps per square meter. Nearly all of the grasslands in the study area support noticeable stands of perennial grasses. There is evidence of a variety of native herbs in many areas.

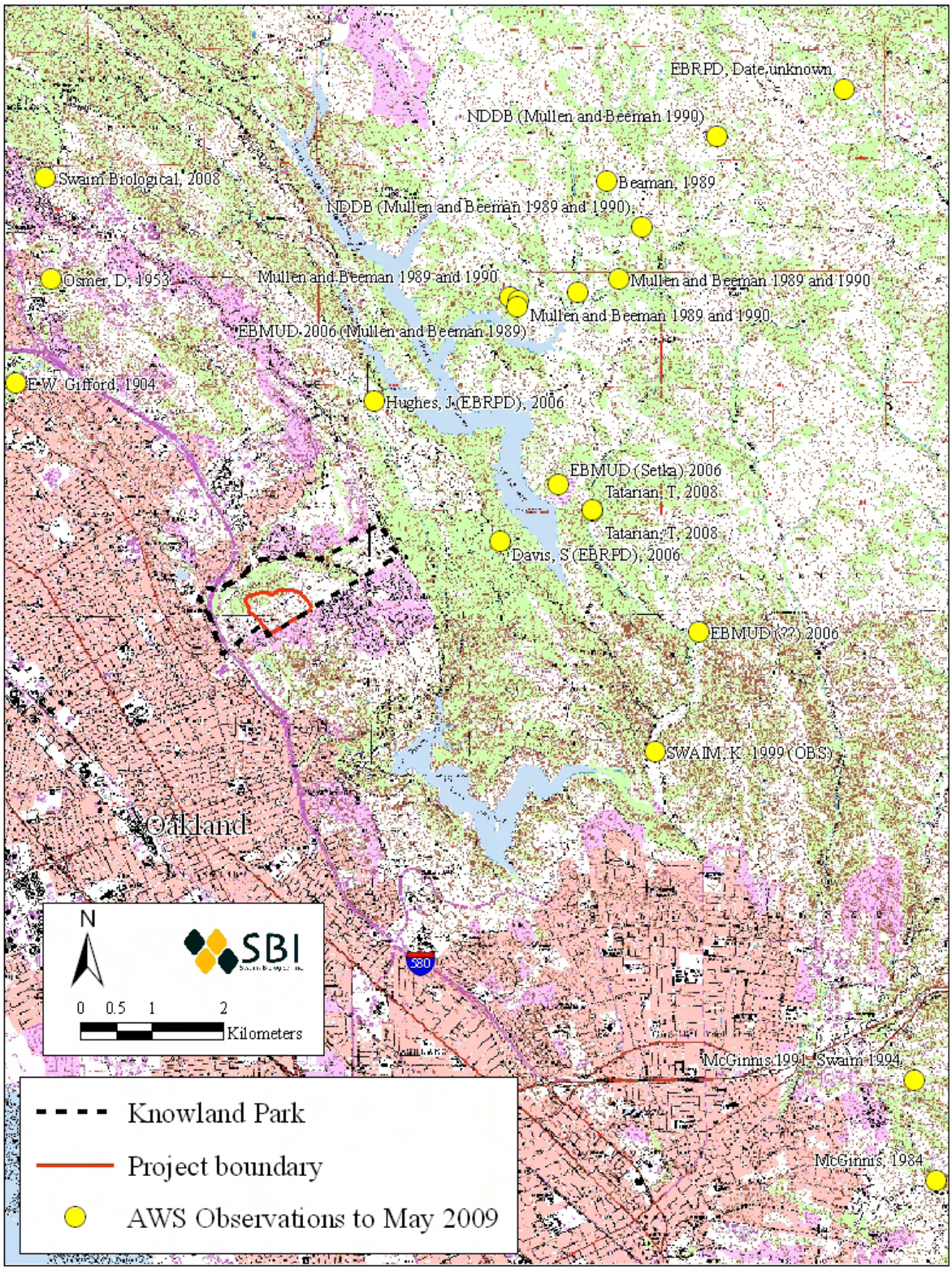


Figure 4. Alameda Whipsnake Observations in the Project Vicinity. (ZOOM in more)

3.3 Northern Coyote Brush Scrub

This natural community is dominated by a single species, coyote brush (*Baccharis pilularis*), although several other shrubby species are present, such as poison-oak (*Toxicodendron diversilobum*), bush monkeyflower (*Mimulus aurantiacus*), coffeeberry (*Rhamnus californica),* elderberry (*Sambucus mexicana*), and coastal sagebrush (*Artemisia californica*). The understory usually resembles the adjacent grasslands. Northern coyote brush scrub tends to encroach into grasslands in the absence of fire or browsing by large herbivores. Likewise, this natural community tends to be invaded by coast live oaks (*Quercus agrifolia*) and California bay (*Umbellularia californica*) in moister sites, deeper soils, and in the absence of other disturbance. Northern coyote brush scrub is on many parts of the upper elevations of the site.

3.4 Diablan Sage Scrub

Diablan coastal sage scrub is dominated by coastal sagebrush, poison-oak, bush monkeyflower, and occasional coyote brush. Coastal sage scrub is typically confined to relatively steep, rocky, often south-facing slopes, as it is in the study area. Patches too small to map were found in the canyon through which the hiking trail is proposed. There is much intergradation of Diablan sage scrub and Northern coyote brush scrub, since the predominant of one natural community is almost always found in the other, though in lesser amounts. Intermediate or transitional vegetation was mapped as Diablan sage scrub because of its importance as wildlife habitat.

3.5 Chamise Chaparral

This natural community is dominated by chamise (*Adenostoma fasciculatum*), growing in tall (up to 10 feet or more), dense stands. In the study area, several other woody species were found in chamise chaparral: on the more shaded slopes with deeper soil, silktassel (*Garrya elliptica*), brittle manzanita (*Arctostaphylos tomentosa* ssp. *crustacea*), coyote brush, poison-oak and coast live oak occur. On more exposed slopes, often in particularly rocky places, small patches or isolated individuals of coastal sagebrush and bush monkeyflower are found. There is little understory in this natural community within the study area. Chamise chaparral is a natural community adapted to repeated fires (Holland 1986) due to its ability to stump sprout. In the study area, however, the stands do not appear to have experienced fire in many decades. The shrubs are tall and somewhat decadent. Chamise chaparral is found on the south-and west-facing slopes of the upper part of the study area, on very steep slopes.

3.6 French Broom Scrub

This vegetation type is not described by Holland (1986), although it occupies extensive and increasing acreage in the coastal regions of California. It is dominated by a non-native shrub, French broom (*Genista monspessulana*) which forms a nearly pure stand. French broom invades grasslands, coyote brush scrub and open oak savanna, out competing much of the understory.

Soil disturbance greatly encourages the spread of French broom. French broom is in every natural community within the study area.

3.7 Coast Live Oak Woodland

This natural community varies from an open savanna with herbaceous or shrubby understory to a closed-canopy woodland. It is dominated by coast live oak. The second most frequently occurring tree is California bay. Other species that occur occasionally in the study area are California buckeye (*Aesculus californica*) and elderberry. The understory of this community varies. When the oaks have an open canopy, the understory is much the same as the adjacent needlegrass grassland or open Northern coyote brush scrub. When coast live oak woodland exists as a closed-canopy woodland, there is a rich understory of herbs and shrubs, including poison-oak, hazelnut (*Corylus cornuta* var. *californica*), gooseberry (*Ribes* spp.), snowberry (*Symphoricarpos albus* var. *laevigatus*), and blackberry (*Rubus* spp.). Coast live oak woodland occurs throughout the study area on shaded, often on north-or east-facing slopes.

3.8 Barren/Disturbed/Developed

A number of areas have been disturbed and de-vegetated, but now support a sparse or weedy vegetation, mostly of non-native plants. Such areas include the compost area and the graded dirt roads. The roads support a variety of non-native species, including sand-spurry (*Spergularia rubra*), plantain (*Plantago* spp.), pigweed (*Chenopodium album*), skunkweed (*Navarretia squarrosa*) and knotweed (*Polygonum arenastrum*). Most such species are well adapted to hard-packed soils and trampling. The compost area supports a different assemblage of species, many thistles belonging to the genera *Cirsium*, *Centaurea*, and *Carduus*, as well as vegetables and fruit such as cantaloupe, pumpkin, and other cultivated species, resulting from discarded food materials from the zoo.

4.0 MATERIALS AND METHODS

The survey was conducted from April 16, 1998 through July 17, 1998 and May 21 through June 21, 1999. Although 90 days of trapping were conducted during 1998, as required by the survey protocol at that time. A total of 25 to 30 days during the survey period were lost due to rainy and/or cold foggy weather the San Francisco Bay Area experienced during the spring of 1998. The period of trapping during 1999 was conducted to make up for the days of trapping lost during 1998. A total of 21 traplines were placed in the areas with the highest quality potential whipsnake habitat in the California 1820 study area as planned at that time. These areas included open and partially open canopy stands of chamise chaparral, coyote brush scrub, Diablan sage scrub, rock outcrops and the ecotone of scrub and grassland communities (Figure 3). Trapline placement was slightly different in 1998 versus 1999 (Figure 3). A trapline consists of an approximately 50-foot length of drift fence with a double funneled trap at each end. Drift fences were constructed with 1/8 inch thick hardboard and were a minimum of 14 inches high (above the surface) with approximately two inches buried in the ground. Where slopes were particularly

steep drift fences were 20-22 inches in height. Traps consisted of a wooden frame with large panels of 1/8 inch wire mesh during the 1998 survey. During the 1998 survey period, the traps used measured 12 inches wide, 12 inches high, and 16 inches long (Figure 5). During the 1999 survey, minnow traps constructed of 1/4 inch hardware cloth supported by a metal frame were used. Written permission from the California Department of Fish and Game and the U.S. Fish and Wildlife Service to use the 1/4 inch wire mesh is on file at Swaim Biological Consulting. The traps used in 1999 measured 8 inches high and wide and 16 inches long. A piece of wire mesh was attached to the outside edge of each trap so that the total width of the entrance funnel measured 12 inches (Figure 5). Traplines were checked at least every other day during the study period. Each time the traps were monitored vertebrate species captured and the location of capture were recorded. Most snake species were measured and marked for individual recognition by clipping a certain ventral scale.

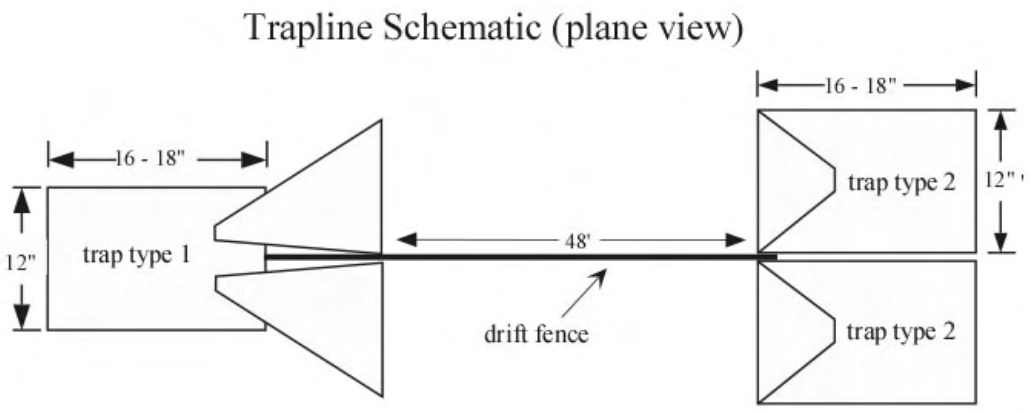
5.0 RESULTS

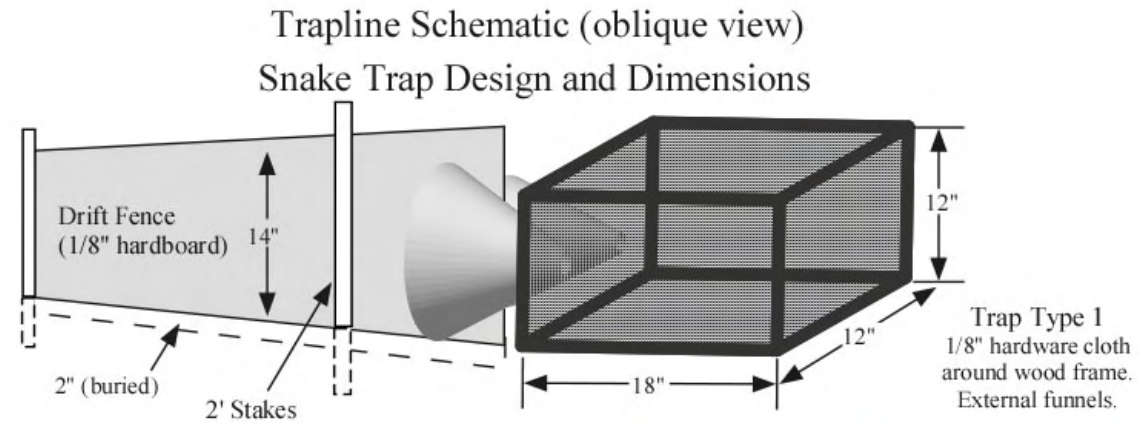
No Alameda whipsnakes were captured or observed during the survey periods in 1998 or 1999. A total of seventeen vertebrate species were captured including four amphibians species, three lizard species, five snake species and five small mammal species. The common and scientific name and number of captures for each species is summarized in Table 1. The most commonly captured snake species was the western yellow-bellied racer (*Coluber constrictor mormon*). Like the Alameda whipsnake, this species is more visually oriented and generally prefers higher ambient temperatures than the other snake species captured on the site. The relatively high number of captures of this species suggests the traplines were functioning well. A total of 44 captures were made of 27 individual racers in 1998 and 11 captures of 10 individuals were made in 1999. One of the individuals had been captured during the 1998 survey.

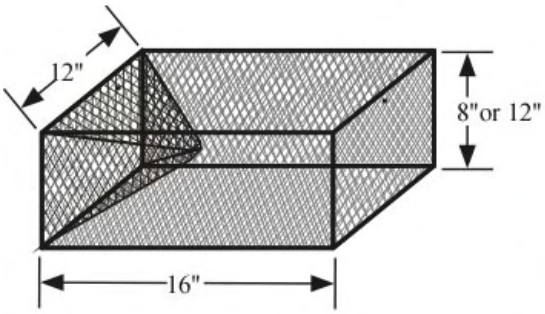
6.0 DISCUSSION AND RECOMMENDATIONS

The negative finding during this survey indicates that it is unlikely that a resident population of the Alameda whipsnake inhabited the study area in 1998-1999. The negative finding is strengthened by the presence of physically suitable core type habitat in the project area that was available to trap during the study. When high quality core habitat is present and AWS are detected they are usually relatively abundant. During the same time period using the same methodology, six captures of Alameda whipsnakes were made during a survey conducted by Swaim Biological Consulting at a site on the Walpert Ridge in the Hayward Hills Swaim Biological 2000). Five of the whipsnake captures at the Hayward site were from scrub habitat and one was from grassland habitat. The Oakland Zoo survey actually had more traplines in the scrub than the Hayward Hills survey (20 at Oakland versus 15 at the Hayward site).

The historic distribution of the Alameda whipsnake would suggest that the area was contiguous with occupied habitat prior to large scale development in the area. The study area has physically suitable habitat and appeared to have an adequate lizard prey base. However, the quality of the habitat is likely reduced by the relatively small and isolated nature of the study area surrounded by residential development to the north and south, existing zoo development to the west, and a







Trap Type 2
1/4" aluminum screen
around metal frame.
Internal funnel.

Example of actual trapline set up.

Figure 5. Trapline Schematic and Trap Designs.

Table 1. Vertebrate species captured from April 16, 1998 through July 17, 1998 and May 21 and June 21, 1999 at the proposed Oakland Zoo California 1820 Expansion area.

Common Name	Scientific Name	1998	1999
Arboreal Salamander	*Aneides lugubris*	8	1
California Slender Salamander	*Batrachoseps attenuatus*	42	0
Coast Range Newt	*Taricha torosa torosa*	45	8
Pacific Chorus Frog	*Pseudacris regilla*	2	1
California Alligator Lizard	*Elgaria multicarinata multicarinata*	205	48
Skilton Skink	*Eumeces skiltonianus skiltonianus*	160	6
Western Fence Lizard	*Sceloporus occidentalis*	725	195
Alameda Whipsnake	***Masticophis lateralis euryxanthus***	**0**	**0**
Western Yellow-bellied Racer	*Coluber constrictor mormon*	44	11
Sharp-tailed Snake	*Contia tenuis*	10	0
Pacific Gopher Snake	*Pituophis catenifer catenifer*	18	11
Ring-necked Snake	*Diadophis punctatus*	9	0
California Kingsnake	*Lampropeltis getula*	4	2
Western Harvest Mouse	*Reithrodontomys megalotis*	75	6
Black Rat	*Rattus rattus*	1	0
California Meadow Vole	*Microtus californicus*	78	30
Deer Mouse	*Peromyscus* spp.	45	12
Botta's Pocket Gopher	*Thomomys bottae*	1	0

Table 2. Total Vertebrates Captured 2003 – 2004. Anthony Chabot Regional Park.

Scientific Name	Common Name	2003	2004
Aneides lugubris	Arboreal Salamander	0	0
Batrachoseps attenuatus	California Slender Salamander	1	2
Callipepla californica	California Quail	23	4
Chaetodipus californicus	California Pocket Mouse	4	5
Coluber constrictor mormon	Western Yellow-bellied Racer	197	52
Contia tenuis	Sharp-tailed Snake	14	8
Diadophis punctatus	Ring-necked Snake	15	5
Elgaria multicarinata multicarinata	California Alligator Lizard	246	103
Ensatina eschscholtzii xanthoptica	Yellow-eyed Salamander	5	4
Eumeces gilberti cancellosus	Varigated Skink	3	0
Eumeces skiltonianus skiltonianus	Skilton Skink	42	39
Lampropeltis getula	California Kingsnake	9	3
Masticophis lateralis euryxanthus	**Alameda Whipsnake**	**0**	**0**
Microtus californicus	California Meadow Vole	35	20
Neotoma fuscipes	Dusky-Footed Wood Rat	2	0
Peromyscus spp.	Deer Mouse	249	103
Pituophis catenifer catenifer	Pacific Gopher Snake	98	33
Pseudacris regilla	Pacific Chorus Frog	0	0
Rattus rattus	Black Rat	0	0
Reithrodontomys megalotis	Western Harvest Mouse	173	134
Sceloporus occidentalis	Western Fence Lizard	586	346
Sorex spp.	Shrew	73	40
Taricha torosa torosa	Coast Range Newt	11	5
Thamnophis atratus atratus	Santa Cruz Aquatic Garter Snake	18	5
Thamnophis elegans terrestris	Coast Garter Snake	10	6
Thomomys bottae	Botta's Pocket Gopher	4	3
Thyromanes bewickii	Bewick's Wren	16	0

major road (Golf Links) to the east. The site is a relatively narrow island of habitat (between 0.3 and 0.5 miles wide) that has been isolated for several decades by the residential development to the north and south and the existing Oakland Zoo to the west. To the east, a major road (Golf Links Road) bisects Knowland Park into two areas. This road does not function as a complete barrier to movement, but likely is a significant deterrent. The potential for whipsnakes moving into the site from the closest known occupied habitat to the east is limited by the need to cross both Golf Links Road and Skyline Boulevard further to the east (Figure 4).

Since the survey was conducted at the expansion area, additional surveys have been conducted in the region. Surveys in 2003 and 2004 along Skyline Blvd in Anthony Chabot Regional Park for the EBRPD, produced negative results for AWS (Swaim Biological, Inc 2003b, 2004). This survey was part of a larger research project investigating the effects of vegetation management practices on AWS. The study area is on the western edge of the park the urban- wildland interface, adjacent to Skyline Blvd (Figure 3). The Chabot surveys were split into two seasonal trapping efforts to coincide with spring and fall peaks of AWS activity. The 2003 spring season ran from 19 May to 1 August, and the fall season spanned 24 September to 25 October. The 2004 spring season ran from 12 May to 16 July, and the fall season spanned 10 September to 11 October. Traps were active for 96 days (64 in the spring and 32 in the fall) in 2003 and 91 days (60 days in the spring and 31 days in the fall) in 2004 (Table 1).

In addition, the site is a relatively narrow island of habitat (between 0.3 and 0.5 miles wide) that has been isolated for several decades by the residential development to the north and south and the existing Oakland Zoo to the west. To the east, Golf LinksRoad bisects Knowland Park into two areas. This road does not function as a barrier to movement, but may be a deterrent. The potential for whipsnakes moving into the site from the closest known occupied habitat to the east is limited by the need to cross both Golf Links Road and Skyline Boulevard further to the east (Figure 4). Although a resident population of the whipsnake does not currently inhabit the study area, there are no major barriers between occupied habitat east of Skyline Boulevard and the study area. This leaves open the potential for a wandering whipsnake to occasionally enter the eastern portion of Knowland Park and possibly the study are on a very infrequent basis.

The lack of AWS at Anthony Chabot Regional Park is most likely due to the marginal AWS habitat quality. No significant rock outcroppings exist in the study area. Large, nearly continuous stands of eucalyptus border the study area to the east. These stands may present a deterrent to AWS moving into the study area. Based on the negative findings, it appears that a resident population of the AWS does not currently occupy the study area or the immediate vicinity of the study area.

Although it is unlikely whipsnakes are present in Knowland Park, including the Zoo Expansion project area area, the long amount of time (10 years) and changes to the protocol warrant confirming the status of the Alameda whipsnake on the project site by conducting a survey using the current protocol. This would require a 45 day fall trapping survey followed by a 90 day spring survey.

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APPENDIX

C

ALAMEDA WHIPSNAKE HABITAT EVALUATION

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July 24, 2009

Ms. Patricia Jeffrey
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RE: Alameda Whipsnake Habitat Evaluation Oakland Zoo Master Plan Update

Dear Ms. Jeffrey:

Swaim Biological, Inc. was retained by Placemakers to provide an updated habitat evaluation on the potential effects of the proposed Oakland Zoo Master Plan on the State and federally-threatened Alameda whipsnake (*Masticophis lateralis euryxanthus*), comparing the impacts to potential Alameda whipsnake (AWS) habitat associated with the currently proposed project with that previously analyzed in the Mitigated Negative Declaration (MND) adopted for the project in 1998. Since 1998, the original Master Plan has been revised to eliminate two new access roads and replace a shuttle road with a gondola, refine the exhibit areas in the original "California 1820" area, include a new Overnight Experience area, and construct a new Vet Hospital where the original River Exhibit was to be located. The new California! Exhibit defines proposed exhibit areas and visitor serving uses in the vicinity of the original "California 1820" exhibit areas.

The project site includes habitat features which are suitable for the AWS. However, the AWS has not been found in the project vicinity during recent trapping efforts. In 1998-99, Swaim Biological, Inc. conducted a protocol survey for the AWS for the Oakland Zoo, and no AWS were trapped or observed. Additionally, trapping surveys conducted on the adjacent Chabot Regional Park in 2003-04 by Swaim Biological and were also negative. Based on these results, it is anticipated that the project site is not likely to be occupied by AWS.

Since the surveys were completed on the project site in 1999, the level of survey effort required for the U.S. Fish and Wildlife Service (USFWS) protocols has increased. In addition, the project area has changed and some locations that may now be impacted were not specifically trapped (see Attachment A). Given the length of time that has elapsed since completion of the earlier surveys, the change in the survey protocol, and the project revisions, the Oakland Zoo will complete additional protocol level surveys for AWS in 2009-10 to re-confirm the status of the AWS on the property. The surveys will be conducted in the areas of Knowland Park with the highest potential to support AWS, if present. No trap lines will be placed within the

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Vet Hospital area as it is includes only marginal habitat, is less than ½ acres, and is dominated by French broom and stockpiled, compost. Further, it is separated from the higher quality scrub/chaparral habitat and is adjacent to the existing developed portion of the zoo.

To evaluate impacts to potential AWS habitat, Swaim Biological identified the land cover and habitat features found on the project site. Swaim Biological then compared the amount and types of vegetation impacted by the currently proposed CA Exhibit with the previously approved California 1820 Exhibit. Tables 1 and 2 (See Attachments B and C) provide a summary of the various habitat types affected under the original California 1820 (Attachment B) and currently proposed California! Exhibit (Attachment C).

Attachment C shows a map of existing vegetative cover types on the site, and the degree of disturbance associated with the revised California! Exhibit. This map separates those areas that would be considered permanent impacts with a high level of disturbance (i.e., structures, roadways, pathways, etc.), those areas with limited disturbance (i.e. visitor use and day-time exhibit areas), and those with low disturbance (i.e. non-display exhibit areas and larger animal enclosure areas), based on mapping provided by the project landscape architect, PJA. Temporary impacts would include the joint trench for utility installation.

Vegetation Impacts

California 1820

As summarized in the 1998 MND, California 1820 would have directly impacted 36.3 acres of potential AWS habitat in exhibit areas. The proposed Shuttle Road that would have served California 1820 would have affected an additional 58 acres of potential AWS habitat by enclosing those habitat areas within the proposed Shuttle Road. Shuttle vehicles would have run frequently along the route during the daytime when AWS are active, and could have created an impediment to snake movement into the enclosed habitat areas, or resulted in an inadvertent take, if snakes are present. The proposed Shuttle Road has been eliminated in the new California! Exhibit and replaced with a gondola for visitors, and upgrades to the existing fire road for maintenance only access.

California!

The California! Exhibit has reduced the permanent impacts to 20.56 acres of potential AWS habitat, including and estimated 0.81 acres associated with widening

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the existing fire road to sever as the future maintenance road. The maintenance road would also be paved. An estimated 4.0 acres would also be temporarily disturbed along an existing fire road and paddock area during installation of a utility trench that would serve the California! Exhibit area, improvements to the maintenance road, and the Snowdown EVA road, .also affecting potential AWS habitat. By eliminating the Shuttle Road and transporting visitors to the exhibit area by gondola, the California! Exhibit would also lessen potential direct impacts to individual AWS through reduced or eliminated mortality on project roadways.

Project Configuration Comparison.

The new configuration of the California! Exhibit is more compact and causes significantly less fragmentation of potential AWS habitat. This reduction in affected acreage, combined with the removal of the Shuttle Road, lessens the projects potential impacts on the AWS, if present on the site, as well as the natural habitat for other wildlife in Knowland Park.

Please call if you have any questions or comment regarding this AWS Habitat Evaluation for the Oakland Zoo Master Plan update.

Sincerely,

Karen E. Swaim

Karen E. Swaim
Herpetologist

Attachments: A: Revised 2009 Project with 1998-99 AWS Survey Traplines;
B: Table of Estimated Vegetation Impacts, California 1820
C: Table of Estimated Vegetation Impacts California!
D: Vegetation Cover and Project Disturbance Areas.

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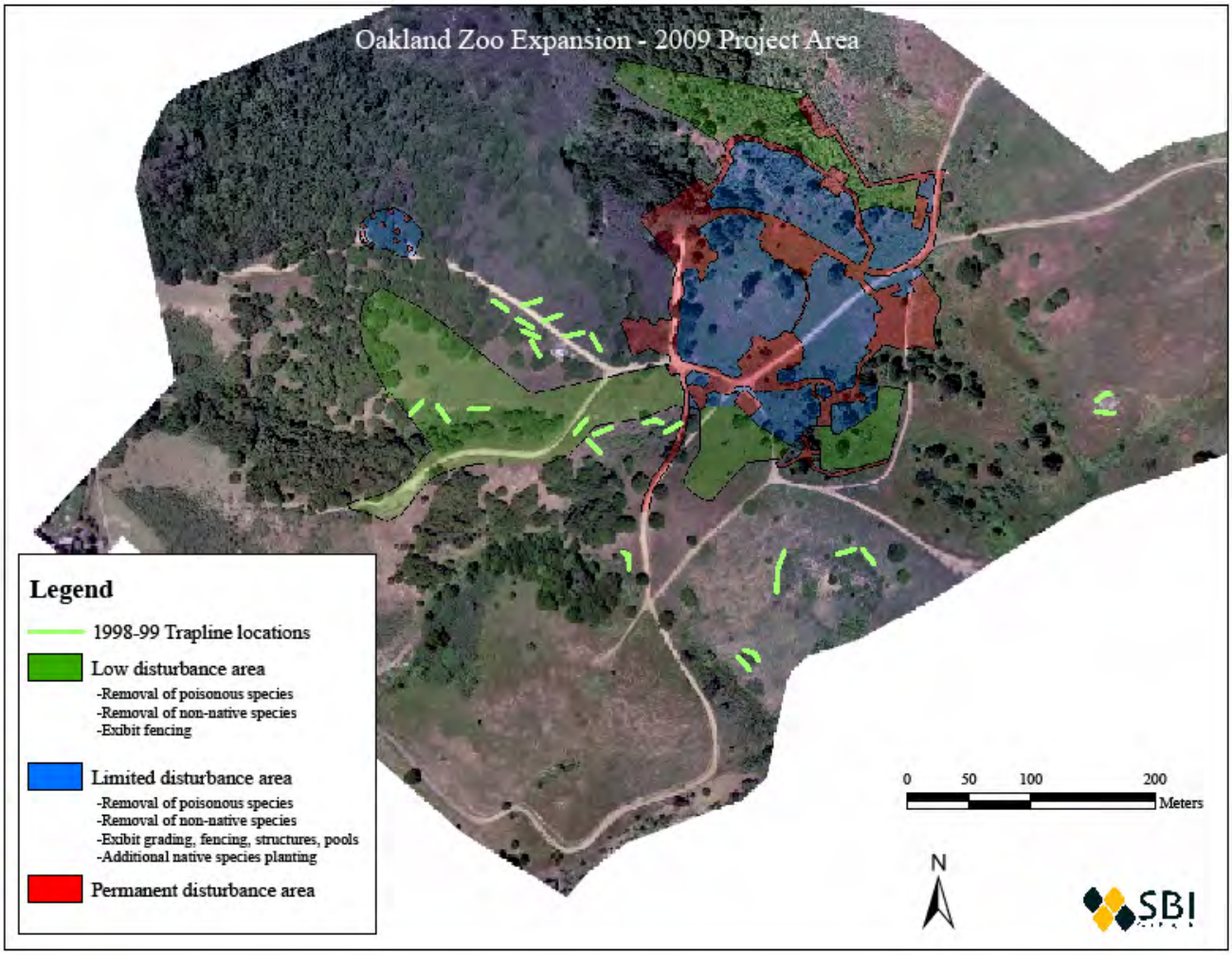
Attachment A: 2009 Project with 1998-1999 AWS Survey Trapline Locations



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Attachment B

Table 1. Estimated Vegetation Impacts: Comparison Between Current Proposed Project (California!) and original California 1820 Evaluated in 1998 MND.

California 1820	Chamise Chaparral	Diablan Sage Scrub	Coyote Brush Scrub	French Broom Scrub	Grassland	Oak Woodland	Barren or Disturbed	Ornamental	Totals
Bison	3.6	0	0.7	0	3.5	0			**7.8**
Breeding	0	0	0	0	0	0.8			**0.8**
Wolf	0	0.4	1.4	0.2	1.5	0.2			**3.7**
River	0	0.2	0.3	5.6	5	0.5			**11.6**
Canyon	0	0	0	4.2	0.9	7.3			**12.4**
Total Exhibit Acreage	3.6	0.6	2.4	10	10.9	8.8			**36.3**
Enclosed by shuttle but outside exhibits	0	1.3	5.8	4	18.9	28			**58**
Totals 1998	**3.6**	**1.9**	**8.2**	**14**	**29.8**	**36.8**			**94.3**

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Attachment C:

Table 2: Estimated Vegetation Impacts: Current Proposed Project -California!-

California!	Chamise Chaparral	Diablan Sage Scrub	Coyote Brush Scrub	French Broom Scrub	Grassland	Oak Woodland	Barren or Disturbed	Ornamental	Totals
Permanent Impacts*									
Maximum + Limited	0.24	0	4.25	0.17	3.79	0.89	1.53	0.02	**10.89**
Low Disturbance	0.32	0	2.82	0	3.17	1.15	0.54	0	**8**
Vet Hospital	0	0	0	0.5	0.03	0	0.33	0	**0.86**
Maintenance Road (pave 16' wide area)	0	0	0	0	0.2	0	0.59	0.02	**0.81**
Total	0.6	0	7.07	0.67	7.19	2.04	2.99	0.04	**20.56**

	Chamise Chaparral	Diablan Sage Scrub	Coyote Brush Scrub	French Broom Scrub	Grassland	Oak Woodland	Barren or Disturbed	Ornamental	Totals
Temporary Impacts *									
Veterinary Hospital **	0	0	0.03	0.48	0.24	0	0.58	0	1.33
Joint Trench	0	0	0.01	0.06	0.31	0	0.15	0	**0.53**
Maintenance Road (40 ft wide total grading)	0	0.01	0.04	0	0.71	0	0.95	0.07	1.78
Snowdown EVA Road	0	0	0	0	0.13	0	0.63	0	0.76
Total	0	0.01	0.08	0.54	1.39	0	2.31	0.07	4.4

Gondola Line (Towers)

** Aliquot estimated 20% beyond limit

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Attachment D: Vegetation Cover and Project Disturbance

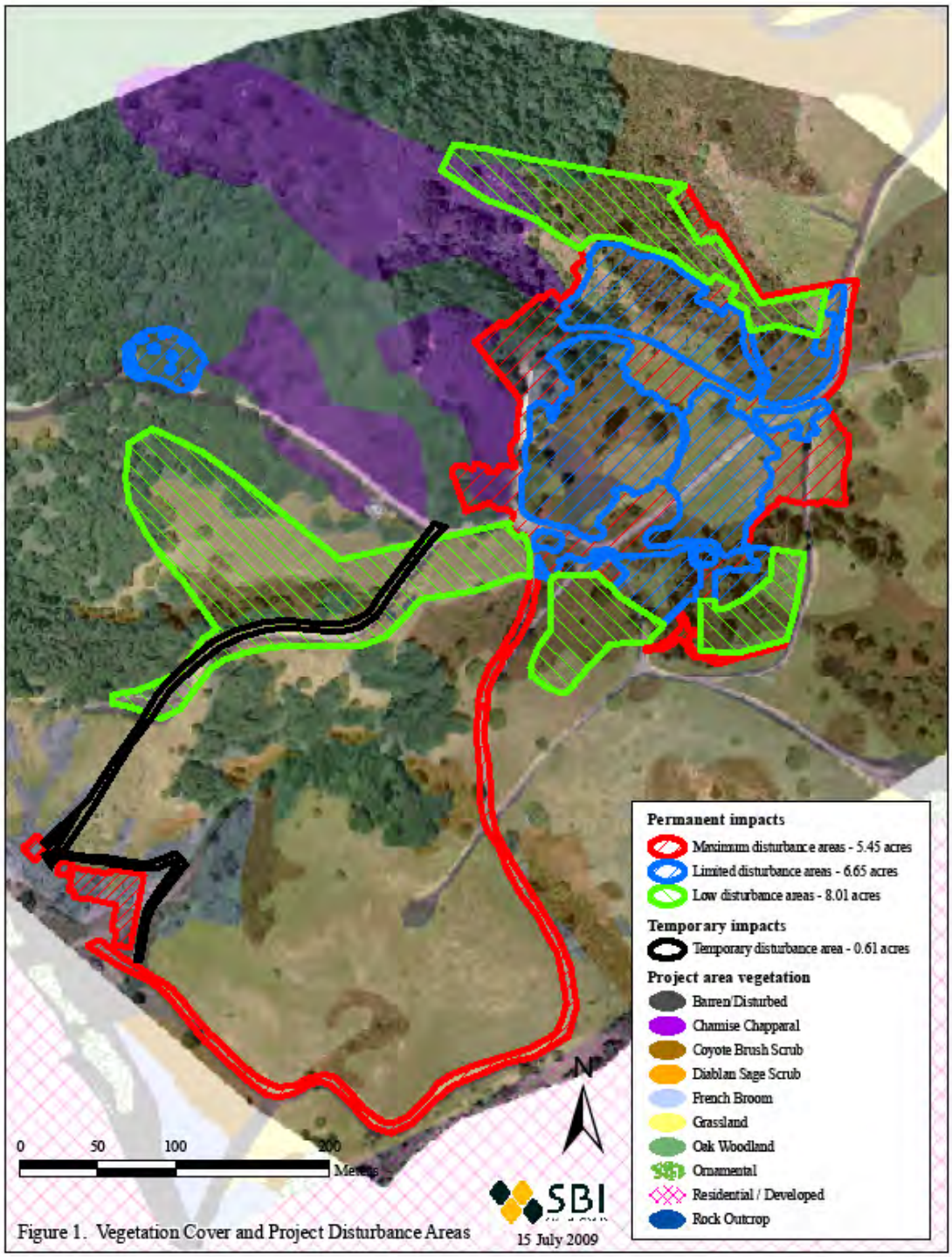

Figure 1. Vegetation Cover and Project Disturbance Areas

APPENDIX

D

ALAMEDA WHIPSNAKE CONCEPTUAL MITIGATION PLAN

Swaim Biological Inc.
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(925) 455-6106 (fax)

July 24, 2009

Ms. Patricia Jeffrey
Placemakers
1500 Park Avenue, Loft 310
Emeryville, CA 94608

RE: Conceptual Mitigation Plan for the Oakland Zoo Master Plan

Dear Ms. Jeffrey:

This Conceptual Mitigation Plan has been prepared by Swaim Biological, Inc., to update the previous mitigation measures and conditions of approval imposed on the Oakland Zoo to address possible impacts to Alameda whipsnake (AWS) and its potential habitat on the project site associated with the 1998 approval of the Oakland Zoo Master Plan. The level and type of mitigation implemented for impacts to potential AWS habitat in the California Exhibit and Overnight Camping area will be dependent on whether or not this species is confirmed to be present or a negative fining is obtained during the supplemental protocol surveys, as outlined below. For the Veterinary Medical Hospital area, construction avoidance measures are sufficient to ensure that no take occurs and construction of this facility will not have a negative impact on AWS habitat. These avoidance measures are provided under "Measures If AWS Surveys Are Negative" in the next section.

Swaim Biological, Inc. conducted a protocol survey for the AWS for the Oakland Zoo in 1998 and 1999 and no AWS were trapped or observed. Since that time, the level of survey effort required for the U.S. Fish and Wildlife Service (USFWS) protocols has increased. In addition, the project area has changed and some locations that may now be impacted were not specifically trapped (Attachment A). Given the length of time that has elapsed since completion of the earlier surveys, the change in the survey protocol, and the project revisions, the Oakland Zoo will complete additional protocol level surveys for AWS in 2009-10 in the California! Exhibit area and the Overnight Camping Area to re-confirm the status of the AWS on the property.

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Measures If AWS Surveys Are Negative

If the 2009-10 protocol level AWS trapping surveys are negative, measures will be implemented to ensure no incidental take of AWS will occur during project construction in the unlikely event that an individual AWS were to disperse into the site during project construction. These measures will also be implemented at the Vet Hospital area where no trapping will be conducted.

A biological monitor would be involved in overseeing construction for the duration of the project and to provide construction crew training. In the remote and unexpected circumstance that an individual AWS were to disperse into the site during construction, all work would stop and the USFWS and California Department of Fish and Game (CDFG) would be consulted. Additional measures would be implemented as required by the regulatory agencies to avoid any take of AWS.

Measures If AWS Are Confirmed Present

If AWS are confirmed to be present in Knowland Park during the supplemental protocol surveys, the project shall implement the standard conditions of approval per the City of Oakland as well as the measures included in the 1998 MND. The 1998 MND was adopted prior to completion of the AWS surveys and therefore was premised on an assumption that the AWS were present on site and would be impacted by the project.

Standard Conditions of Approval (City of Oakland).

The following list of conditions of approval have been adopted by the City of Oakland for construction projects in <u>confirmed</u> AWS habitat. For the purposes of the proposed Oakland Zoo California! Exhibit, modifications or clarifications, if needed, are provided in italics and underlined in the text of each condition.

1. **<u>Whipsnake Habitat, Biological Monitor</u>**
   Prior to issuance of a demolition, grading, or building permit and ongoing throughout demolition, grading, and/or construction
   If the project is located within confirmed Alameda Whipsnake Habitat area, the project applicant shall hire an on-site biological monitor who is qualified to identify Alameda Whipsnakes. The on-site biological monitor shall instruct the project superintendent and the construction crews (primarily the clearing,

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demolition and foundation crews) of the potential presence, status and identification of Alameda Whipsnakes. The biological monitor shall also provide information to the Planning and Zoning Division on the steps to take if a whipsnake is seen on the project site, including who to contact, to ensure that whipsnakes are not harmed or killed, as regulation by the federal Endangered Species Act.

2. **Whipsnake Habitat, Placement of Debris**
Prior to issuance of a demolition, grading, or building permit and throughout construction
If the project is located within confirmed Alameda Whipsnake Habitat area, the project applicant shall ensure that the placement of construction debris is limited to the area immediately adjacent to the foundation of the proposed buildings or and to the area between the foundation and the street. Install flexible construction fencing at the limit of work line (approximately ten feet beyond the foundation of the proposed building other than in the direction of the street). Such construction fencing shall limit the placement of construction materials and construction debris to inside the fencing.

3. **Whipsnake Habitat, Barrier Fence**
Prior to issuance of a demolition, grading, or building permit and throughout construction
If the project is located within confirmed Alameda Whipsnake Habitat area, the project applicant shall install a solid fence along the real limit of construction line, and for a distance of **insert distance** perpendicular to the real line, to prevent whipsnakes from entering the work site.

SBI Note: The resource agencies typically require that an exclusion fence enclose the work site or construction area rather than have fences along on select sides of the project area because whipsnakes will follow the fence and go around the ends. An alternative to this is to have traps at the ends of exclusion fence segments that allow capture and relocation of AWS away from the construction area. This would negate the need to determine a distance perpendicular to the real line of construction for fence placement.

The snake barrier shall be constructed as follows and shall remain in place throughout the entire construction period:

.

a) Plywood sheets at least three feet in height *above ground*; *Heavy duty geotextile fabric approved by USFWS and CDFG may also be used for snake exclusion fences*

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b) Buried four ~~*foot*~~ *to* six inches into the ground;
c) Soil back-filled against the plywood fence to create a solid barrier at the ground;
d) Plywood sheets maintained in an upright position with wooden or masonry stakes;
e) Ends of each plywood sheet overlapped to ensure a continuous barrier.

4. **Whipsnake Habitat, Downsloping Lots**
Prior to issuance of a demolition, grading, or building permit and throughout construction
If the project is located within confirmed Alameda Whipsnake Habitat area, the project applicant shall install erosion control devices, such as hay bales, at the downhill limit of construction line to prevent rocks and soil from moving downhill.

Proposed Addition to City Standards:

No erosion control materials with plastic or nylon monofilament netting shall be used.

Project Specific Mitigation Measures

The 1998 MND included measures to mitigate impacts to AWS based on an assumption that AWS were present on the site. If this assumption is confirmed in the 2009-10 protocol level surveys, these measures will be implemented. Following are the applicable mitigation measures which have been amplified and clarified. The condition number from the MND is indicated following each condition.

1. Obtain incidental take authorization from the California Department of Fish and Game and the U.S. Fish and Wildlife Service (condition 14c). A compensatory mitigation program will be prepared by a qualified biologist in consultation with and subject to approval of CDFG and USFWS. The compensation program will include avoidance measures, long-term management measures for avoided habitat, and long-term preservation of suitable AWS habitat, through on- or off-site, or a combination thereof.

2. All removal of scrub or chaparral habitat shall be done by hand with axes or

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machetes. Chain saws could be used for larger shrubs (condition 14d).

3. A biologist qualified to handle Alameda whipsnake shall monitor all scrub or chaparral removal and all construction activities which may impact the Alameda whipsnake (14e).

4. Alameda whipsnake habitat shall be preserved in perpetuity and will be managed for the benefit of the AWS. The amount of compensatory mitigation required will be subject to the requirements of CDFG and USFWS but shall at a minimum be equal to 3:1 ratio for permanent impacts and 1:1 ratio for temporary impacts (14f).

5. To reduce the potential for mortality on the maintenance road, a maximum speed of 10 miles per hour shall be required and personnel driving to the off-site breeding exhibit will be instructed to watch for and yield to all wildlife (14g).

6. Vegetative management will be undertaken onsite to ensure long-term viability of AWS habitat, including removal and control of French broom and selective thinning of chamise chaparral (14h). .

Please call if you have any questions or comment regarding this Conceptual Mitigation Plan.

Sincerely,

Karen E. Swaim

Karen E. Swaim
Herpetologist

Attachments: A: Revised 2009 Project with 1998-99 AWS Survey Traplines;

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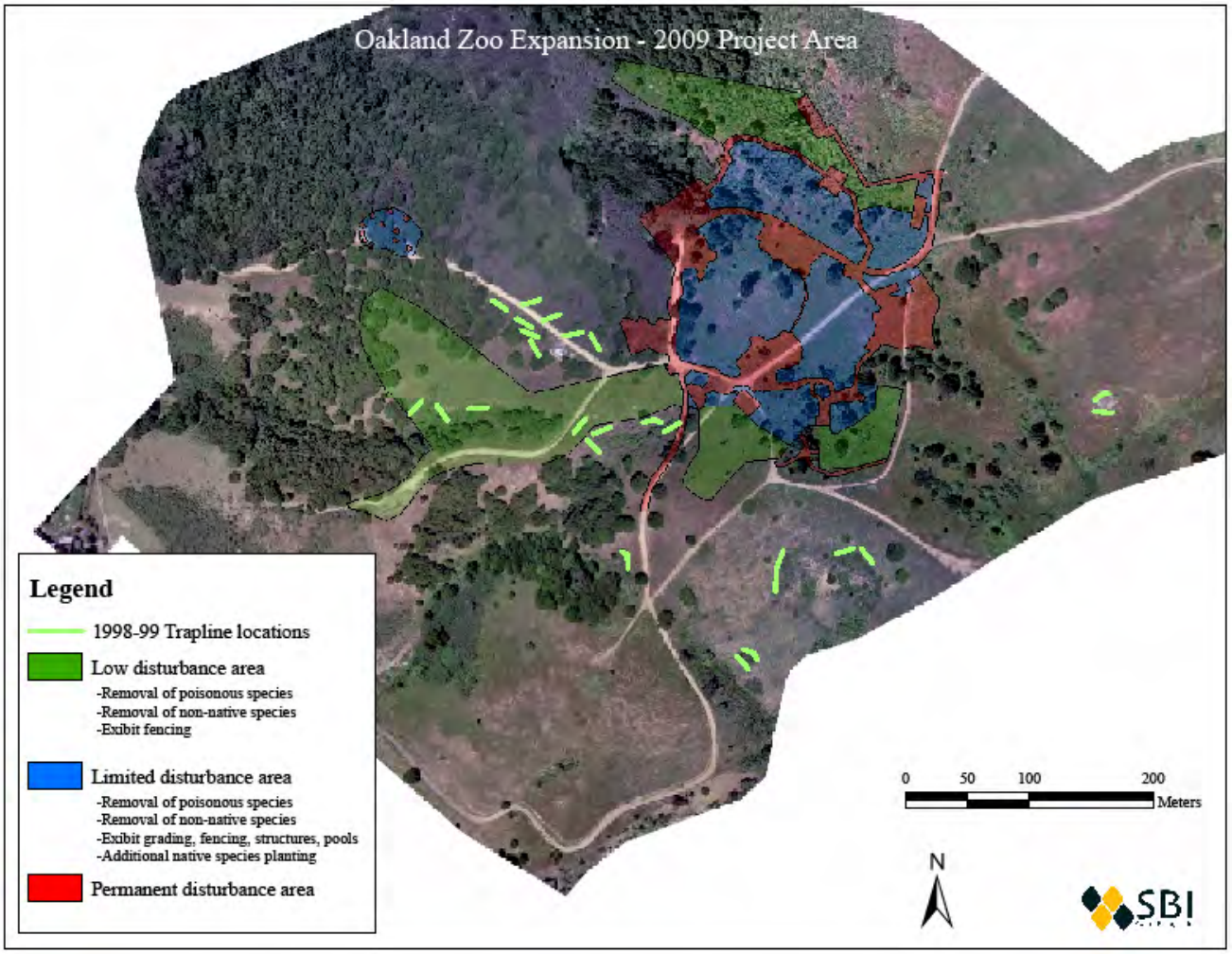
Attachment A.
2009 Project with 1998-1999 AWS Survey Trapline Locations



APPENDIX

E

TRAFFIC ANALYSIS WORKSHEETS

APPENDIX A

INTERSECTION TURNING MOVEMENT COUNTS

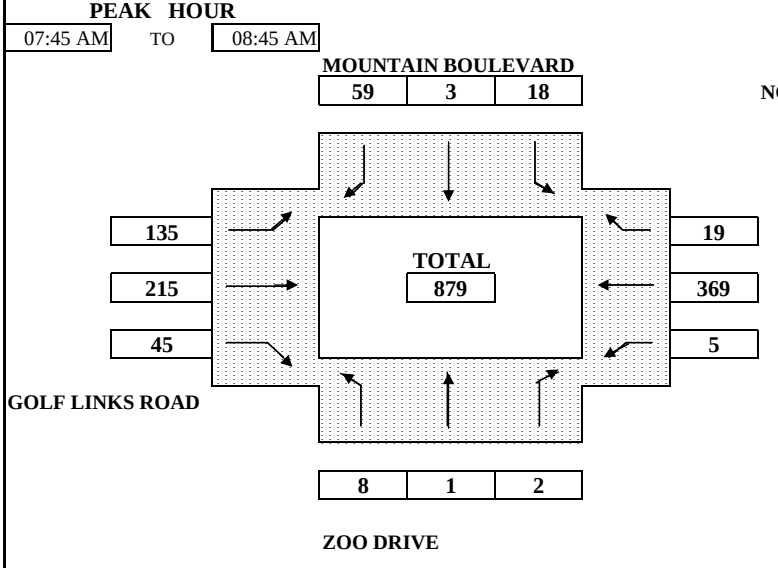
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

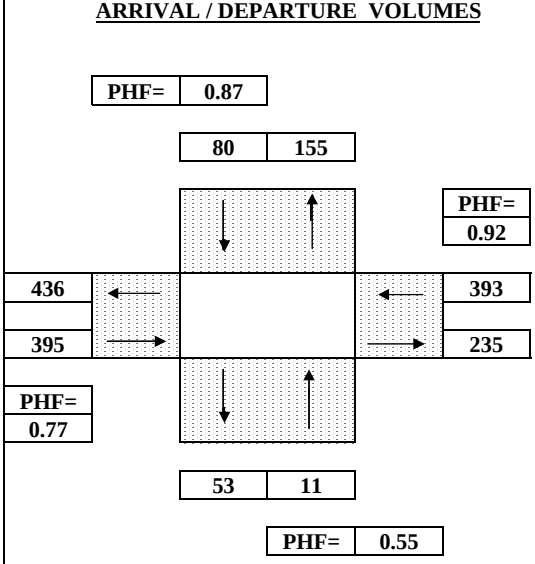
PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**MOUNTAIN BOULEVARD / ZOO DRIVE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W Approach:	**GOLF LINKS ROAD**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-1AM**

PEAK HOUR

07:45 AM TO 08:45 AM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
7:00 AM	---	7:15 AM	0	0	1	0	0	12	12	48	3	0	61	3	***140***
7:15 AM	---	7:30 AM	0	0	1	0	0	24	31	87	10	0	126	4	***283***
7:30 AM	---	7:45 AM	1	0	2	0	1	30	58	134	17	0	201	6	***450***
7:45 AM	---	8:00 AM	3	1	2	1	1	45	97	174	37	1	282	7	***651***
8:00 AM	---	8:15 AM	7	1	3	4	2	60	123	222	44	2	375	10	***853***
8:15 AM	---	8:30 AM	8	1	3	13	3	72	162	299	56	3	474	16	***1,110***
8:30 AM	---	8:45 AM	9	1	4	18	4	89	193	349	62	5	570	25	***1,329***
8:45 AM	---	9:00 AM	12	2	4	19	4	109	217	389	77	5	638	27	***1,503***
TOTAL BY PERIOD															
7:00 AM	---	7:15 AM	0	0	1	0	0	12	12	48	3	0	61	3	***140***
7:15 AM	---	7:30 AM	0	0	0	0	0	12	19	39	7	0	65	1	***143***
7:30 AM	---	7:45 AM	1	0	1	0	1	6	27	47	7	0	75	2	***167***
7:45 AM	---	8:00 AM	2	1	0	1	0	15	39	40	20	1	81	1	***201***
8:00 AM	---	8:15 AM	4	0	1	3	1	15	26	48	7	1	93	3	***202***
8:15 AM	---	8:30 AM	1	0	0	9	1	12	39	77	12	1	99	6	***257***
8:30 AM	---	8:45 AM	1	0	1	5	1	17	31	50	6	2	96	9	***219***
8:45 AM	---	9:00 AM	3	1	0	1	0	20	24	40	15	0	68	2	***174***
HOURLY TOTALS															
7:00 AM	---	8:00 AM	3	1	2	1	1	45	97	174	37	1	282	7	***651***
7:15 AM	---	8:15 AM	7	1	2	4	2	48	111	174	41	2	314	7	***713***
7:30 AM	---	8:30 AM	8	1	2	13	3	48	131	212	46	3	348	12	***827***
7:45 AM	---	8:45 AM	8	1	2	18	3	59	135	215	45	5	369	19	***879***
8:00 AM	---	9:00 AM	9	1	2	18	3	64	120	215	40	4	356	20	***852***

Telephone: (510)232-1271 **Fax: (510)232-1272**

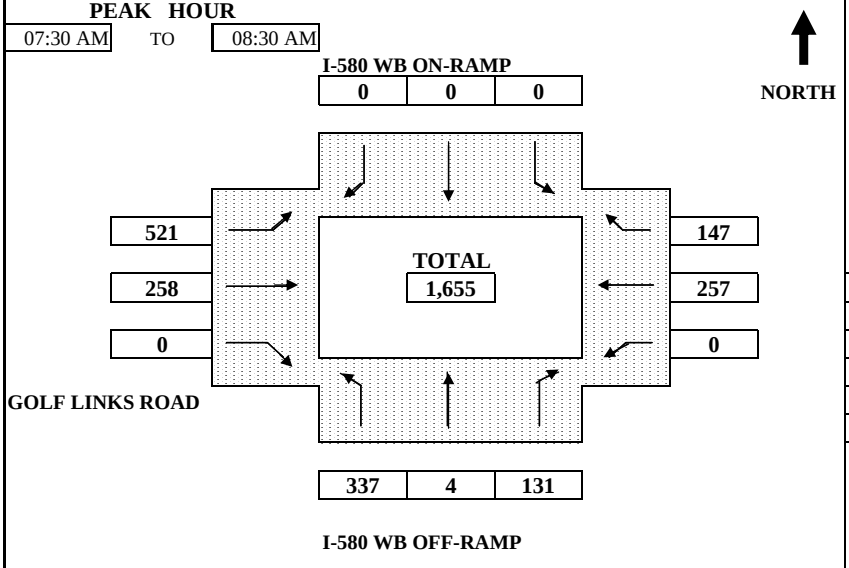
B . A . Y . M . E . T . R . I . C . S .

INTERSECTION TURNING MOVEMENT SUMMARY

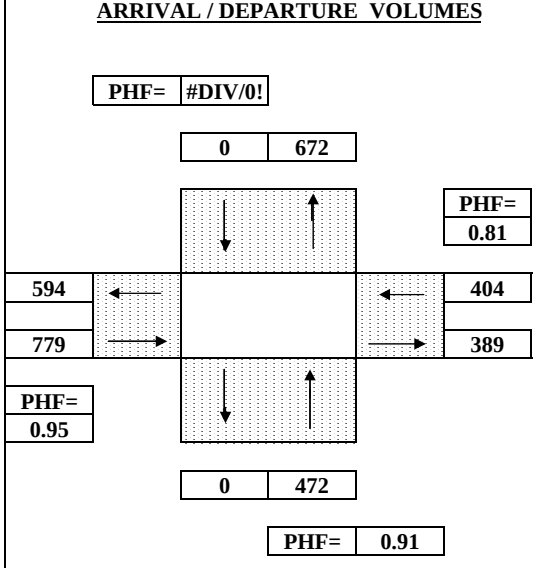
PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**I-580 WB OFF-RAMP / I-580 WB ON-RAMP**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W Approach:	**GOLF LINKS ROAD**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-2AM**

PEAK HOUR

07:30 AM TO 08:30 AM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
7:00 AM	---	7:15 AM	49	1	14	0	0	0	106	49	0	0	47	26	***292***
7:15 AM	---	7:30 AM	123	1	41	0	0	0	235	87	0	0	96	54	***637***
7:30 AM	---	7:45 AM	215	1	65	0	0	0	380	144	0	0	150	87	***1,042***
7:45 AM	---	8:00 AM	304	1	106	0	0	0	526	202	0	0	215	125	***1,479***
8:00 AM	---	8:15 AM	395	2	136	0	0	0	655	263	0	0	287	155	***1,893***
8:15 AM	---	8:30 AM	460	5	172	0	0	0	756	345	0	0	353	201	***2,292***
8:30 AM	---	8:45 AM	556	5	190	0	0	0	845	414	0	0	433	245	***2,688***
8:45 AM	---	9:00 AM	651	5	207	0	0	0	958	476	0	0	490	269	***3,056***
TOTAL BY PERIOD															
7:00 AM	---	7:15 AM	49	1	14	0	0	0	106	49	0	0	47	26	***292***
7:15 AM	---	7:30 AM	74	0	27	0	0	0	129	38	0	0	49	28	***345***
7:30 AM	---	7:45 AM	92	0	24	0	0	0	145	57	0	0	54	33	***405***
7:45 AM	---	8:00 AM	89	0	41	0	0	0	146	58	0	0	65	38	***437***
8:00 AM	---	8:15 AM	91	1	30	0	0	0	129	61	0	0	72	30	***414***
8:15 AM	---	8:30 AM	65	3	36	0	0	0	101	82	0	0	66	46	***399***
8:30 AM	---	8:45 AM	96	0	18	0	0	0	89	69	0	0	80	44	***396***
8:45 AM	---	9:00 AM	95	0	17	0	0	0	113	62	0	0	57	24	***368***
HOURLY TOTALS															
7:00 AM	---	8:00 AM	304	1	106	0	0	0	526	202	0	0	215	125	***1,479***
7:15 AM	---	8:15 AM	346	1	122	0	0	0	549	214	0	0	240	129	***1,601***
7:30 AM	---	8:30 AM	337	4	131	0	0	0	521	258	0	0	257	147	***1,655***
7:45 AM	---	8:45 AM	341	4	125	0	0	0	465	270	0	0	283	158	***1,646***
8:00 AM	---	9:00 AM	347	4	101	0	0	0	432	274	0	0	275	144	***1,577***

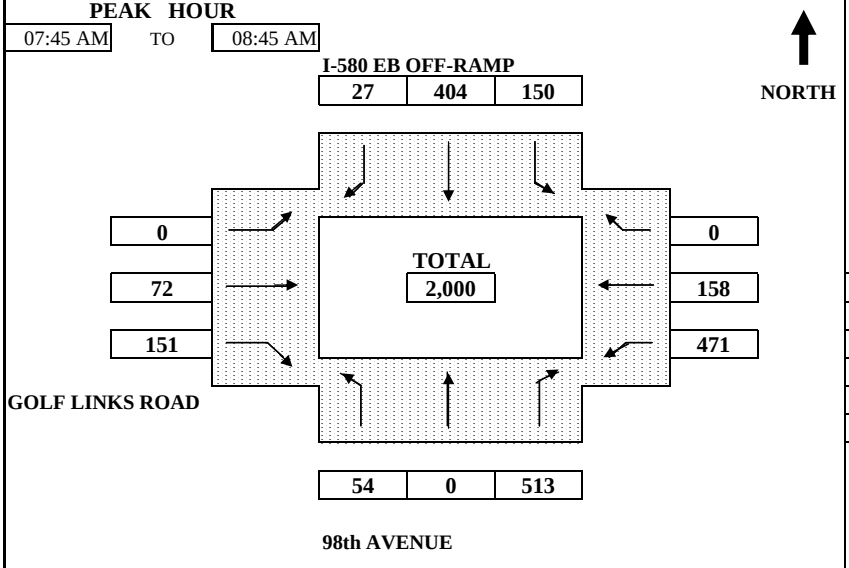
Telephone: (510)232-1271 **Fax: (510)232-1272**

B.A.Y.M.E.T.R.I.C.S.

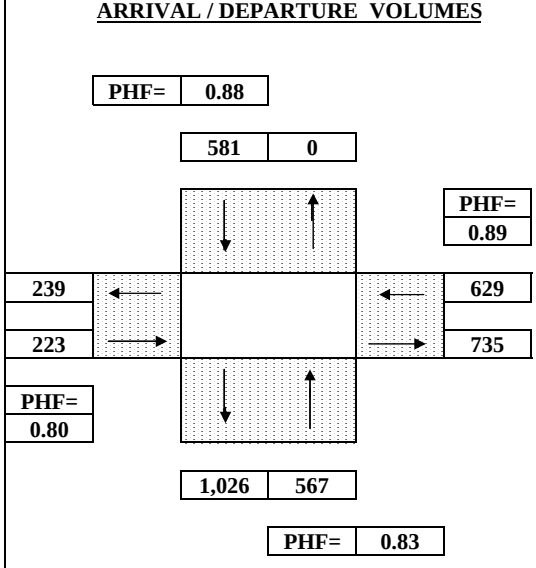
INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**98th AVENUE / I-580 EB OFF-RAMP**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W Approach:	**GOLF LINKS ROAD**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-3AM**

PEAK HOUR
07:45 AM TO 08:45 AM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
7:00 AM	---	7:15 AM	3	0	134	14	58	2	0	7	26	82	14	0	***340***
7:15 AM	---	7:30 AM	8	0	274	29	120	2	0	19	60	177	42	0	***731***
7:30 AM	---	7:45 AM	16	0	437	50	194	6	0	37	99	295	65	0	***1,199***
7:45 AM	---	8:00 AM	29	0	586	77	296	14	0	55	138	406	103	0	***1,704***
8:00 AM	---	8:15 AM	41	0	718	104	393	21	0	76	172	531	151	0	***2,207***
8:15 AM	---	8:30 AM	64	0	848	152	488	26	0	101	217	632	181	0	***2,709***
8:30 AM	---	8:45 AM	70	0	950	200	598	33	0	109	250	766	223	0	***3,199***
8:45 AM	---	9:00 AM	80	0	1,086	231	710	40	0	117	293	884	257	0	***3,698***
TOTAL BY PERIOD															
7:00 AM	---	7:15 AM	3	0	134	14	58	2	0	7	26	82	14	0	***340***
7:15 AM	---	7:30 AM	5	0	140	15	62	0	0	12	34	95	28	0	***391***
7:30 AM	---	7:45 AM	8	0	163	21	74	4	0	18	39	118	23	0	***468***
7:45 AM	---	8:00 AM	13	0	149	27	102	8	0	18	39	111	38	0	***505***
8:00 AM	---	8:15 AM	12	0	132	27	97	7	0	21	34	125	48	0	***503***
8:15 AM	---	8:30 AM	23	0	130	48	95	5	0	25	45	101	30	0	***502***
8:30 AM	---	8:45 AM	6	0	102	48	110	7	0	8	33	134	42	0	***490***
8:45 AM	---	9:00 AM	10	0	136	31	112	7	0	8	43	118	34	0	***499***
HOURLY TOTALS															
7:00 AM	---	8:00 AM	29	0	586	77	296	14	0	55	138	406	103	0	***1,704***
7:15 AM	---	8:15 AM	38	0	584	90	335	19	0	69	146	449	137	0	***1,867***
7:30 AM	---	8:30 AM	56	0	574	123	368	24	0	82	157	455	139	0	***1,978***
7:45 AM	---	8:45 AM	54	0	513	150	404	27	0	72	151	471	158	0	***2,000***
8:00 AM	---	9:00 AM	51	0	500	154	414	26	0	62	155	478	154	0	***1,994***

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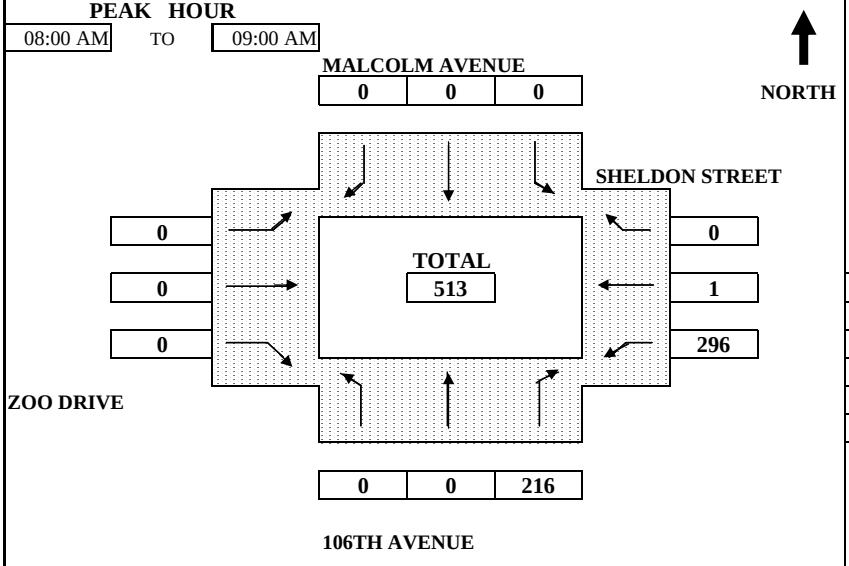
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

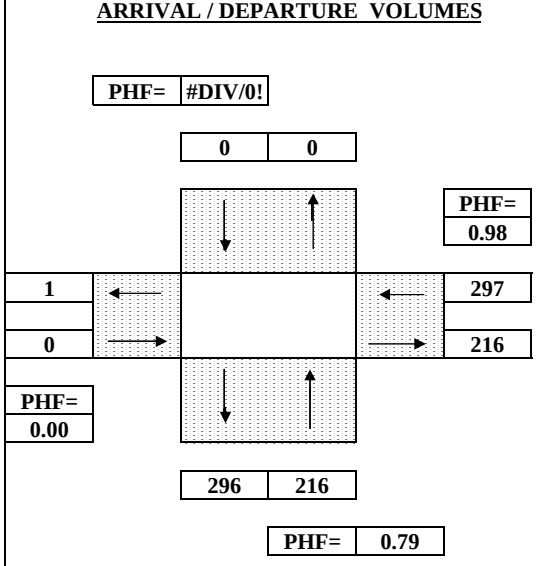
PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**106TH AVENUE / MALCOLM AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W Approach:	**ZOO DRIVE / SHELDON STREET**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-4AM**

PEAK HOUR

08:00 AM TO 09:00 AM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
7:00 AM	---	7:15 AM	0	0	13	0	0	0	0	0	0	34	0	0	***47***
7:15 AM	---	7:30 AM	0	0	28	0	0	0	0	0	1	79	0	0	***108***
7:30 AM	---	7:45 AM	0	0	49	0	0	0	0	0	2	137	0	0	***188***
7:45 AM	---	8:00 AM	1	0	77	0	0	0	0	0	2	193	0	0	***273***
8:00 AM	---	8:15 AM	1	0	130	0	0	0	0	0	2	266	0	0	***399***
8:15 AM	---	8:30 AM	1	0	198	0	0	0	0	0	2	342	0	0	***543***
8:30 AM	---	8:45 AM	1	0	262	0	0	0	0	0	2	415	0	0	***680***
8:45 AM	---	9:00 AM	1	0	293	0	0	0	0	0	2	489	1	0	***786***
TOTAL BY PERIOD															
7:00 AM	---	7:15 AM	0	0	13	0	0	0	0	0	0	34	0	0	***47***
7:15 AM	---	7:30 AM	0	0	15	0	0	0	0	0	1	45	0	0	***61***
7:30 AM	---	7:45 AM	0	0	21	0	0	0	0	0	1	58	0	0	***80***
7:45 AM	---	8:00 AM	1	0	28	0	0	0	0	0	0	56	0	0	***85***
8:00 AM	---	8:15 AM	0	0	53	0	0	0	0	0	0	73	0	0	***126***
8:15 AM	---	8:30 AM	0	0	68	0	0	0	0	0	0	76	0	0	***144***
8:30 AM	---	8:45 AM	0	0	64	0	0	0	0	0	0	73	0	0	***137***
8:45 AM	---	9:00 AM	0	0	31	0	0	0	0	0	0	74	1	0	***106***
HOURLY TOTALS															
7:00 AM	---	8:00 AM	1	0	77	0	0	0	0	0	2	193	0	0	***273***
7:15 AM	---	8:15 AM	1	0	117	0	0	0	0	0	2	232	0	0	***352***
7:30 AM	---	8:30 AM	1	0	170	0	0	0	0	0	1	263	0	0	***435***
7:45 AM	---	8:45 AM	1	0	213	0	0	0	0	0	0	278	0	0	***492***
8:00 AM	---	9:00 AM	0	0	216	0	0	0	0	0	0	296	1	0	***513***

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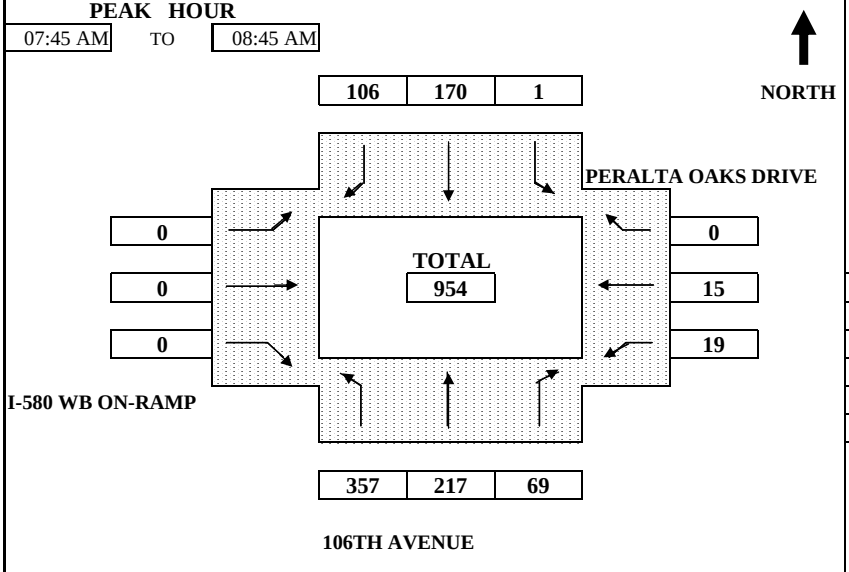
B . A . Y . M . E . T . R . I . C . S .

INTERSECTION TURNING MOVEMENT SUMMARY

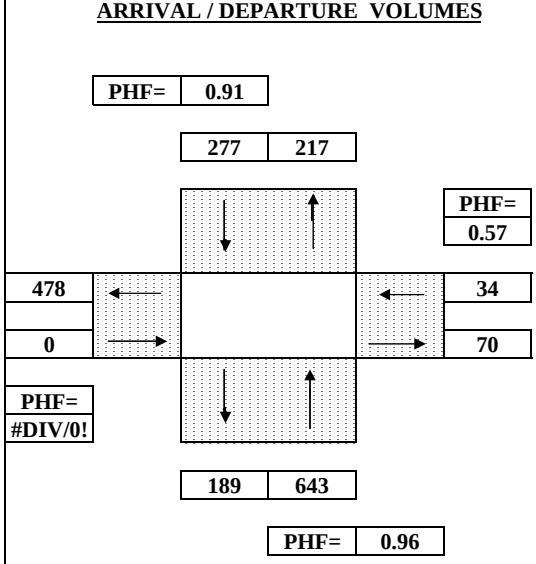
PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**106TH AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W Approach:	**I-580 WB ON-RAMP / PERALTA OAKS DR**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-5AM**

PEAK HOUR

07:45 AM TO 08:45 AM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
7:00 AM	---	7:15 AM	72	12	9	0	16	17	0	0	0	1	1	0	***128***
7:15 AM	---	7:30 AM	142	27	19	0	37	42	0	0	0	1	3	0	***271***
7:30 AM	---	7:45 AM	245	47	36	0	67	72	0	0	0	5	3	0	***475***
7:45 AM	---	8:00 AM	358	76	48	0	98	97	0	0	0	10	4	0	***691***
8:00 AM	---	8:15 AM	457	129	59	0	137	130	0	0	0	16	7	0	***935***
8:15 AM	---	8:30 AM	526	200	87	0	189	154	0	0	0	17	10	0	***1,183***
8:30 AM	---	8:45 AM	602	264	105	1	237	178	0	0	0	24	18	0	***1,429***
8:45 AM	---	9:00 AM	665	294	124	1	290	200	0	0	0	25	21	0	***1,620***
TOTAL BY PERIOD															
7:00 AM	---	7:15 AM	72	12	9	0	16	17	0	0	0	1	1	0	***128***
7:15 AM	---	7:30 AM	70	15	10	0	21	25	0	0	0	0	2	0	***143***
7:30 AM	---	7:45 AM	103	20	17	0	30	30	0	0	0	4	0	0	***204***
7:45 AM	---	8:00 AM	113	29	12	0	31	25	0	0	0	5	1	0	***216***
8:00 AM	---	8:15 AM	99	53	11	0	39	33	0	0	0	6	3	0	***244***
8:15 AM	---	8:30 AM	69	71	28	0	52	24	0	0	0	1	3	0	***248***
8:30 AM	---	8:45 AM	76	64	18	1	48	24	0	0	0	7	8	0	***246***
8:45 AM	---	9:00 AM	63	30	19	0	53	22	0	0	0	1	3	0	***191***
HOURLY TOTALS															
7:00 AM	---	8:00 AM	358	76	48	0	98	97	0	0	0	10	4	0	***691***
7:15 AM	---	8:15 AM	385	117	50	0	121	113	0	0	0	15	6	0	***807***
7:30 AM	---	8:30 AM	384	173	68	0	152	112	0	0	0	16	7	0	***912***
7:45 AM	---	8:45 AM	357	217	69	1	170	106	0	0	0	19	15	0	***954***
8:00 AM	---	9:00 AM	307	218	76	1	192	103	0	0	0	15	17	0	***929***

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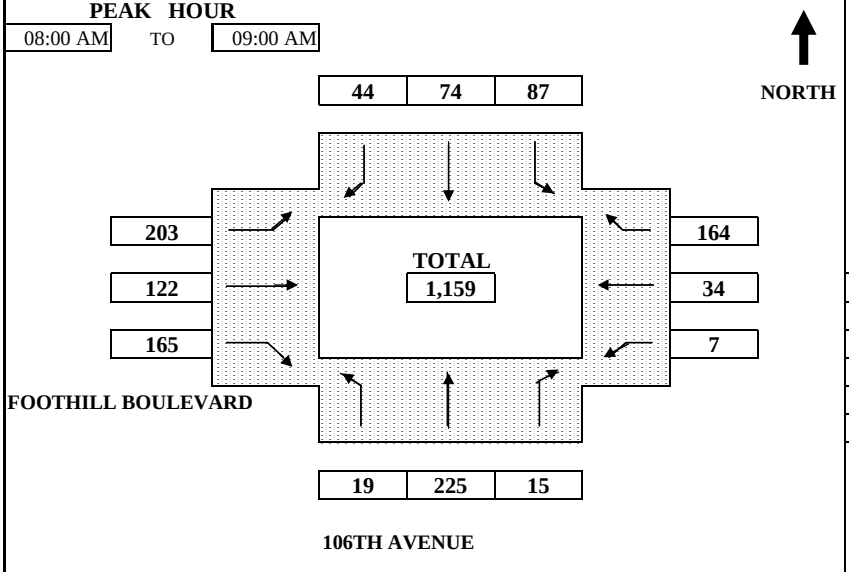
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

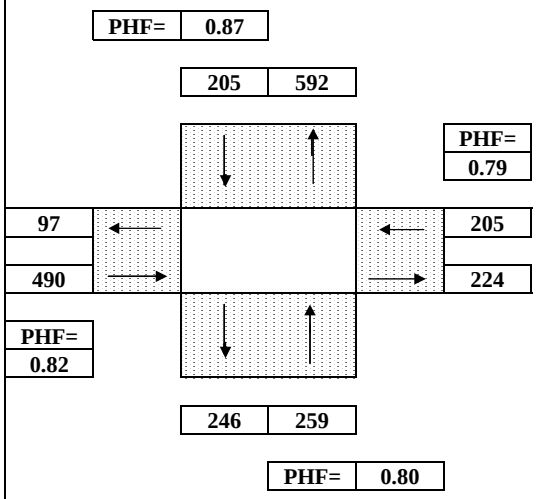
PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**106TH AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W Approach:	**FOOTHILL BOULEVARD**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-6AM**

PEAK HOUR

08:00 AM TO 09:00 AM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
7:00 AM	---	7:15 AM	3	47	1	6	8	4	18	13	17	1	4	32	***154***
7:15 AM	---	7:30 AM	4	88	3	20	13	9	47	27	39	1	10	60	***321***
7:30 AM	---	7:45 AM	6	150	4	42	17	17	87	40	70	2	21	93	***549***
7:45 AM	---	8:00 AM	10	224	7	57	27	30	134	60	90	4	27	124	***794***
8:00 AM	---	8:15 AM	18	294	10	70	44	44	186	87	119	5	33	182	***1,092***
8:15 AM	---	8:30 AM	24	347	13	88	64	60	260	117	164	8	42	227	***1,414***
8:30 AM	---	8:45 AM	26	404	16	115	87	69	300	148	213	10	53	264	***1,705***
8:45 AM	---	9:00 AM	29	449	22	144	101	74	337	182	255	11	61	288	***1,953***
TOTAL BY PERIOD															
7:00 AM	---	7:15 AM	3	47	1	6	8	4	18	13	17	1	4	32	***154***
7:15 AM	---	7:30 AM	1	41	2	14	5	5	29	14	22	0	6	28	***167***
7:30 AM	---	7:45 AM	2	62	1	22	4	8	40	13	31	1	11	33	***228***
7:45 AM	---	8:00 AM	4	74	3	15	10	13	47	20	20	2	6	31	***245***
8:00 AM	---	8:15 AM	8	70	3	13	17	14	52	27	29	1	6	58	***298***
8:15 AM	---	8:30 AM	6	53	3	18	20	16	74	30	45	3	9	45	***322***
8:30 AM	---	8:45 AM	2	57	3	27	23	9	40	31	49	2	11	37	***291***
8:45 AM	---	9:00 AM	3	45	6	29	14	5	37	34	42	1	8	24	***248***
HOURLY TOTALS															
7:00 AM	---	8:00 AM	10	224	7	57	27	30	134	60	90	4	27	124	***794***
7:15 AM	---	8:15 AM	15	247	9	64	36	40	168	74	102	4	29	150	***938***
7:30 AM	---	8:30 AM	20	259	10	68	51	51	213	90	125	7	32	167	***1,093***
7:45 AM	---	8:45 AM	20	254	12	73	70	52	213	108	143	8	32	171	***1,156***
8:00 AM	---	9:00 AM	19	225	15	87	74	44	203	122	165	7	34	164	***1,159***

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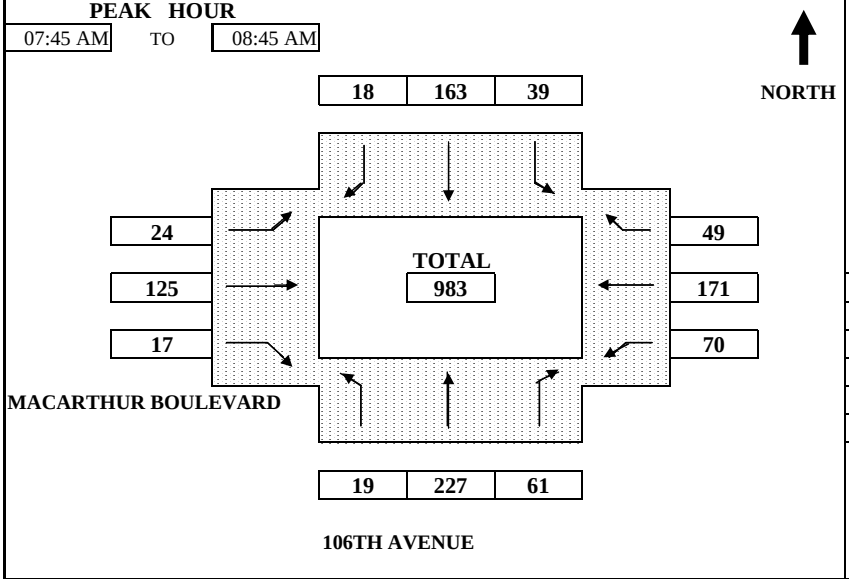
B . A . Y . M . E . T . R . I . C . S .

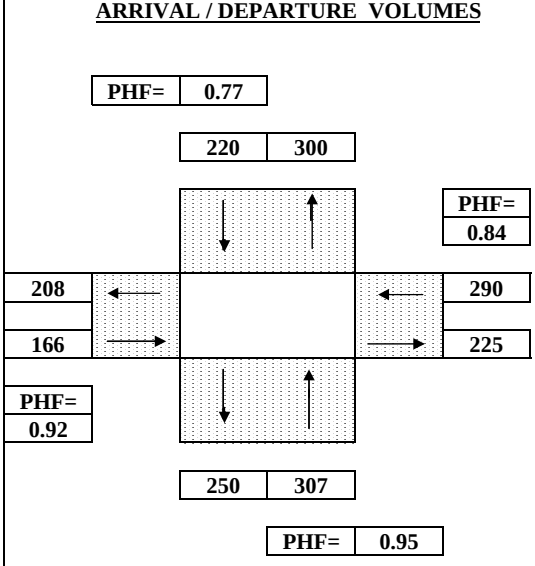
INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**106TH AVENUE**	**SURVEY TIME:**	**7:00 AM**	**TO**	**9:00 AM**
E-W Approach:	**MACARTHUR BOULEVARD**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-7AM**

PEAK HOUR
07:45 AM TO 08:45 AM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
7:00 AM	---	7:15 AM	1	38	10	3	17	0	2	17	1	8	19	10	***126***
7:15 AM	---	7:30 AM	5	74	25	9	40	0	5	32	3	16	49	17	***275***
7:30 AM	---	7:45 AM	10	120	40	13	68	1	9	48	5	32	78	30	***454***
7:45 AM	---	8:00 AM	17	180	54	17	99	4	10	81	10	50	132	44	***698***
8:00 AM	---	8:15 AM	23	241	67	25	132	8	25	106	15	66	172	57	***937***
8:15 AM	---	8:30 AM	27	296	85	38	180	13	28	138	20	82	204	70	***1,181***
8:30 AM	---	8:45 AM	29	347	101	52	231	19	33	173	22	102	249	79	***1,437***
8:45 AM	---	9:00 AM	32	389	111	69	272	21	39	203	26	121	274	89	***1,646***
TOTAL BY PERIOD															
7:00 AM	---	7:15 AM	1	38	10	3	17	0	2	17	1	8	19	10	***126***
7:15 AM	---	7:30 AM	4	36	15	6	23	0	3	15	2	8	30	7	***149***
7:30 AM	---	7:45 AM	5	46	15	4	28	1	4	16	2	16	29	13	***179***
7:45 AM	---	8:00 AM	7	60	14	4	31	3	1	33	5	18	54	14	***244***
8:00 AM	---	8:15 AM	6	61	13	8	33	4	15	25	5	16	40	13	***239***
8:15 AM	---	8:30 AM	4	55	18	13	48	5	3	32	5	16	32	13	***244***
8:30 AM	---	8:45 AM	2	51	16	14	51	6	5	35	2	20	45	9	***256***
8:45 AM	---	9:00 AM	3	42	10	17	41	2	6	30	4	19	25	10	***209***
HOURLY TOTALS															
7:00 AM	---	8:00 AM	17	180	54	17	99	4	10	81	10	50	132	44	***698***
7:15 AM	---	8:15 AM	22	203	57	22	115	8	23	89	14	58	153	47	***811***
7:30 AM	---	8:30 AM	22	222	60	29	140	13	23	106	17	66	155	53	***906***
7:45 AM	---	8:45 AM	19	227	61	39	163	18	24	125	17	70	171	49	***983***
8:00 AM	---	9:00 AM	15	209	57	52	173	17	29	122	16	71	142	45	***948***

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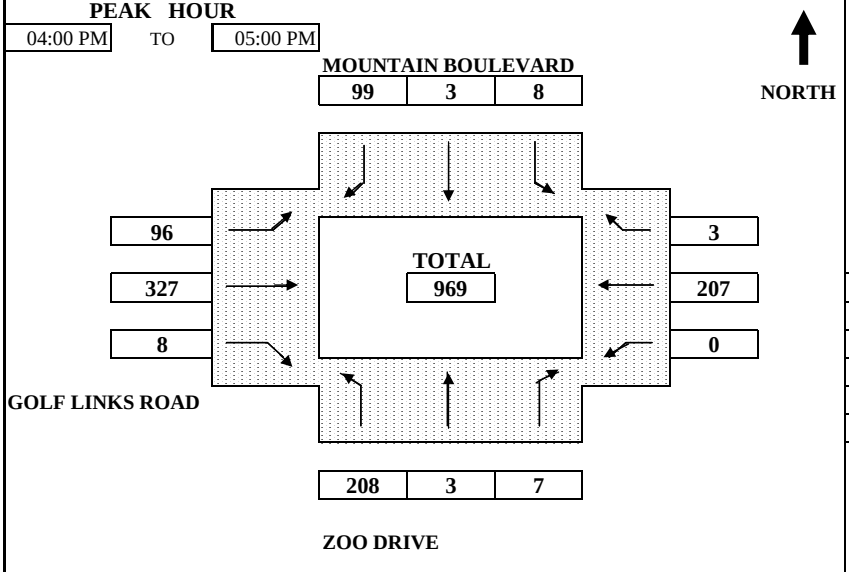
B . A . Y . M . E . T . R . I . C . S .

INTERSECTION TURNING MOVEMENT SUMMARY

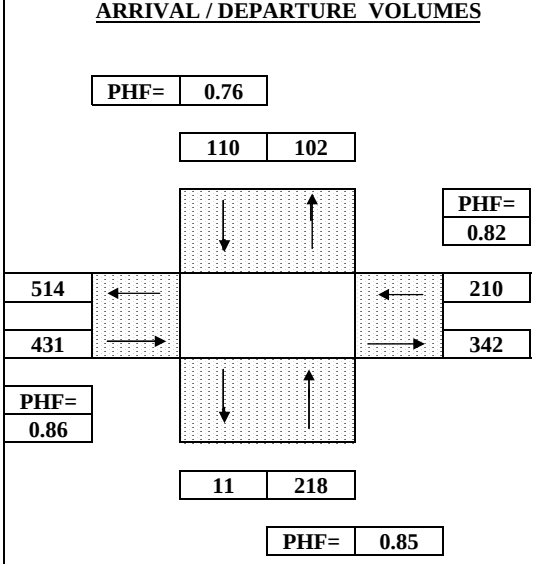
PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**MOUNTAIN BOULEVARD / ZOO DRIVE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W Approach:	**GOLF LINKS ROAD**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-1PM**

PEAK HOUR

04:00 PM TO 05:00 PM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		To	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	TOTAL
SURVEY DATA															
4:00 PM	---	4:15 PM	52	0	1	2	0	29	25	65	3	0	57	1	***235***
4:15 PM	---	4:30 PM	99	2	4	4	2	54	57	155	7	0	94	1	***479***
4:30 PM	---	4:45 PM	159	3	7	7	2	87	82	248	7	0	149	3	***754***
4:45 PM	---	5:00 PM	208	3	7	8	3	99	96	327	8	0	207	3	***969***
5:00 PM	---	5:15 PM	249	3	12	9	4	119	113	405	14	0	246	4	***1,178***
5:15 PM	---	5:30 PM	260	4	16	10	6	136	141	482	15	0	309	5	***1,384***
5:30 PM	---	5:45 PM	267	4	17	12	7	158	157	578	17	0	348	5	***1,570***
5:45 PM	---	6:00 PM	277	4	20	16	7	174	186	668	17	0	404	5	***1,778***
TOTAL BY PERIOD															
4:00 PM	---	4:15 PM	52	0	1	2	0	29	25	65	3	0	57	1	***235***
4:15 PM	---	4:30 PM	47	2	3	2	2	25	32	90	4	0	37	0	***244***
4:30 PM	---	4:45 PM	60	1	3	3	0	33	25	93	0	0	55	2	***275***
4:45 PM	---	5:00 PM	49	0	0	1	1	12	14	79	1	0	58	0	***215***
5:00 PM	---	5:15 PM	41	0	5	1	1	20	17	78	6	0	39	1	***209***
5:15 PM	---	5:30 PM	11	1	4	1	2	17	28	77	1	0	63	1	***206***
5:30 PM	---	5:45 PM	7	0	1	2	1	22	16	96	2	0	39	0	***186***
5:45 PM	---	6:00 PM	10	0	3	4	0	16	29	90	0	0	56	0	***208***
HOURLY TOTALS															
4:00 PM	---	5:00 PM	208	3	7	8	3	99	96	327	8	0	207	3	***969***
4:15 PM	---	5:15 PM	197	3	11	7	4	90	88	340	11	0	189	3	***943***
4:30 PM	---	5:30 PM	161	2	12	6	4	82	84	327	8	0	215	4	***905***
4:45 PM	---	5:45 PM	108	1	10	5	5	71	75	330	10	0	199	2	***816***
5:00 PM	---	6:00 PM	69	1	13	8	4	75	90	341	9	0	197	2	***809***

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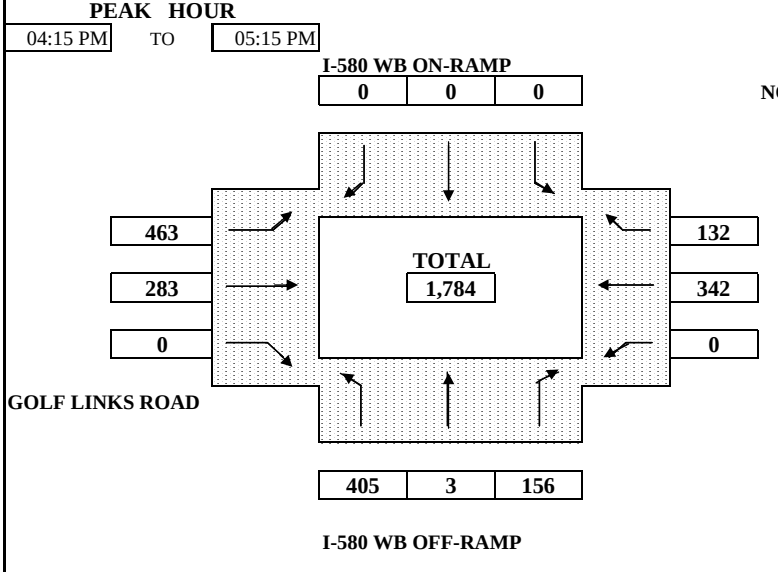
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

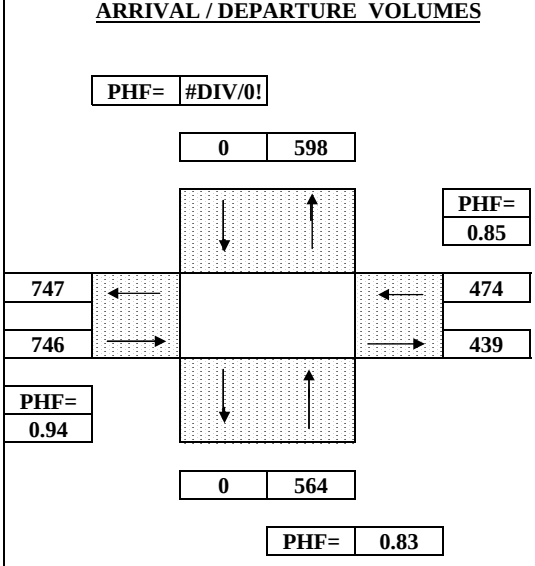
PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**I-580 WB OFF-RAMP / I-580 WB ON-RAMP**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W Approach:	**GOLF LINKS ROAD**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-2PM**

PEAK HOUR

04:15 PM TO 05:15 PM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
4:00 PM	---	4:15 PM	69	0	26	0	0	0	98	62	0	0	110	30	***395***
4:15 PM	---	4:30 PM	176	1	71	0	0	0	215	143	0	0	203	54	***863***
4:30 PM	---	4:45 PM	256	1	104	0	0	0	321	228	0	0	309	86	***1,305***
4:45 PM	---	5:00 PM	353	2	139	0	0	0	439	287	0	0	406	128	***1,754***
5:00 PM	---	5:15 PM	474	3	182	0	0	0	561	345	0	0	452	162	***2,179***
5:15 PM	---	5:30 PM	596	3	229	0	0	0	695	404	0	0	520	187	***2,634***
5:30 PM	---	5:45 PM	715	3	277	0	0	0	808	480	0	0	564	209	***3,056***
5:45 PM	---	6:00 PM	831	3	321	0	0	0	911	550	0	0	625	230	***3,471***
TOTAL BY PERIOD															
4:00 PM	---	4:15 PM	69	0	26	0	0	0	98	62	0	0	110	30	***395***
4:15 PM	---	4:30 PM	107	1	45	0	0	0	117	81	0	0	93	24	***468***
4:30 PM	---	4:45 PM	80	0	33	0	0	0	106	85	0	0	106	32	***442***
4:45 PM	---	5:00 PM	97	1	35	0	0	0	118	59	0	0	97	42	***449***
5:00 PM	---	5:15 PM	121	1	43	0	0	0	122	58	0	0	46	34	***425***
5:15 PM	---	5:30 PM	122	0	47	0	0	0	134	59	0	0	68	25	***455***
5:30 PM	---	5:45 PM	119	0	48	0	0	0	113	76	0	0	44	22	***422***
5:45 PM	---	6:00 PM	116	0	44	0	0	0	103	70	0	0	61	21	***415***
HOURLY TOTALS															
4:00 PM	---	5:00 PM	353	2	139	0	0	0	439	287	0	0	406	128	***1,754***
4:15 PM	---	5:15 PM	405	3	156	0	0	0	463	283	0	0	342	132	***1,784***
4:30 PM	---	5:30 PM	420	2	158	0	0	0	480	261	0	0	317	133	***1,771***
4:45 PM	---	5:45 PM	459	2	173	0	0	0	487	252	0	0	255	123	***1,751***
5:00 PM	---	6:00 PM	478	1	182	0	0	0	472	263	0	0	219	102	***1,717***

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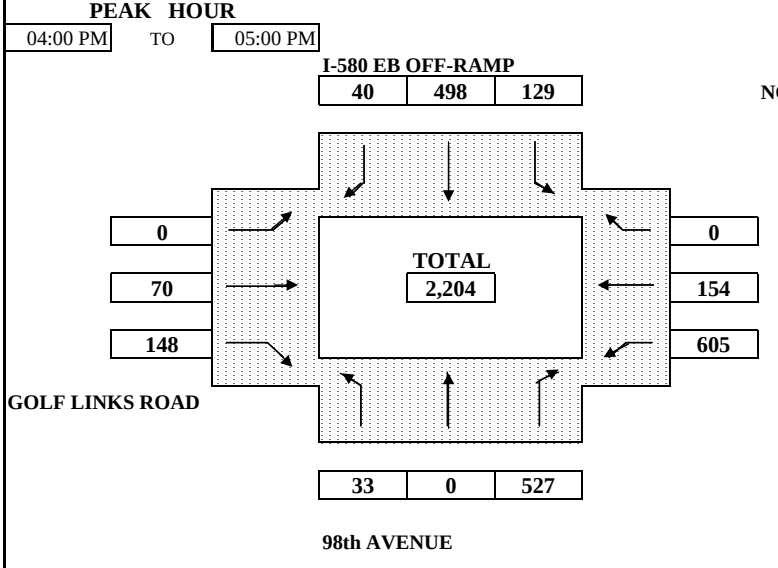
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

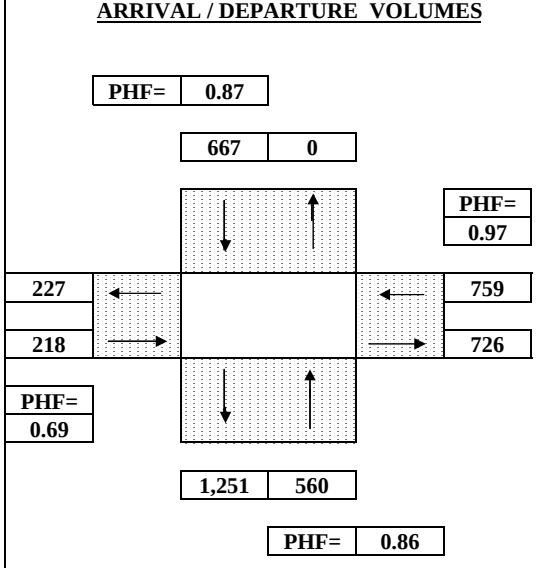
PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**98th AVENUE / I-580 EB OFF-RAMP**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W Approach:	**GOLF LINKS ROAD**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-3PM**

PEAK HOUR

04:00 PM TO 05:00 PM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
4:00 PM	---	4:15 PM	7	0	114	30	151	11	0	16	44	141	38	0	***552***
4:15 PM	---	4:30 PM	16	0	262	59	295	25	0	37	74	295	74	0	***1,137***
4:30 PM	---	4:45 PM	26	0	403	92	410	32	0	54	115	453	112	0	***1,697***
4:45 PM	---	5:00 PM	33	0	527	129	498	40	0	70	148	605	154	0	***2,204***
5:00 PM	---	5:15 PM	46	0	648	160	629	52	0	88	185	725	201	0	***2,734***
5:15 PM	---	5:30 PM	58	0	772	199	743	60	0	108	231	855	261	0	***3,287***
5:30 PM	---	5:45 PM	77	0	916	241	867	66	0	131	287	970	309	0	***3,864***
5:45 PM	---	6:00 PM	86	0	1,038	276	976	79	0	147	327	1,097	359	0	***4,385***
TOTAL BY PERIOD															
4:00 PM	---	4:15 PM	7	0	114	30	151	11	0	16	44	141	38	0	***552***
4:15 PM	---	4:30 PM	9	0	148	29	144	14	0	21	30	154	36	0	***585***
4:30 PM	---	4:45 PM	10	0	141	33	115	7	0	17	41	158	38	0	***560***
4:45 PM	---	5:00 PM	7	0	124	37	88	8	0	16	33	152	42	0	***507***
5:00 PM	---	5:15 PM	13	0	121	31	131	12	0	18	37	120	47	0	***530***
5:15 PM	---	5:30 PM	12	0	124	39	114	8	0	20	46	130	60	0	***553***
5:30 PM	---	5:45 PM	19	0	144	42	124	6	0	23	56	115	48	0	***577***
5:45 PM	---	6:00 PM	9	0	122	35	109	13	0	16	40	127	50	0	***521***
HOURLY TOTALS															
4:00 PM	---	5:00 PM	33	0	527	129	498	40	0	70	148	605	154	0	***2,204***
4:15 PM	---	5:15 PM	39	0	534	130	478	41	0	72	141	584	163	0	***2,182***
4:30 PM	---	5:30 PM	42	0	510	140	448	35	0	71	157	560	187	0	***2,150***
4:45 PM	---	5:45 PM	51	0	513	149	457	34	0	77	172	517	197	0	***2,167***
5:00 PM	---	6:00 PM	53	0	511	147	478	39	0	77	179	492	205	0	***2,181***

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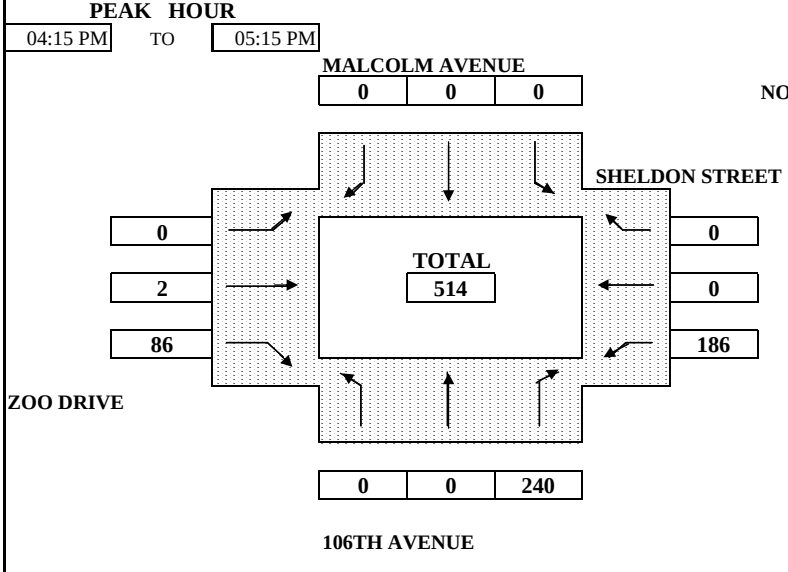
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

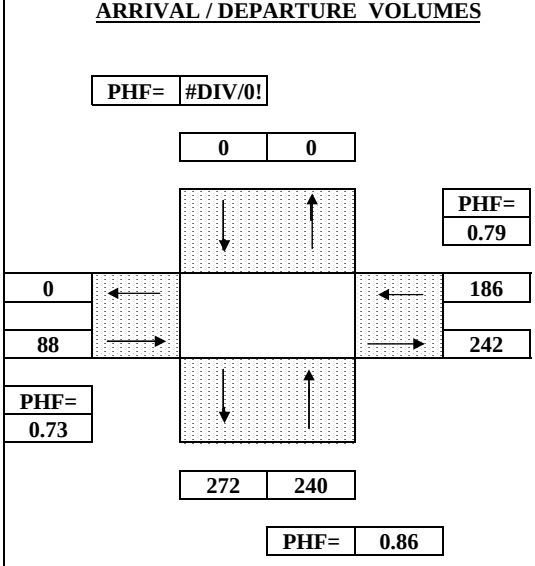
PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**		**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**106TH AVENUE**	**/ MALCOLM AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W Approach:	**ZOO DRIVE**	**/ SHELDON STREET**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-4PM**

PEAK HOUR

04:15 PM TO 05:15 PM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
4:00 PM	---	4:15 PM	0	0	36	0	0	0	0	0	22	46	0	0	***104***
4:15 PM	---	4:30 PM	0	0	92	0	0	0	0	1	42	105	0	0	***240***
4:30 PM	---	4:45 PM	0	0	146	0	0	0	0	2	64	142	0	0	***354***
4:45 PM	---	5:00 PM	0	0	208	0	0	0	0	2	94	184	0	0	***488***
5:00 PM	---	5:15 PM	0	0	276	0	0	0	0	2	108	232	0	0	***618***
5:15 PM	---	5:30 PM	0	0	332	0	0	0	0	2	114	285	0	0	***733***
5:30 PM	---	5:45 PM	0	0	402	0	0	0	0	2	118	337	0	0	***859***
5:45 PM	---	6:00 PM	0	0	466	0	0	0	0	2	120	383	1	0	***972***
TOTAL BY PERIOD															
4:00 PM	---	4:15 PM	0	0	36	0	0	0	0	0	22	46	0	0	***104***
4:15 PM	---	4:30 PM	0	0	56	0	0	0	0	1	20	59	0	0	***136***
4:30 PM	---	4:45 PM	0	0	54	0	0	0	0	1	22	37	0	0	***114***
4:45 PM	---	5:00 PM	0	0	62	0	0	0	0	0	30	42	0	0	***134***
5:00 PM	---	5:15 PM	0	0	68	0	0	0	0	0	14	48	0	0	***130***
5:15 PM	---	5:30 PM	0	0	56	0	0	0	0	0	6	53	0	0	***115***
5:30 PM	---	5:45 PM	0	0	70	0	0	0	0	0	4	52	0	0	***126***
5:45 PM	---	6:00 PM	0	0	64	0	0	0	0	0	2	46	1	0	***113***
HOURLY TOTALS															
4:00 PM	---	5:00 PM	0	0	208	0	0	0	0	2	94	184	0	0	***488***
4:15 PM	---	5:15 PM	0	0	240	0	0	0	0	2	86	186	0	0	***514***
4:30 PM	---	5:30 PM	0	0	240	0	0	0	0	1	72	180	0	0	***493***
4:45 PM	---	5:45 PM	0	0	256	0	0	0	0	0	54	195	0	0	***505***
5:00 PM	---	6:00 PM	0	0	258	0	0	0	0	0	26	199	1	0	***484***

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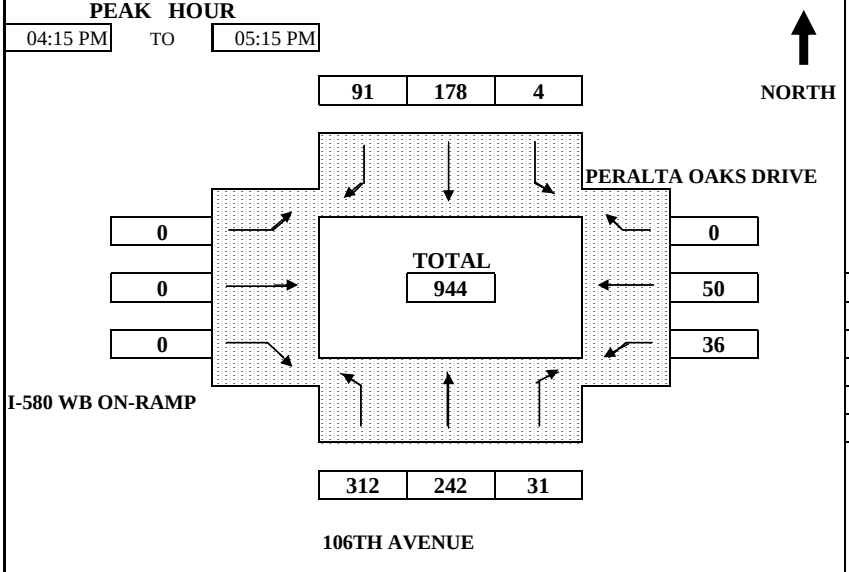
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

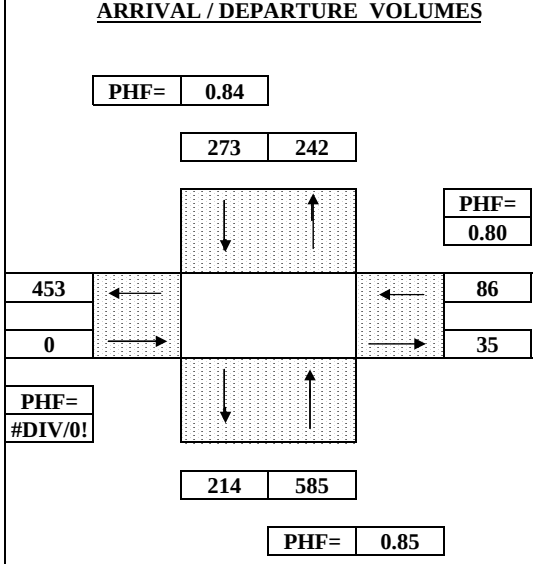
PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**106TH AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W Approach:	**I-580 WB ON-RAMP / PERALTA OAKS DR**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-5PM**

PEAK HOUR

04:15 PM TO 05:15 PM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
4:00 PM	---	4:15 PM	91	34	6	0	46	22	0	0	0	5	6	1	***211***
4:15 PM	---	4:30 PM	161	90	12	1	100	48	0	0	0	11	19	1	***443***
4:30 PM	---	4:45 PM	239	144	20	2	139	67	0	0	0	24	33	1	***669***
4:45 PM	---	5:00 PM	311	207	26	4	185	90	0	0	0	30	42	1	***896***
5:00 PM	---	5:15 PM	403	276	37	4	224	113	0	0	0	41	56	1	***1,155***
5:15 PM	---	5:30 PM	473	331	39	4	266	130	0	0	0	49	70	1	***1,363***
5:30 PM	---	5:45 PM	558	402	44	4	304	148	0	0	0	60	80	1	***1,601***
5:45 PM	---	6:00 PM	645	465	49	4	332	167	0	0	0	65	84	1	***1,812***
TOTAL BY PERIOD															
4:00 PM	---	4:15 PM	91	34	6	0	46	22	0	0	0	5	6	1	***211***
4:15 PM	---	4:30 PM	70	56	6	1	54	26	0	0	0	6	13	0	***232***
4:30 PM	---	4:45 PM	78	54	8	1	39	19	0	0	0	13	14	0	***226***
4:45 PM	---	5:00 PM	72	63	6	2	46	23	0	0	0	6	9	0	***227***
5:00 PM	---	5:15 PM	92	69	11	0	39	23	0	0	0	11	14	0	***259***
5:15 PM	---	5:30 PM	70	55	2	0	42	17	0	0	0	8	14	0	***208***
5:30 PM	---	5:45 PM	85	71	5	0	38	18	0	0	0	11	10	0	***238***
5:45 PM	---	6:00 PM	87	63	5	0	28	19	0	0	0	5	4	0	***211***
HOURLY TOTALS															
4:00 PM	---	5:00 PM	311	207	26	4	185	90	0	0	0	30	42	1	***896***
4:15 PM	---	5:15 PM	312	242	31	4	178	91	0	0	0	36	50	0	***944***
4:30 PM	---	5:30 PM	312	241	27	3	166	82	0	0	0	38	51	0	***920***
4:45 PM	---	5:45 PM	319	258	24	2	165	81	0	0	0	36	47	0	***932***
5:00 PM	---	6:00 PM	334	258	23	0	147	77	0	0	0	35	42	0	***916***

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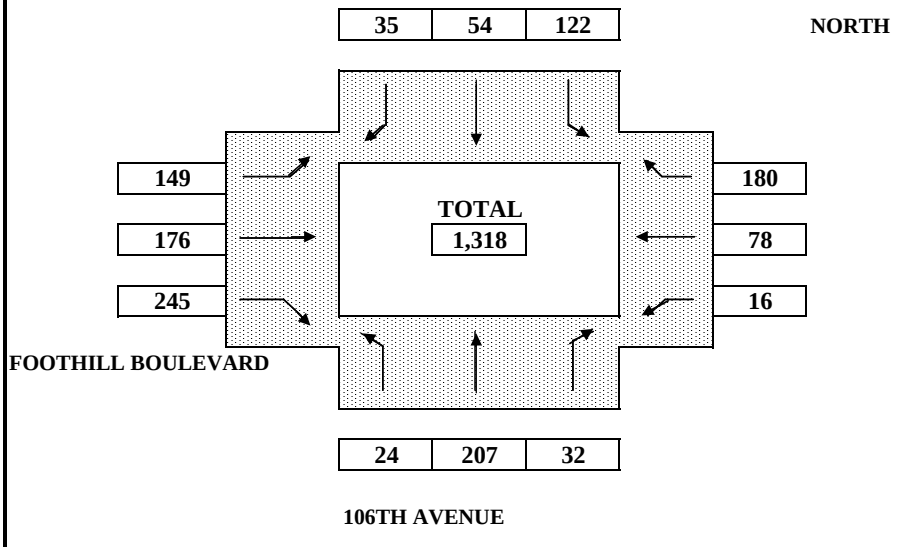
B.A.Y.M.E.T.R.I.C.S.

INTERSECTION TURNING MOVEMENT SUMMARY

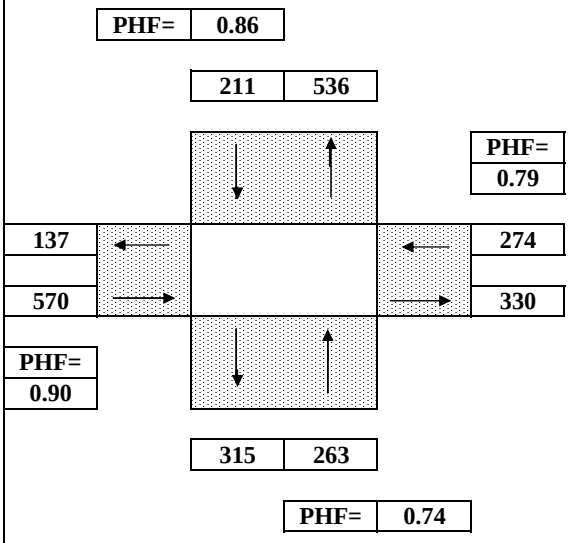
PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**106TH AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W Approach:	**FOOTHILL BOULEVARD**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-6PM**

PEAK HOUR

04:00 PM TO 05:00 PM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		To	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	TOTAL
SURVEY DATA															
4:00 PM	---	4:15 PM	6	60	10	35	11	9	36	56	67	4	26	53	***373***
4:15 PM	---	4:30 PM	12	108	18	70	25	21	75	101	135	8	40	93	***706***
4:30 PM	---	4:45 PM	19	159	26	91	38	32	111	138	188	14	57	133	***1,006***
4:45 PM	---	5:00 PM	24	207	32	122	54	35	149	176	245	16	78	180	***1,318***
5:00 PM	---	5:15 PM	37	276	39	152	66	49	196	210	294	19	92	234	***1,664***
5:15 PM	---	5:30 PM	38	335	44	172	82	57	229	242	361	22	108	280	***1,970***
5:30 PM	---	5:45 PM	40	392	48	204	94	62	266	277	420	24	127	346	***2,300***
5:45 PM	---	6:00 PM	50	459	59	222	103	67	307	319	463	28	153	385	***2,615***
TOTAL BY PERIOD															
4:00 PM	---	4:15 PM	6	60	10	35	11	9	36	56	67	4	26	53	***373***
4:15 PM	---	4:30 PM	6	48	8	35	14	12	39	45	68	4	14	40	***333***
4:30 PM	---	4:45 PM	7	51	8	21	13	11	36	37	53	6	17	40	***300***
4:45 PM	---	5:00 PM	5	48	6	31	16	3	38	38	57	2	21	47	***312***
5:00 PM	---	5:15 PM	13	69	7	30	12	14	47	34	49	3	14	54	***346***
5:15 PM	---	5:30 PM	1	59	5	20	16	8	33	32	67	3	16	46	***306***
5:30 PM	---	5:45 PM	2	57	4	32	12	5	37	35	59	2	19	66	***330***
5:45 PM	---	6:00 PM	10	67	11	18	9	5	41	42	43	4	26	39	***315***
HOURLY TOTALS															
4:00 PM	---	5:00 PM	24	207	32	122	54	35	149	176	245	16	78	180	***1,318***
4:15 PM	---	5:15 PM	31	216	29	117	55	40	160	154	227	15	66	181	***1,291***
4:30 PM	---	5:30 PM	26	227	26	102	57	36	154	141	226	14	68	187	***1,264***
4:45 PM	---	5:45 PM	21	233	22	113	56	30	155	139	232	10	70	213	***1,294***
5:00 PM	---	6:00 PM	26	252	27	100	49	32	158	143	218	12	75	205	***1,297***

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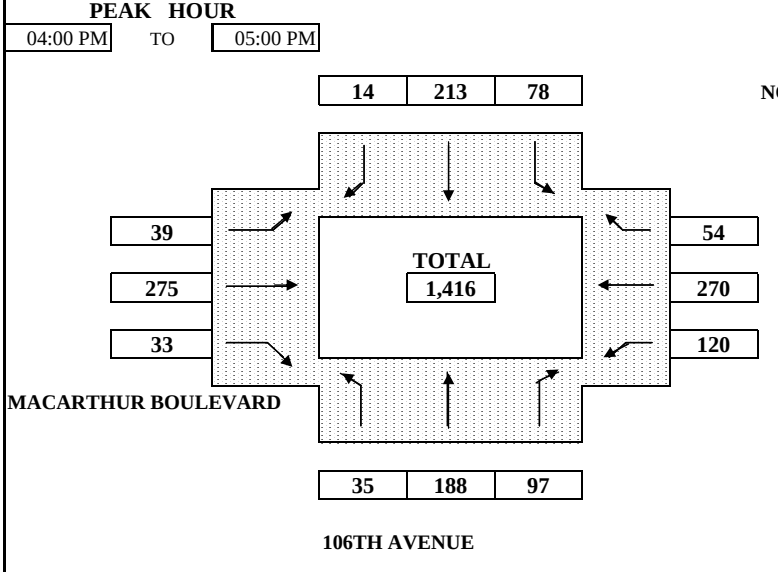
B.A.Y.M.E.T.R.I.C.S.

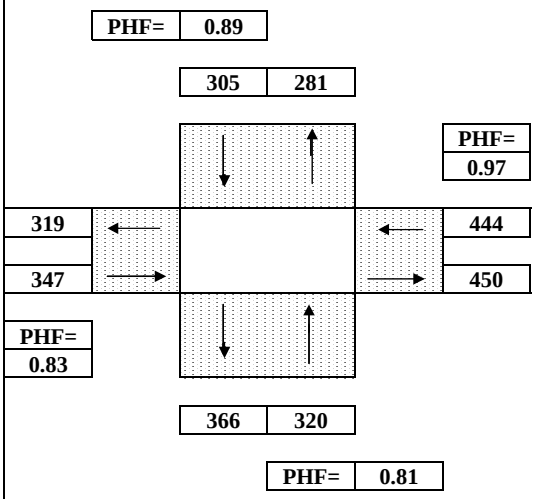
INTERSECTION TURNING MOVEMENT SUMMARY

PROJECT:	**OAKLAND ZOO TRAFFIC STUDY**	**SURVEY DATE:**	**4/16/2009**	**DAY:**	**THURSDAY**
N-S Approach:	**106TH AVENUE**	**SURVEY TIME:**	**4:00 PM**	**TO**	**6:00 PM**
E-W Approach:	**MACARTHUR BOULEVARD**	**CITY:**	**OAKLAND**	**FILE:**	**2904025-7PM**

PEAK HOUR
04:00 PM TO 05:00 PM



ARRIVAL / DEPARTURE VOLUMES



TIME PERIOD			NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
From		**To**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**TOTAL**
SURVEY DATA															
4:00 PM	---	4:15 PM	9	59	22	12	51	3	9	47	6	26	78	8	***330***
4:15 PM	---	4:30 PM	10	92	49	33	107	5	23	115	13	50	154	23	***674***
4:30 PM	---	4:45 PM	27	141	71	57	165	9	31	189	22	85	216	40	***1,053***
4:45 PM	---	5:00 PM	35	188	97	78	213	14	39	275	33	120	270	54	***1,416***
5:00 PM	---	5:15 PM	44	248	120	97	250	19	47	314	39	156	324	71	***1,729***
5:15 PM	---	5:30 PM	49	301	148	121	306	21	52	388	51	174	373	83	***2,067***
5:30 PM	---	5:45 PM	62	347	177	135	365	25	58	443	57	190	428	96	***2,383***
5:45 PM	---	6:00 PM	74	410	201	147	409	27	63	528	66	206	485	114	***2,730***
TOTAL BY PERIOD															
4:00 PM	---	4:15 PM	9	59	22	12	51	3	9	47	6	26	78	8	***330***
4:15 PM	---	4:30 PM	1	33	27	21	56	2	14	68	7	24	76	15	***344***
4:30 PM	---	4:45 PM	17	49	22	24	58	4	8	74	9	35	62	17	***379***
4:45 PM	---	5:00 PM	8	47	26	21	48	5	8	86	11	35	54	14	***363***
5:00 PM	---	5:15 PM	9	60	23	19	37	5	8	39	6	36	54	17	***313***
5:15 PM	---	5:30 PM	5	53	28	24	56	2	5	74	12	18	49	12	***338***
5:30 PM	---	5:45 PM	13	46	29	14	59	4	6	55	6	16	55	13	***316***
5:45 PM	---	6:00 PM	12	63	24	12	44	2	5	85	9	16	57	18	***347***
HOURLY TOTALS															
4:00 PM	---	5:00 PM	35	188	97	78	213	14	39	275	33	120	270	54	***1,416***
4:15 PM	---	5:15 PM	35	189	98	85	199	16	38	267	33	130	246	63	***1,399***
4:30 PM	---	5:30 PM	39	209	99	88	199	16	29	273	38	124	219	60	***1,393***
4:45 PM	---	5:45 PM	35	206	106	78	200	16	27	254	35	105	212	56	***1,330***
5:00 PM	---	6:00 PM	39	222	104	69	196	13	24	253	33	86	215	60	***1,314***

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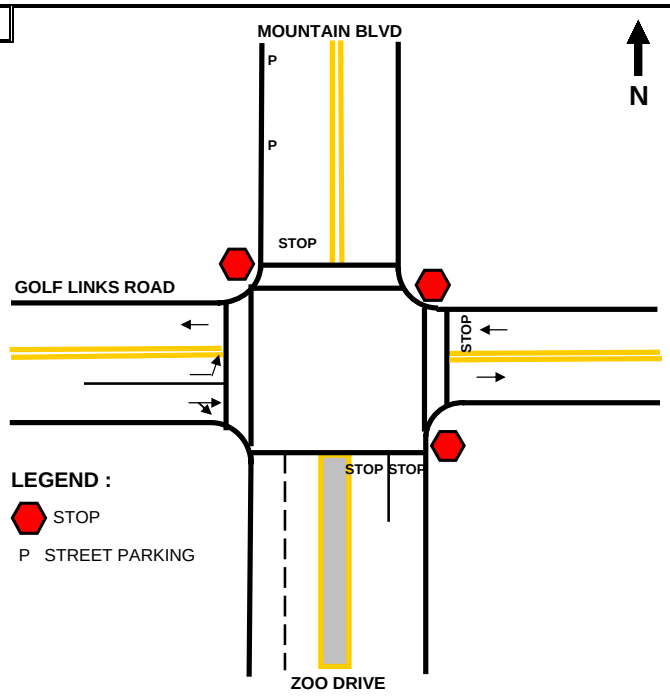
BAYMETRICS

INTERSECTION GEOMETRY & TRAFFIC CONTROL PLAN

PROJECT: OAKLAND ZOO TRAFFIC STUDY **JURISDICTION: OAKLAND** **DATE: 4/16/2009 THURSDAY**

1



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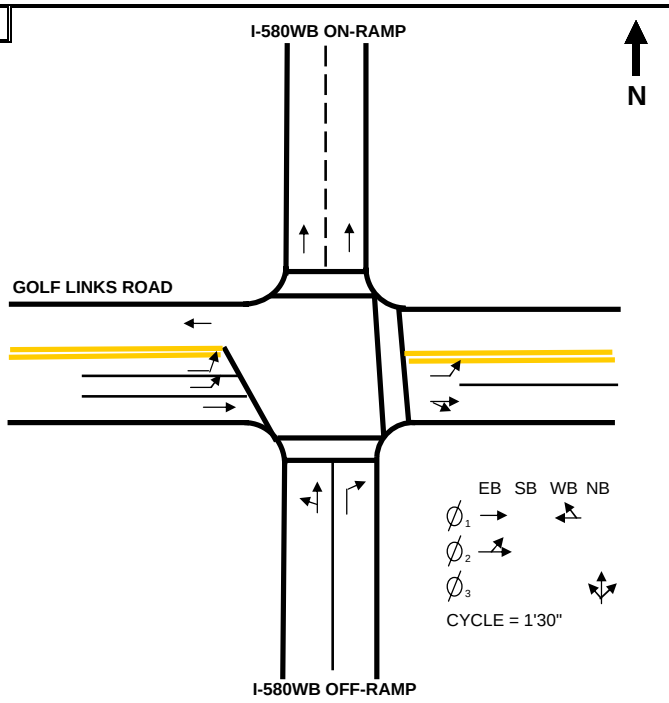

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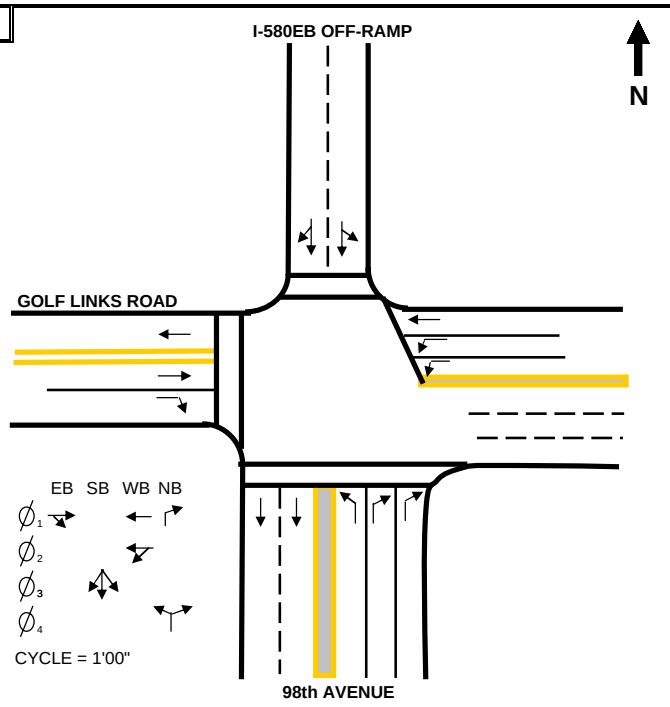

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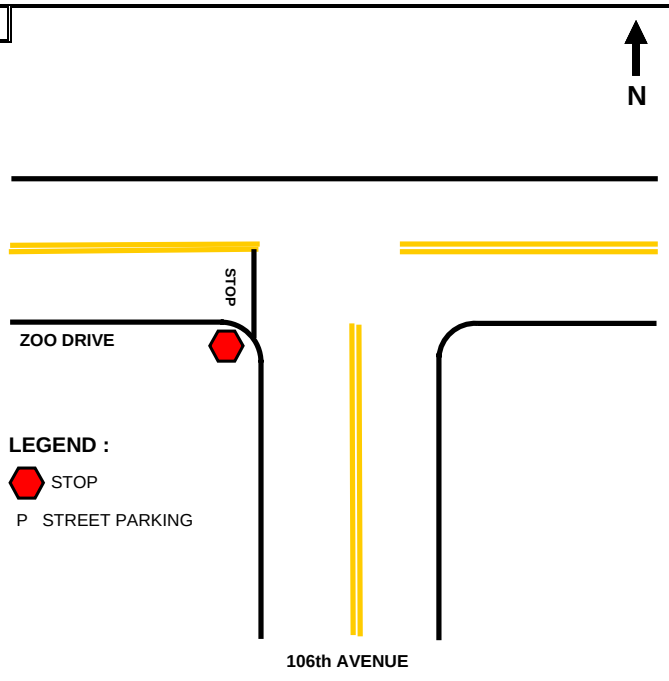

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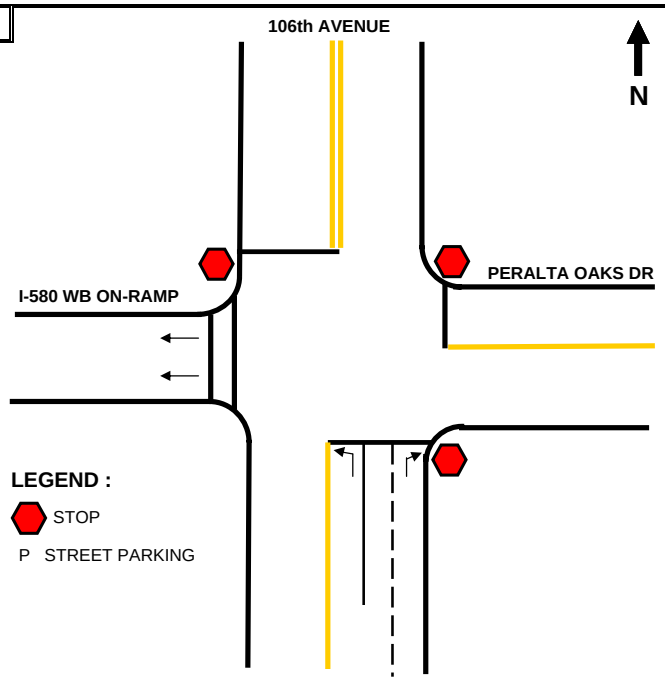
BAYMETRICS

INTERSECTION GEOMETRY & TRAFFIC CONTROL PLAN

PROJECT: OAKLAND ZOO TRAFFIC STUDY **JURISDICTION: OAKLAND** **DATE: 4/16/2009 THURSDAY**

5



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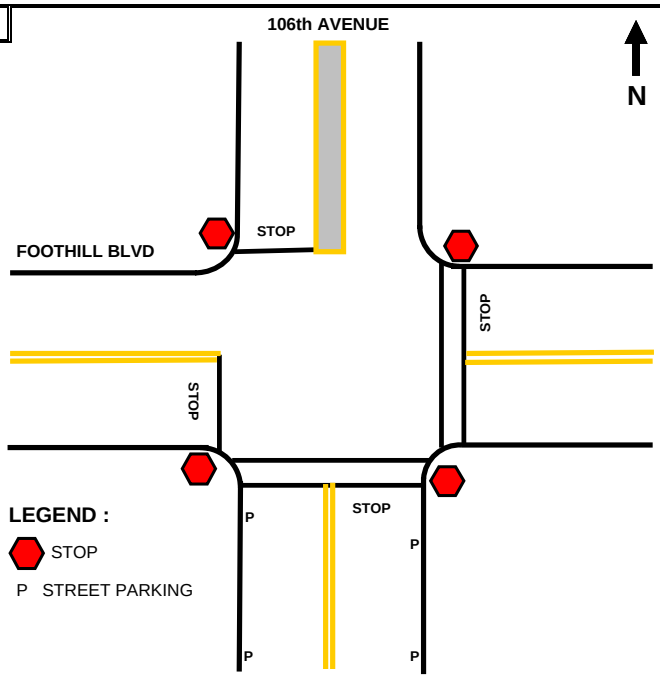

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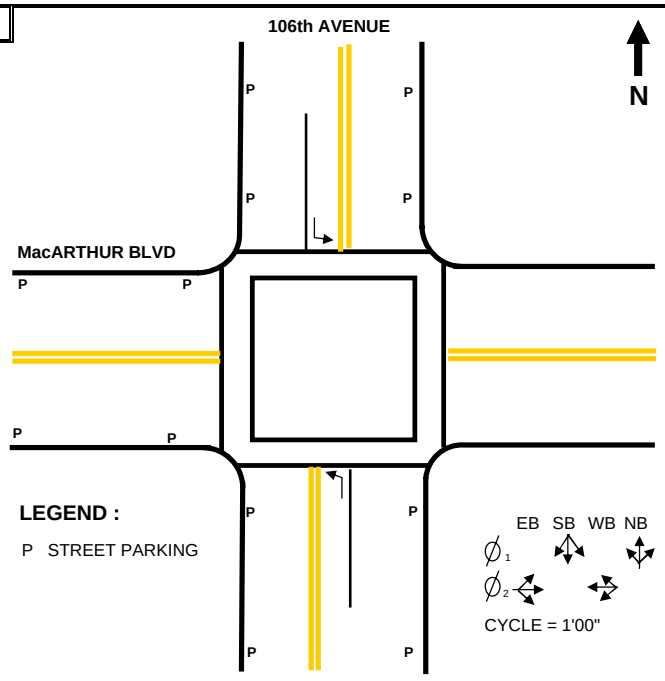

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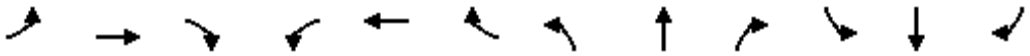
APPENDIX B

LEVEL OF SERVICE CALCULATION WORKSHEETS

EXISTING CONDITIONS
AM PEAK HOUR

HCM Unsignalized Intersection Capacity Analysis
1: Golf Links Road & Mountain Blvd

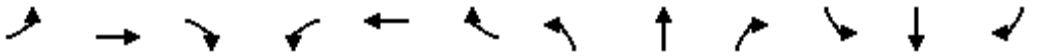
7/17/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	135	215	45	5	369	19	8	1	2	18	3	59
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	147	234	49	6	410	21	9	1	2	20	3	66

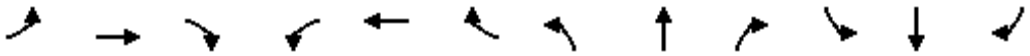
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	147	283	437	9	3	89
Volume Left (vph)	147	0	6	9	0	20
Volume Right (vph)	0	49	21	0	2	66
Hadj (s)	0.53	-0.09	0.01	0.50	-0.53	-0.36
Departure Headway (s)	5.8	5.2	5.3	7.3	6.3	6.2
Degree Utilization, x	0.24	0.41	0.65	0.02	0.00	0.15
Capacity (veh/h)	609	680	665	425	496	522
Control Delay (s)	9.4	10.5	17.5	9.3	8.1	10.3
Approach Delay (s)	10.1		17.5	9.0		10.3
Approach LOS	B		C	A		B

Intersection Summary				
Delay	13.4			
HCM Level of Service	B			
Intersection Capacity Utilization	56.4%	ICU Level of Service	B	
Analysis Period (min)	15			



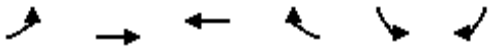
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	521	258	0	0	257	147	337	4	131	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.95			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1771			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1771			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	548	272	0	0	286	163	370	4	144	0	0	0
RTOR Reduction (vph)	0	0	0	0	38	0	0	0	101	0	0	0
Lane Group Flow (vph)	548	272	0	0	411	0	0	374	43	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	10.8	29.8			15.0			16.0	16.0			
Effective Green, g (s)	10.8	29.8			15.0			16.0	16.0			
Actuated g/C Ratio	0.20	0.55			0.28			0.30	0.30			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	689	1032			494			528	471			
v/s Ratio Prot	c0.16	0.15			c0.23			c0.21				
v/s Ratio Perm									0.03			
v/c Ratio	0.80	0.26			0.83			0.71	0.09			
Uniform Delay, d1	20.4	6.3			18.2			16.8	13.6			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	6.3	0.1			11.4			7.8	0.4			
Delay (s)	26.8	6.4			29.6			24.6	14.0			
Level of Service	C	A			C			C	B			
Approach Delay (s)		20.0			29.6			21.7			0.0	
Approach LOS		C			C			C			A	

Intersection Summary			
HCM Average Control Delay	22.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	53.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	72	151	471	158	0	54	0	513	150	404	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3470	
Flt Permitted		1.00	1.00	0.95	1.00		0.41		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		757		2787		3470	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	80	168	523	176	0	60	0	570	167	449	30
RTOR Reduction (vph)	0	0	132	0	0	0	0	0	336	0	4	0
Lane Group Flow (vph)	0	80	36	523	176	0	60	0	234	0	642	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		18.5	18.5	19.2	41.7		12.4		35.6		20.7	
Effective Green, g (s)		18.5	18.5	19.2	41.7		12.4		35.6		20.7	
Actuated g/C Ratio		0.21	0.21	0.22	0.48		0.14		0.41		0.24	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		397	337	759	895		108		1143		828	
v/s Ratio Prot		0.04		c0.15	c0.09				0.08		c0.19	
v/s Ratio Perm			0.02				c0.08					
v/c Ratio		0.20	0.11	0.69	0.20		0.56		0.20		0.78	
Uniform Delay, d1		28.1	27.5	31.1	12.9		34.6		16.5		30.9	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		1.1	0.6	2.6	0.1		6.1		0.1		4.6	
Delay (s)		29.2	28.1	33.7	13.0		40.7		16.6		35.5	
Level of Service		C	C	C	B		D		B		D	
Approach Delay (s)		28.5			28.5			18.9			35.5	
Approach LOS		C			C			B			D	

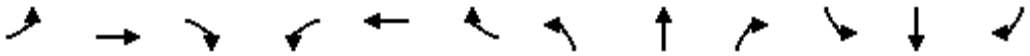
Intersection Summary			
HCM Average Control Delay	27.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	86.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	49.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	216	296	1	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	240	302	1	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	303				543	303
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	303				543	303
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1258				501	737

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	240	303	0	0
Volume Left	0	0	0	0
Volume Right	0	1	0	0
cSH	1258	1700	1700	1700
Volume to Capacity	0.00	0.18	0.00	0.00
Queue Length 95th (ft)	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0
Lane LOS			A	A
Approach Delay (s)	0.0	0.0	0.0	
Approach LOS			A	

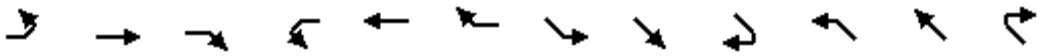
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	19.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	357	217	69	1	170	106	19	15	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	372	226	72	1	187	116	21	17	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	372	298	304	38
Volume Left (vph)	372	0	1	21
Volume Right (vph)	0	72	116	0
Hadj (s)	0.53	-0.13	-0.19	0.15
Departure Headway (s)	5.4	4.7	4.5	6.0
Degree Utilization, x	0.56	0.39	0.38	0.06
Capacity (veh/h)	663	754	778	546
Control Delay (s)	13.7	9.5	10.3	9.4
Approach Delay (s)	11.8		10.3	9.4
Approach LOS	B		B	A

Intersection Summary				
Delay	11.3			
HCM Level of Service	B			
Intersection Capacity Utilization	48.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	19	225	15	87	74	44	203	122	165	7	34	164
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	21	250	17	97	82	49	226	136	183	8	38	182

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	288	228	293	251	228
Volume Left (vph)	21	97	226	0	8
Volume Right (vph)	17	49	0	183	182
Hadj (s)	0.01	-0.01	0.42	-0.48	-0.44
Departure Headway (s)	6.6	6.8	7.1	6.2	6.4
Degree Utilization, x	0.53	0.43	0.58	0.43	0.40
Capacity (veh/h)	499	475	486	555	508
Control Delay (s)	16.8	14.7	18.4	12.7	13.6
Approach Delay (s)	16.8	14.7	15.8		13.6
Approach LOS	C	B	C		B

Intersection Summary				
Delay	15.4			
HCM Level of Service	C			
Intersection Capacity Utilization	65.4%	ICU Level of Service	C	
Analysis Period (min)	15			

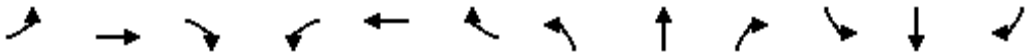
Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	19	227	61	39	163	18	24	125	17	70	171	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.97			0.99		1.00	0.98		1.00	0.97	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1807			1826		1770	1830		1770	1801	
Flt Permitted		0.98			0.91		0.61	1.00		0.66	1.00	
Satd. Flow (perm)		1768			1670		1131	1830		1228	1801	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	20	239	64	43	181	20	26	136	18	78	190	54
RTOR Reduction (vph)	0	22	0	0	8	0	0	11	0	0	26	0
Lane Group Flow (vph)	0	301	0	0	236	0	26	143	0	78	218	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		707			668		452	732		491	720	
v/s Ratio Prot								0.08			c0.12	
v/s Ratio Perm		c0.17			0.14		0.02			0.06		
v/c Ratio		0.43			0.35		0.06	0.20		0.16	0.30	
Uniform Delay, d1		8.7			8.4		7.4	7.8		7.7	8.2	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.9			1.5		0.2	0.6		0.7	1.1	
Delay (s)		10.5			9.9		7.6	8.4		8.4	9.3	
Level of Service		B			A		A	A		A	A	
Approach Delay (s)		10.5			9.9			8.3			9.1	
Approach LOS		B			A			A			A	

Intersection Summary			
HCM Average Control Delay	9.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	48.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

LEVEL OF SERVICE CALCULATION WORKSHEETS

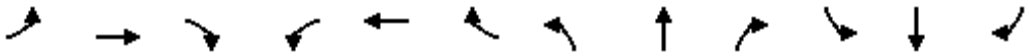
EXISTING CONDITIONS
PM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	96	327	8	0	207	3	208	3	7	8	3	99
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	104	355	9	0	230	3	231	3	8	9	3	110

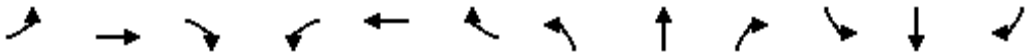
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	104	364	233	233	9	122
Volume Left (vph)	104	0	0	231	0	9
Volume Right (vph)	0	9	3	0	8	110
Hadj (s)	0.53	0.02	0.03	0.53	-0.54	-0.49
Departure Headway (s)	6.8	6.3	6.7	7.4	6.3	6.7
Degree Utilization, x	0.20	0.63	0.43	0.48	0.02	0.23
Capacity (veh/h)	505	549	499	455	528	474
Control Delay (s)	10.2	18.3	14.6	15.7	8.2	11.7
Approach Delay (s)	16.5		14.6	15.5		11.7
Approach LOS	C		B	C		B

Intersection Summary				
Delay	15.3			
HCM Level of Service	C			
Intersection Capacity Utilization	57.0%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	463	283	0	0	342	132	405	3	156	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.96			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1793			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1793			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	487	298	0	0	380	147	445	3	171	0	0	0
RTOR Reduction (vph)	0	0	0	0	23	0	0	0	111	0	0	0
Lane Group Flow (vph)	487	298	0	0	504	0	0	448	60	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	9.0	31.0			18.0			21.0	21.0			
Effective Green, g (s)	9.0	31.0			18.0			21.0	21.0			
Actuated g/C Ratio	0.15	0.52			0.30			0.35	0.35			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	515	963			538			621	554			
v/s Ratio Prot	c0.14	0.16			c0.28			c0.25				
v/s Ratio Perm									0.04			
v/c Ratio	0.95	0.31			0.94			0.72	0.11			
Uniform Delay, d1	25.3	8.3			20.4			17.0	13.2			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	26.4	0.2			23.9			7.1	0.4			
Delay (s)	51.7	8.5			44.3			24.1	13.6			
Level of Service	D	A			D			C	B			
Approach Delay (s)		35.3			44.3			21.2			0.0	
Approach LOS		D			D			C			A	

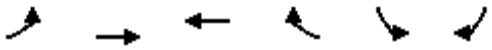
Intersection Summary			
HCM Average Control Delay	33.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	70	148	605	154	0	33	0	527	129	498	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3474	
Flt Permitted		1.00	1.00	0.95	1.00		0.38		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		703		2787		3474	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	78	164	672	171	0	37	0	586	143	553	44
RTOR Reduction (vph)	0	0	133	0	0	0	0	0	342	0	4	0
Lane Group Flow (vph)	0	78	31	672	171	0	37	0	244	0	736	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		17.3	17.3	22.9	44.2		10.6		37.5		23.3	
Effective Green, g (s)		17.3	17.3	22.9	44.2		10.6		37.5		23.3	
Actuated g/C Ratio		0.19	0.19	0.25	0.49		0.12		0.42		0.26	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		358	304	873	914		83		1160		898	
v/s Ratio Prot		c0.04		c0.20	0.09				0.09		c0.21	
v/s Ratio Perm			0.02				c0.05					
v/c Ratio		0.22	0.10	0.77	0.19		0.45		0.21		0.82	
Uniform Delay, d1		30.7	30.0	31.2	12.9		37.0		16.8		31.4	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		1.4	0.7	4.1	0.1		3.8		0.1		5.9	
Delay (s)		32.1	30.7	35.3	13.0		40.8		16.9		37.3	
Level of Service		C	C	D	B		D		B		D	
Approach Delay (s)		31.1			30.8			18.3			37.3	
Approach LOS		C			C			B			D	

Intersection Summary			
HCM Average Control Delay	29.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	90.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	56.0%	ICU Level of Service	B
Analysis Period (min)	15		

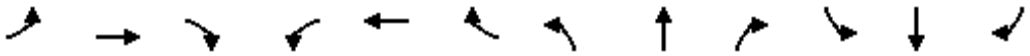
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	240	186	1	2	86
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	267	190	1	2	96
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	191				457	190
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	191				457	190
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	89
cM capacity (veh/h)	1383				562	851

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	267	191	2	96
Volume Left	0	0	2	0
Volume Right	0	1	0	96
cSH	1383	1700	562	851
Volume to Capacity	0.00	0.11	0.00	0.11
Queue Length 95th (ft)	0	0	0	9
Control Delay (s)	0.0	0.0	11.4	9.8
Lane LOS			B	A
Approach Delay (s)	0.0	0.0	9.8	
Approach LOS			A	

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	22.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	312	242	31	4	178	91	36	50	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	325	252	32	4	196	100	40	56	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	325	284	300	96
Volume Left (vph)	325	0	4	40
Volume Right (vph)	0	32	100	0
Hadj (s)	0.53	-0.05	-0.16	0.12
Departure Headway (s)	5.6	5.0	4.8	5.9
Degree Utilization, x	0.51	0.40	0.40	0.16
Capacity (veh/h)	626	705	735	556
Control Delay (s)	13.0	10.1	10.8	10.0
Approach Delay (s)	11.6		10.8	10.0
Approach LOS	B		B	A

Intersection Summary				
Delay	11.2			
HCM Level of Service	B			
Intersection Capacity Utilization	47.0%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	24	207	32	122	54	35	149	176	245	16	78	180
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	27	230	36	136	60	39	166	196	272	18	87	200

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	292	234	263	370	304
Volume Left (vph)	27	136	166	0	18
Volume Right (vph)	36	39	0	272	200
Hadj (s)	-0.02	0.05	0.35	-0.48	-0.35
Departure Headway (s)	7.2	7.5	7.5	6.7	6.9
Degree Utilization, x	0.59	0.49	0.55	0.69	0.58
Capacity (veh/h)	459	428	464	516	483
Control Delay (s)	19.9	17.4	18.2	21.8	18.9
Approach Delay (s)	19.9	17.4	20.3		18.9
Approach LOS	C	C	C		C

Intersection Summary				
Delay	19.5			
HCM Level of Service	C			
Intersection Capacity Utilization	72.3%	ICU Level of Service	C	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	35	188	97	78	213	14	39	275	33	120	270	54
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.98		1.00	0.98	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1777			1828		1770	1833		1770	1816	
Flt Permitted		0.94			0.86		0.48	1.00		0.51	1.00	
Satd. Flow (perm)		1678			1592		890	1833		944	1816	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	37	198	102	87	237	16	42	299	36	133	300	60
RTOR Reduction (vph)	0	39	0	0	4	0	0	11	0	0	18	0
Lane Group Flow (vph)	0	298	0	0	336	0	42	324	0	133	342	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		671			637		356	733		378	726	
v/s Ratio Prot								0.18			c0.19	
v/s Ratio Perm		0.18			c0.21		0.05			0.14		
v/c Ratio		0.44			0.53		0.12	0.44		0.35	0.47	
Uniform Delay, d1		8.8			9.1		7.6	8.7		8.4	8.9	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.1			3.1		0.7	1.9		2.6	2.2	
Delay (s)		10.9			12.2		8.2	10.7		10.9	11.1	
Level of Service		B			B		A	B		B	B	
Approach Delay (s)		10.9			12.2			10.4			11.0	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	11.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	64.3%	ICU Level of Service	C
Analysis Period (min)	15		

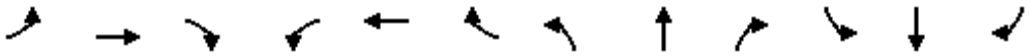
c Critical Lane Group

LEVEL OF SERVICE CALCULATION WORKSHEETS

EXISTING PLUS PROJECT CONDITIONS
AM PEAK HOUR

HCM Unsignalized Intersection Capacity Analysis
1: Golf Links Road & Mountain Blvd

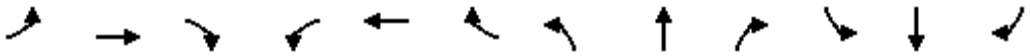
7/17/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	137	215	45	5	369	19	8	1	2	18	3	59
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	149	234	49	6	410	21	9	1	2	20	3	66

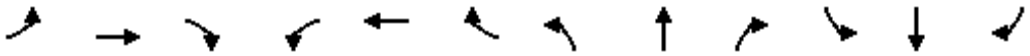
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	149	283	437	9	3	89
Volume Left (vph)	149	0	6	9	0	20
Volume Right (vph)	0	49	21	0	2	66
Hadj (s)	0.53	-0.09	0.01	0.50	-0.53	-0.36
Departure Headway (s)	5.8	5.2	5.3	7.3	6.3	6.2
Degree Utilization, x	0.24	0.41	0.65	0.02	0.00	0.15
Capacity (veh/h)	609	680	665	425	495	522
Control Delay (s)	9.4	10.5	17.5	9.3	8.1	10.3
Approach Delay (s)	10.1		17.5	9.0		10.3
Approach LOS	B		C	A		B

Intersection Summary				
Delay	13.4			
HCM Level of Service	B			
Intersection Capacity Utilization	56.4%	ICU Level of Service	B	
Analysis Period (min)	15			



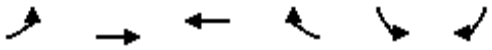
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	521	160	0	0	257	147	337	4	131	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.95			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1771			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1771			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	548	168	0	0	286	163	370	4	144	0	0	0
RTOR Reduction (vph)	0	0	0	0	38	0	0	0	101	0	0	0
Lane Group Flow (vph)	548	168	0	0	411	0	0	374	43	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	10.8	29.8			15.0			16.0	16.0			
Effective Green, g (s)	10.8	29.8			15.0			16.0	16.0			
Actuated g/C Ratio	0.20	0.55			0.28			0.30	0.30			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	689	1032			494			528	471			
v/s Ratio Prot	c0.16	0.09			c0.23			c0.21				
v/s Ratio Perm									0.03			
v/c Ratio	0.80	0.16			0.83			0.71	0.09			
Uniform Delay, d1	20.4	5.9			18.2			16.8	13.6			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	6.3	0.1			11.4			7.8	0.4			
Delay (s)	26.8	6.0			29.6			24.6	14.0			
Level of Service	C	A			C			C	B			
Approach Delay (s)		21.9			29.6			21.7			0.0	
Approach LOS		C			C			C			A	

Intersection Summary			
HCM Average Control Delay	23.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	53.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	72	151	471	158	0	54	0	514	150	404	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3469	
Flt Permitted		1.00	1.00	0.95	1.00		0.41		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		756		2787		3469	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	80	168	523	176	0	60	0	571	167	449	31
RTOR Reduction (vph)	0	0	132	0	0	0	0	0	337	0	4	0
Lane Group Flow (vph)	0	80	36	523	176	0	60	0	234	0	643	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		18.5	18.5	19.2	41.7		12.4		35.6		20.8	
Effective Green, g (s)		18.5	18.5	19.2	41.7		12.4		35.6		20.8	
Actuated g/C Ratio		0.21	0.21	0.22	0.48		0.14		0.41		0.24	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		397	337	758	894		108		1142		830	
v/s Ratio Prot		0.04		c0.15	c0.09				0.08		c0.19	
v/s Ratio Perm			0.02				c0.08					
v/c Ratio		0.20	0.11	0.69	0.20		0.56		0.20		0.77	
Uniform Delay, d1		28.1	27.5	31.1	13.0		34.7		16.5		30.9	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		1.1	0.6	2.6	0.1		6.1		0.1		4.6	
Delay (s)		29.3	28.2	33.7	13.1		40.8		16.6		35.4	
Level of Service		C	C	C	B		D		B		D	
Approach Delay (s)		28.5			28.5			18.9			35.4	
Approach LOS		C			C			B			D	

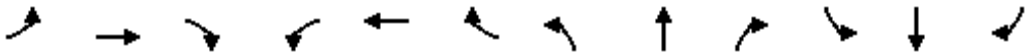
Intersection Summary			
HCM Average Control Delay	27.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	86.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	49.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	216	296	1	0	1
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	240	302	1	0	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	303				543	303
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	303				543	303
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1258				501	737

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	240	303	0	1
Volume Left	0	0	0	0
Volume Right	0	1	0	1
cSH	1258	1700	1700	737
Volume to Capacity	0.00	0.18	0.00	0.00
Queue Length 95th (ft)	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	9.9
Lane LOS			A	A
Approach Delay (s)	0.0	0.0	9.9	
Approach LOS			A	

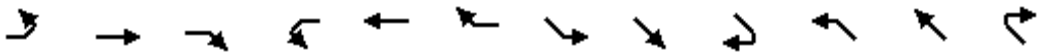
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	25.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	357	217	69	1	171	106	19	15	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	372	226	72	1	188	116	21	17	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	372	298	305	38
Volume Left (vph)	372	0	1	21
Volume Right (vph)	0	72	116	0
Hadj (s)	0.53	-0.13	-0.19	0.15
Departure Headway (s)	5.4	4.7	4.5	6.0
Degree Utilization, x	0.56	0.39	0.38	0.06
Capacity (veh/h)	663	754	778	545
Control Delay (s)	13.7	9.5	10.3	9.4
Approach Delay (s)	11.8		10.3	9.4
Approach LOS	B		B	A

Intersection Summary				
Delay	11.3			
HCM Level of Service	B			
Intersection Capacity Utilization	48.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	19	225	15	87	75	44	203	122	165	7	34	164
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	21	250	17	97	83	49	226	136	183	8	38	182

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	288	229	293	251	228
Volume Left (vph)	21	97	226	0	8
Volume Right (vph)	17	49	0	183	182
Hadj (s)	0.01	-0.01	0.42	-0.48	-0.44
Departure Headway (s)	6.6	6.8	7.1	6.2	6.4
Degree Utilization, x	0.53	0.43	0.58	0.43	0.40
Capacity (veh/h)	499	475	485	555	508
Control Delay (s)	16.8	14.8	18.4	12.7	13.6
Approach Delay (s)	16.8	14.8	15.8		13.6
Approach LOS	C	B	C		B

Intersection Summary				
Delay	15.5			
HCM Level of Service	C			
Intersection Capacity Utilization	65.4%	ICU Level of Service	C	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	19	227	61	39	164	18	24	125	17	70	171	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.97			0.99		1.00	0.98		1.00	0.97	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1807			1826		1770	1830		1770	1801	
Flt Permitted		0.98			0.91		0.61	1.00		0.66	1.00	
Satd. Flow (perm)		1768			1670		1131	1830		1228	1801	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	20	239	64	43	182	20	26	136	18	78	190	54
RTOR Reduction (vph)	0	22	0	0	8	0	0	11	0	0	26	0
Lane Group Flow (vph)	0	301	0	0	237	0	26	143	0	78	218	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		707			668		452	732		491	720	
v/s Ratio Prot								0.08			c0.12	
v/s Ratio Perm		c0.17			0.14		0.02			0.06		
v/c Ratio		0.43			0.36		0.06	0.20		0.16	0.30	
Uniform Delay, d1		8.7			8.4		7.4	7.8		7.7	8.2	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.9			1.5		0.2	0.6		0.7	1.1	
Delay (s)		10.5			9.9		7.6	8.4		8.4	9.3	
Level of Service		B			A		A	A		A	A	
Approach Delay (s)		10.5			9.9			8.3			9.1	
Approach LOS		B			A			A			A	

Intersection Summary			
HCM Average Control Delay	9.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	48.2%	ICU Level of Service	A
Analysis Period (min)	15		

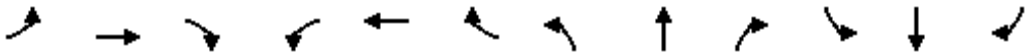
c Critical Lane Group

LEVEL OF SERVICE CALCULATION WORKSHEETS

EXISTING PLUS PROJECT CONDITIONS
PM PEAK HOUR

HCM Unsignalized Intersection Capacity Analysis
1: Golf Links Road & Mountain Blvd

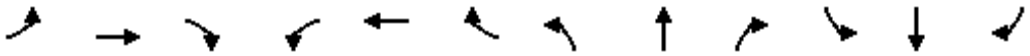
7/17/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	99	327	8	0	207	3	209	3	7	8	3	99
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	108	355	9	0	230	3	232	3	8	9	3	110

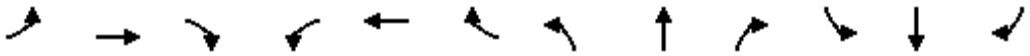
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	108	364	233	234	9	122
Volume Left (vph)	108	0	0	232	0	9
Volume Right (vph)	0	9	3	0	8	110
Hadj (s)	0.53	0.02	0.03	0.53	-0.54	-0.49
Departure Headway (s)	6.8	6.3	6.7	7.4	6.3	6.7
Degree Utilization, x	0.20	0.63	0.43	0.48	0.02	0.23
Capacity (veh/h)	505	549	499	455	527	474
Control Delay (s)	10.3	18.3	14.7	15.8	8.2	11.7
Approach Delay (s)	16.5		14.7	15.5		11.7
Approach LOS	C		B	C		B

Intersection Summary				
Delay	15.3			
HCM Level of Service	C			
Intersection Capacity Utilization	57.0%	ICU Level of Service	B	
Analysis Period (min)	15			



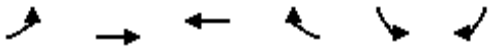
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	463	285	0	0	342	133	405	3	157	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.96			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1792			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1792			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	487	300	0	0	380	148	445	3	173	0	0	0
RTOR Reduction (vph)	0	0	0	0	23	0	0	0	112	0	0	0
Lane Group Flow (vph)	487	300	0	0	505	0	0	448	61	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	9.0	31.0			18.0			21.0	21.0			
Effective Green, g (s)	9.0	31.0			18.0			21.0	21.0			
Actuated g/C Ratio	0.15	0.52			0.30			0.35	0.35			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	515	963			538			621	554			
v/s Ratio Prot	c0.14	0.16			c0.28			c0.25				
v/s Ratio Perm									0.04			
v/c Ratio	0.95	0.31			0.94			0.72	0.11			
Uniform Delay, d1	25.3	8.4			20.5			17.0	13.2			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	26.4	0.2			24.2			7.1	0.4			
Delay (s)	51.7	8.5			44.6			24.1	13.6			
Level of Service	D	A			D			C	B			
Approach Delay (s)		35.2			44.6			21.1			0.0	
Approach LOS		D			D			C			A	

Intersection Summary			
HCM Average Control Delay	33.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	70	148	605	155	0	33	0	527	129	498	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3473	
Flt Permitted		1.00	1.00	0.95	1.00		0.38		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		703		2787		3473	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	78	164	672	172	0	37	0	586	143	553	46
RTOR Reduction (vph)	0	0	133	0	0	0	0	0	342	0	4	0
Lane Group Flow (vph)	0	78	31	672	172	0	37	0	244	0	738	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		17.3	17.3	22.9	44.2		10.6		37.5		23.3	
Effective Green, g (s)		17.3	17.3	22.9	44.2		10.6		37.5		23.3	
Actuated g/C Ratio		0.19	0.19	0.25	0.49		0.12		0.42		0.26	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		358	304	873	914		83		1160		898	
v/s Ratio Prot		c0.04		c0.20	0.09				0.09		c0.21	
v/s Ratio Perm			0.02				c0.05					
v/c Ratio		0.22	0.10	0.77	0.19		0.45		0.21		0.82	
Uniform Delay, d1		30.7	30.0	31.2	12.9		37.0		16.8		31.4	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		1.4	0.7	4.1	0.1		3.8		0.1		6.1	
Delay (s)		32.1	30.7	35.3	13.0		40.8		16.9		37.5	
Level of Service		C	C	D	B		D		B		D	
Approach Delay (s)		31.1			30.7			18.3			37.5	
Approach LOS		C			C			B			D	

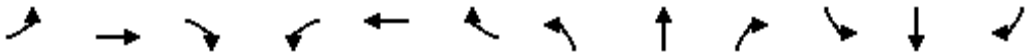
Intersection Summary			
HCM Average Control Delay	29.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	90.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	56.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	240	186	1	2	87
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	267	190	1	2	97
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	191				457	190
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	191				457	190
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	89
cM capacity (veh/h)	1383				562	851

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	267	191	2	97
Volume Left	0	0	2	0
Volume Right	0	1	0	97
cSH	1383	1700	562	851
Volume to Capacity	0.00	0.11	0.00	0.11
Queue Length 95th (ft)	0	0	0	10
Control Delay (s)	0.0	0.0	11.4	9.8
Lane LOS			B	A
Approach Delay (s)	0.0	0.0	9.8	
Approach LOS			A	

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	22.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	312	242	31	4	179	91	36	50	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	325	252	32	4	197	100	40	56	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	325	284	301	96
Volume Left (vph)	325	0	4	40
Volume Right (vph)	0	32	100	0
Hadj (s)	0.53	-0.05	-0.16	0.12
Departure Headway (s)	5.6	5.0	4.8	5.9
Degree Utilization, x	0.51	0.40	0.40	0.16
Capacity (veh/h)	626	705	735	556
Control Delay (s)	13.0	10.1	10.8	10.0
Approach Delay (s)	11.6		10.8	10.0
Approach LOS	B		B	B

Intersection Summary				
Delay	11.2			
HCM Level of Service	B			
Intersection Capacity Utilization	47.1%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	24	207	32	122	55	35	149	176	245	16	78	180
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	27	230	36	136	61	39	166	196	272	18	87	200

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	292	236	263	370	304
Volume Left (vph)	27	136	166	0	18
Volume Right (vph)	36	39	0	272	200
Hadj (s)	-0.02	0.05	0.35	-0.48	-0.35
Departure Headway (s)	7.2	7.5	7.5	6.7	6.9
Degree Utilization, x	0.59	0.49	0.55	0.69	0.58
Capacity (veh/h)	459	428	463	516	483
Control Delay (s)	19.9	17.4	18.2	21.9	18.9
Approach Delay (s)	19.9	17.4	20.3		18.9
Approach LOS	C	C	C		C

Intersection Summary				
Delay	19.5			
HCM Level of Service	C			
Intersection Capacity Utilization	72.4%	ICU Level of Service	C	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	35	188	97	79	213	14	39	275	33	120	270	54
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.98		1.00	0.98	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1777			1827		1770	1833		1770	1816	
Flt Permitted		0.94			0.86		0.48	1.00		0.51	1.00	
Satd. Flow (perm)		1678			1590		890	1833		944	1816	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	37	198	102	88	237	16	42	299	36	133	300	60
RTOR Reduction (vph)	0	39	0	0	4	0	0	11	0	0	18	0
Lane Group Flow (vph)	0	298	0	0	337	0	42	324	0	133	342	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		671			636		356	733		378	726	
v/s Ratio Prot								0.18			c0.19	
v/s Ratio Perm		0.18			c0.21		0.05			0.14		
v/c Ratio		0.44			0.53		0.12	0.44		0.35	0.47	
Uniform Delay, d1		8.8			9.1		7.6	8.7		8.4	8.9	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.1			3.1		0.7	1.9		2.6	2.2	
Delay (s)		10.9			12.3		8.2	10.7		10.9	11.1	
Level of Service		B			B		A	B		B	B	
Approach Delay (s)		10.9			12.3			10.4			11.0	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	11.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	64.6%	ICU Level of Service	C
Analysis Period (min)	15		

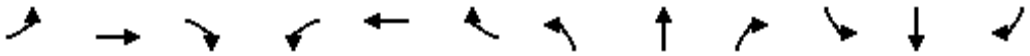
c Critical Lane Group

LEVEL OF SERVICE CALCULATION WORKSHEETS

2015 CONDITIONS
AM PEAK HOUR

HCM Unsignalized Intersection Capacity Analysis
1: Golf Links Road & Mountain Blvd

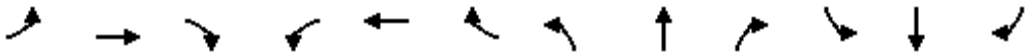
7/17/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	145	230	48	6	418	22	8	1	2	19	3	64
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	158	250	52	7	464	24	9	1	2	21	3	71

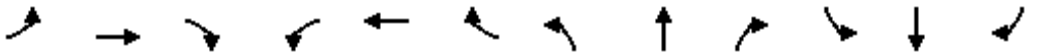
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	158	302	496	9	3	96
Volume Left (vph)	158	0	7	9	0	21
Volume Right (vph)	0	52	24	0	2	71
Hadj (s)	0.53	-0.09	0.01	0.50	-0.53	-0.37
Departure Headway (s)	5.9	5.3	5.4	7.6	6.5	6.4
Degree Utilization, x	0.26	0.44	0.74	0.02	0.01	0.17
Capacity (veh/h)	588	666	659	431	490	515
Control Delay (s)	9.8	11.2	22.2	9.5	8.4	10.7
Approach Delay (s)	10.7		22.2	9.3		10.7
Approach LOS	B		C	A		B

Intersection Summary				
Delay	16.1			
HCM Level of Service	C			
Intersection Capacity Utilization	60.5%	ICU Level of Service	B	
Analysis Period (min)	15			



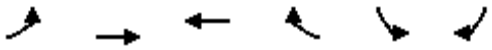
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	558	276	0	0	291	166	353	4	137	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.95			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1771			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1771			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	587	291	0	0	323	184	388	4	151	0	0	0
RTOR Reduction (vph)	0	0	0	0	35	0	0	0	107	0	0	0
Lane Group Flow (vph)	587	291	0	0	472	0	0	392	44	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	11.9	33.9			18.0			17.0	17.0			
Effective Green, g (s)	11.9	33.9			18.0			17.0	17.0			
Actuated g/C Ratio	0.20	0.58			0.31			0.29	0.29			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	694	1072			541			512	457			
v/s Ratio Prot	c0.17	0.16			c0.27			c0.22				
v/s Ratio Perm									0.03			
v/c Ratio	0.85	0.27			0.87			0.77	0.10			
Uniform Delay, d1	22.6	6.3			19.4			19.1	15.3			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	9.3	0.1			14.5			10.4	0.4			
Delay (s)	31.9	6.4			33.8			29.6	15.7			
Level of Service	C	A			C			C	B			
Approach Delay (s)		23.5			33.8			25.7			0.0	
Approach LOS		C			C			C			A	

Intersection Summary			
HCM Average Control Delay	26.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	58.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	77	162	533	179	0	57	0	538	162	436	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3470	
Flt Permitted		1.00	1.00	0.95	1.00		0.39		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		721		2787		3470	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	86	180	592	199	0	63	0	598	180	484	32
RTOR Reduction (vph)	0	0	145	0	0	0	0	0	346	0	4	0
Lane Group Flow (vph)	0	86	35	592	199	0	63	0	252	0	692	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		17.5	17.5	20.7	42.2		13.0		37.7		22.1	
Effective Green, g (s)		17.5	17.5	20.7	42.2		13.0		37.7		22.1	
Actuated g/C Ratio		0.20	0.20	0.23	0.47		0.15		0.42		0.25	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		365	310	796	880		105		1177		859	
v/s Ratio Prot		0.05		c0.17	c0.11				0.09		c0.20	
v/s Ratio Perm			0.02				c0.09					
v/c Ratio		0.24	0.11	0.74	0.23		0.60		0.21		0.81	
Uniform Delay, d1		30.3	29.5	31.8	13.9		35.7		16.4		31.6	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		1.5	0.7	3.8	0.1		9.3		0.1		5.6	
Delay (s)		31.8	30.3	35.6	14.0		45.0		16.5		37.1	
Level of Service		C	C	D	B		D		B		D	
Approach Delay (s)		30.8			30.2			19.2			37.1	
Approach LOS		C			C			B			D	

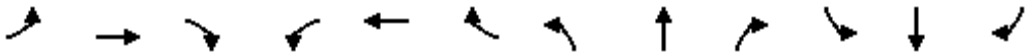
Intersection Summary			
HCM Average Control Delay	29.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	89.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	231	335	1	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	257	342	1	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	343				599	342
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	343				599	342
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1216				465	700

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	257	343	0	0
Volume Left	0	0	0	0
Volume Right	0	1	0	0
cSH	1216	1700	1700	1700
Volume to Capacity	0.00	0.20	0.00	0.00
Queue Length 95th (ft)	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0
Lane LOS			A	A
Approach Delay (s)	0.0	0.0	0.0	
Approach LOS			A	

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	21.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	376	228	73	1	189	118	20	16	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	392	238	76	1	208	130	22	18	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	392	314	338	40
Volume Left (vph)	392	0	1	22
Volume Right (vph)	0	76	130	0
Hadj (s)	0.53	-0.14	-0.20	0.15
Departure Headway (s)	5.4	4.7	4.6	6.1
Degree Utilization, x	0.59	0.41	0.43	0.07
Capacity (veh/h)	649	749	773	534
Control Delay (s)	14.7	9.8	10.9	9.5
Approach Delay (s)	12.5		10.9	9.5
Approach LOS	B		B	A

Intersection Summary				
Delay	11.9			
HCM Level of Service	B			
Intersection Capacity Utilization	51.4%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	20	237	64	97	82	49	219	132	178	7	36	172
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	22	263	71	108	91	54	243	147	198	8	40	191

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	357	253	317	271	239
Volume Left (vph)	22	108	243	0	8
Volume Right (vph)	71	54	0	198	191
Hadj (s)	-0.07	-0.01	0.42	-0.48	-0.44
Departure Headway (s)	7.0	7.4	7.7	6.8	7.1
Degree Utilization, x	0.69	0.52	0.68	0.51	0.47
Capacity (veh/h)	487	442	450	500	454
Control Delay (s)	24.3	18.1	24.5	15.6	16.3
Approach Delay (s)	24.3	18.1	20.4		16.3
Approach LOS	C	C	C		C

Intersection Summary				
Delay	20.3			
HCM Level of Service	C			
Intersection Capacity Utilization	72.1%	ICU Level of Service	C	
Analysis Period (min)	15			

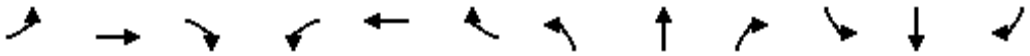
Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	20	239	64	43	181	20	26	135	18	73	179	51
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.97			0.99		1.00	0.98		1.00	0.97	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1808			1826		1770	1829		1770	1801	
Flt Permitted		0.97			0.90		0.60	1.00		0.65	1.00	
Satd. Flow (perm)		1766			1658		1119	1829		1214	1801	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	21	252	67	48	201	22	28	147	20	81	199	57
RTOR Reduction (vph)	0	22	0	0	8	0	0	12	0	0	26	0
Lane Group Flow (vph)	0	318	0	0	263	0	28	155	0	81	230	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		706			663		448	732		486	720	
v/s Ratio Prot								0.08			c0.13	
v/s Ratio Perm		c0.18			0.16		0.03			0.07		
v/c Ratio		0.45			0.40		0.06	0.21		0.17	0.32	
Uniform Delay, d1		8.8			8.6		7.4	7.9		7.7	8.3	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.1			1.8		0.3	0.7		0.7	1.2	
Delay (s)		10.9			10.3		7.7	8.5		8.5	9.4	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		10.9			10.3			8.4			9.2	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	9.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

LEVEL OF SERVICE CALCULATION WORKSHEETS

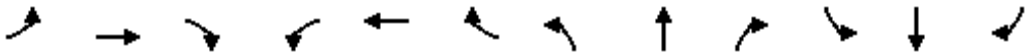
2015 CONDITIONS
PM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	102	348	9	0	234	3	217	3	7	8	3	101
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	111	378	10	0	260	3	241	3	8	9	3	112

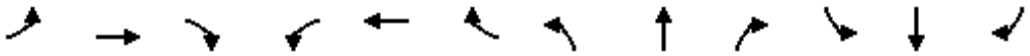
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	111	388	263	243	9	124
Volume Left (vph)	111	0	0	241	0	9
Volume Right (vph)	0	10	3	0	8	112
Hadj (s)	0.53	0.02	0.03	0.53	-0.54	-0.49
Departure Headway (s)	7.0	6.4	6.8	7.6	6.5	7.0
Degree Utilization, x	0.21	0.70	0.50	0.51	0.02	0.24
Capacity (veh/h)	493	538	491	441	509	441
Control Delay (s)	10.7	21.6	16.5	17.2	8.4	12.3
Approach Delay (s)	19.2		16.5	16.9		12.3
Approach LOS	C		C	C		B

Intersection Summary				
Delay	17.3			
HCM Level of Service	C			
Intersection Capacity Utilization	60.0%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	492	301	0	0	386	149	423	3	163	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.96			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1793			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1793			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	518	317	0	0	429	166	465	3	179	0	0	0
RTOR Reduction (vph)	0	0	0	0	18	0	0	0	118	0	0	0
Lane Group Flow (vph)	518	317	0	0	577	0	0	468	61	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	13.0	44.1			27.1			27.0	27.0			
Effective Green, g (s)	13.0	44.1			27.1			27.0	27.0			
Actuated g/C Ratio	0.16	0.56			0.34			0.34	0.34			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	564	1039			614			606	540			
v/s Ratio Prot	c0.15	0.17			c0.32			c0.26				
v/s Ratio Perm									0.04			
v/c Ratio	0.92	0.31			0.94			0.77	0.11			
Uniform Delay, d1	32.5	9.3			25.2			23.3	17.8			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	19.9	0.2			22.6			9.2	0.4			
Delay (s)	52.5	9.5			47.8			32.5	18.3			
Level of Service	D	A			D			C	B			
Approach Delay (s)		36.2			47.8			28.6			0.0	
Approach LOS		D			D			C			A	

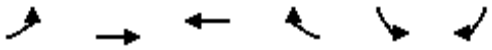
Intersection Summary			
HCM Average Control Delay	37.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	79.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	74	157	683	174	0	34	0	551	131	503	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3473	
Flt Permitted		1.00	1.00	0.95	1.00		0.37		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		690		2787		3473	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	82	174	759	193	0	38	0	612	146	559	46
RTOR Reduction (vph)	0	0	140	0	0	0	0	0	351	0	5	0
Lane Group Flow (vph)	0	82	34	759	193	0	38	0	261	0	746	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		18.2	18.2	24.8	47.0		10.8		39.6		22.9	
Effective Green, g (s)		18.2	18.2	24.8	47.0		10.8		39.6		22.9	
Actuated g/C Ratio		0.20	0.20	0.27	0.51		0.12		0.43		0.25	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		366	311	918	945		80		1191		858	
v/s Ratio Prot		0.04		c0.22	c0.10				0.09		c0.21	
v/s Ratio Perm			0.02				c0.06					
v/c Ratio		0.22	0.11	0.83	0.20		0.48		0.22		0.87	
Uniform Delay, d1		31.3	30.6	31.9	12.6		38.3		16.8		33.5	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		1.4	0.7	6.2	0.1		4.4		0.1		9.6	
Delay (s)		32.7	31.3	38.1	12.7		42.7		16.9		43.0	
Level of Service		C	C	D	B		D		B		D	
Approach Delay (s)		31.8			32.9			18.4			43.0	
Approach LOS		C			C			B			D	

Intersection Summary			
HCM Average Control Delay	32.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	92.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	58.5%	ICU Level of Service	B
Analysis Period (min)	15		

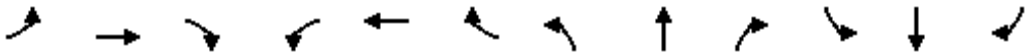
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	255	210	1	2	87
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	283	214	1	2	97
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	215				498	215
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	215				498	215
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	88
cM capacity (veh/h)	1355				532	825

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	283	215	2	97
Volume Left	0	0	2	0
Volume Right	0	1	0	97
cSH	1355	1700	532	825
Volume to Capacity	0.00	0.13	0.00	0.12
Queue Length 95th (ft)	0	0	0	10
Control Delay (s)	0.0	0.0	11.8	9.9
Lane LOS			B	A
Approach Delay (s)	0.0	0.0	10.0	
Approach LOS			A	

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	23.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	335	260	33	4	192	98	38	52	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	349	271	34	4	211	108	42	58	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	349	305	323	100
Volume Left (vph)	349	0	4	42
Volume Right (vph)	0	34	108	0
Hadj (s)	0.53	-0.04	-0.16	0.12
Departure Headway (s)	5.6	5.1	4.8	6.0
Degree Utilization, x	0.55	0.43	0.43	0.17
Capacity (veh/h)	622	700	727	545
Control Delay (s)	14.0	10.6	11.4	10.2
Approach Delay (s)	12.4		11.4	10.2
Approach LOS	B		B	B

Intersection Summary				
Delay	11.9			
HCM Level of Service	B			
Intersection Capacity Utilization	49.7%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	26	222	34	132	58	38	151	179	249	17	81	188
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	29	247	38	147	64	42	168	199	277	19	90	209

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	313	253	267	376	318
Volume Left (vph)	29	147	168	0	19
Volume Right (vph)	38	42	0	277	209
Hadj (s)	-0.02	0.05	0.35	-0.48	-0.35
Departure Headway (s)	7.6	7.8	7.9	7.1	7.3
Degree Utilization, x	0.66	0.55	0.59	0.74	0.64
Capacity (veh/h)	444	415	442	493	462
Control Delay (s)	23.9	20.1	20.4	26.2	22.3
Approach Delay (s)	23.9	20.1	23.8		22.3
Approach LOS	C	C	C		C

Intersection Summary				
Delay	22.9			
HCM Level of Service	C			
Intersection Capacity Utilization	75.3%	ICU Level of Service	D	
Analysis Period (min)	15			

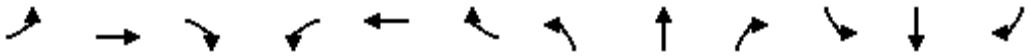
Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	38	202	104	84	230	15	40	280	34	125	282	56
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.98		1.00	0.98	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1777			1828		1770	1832		1770	1817	
Flt Permitted		0.93			0.86		0.46	1.00		0.50	1.00	
Satd. Flow (perm)		1670			1585		858	1832		931	1817	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	40	213	109	93	256	17	43	304	37	139	313	62
RTOR Reduction (vph)	0	39	0	0	4	0	0	11	0	0	18	0
Lane Group Flow (vph)	0	323	0	0	362	0	43	330	0	139	357	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		668			634		343	733		372	727	
v/s Ratio Prot								0.18			c0.20	
v/s Ratio Perm		0.19			c0.23		0.05			0.15		
v/c Ratio		0.48			0.57		0.13	0.45		0.37	0.49	
Uniform Delay, d1		8.9			9.3		7.6	8.8		8.5	9.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.5			3.7		0.8	2.0		2.9	2.4	
Delay (s)		11.4			13.0		8.3	10.8		11.3	11.3	
Level of Service		B			B		A	B		B	B	
Approach Delay (s)		11.4			13.0			10.5			11.3	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	11.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	67.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

LEVEL OF SERVICE CALCULATION WORKSHEETS

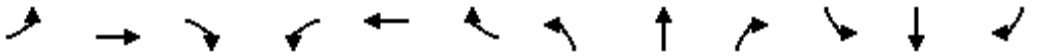
2015 PLUS PROJECT CONDITIONS
AM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	145	230	50	6	418	22	8	1	2	19	3	64
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	158	250	54	7	464	24	9	1	2	21	3	71

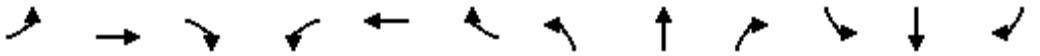
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	158	304	496	9	3	96
Volume Left (vph)	158	0	7	9	0	21
Volume Right (vph)	0	54	24	0	2	71
Hadj (s)	0.53	-0.09	0.01	0.50	-0.53	-0.37
Departure Headway (s)	5.9	5.3	5.4	7.6	6.5	6.4
Degree Utilization, x	0.26	0.45	0.74	0.02	0.01	0.17
Capacity (veh/h)	588	667	659	430	490	515
Control Delay (s)	9.8	11.3	22.3	9.5	8.4	10.7
Approach Delay (s)	10.7		22.3	9.3		10.7
Approach LOS	B		C	A		B

Intersection Summary				
Delay	16.1			
HCM Level of Service	C			
Intersection Capacity Utilization	60.6%	ICU Level of Service	B	
Analysis Period (min)	15			



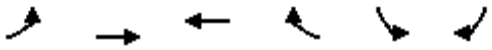
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	558	278	0	0	291	166	353	4	137	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.95			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1771			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1771			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	587	293	0	0	323	184	388	4	151	0	0	0
RTOR Reduction (vph)	0	0	0	0	35	0	0	0	107	0	0	0
Lane Group Flow (vph)	587	293	0	0	472	0	0	392	44	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	11.9	33.9			18.0			17.0	17.0			
Effective Green, g (s)	11.9	33.9			18.0			17.0	17.0			
Actuated g/C Ratio	0.20	0.58			0.31			0.29	0.29			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	694	1072			541			512	457			
v/s Ratio Prot	c0.17	0.16			c0.27			c0.22				
v/s Ratio Perm									0.03			
v/c Ratio	0.85	0.27			0.87			0.77	0.10			
Uniform Delay, d1	22.6	6.3			19.4			19.1	15.3			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	9.3	0.1			14.5			10.4	0.4			
Delay (s)	31.9	6.4			33.8			29.6	15.7			
Level of Service	C	A			C			C	B			
Approach Delay (s)		23.5			33.8			25.7			0.0	
Approach LOS		C			C			C			A	

Intersection Summary			
HCM Average Control Delay	26.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	58.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	77	162	533	179	0	57	0	538	163	436	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3470	
Flt Permitted		1.00	1.00	0.95	1.00		0.39		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		720		2787		3470	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	86	180	592	199	0	63	0	598	181	484	32
RTOR Reduction (vph)	0	0	145	0	0	0	0	0	346	0	4	0
Lane Group Flow (vph)	0	86	35	592	199	0	63	0	252	0	693	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		17.4	17.4	20.7	42.1		13.0		37.7		22.2	
Effective Green, g (s)		17.4	17.4	20.7	42.1		13.0		37.7		22.2	
Actuated g/C Ratio		0.19	0.19	0.23	0.47		0.15		0.42		0.25	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		363	308	796	878		105		1177		863	
v/s Ratio Prot		0.05		c0.17	c0.11				0.09		c0.20	
v/s Ratio Perm			0.02				c0.09					
v/c Ratio		0.24	0.11	0.74	0.23		0.60		0.21		0.80	
Uniform Delay, d1		30.3	29.6	31.8	14.0		35.7		16.4		31.5	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		1.5	0.7	3.8	0.1		9.3		0.1		5.5	
Delay (s)		31.9	30.4	35.6	14.1		45.0		16.5		37.0	
Level of Service		C	C	D	B		D		B		D	
Approach Delay (s)		30.8			30.2			19.2			37.0	
Approach LOS		C			C			B			D	

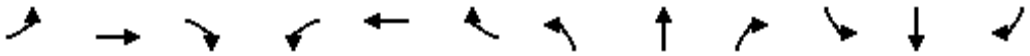
Intersection Summary			
HCM Average Control Delay	29.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	89.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	231	335	1	0	1
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	257	342	1	0	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	343				599	342
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	343				599	342
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1216				465	700

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	257	343	0	1
Volume Left	0	0	0	0
Volume Right	0	1	0	1
cSH	1216	1700	1700	700
Volume to Capacity	0.00	0.20	0.00	0.00
Queue Length 95th (ft)	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	10.1
Lane LOS			A	B
Approach Delay (s)	0.0	0.0	10.1	
Approach LOS			B	

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	27.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	376	228	73	1	190	118	20	16	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	392	238	76	1	209	130	22	18	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	392	314	340	40
Volume Left (vph)	392	0	1	22
Volume Right (vph)	0	76	130	0
Hadj (s)	0.53	-0.14	-0.19	0.15
Departure Headway (s)	5.4	4.7	4.6	6.1
Degree Utilization, x	0.59	0.41	0.43	0.07
Capacity (veh/h)	649	749	773	534
Control Delay (s)	14.7	9.8	11.0	9.5
Approach Delay (s)	12.5		11.0	9.5
Approach LOS	B		B	A

Intersection Summary				
Delay	11.9			
HCM Level of Service	B			
Intersection Capacity Utilization	51.4%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	20	237	64	97	83	49	219	132	178	7	36	172
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	22	263	71	108	92	54	243	147	198	8	40	191

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	357	254	317	271	239
Volume Left (vph)	22	108	243	0	8
Volume Right (vph)	71	54	0	198	191
Hadj (s)	-0.07	-0.01	0.42	-0.48	-0.44
Departure Headway (s)	7.0	7.4	7.8	6.8	7.1
Degree Utilization, x	0.69	0.52	0.68	0.51	0.47
Capacity (veh/h)	486	442	450	499	453
Control Delay (s)	24.4	18.1	24.6	15.7	16.3
Approach Delay (s)	24.4	18.1	20.5		16.3
Approach LOS	C	C	C		C

Intersection Summary				
Delay	20.3			
HCM Level of Service	C			
Intersection Capacity Utilization	72.1%	ICU Level of Service	C	
Analysis Period (min)	15			

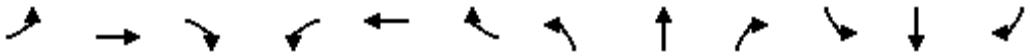
Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	20	239	64	43	182	20	26	135	18	73	179	51
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.97			0.99		1.00	0.98		1.00	0.97	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1808			1826		1770	1829		1770	1801	
Flt Permitted		0.97			0.90		0.60	1.00		0.65	1.00	
Satd. Flow (perm)		1765			1658		1119	1829		1214	1801	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	21	252	67	48	202	22	28	147	20	81	199	57
RTOR Reduction (vph)	0	22	0	0	8	0	0	12	0	0	26	0
Lane Group Flow (vph)	0	318	0	0	264	0	28	155	0	81	230	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		706			663		448	732		486	720	
v/s Ratio Prot								0.08			c0.13	
v/s Ratio Perm		c0.18			0.16		0.03			0.07		
v/c Ratio		0.45			0.40		0.06	0.21		0.17	0.32	
Uniform Delay, d1		8.8			8.6		7.4	7.9		7.7	8.3	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.1			1.8		0.3	0.7		0.7	1.2	
Delay (s)		10.9			10.4		7.7	8.5		8.5	9.4	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		10.9			10.4			8.4			9.2	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	9.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

LEVEL OF SERVICE CALCULATION WORKSHEETS

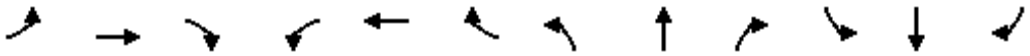
2015 PLUS PROJECT CONDITIONS
PM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	102	348	12	0	234	3	218	3	7	8	3	101
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	111	378	13	0	260	3	242	3	8	9	3	112

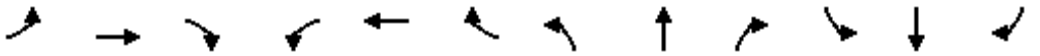
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	111	391	263	244	9	124
Volume Left (vph)	111	0	0	242	0	9
Volume Right (vph)	0	13	3	0	8	112
Hadj (s)	0.53	0.01	0.03	0.53	-0.54	-0.49
Departure Headway (s)	7.0	6.5	6.9	7.6	6.5	7.0
Degree Utilization, x	0.22	0.70	0.50	0.52	0.02	0.24
Capacity (veh/h)	493	538	490	440	508	439
Control Delay (s)	10.7	22.0	16.6	17.3	8.5	12.3
Approach Delay (s)	19.5		16.6	17.0		12.3
Approach LOS	C		C	C		B

Intersection Summary				
Delay	17.5			
HCM Level of Service	C			
Intersection Capacity Utilization	60.3%	ICU Level of Service	B	
Analysis Period (min)	15			



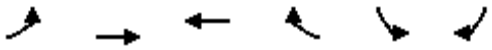
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	492	303	0	0	386	150	423	3	164	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.96			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1792			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1792			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	518	319	0	0	429	167	465	3	180	0	0	0
RTOR Reduction (vph)	0	0	0	0	18	0	0	0	119	0	0	0
Lane Group Flow (vph)	518	319	0	0	578	0	0	468	61	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	13.0	44.1			27.1			27.0	27.0			
Effective Green, g (s)	13.0	44.1			27.1			27.0	27.0			
Actuated g/C Ratio	0.16	0.56			0.34			0.34	0.34			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	564	1039			614			606	540			
v/s Ratio Prot	c0.15	0.17			c0.32			c0.26				
v/s Ratio Perm									0.04			
v/c Ratio	0.92	0.31			0.94			0.77	0.11			
Uniform Delay, d1	32.5	9.3			25.2			23.3	17.9			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	19.9	0.2			22.9			9.2	0.4			
Delay (s)	52.5	9.5			48.1			32.5	18.3			
Level of Service	D	A			D			C	B			
Approach Delay (s)		36.1			48.1			28.6			0.0	
Approach LOS		D			D			C			A	

Intersection Summary			
HCM Average Control Delay	37.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	79.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	75	157	683	174	0	34	0	551	132	503	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3473	
Flt Permitted		1.00	1.00	0.95	1.00		0.37		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		690		2787		3473	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	83	174	759	193	0	38	0	612	147	559	46
RTOR Reduction (vph)	0	0	140	0	0	0	0	0	351	0	5	0
Lane Group Flow (vph)	0	83	34	759	193	0	38	0	261	0	747	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		18.2	18.2	24.8	47.0		10.8		39.6		22.9	
Effective Green, g (s)		18.2	18.2	24.8	47.0		10.8		39.6		22.9	
Actuated g/C Ratio		0.20	0.20	0.27	0.51		0.12		0.43		0.25	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		366	311	918	945		80		1191		858	
v/s Ratio Prot		0.04		c0.22	c0.10				0.09		c0.22	
v/s Ratio Perm			0.02				c0.06					
v/c Ratio		0.23	0.11	0.83	0.20		0.48		0.22		0.87	
Uniform Delay, d1		31.3	30.6	31.9	12.6		38.3		16.8		33.5	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		1.4	0.7	6.2	0.1		4.4		0.1		9.6	
Delay (s)		32.8	31.3	38.1	12.7		42.7		16.9		43.1	
Level of Service		C	C	D	B		D		B		D	
Approach Delay (s)		31.8			32.9			18.4			43.1	
Approach LOS		C			C			B			D	

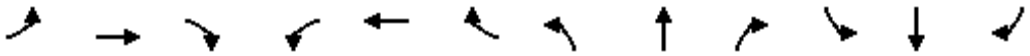
Intersection Summary			
HCM Average Control Delay	32.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	92.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	58.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	255	210	1	2	88
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	283	214	1	2	98
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	215				498	215
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	215				498	215
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	88
cM capacity (veh/h)	1355				532	825

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	283	215	2	98
Volume Left	0	0	2	0
Volume Right	0	1	0	98
cSH	1355	1700	532	825
Volume to Capacity	0.00	0.13	0.00	0.12
Queue Length 95th (ft)	0	0	0	10
Control Delay (s)	0.0	0.0	11.8	9.9
Lane LOS			B	A
Approach Delay (s)	0.0	0.0	10.0	
Approach LOS			A	

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	23.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	335	260	33	4	193	98	38	52	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	349	271	34	4	212	108	42	58	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	349	305	324	100
Volume Left (vph)	349	0	4	42
Volume Right (vph)	0	34	108	0
Hadj (s)	0.53	-0.04	-0.16	0.12
Departure Headway (s)	5.6	5.1	4.8	6.0
Degree Utilization, x	0.55	0.43	0.43	0.17
Capacity (veh/h)	622	700	727	545
Control Delay (s)	14.0	10.6	11.4	10.2
Approach Delay (s)	12.4		11.4	10.2
Approach LOS	B		B	B

Intersection Summary				
Delay	11.9			
HCM Level of Service	B			
Intersection Capacity Utilization	49.8%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	26	222	34	132	59	38	151	179	249	17	81	188
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	29	247	38	147	66	42	168	199	277	19	90	209

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	313	254	267	376	318
Volume Left (vph)	29	147	168	0	19
Volume Right (vph)	38	42	0	277	209
Hadj (s)	-0.02	0.05	0.35	-0.48	-0.35
Departure Headway (s)	7.6	7.8	7.9	7.1	7.3
Degree Utilization, x	0.66	0.55	0.59	0.74	0.64
Capacity (veh/h)	444	415	442	493	461
Control Delay (s)	24.0	20.2	20.4	26.2	22.4
Approach Delay (s)	24.0	20.2	23.8		22.4
Approach LOS	C	C	C		C

Intersection Summary				
Delay	22.9			
HCM Level of Service	C			
Intersection Capacity Utilization	75.3%	ICU Level of Service	D	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	38	202	104	85	230	15	40	280	34	125	282	56
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.98		1.00	0.98	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1777			1828		1770	1832		1770	1817	
Flt Permitted		0.93			0.85		0.46	1.00		0.50	1.00	
Satd. Flow (perm)		1669			1582		858	1832		931	1817	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	40	213	109	94	256	17	43	304	37	139	313	62
RTOR Reduction (vph)	0	39	0	0	4	0	0	11	0	0	18	0
Lane Group Flow (vph)	0	323	0	0	363	0	43	330	0	139	357	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		668			633		343	733		372	727	
v/s Ratio Prot								0.18			c0.20	
v/s Ratio Perm		0.19			c0.23		0.05			0.15		
v/c Ratio		0.48			0.57		0.13	0.45		0.37	0.49	
Uniform Delay, d1		8.9			9.3		7.6	8.8		8.5	9.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.5			3.7		0.8	2.0		2.9	2.4	
Delay (s)		11.4			13.1		8.3	10.8		11.3	11.3	
Level of Service		B			B		A	B		B	B	
Approach Delay (s)		11.4			13.1			10.5			11.3	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	67.4%	ICU Level of Service	C
Analysis Period (min)	15		

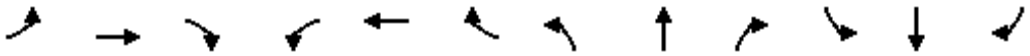
c Critical Lane Group

LEVEL OF SERVICE CALCULATION WORKSHEETS

2030 CONDITIONS
AM PEAK HOUR

HCM Unsignalized Intersection Capacity Analysis
1: Golf Links Road & Mountain Blvd

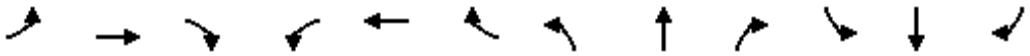
7/17/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	172	274	57	8	570	29	9	1	2	24	4	77
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	187	298	62	9	633	32	10	1	2	27	4	86

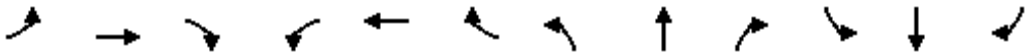
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	187	360	674	11	3	117
Volume Left (vph)	187	0	9	10	0	27
Volume Right (vph)	0	62	32	0	2	86
Hadj (s)	0.53	-0.09	0.01	0.51	-0.53	-0.36
Departure Headway (s)	6.2	5.5	5.6	8.1	7.1	6.9
Degree Utilization, x	0.32	0.55	1.05	0.02	0.01	0.22
Capacity (veh/h)	569	641	637	416	472	500
Control Delay (s)	10.8	14.0	73.2	10.1	8.9	11.8
Approach Delay (s)	12.9		73.2	9.9		11.8
Approach LOS	B		F	A		B

Intersection Summary				
Delay	42.9			
HCM Level of Service	E			
Intersection Capacity Utilization	73.0%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	664	329	0	0	397	227	398	5	155	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.95			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1771			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1771			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	699	346	0	0	441	252	437	5	170	0	0	0
RTOR Reduction (vph)	0	0	0	0	26	0	0	0	125	0	0	0
Lane Group Flow (vph)	699	346	0	0	667	0	0	442	45	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	17.0	51.0			30.0			21.0	21.0			
Effective Green, g (s)	17.0	51.0			30.0			21.0	21.0			
Actuated g/C Ratio	0.21	0.64			0.38			0.26	0.26			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	730	1188			664			466	416			
v/s Ratio Prot	c0.20	0.19			c0.38			c0.25				
v/s Ratio Perm									0.03			
v/c Ratio	0.96	0.29			1.01			0.95	0.11			
Uniform Delay, d1	31.1	6.5			25.0			29.0	22.4			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	23.1	0.1			36.2			30.6	0.5			
Delay (s)	54.3	6.6			61.2			59.6	22.9			
Level of Service	D	A			E			E	C			
Approach Delay (s)		38.5			61.2			49.4			0.0	
Approach LOS		D			E			D			A	

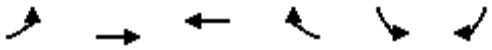
Intersection Summary			
HCM Average Control Delay	48.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	92	192	727	244	0	64	0	605	197	530	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3470	
Flt Permitted		1.00	1.00	0.95	1.00		0.33		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		621		2787		3470	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	102	213	808	271	0	71	0	672	219	589	39
RTOR Reduction (vph)	0	0	174	0	0	0	0	0	377	0	4	0
Lane Group Flow (vph)	0	102	39	808	271	0	71	0	295	0	843	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		18.0	18.0	25.0	47.0		14.1		43.1		25.0	
Effective Green, g (s)		18.0	18.0	25.0	47.0		14.1		43.1		25.0	
Actuated g/C Ratio		0.18	0.18	0.25	0.48		0.14		0.44		0.25	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		342	290	875	893		89		1224		884	
v/s Ratio Prot		0.05		c0.24	c0.15				0.11		c0.24	
v/s Ratio Perm			0.02				c0.11					
v/c Ratio		0.30	0.13	0.92	0.30		0.80		0.24		0.95	
Uniform Delay, d1		34.6	33.5	35.6	15.6		40.6		17.2		36.0	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		2.2	1.0	15.1	0.2		37.6		0.1		19.8	
Delay (s)		36.8	34.5	50.7	15.8		78.2		17.3		55.8	
Level of Service		D	C	D	B		E		B		E	
Approach Delay (s)		35.2			41.9			23.2			55.8	
Approach LOS		D			D			C			E	

Intersection Summary			
HCM Average Control Delay	40.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	98.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		

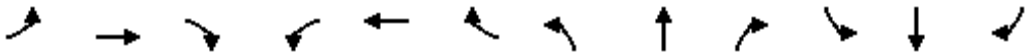
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	275	457	1	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	306	466	1	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	467				772	467
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	467				772	467
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1094				368	596

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	306	467	0	0
Volume Left	0	0	0	0
Volume Right	0	1	0	0
cSH	1094	1700	1700	1700
Volume to Capacity	0.00	0.27	0.00	0.00
Queue Length 95th (ft)	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0
Lane LOS			A	A
Approach Delay (s)	0.0	0.0	0.0	
Approach LOS			A	

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	27.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	427	260	83	1	247	154	22	18	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	445	271	86	1	271	169	24	20	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	445	357	442	44
Volume Left (vph)	445	0	1	24
Volume Right (vph)	0	86	169	0
Hadj (s)	0.53	-0.14	-0.20	0.14
Departure Headway (s)	5.5	4.9	4.7	6.4
Degree Utilization, x	0.68	0.48	0.57	0.08
Capacity (veh/h)	445	735	762	507
Control Delay (s)	18.4	11.1	13.6	10.0
Approach Delay (s)	15.1		13.6	10.0
Approach LOS	C		B	A

Intersection Summary				
Delay	14.4			
HCM Level of Service	B			
Intersection Capacity Utilization	59.4%	ICU Level of Service	B	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	23	269	18	126	108	64	266	160	216	8	40	193
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	26	299	20	140	120	71	296	178	240	9	44	214

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	344	331	384	329	268
Volume Left (vph)	26	140	296	0	9
Volume Right (vph)	20	71	0	240	214
Hadj (s)	0.01	-0.01	0.42	-0.48	-0.44
Departure Headway (s)	8.1	8.1	8.5	7.6	8.1
Degree Utilization, x	0.77	0.75	0.91	0.70	0.60
Capacity (veh/h)	426	420	410	461	417
Control Delay (s)	33.6	31.3	52.9	25.0	22.6
Approach Delay (s)	33.6	31.3	40.1		22.6
Approach LOS	D	D	E		C

Intersection Summary				
Delay	34.2			
HCM Level of Service	D			
Intersection Capacity Utilization	79.9%	ICU Level of Service	D	
Analysis Period (min)	15			

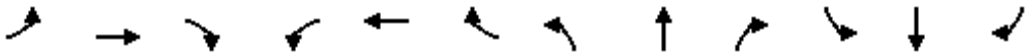
Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	23	272	73	57	237	26	31	164	22	83	202	58
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.97			0.99		1.00	0.98		1.00	0.97	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1807			1826		1770	1830		1770	1801	
Flt Permitted		0.97			0.89		0.56	1.00		0.63	1.00	
Satd. Flow (perm)		1754			1648		1048	1830		1175	1801	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	24	286	77	63	263	29	34	178	24	92	224	64
RTOR Reduction (vph)	0	22	0	0	8	0	0	12	0	0	26	0
Lane Group Flow (vph)	0	365	0	0	347	0	34	190	0	92	262	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		702			659		419	732		470	720	
v/s Ratio Prot								0.10			c0.15	
v/s Ratio Perm		0.21			c0.21		0.03			0.08		
v/c Ratio		0.52			0.53		0.08	0.26		0.20	0.36	
Uniform Delay, d1		9.1			9.1		7.4	8.0		7.8	8.4	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.7			3.0		0.4	0.9		0.9	1.4	
Delay (s)		11.8			12.1		7.8	8.9		8.7	9.9	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		11.8			12.1			8.7			9.6	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	10.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

LEVEL OF SERVICE CALCULATION WORKSHEETS

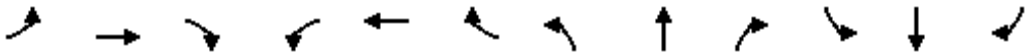
2030 CONDITIONS
PM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	119	406	10	0	317	5	242	3	8	8	3	105
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	129	441	11	0	352	6	269	3	9	9	3	117

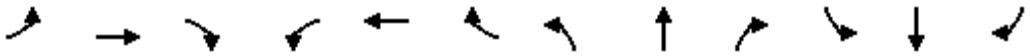
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	129	452	358	271	11	129
Volume Left (vph)	129	0	0	269	0	9
Volume Right (vph)	0	11	6	0	9	117
Hadj (s)	0.53	0.02	0.02	0.53	-0.56	-0.50
Departure Headway (s)	7.6	7.1	7.4	8.4	7.3	8.1
Degree Utilization, x	0.27	0.89	0.74	0.63	0.02	0.29
Capacity (veh/h)	457	500	467	412	473	407
Control Delay (s)	12.3	43.1	28.6	23.4	9.2	14.3
Approach Delay (s)	36.2		28.6	22.9		14.3
Approach LOS	E		D	C		B

Intersection Summary				
Delay	29.3			
HCM Level of Service	D			
Intersection Capacity Utilization	69.0%	ICU Level of Service		C
Analysis Period (min)	15			



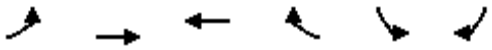
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	574	351	0	0	524	202	472	3	182	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.96			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1793			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1793			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	604	369	0	0	582	224	519	3	200	0	0	0
RTOR Reduction (vph)	0	0	0	0	13	0	0	0	138	0	0	0
Lane Group Flow (vph)	604	369	0	0	793	0	0	522	62	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	19.0	69.0			46.0			33.0	33.0			
Effective Green, g (s)	19.0	69.0			46.0			33.0	33.0			
Actuated g/C Ratio	0.17	0.63			0.42			0.30	0.30			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	593	1169			750			533	475			
v/s Ratio Prot	c0.18	0.20			c0.44			c0.29				
v/s Ratio Perm									0.04			
v/c Ratio	1.02	0.32			1.06			0.98	0.13			
Uniform Delay, d1	45.5	9.5			32.0			38.2	28.1			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	41.7	0.2			49.2			34.2	0.6			
Delay (s)	87.2	9.7			81.2			72.4	28.6			
Level of Service	F	A			F			E	C			
Approach Delay (s)		57.8			81.2			60.3			0.0	
Approach LOS		E			F			E			A	

Intersection Summary			
HCM Average Control Delay	66.0	HCM Level of Service	E
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	87	184	927	236	0	38	0	614	137	527	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3474	
Flt Permitted		1.00	1.00	0.95	1.00		0.35		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		660		2787		3474	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	97	204	1030	262	0	42	0	682	152	586	47
RTOR Reduction (vph)	0	0	168	0	0	0	0	0	356	0	5	0
Lane Group Flow (vph)	0	97	36	1030	262	0	42	0	326	0	780	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		17.0	17.0	30.1	51.1		11.6		45.7		21.0	
Effective Green, g (s)		17.0	17.0	30.1	51.1		11.6		45.7		21.0	
Actuated g/C Ratio		0.18	0.18	0.31	0.53		0.12		0.48		0.22	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		331	281	1080	995		80		1331		762	
v/s Ratio Prot		0.05		c0.30	c0.14				0.12		c0.22	
v/s Ratio Perm			0.02				c0.06					
v/c Ratio		0.29	0.13	0.95	0.26		0.52		0.24		1.02	
Uniform Delay, d1		34.1	33.1	32.1	12.1		39.5		14.8		37.4	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		2.2	0.9	17.3	0.1		6.1		0.1		38.8	
Delay (s)		36.4	34.1	49.4	12.2		45.6		14.9		76.2	
Level of Service		D	C	D	B		D		B		E	
Approach Delay (s)		34.8			41.9			16.7			76.2	
Approach LOS		C			D			B			E	

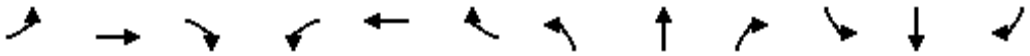
Intersection Summary			
HCM Average Control Delay	44.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	95.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	298	285	1	2	91
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	331	291	1	2	101
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	292				622	291
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	292				622	291
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	86
cM capacity (veh/h)	1270				450	748

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	331	292	2	101
Volume Left	0	0	2	0
Volume Right	0	1	0	101
cSH	1270	1700	450	748
Volume to Capacity	0.00	0.17	0.00	0.14
Queue Length 95th (ft)	0	0	0	12
Control Delay (s)	0.0	0.0	13.0	10.6
Lane LOS			B	B
Approach Delay (s)	0.0	0.0	10.6	
Approach LOS			B	

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	27.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	401	311	40	5	232	119	42	58	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	418	324	42	5	255	131	47	64	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	418	366	391	111
Volume Left (vph)	418	0	5	47
Volume Right (vph)	0	42	131	0
Hadj (s)	0.53	-0.05	-0.16	0.12
Departure Headway (s)	5.8	5.2	5.0	6.3
Degree Utilization, x	0.67	0.53	0.54	0.20
Capacity (veh/h)	609	684	708	521
Control Delay (s)	18.5	12.6	13.6	10.9
Approach Delay (s)	15.8		13.6	10.9
Approach LOS	C		B	B

Intersection Summary				
Delay	14.7			
HCM Level of Service	B			
Intersection Capacity Utilization	57.3%	ICU Level of Service		B
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	31	266	41	159	70	46	158	186	259	19	91	210
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	34	296	46	177	78	51	176	207	288	21	101	233

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	376	306	279	391	356
Volume Left (vph)	34	177	176	0	21
Volume Right (vph)	46	51	0	288	233
Hadj (s)	-0.02	0.05	0.35	-0.48	-0.35
Departure Headway (s)	8.7	9.1	9.2	8.4	8.6
Degree Utilization, x	0.91	0.77	0.72	0.91	0.85
Capacity (veh/h)	402	374	376	416	403
Control Delay (s)	53.6	36.7	31.2	52.0	44.3
Approach Delay (s)	53.6	36.7	43.3		44.3
Approach LOS	F	E	E		E

Intersection Summary				
Delay	44.6			
HCM Level of Service	E			
Intersection Capacity Utilization	83.6%	ICU Level of Service	E	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	45	242	125	102	278	18	41	291	35	140	315	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.98		1.00	0.98	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1777			1828		1770	1833		1770	1816	
Flt Permitted		0.93			0.82		0.41	1.00		0.48	1.00	
Satd. Flow (perm)		1662			1511		764	1833		903	1816	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	47	255	132	113	309	20	45	316	38	156	350	70
RTOR Reduction (vph)	0	40	0	0	4	0	0	11	0	0	18	0
Lane Group Flow (vph)	0	394	0	0	438	0	45	343	0	156	402	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		665			604		306	733		361	726	
v/s Ratio Prot								0.19			c0.22	
v/s Ratio Perm		0.24			c0.29		0.06			0.17		
v/c Ratio		0.59			0.72		0.15	0.47		0.43	0.55	
Uniform Delay, d1		9.4			10.1		7.6	8.9		8.7	9.2	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		3.9			7.4		1.0	2.1		3.7	3.0	
Delay (s)		13.3			17.5		8.7	11.0		12.4	12.3	
Level of Service		B			B		A	B		B	B	
Approach Delay (s)		13.3			17.5			10.7			12.3	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	13.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	15		

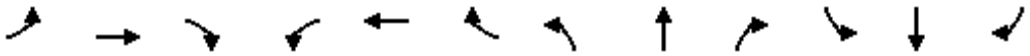
c Critical Lane Group

LEVEL OF SERVICE CALCULATION WORKSHEETS

2030 PLUS PROJECT CONDITIONS
AM PEAK HOUR

HCM Unsignalized Intersection Capacity Analysis
1: Golf Links Road & Mountain Blvd

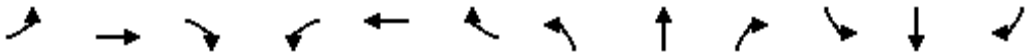
7/17/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	174	274	57	8	570	29	9	1	2	24	4	77
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	189	298	62	9	633	32	10	1	2	27	4	86

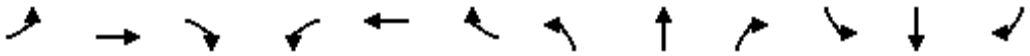
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	189	360	674	11	3	117
Volume Left (vph)	189	0	9	10	0	27
Volume Right (vph)	0	62	32	0	2	86
Hadj (s)	0.53	-0.09	0.01	0.51	-0.53	-0.36
Departure Headway (s)	6.2	5.5	5.6	8.1	7.1	6.9
Degree Utilization, x	0.32	0.55	1.05	0.02	0.01	0.22
Capacity (veh/h)	569	641	637	416	472	500
Control Delay (s)	10.9	14.0	73.3	10.1	8.9	11.8
Approach Delay (s)	12.9		73.3	9.9		11.8
Approach LOS	B		F	A		B

Intersection Summary				
Delay	42.9			
HCM Level of Service	E			
Intersection Capacity Utilization	73.0%	ICU Level of Service	D	
Analysis Period (min)	15			



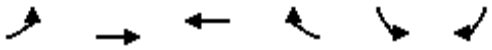
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	664	331	0	0	397	227	398	5	155	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.95			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1771			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1771			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	699	348	0	0	441	252	437	5	170	0	0	0
RTOR Reduction (vph)	0	0	0	0	26	0	0	0	125	0	0	0
Lane Group Flow (vph)	699	348	0	0	667	0	0	442	45	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	17.0	51.0			30.0			21.0	21.0			
Effective Green, g (s)	17.0	51.0			30.0			21.0	21.0			
Actuated g/C Ratio	0.21	0.64			0.38			0.26	0.26			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	730	1188			664			466	416			
v/s Ratio Prot	c0.20	0.19			c0.38			c0.25				
v/s Ratio Perm									0.03			
v/c Ratio	0.96	0.29			1.01			0.95	0.11			
Uniform Delay, d1	31.1	6.5			25.0			29.0	22.4			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	23.1	0.1			36.2			30.6	0.5			
Delay (s)	54.3	6.6			61.2			59.6	22.9			
Level of Service	D	A			E			E	C			
Approach Delay (s)		38.4			61.2			49.4			0.0	
Approach LOS		D			E			D			A	

Intersection Summary			
HCM Average Control Delay	48.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	92	192	727	244	0	64	0	606	197	530	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3469	
Flt Permitted		1.00	1.00	0.95	1.00		0.33		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		621		2787		3469	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	102	213	808	271	0	71	0	673	219	589	40
RTOR Reduction (vph)	0	0	174	0	0	0	0	0	377	0	4	0
Lane Group Flow (vph)	0	102	39	808	271	0	71	0	296	0	844	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		18.0	18.0	25.0	47.0		14.2		43.2		25.0	
Effective Green, g (s)		18.0	18.0	25.0	47.0		14.2		43.2		25.0	
Actuated g/C Ratio		0.18	0.18	0.25	0.48		0.14		0.44		0.25	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		341	290	874	892		90		1226		883	
v/s Ratio Prot		0.05		c0.24	c0.15				0.11		c0.24	
v/s Ratio Perm			0.02				c0.11					
v/c Ratio		0.30	0.13	0.92	0.30		0.79		0.24		0.96	
Uniform Delay, d1		34.6	33.6	35.7	15.6		40.6		17.2		36.1	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		2.2	1.0	15.2	0.2		35.5		0.1		20.2	
Delay (s)		36.9	34.5	50.9	15.8		76.0		17.3		56.3	
Level of Service		D	C	D	B		E		B		E	
Approach Delay (s)		35.3			42.1			22.9			56.3	
Approach LOS		D			D			C			E	

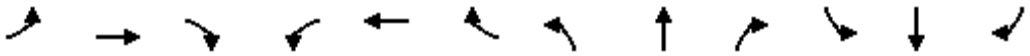
Intersection Summary			
HCM Average Control Delay	40.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	98.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	275	457	1	0	1
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	306	466	1	0	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	467				772	467
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	467				772	467
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1094				368	596

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	306	467	0	1
Volume Left	0	0	0	0
Volume Right	0	1	0	1
cSH	1094	1700	1700	596
Volume to Capacity	0.00	0.27	0.00	0.00
Queue Length 95th (ft)	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	11.1
Lane LOS			A	B
Approach Delay (s)	0.0	0.0	11.1	
Approach LOS			B	

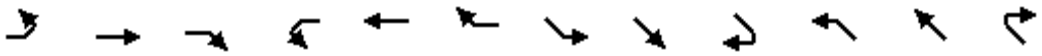
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	34.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	427	260	83	1	248	154	22	18	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	445	271	86	1	273	169	24	20	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	445	357	443	44
Volume Left (vph)	445	0	1	24
Volume Right (vph)	0	86	169	0
Hadj (s)	0.53	-0.14	-0.19	0.14
Departure Headway (s)	5.5	4.9	4.7	6.4
Degree Utilization, x	0.68	0.48	0.57	0.08
Capacity (veh/h)	445	735	761	506
Control Delay (s)	18.4	11.1	13.7	10.0
Approach Delay (s)	15.1		13.7	10.0
Approach LOS	C		B	A

Intersection Summary				
Delay	14.4			
HCM Level of Service	B			
Intersection Capacity Utilization	59.5%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	23	269	18	126	109	64	266	160	216	8	40	193
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	26	299	20	140	121	71	296	178	240	9	44	214

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	344	332	384	329	268
Volume Left (vph)	26	140	296	0	9
Volume Right (vph)	20	71	0	240	214
Hadj (s)	0.01	-0.01	0.42	-0.48	-0.44
Departure Headway (s)	8.1	8.1	8.5	7.6	8.1
Degree Utilization, x	0.77	0.75	0.91	0.70	0.60
Capacity (veh/h)	425	420	410	460	417
Control Delay (s)	33.7	31.6	53.1	25.1	22.7
Approach Delay (s)	33.7	31.6	40.2		22.7
Approach LOS	D	D	E		C

Intersection Summary				
Delay	34.3			
HCM Level of Service	D			
Intersection Capacity Utilization	80.0%	ICU Level of Service	D	
Analysis Period (min)	15			

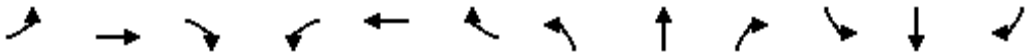
Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	23	272	73	57	238	26	31	164	22	83	202	58
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.97			0.99		1.00	0.98		1.00	0.97	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1807			1826		1770	1830		1770	1801	
Flt Permitted		0.97			0.89		0.56	1.00		0.63	1.00	
Satd. Flow (perm)		1754			1649		1048	1830		1175	1801	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	24	286	77	63	264	29	34	178	24	92	224	64
RTOR Reduction (vph)	0	22	0	0	8	0	0	12	0	0	26	0
Lane Group Flow (vph)	0	365	0	0	348	0	34	190	0	92	262	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		702			660		419	732		470	720	
v/s Ratio Prot								0.10			c0.15	
v/s Ratio Perm		0.21			c0.21		0.03			0.08		
v/c Ratio		0.52			0.53		0.08	0.26		0.20	0.36	
Uniform Delay, d1		9.1			9.1		7.4	8.0		7.8	8.4	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.7			3.0		0.4	0.9		0.9	1.4	
Delay (s)		11.8			12.1		7.8	8.9		8.7	9.9	
Level of Service		B			B		A	A		A	A	
Approach Delay (s)		11.8			12.1			8.7			9.6	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	10.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

LEVEL OF SERVICE CALCULATION WORKSHEETS

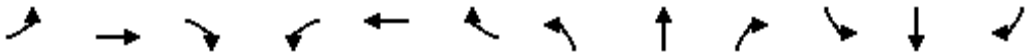
2030 PLUS PROJECT CONDITIONS
PM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Yield			Stop			Stop			Stop	
Volume (vph)	122	406	10	0	317	5	243	3	8	8	3	105
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	133	441	11	0	352	6	270	3	9	9	3	117

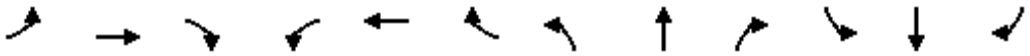
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1
Volume Total (vph)	133	452	358	272	11	129
Volume Left (vph)	133	0	0	270	0	9
Volume Right (vph)	0	11	6	0	9	117
Hadj (s)	0.53	0.02	0.02	0.53	-0.56	-0.50
Departure Headway (s)	7.6	7.1	7.4	8.4	7.3	8.1
Degree Utilization, x	0.28	0.89	0.74	0.63	0.02	0.29
Capacity (veh/h)	457	500	466	412	473	407
Control Delay (s)	12.4	43.3	28.7	23.6	9.2	14.4
Approach Delay (s)	36.3		28.7	23.1		14.4
Approach LOS	E		D	C		B

Intersection Summary				
Delay	29.4			
HCM Level of Service	D			
Intersection Capacity Utilization	69.1%	ICU Level of Service	C	
Analysis Period (min)	15			



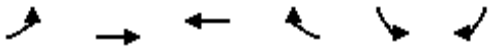
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	574	353	0	0	524	203	472	3	183	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	0.97	1.00			1.00			1.00	1.00			
Frt	1.00	1.00			0.96			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	3433	1863			1792			1775	1583			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	3433	1863			1792			1775	1583			
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	604	372	0	0	582	226	519	3	201	0	0	0
RTOR Reduction (vph)	0	0	0	0	13	0	0	0	139	0	0	0
Lane Group Flow (vph)	604	372	0	0	795	0	0	522	62	0	0	0
Turn Type	Prot			Perm			Split		Perm			
Protected Phases	7	4			8		2	2				
Permitted Phases				8					2			
Actuated Green, G (s)	19.0	69.0			46.0			33.0	33.0			
Effective Green, g (s)	19.0	69.0			46.0			33.0	33.0			
Actuated g/C Ratio	0.17	0.63			0.42			0.30	0.30			
Clearance Time (s)	4.0	4.0			4.0			4.0	4.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	593	1169			749			533	475			
v/s Ratio Prot	c0.18	0.20			c0.44			c0.29				
v/s Ratio Perm									0.04			
v/c Ratio	1.02	0.32			1.06			0.98	0.13			
Uniform Delay, d1	45.5	9.5			32.0			38.2	28.1			
Progression Factor	1.00	1.00			1.00			1.00	1.00			
Incremental Delay, d2	41.7	0.2			50.5			34.2	0.6			
Delay (s)	87.2	9.7			82.5			72.4	28.6			
Level of Service	F	A			F			E	C			
Approach Delay (s)		57.7			82.5			60.2			0.0	
Approach LOS		E			F			E			A	

Intersection Summary			
HCM Average Control Delay	66.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	87	184	927	237	0	38	0	614	137	527	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0		4.0		4.0	
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00		0.88		0.95	
Frt		1.00	0.85	1.00	1.00		1.00		0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00		0.99	
Satd. Flow (prot)		1863	1583	3433	1863		1770		2787		3473	
Flt Permitted		1.00	1.00	0.95	1.00		0.35		1.00		0.99	
Satd. Flow (perm)		1863	1583	3433	1863		660		2787		3473	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	97	204	1030	263	0	42	0	682	152	586	48
RTOR Reduction (vph)	0	0	168	0	0	0	0	0	356	0	5	0
Lane Group Flow (vph)	0	97	36	1030	263	0	42	0	326	0	781	0
Turn Type			Perm	Prot			custom		custom	Split		
Protected Phases		2		1	6				1 8	4	4	
Permitted Phases			2				8					
Actuated Green, G (s)		17.0	17.0	30.1	51.1		11.6		45.7		21.0	
Effective Green, g (s)		17.0	17.0	30.1	51.1		11.6		45.7		21.0	
Actuated g/C Ratio		0.18	0.18	0.31	0.53		0.12		0.48		0.22	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0				4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0				3.0	
Lane Grp Cap (vph)		331	281	1080	995		80		1331		762	
v/s Ratio Prot		0.05		c0.30	c0.14				0.12		c0.22	
v/s Ratio Perm			0.02				c0.06					
v/c Ratio		0.29	0.13	0.95	0.26		0.52		0.24		1.03	
Uniform Delay, d1		34.1	33.1	32.1	12.1		39.5		14.8		37.4	
Progression Factor		1.00	1.00	1.00	1.00		1.00		1.00		1.00	
Incremental Delay, d2		2.2	0.9	17.3	0.1		6.1		0.1		39.2	
Delay (s)		36.4	34.1	49.4	12.2		45.6		14.9		76.6	
Level of Service		D	C	D	B		D		B		E	
Approach Delay (s)		34.8			41.8			16.7			76.6	
Approach LOS		C			D			B			E	

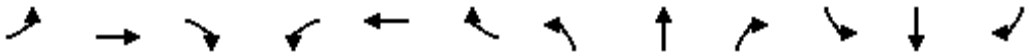
Intersection Summary			
HCM Average Control Delay	44.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	95.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	298	285	1	2	92
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.98	0.98	0.90	0.90
Hourly flow rate (vph)	0	331	291	1	2	102
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	292				622	291
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	292				622	291
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	86
cM capacity (veh/h)	1270				450	748

Direction, Lane #	EB 1	WB 1	SB 1	SB 2
Volume Total	331	292	2	102
Volume Left	0	0	2	0
Volume Right	0	1	0	102
cSH	1270	1700	450	748
Volume to Capacity	0.00	0.17	0.00	0.14
Queue Length 95th (ft)	0	0	0	12
Control Delay (s)	0.0	0.0	13.0	10.6
Lane LOS			B	B
Approach Delay (s)	0.0	0.0	10.6	
Approach LOS			B	

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	27.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	401	311	40	5	233	119	42	58	0	0	0	0
Peak Hour Factor	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	418	324	42	5	256	131	47	64	0	0	0	0

Direction, Lane #	EB 1	EB 2	WB 1	NB 1
Volume Total (vph)	418	366	392	111
Volume Left (vph)	418	0	5	47
Volume Right (vph)	0	42	131	0
Hadj (s)	0.53	-0.05	-0.16	0.12
Departure Headway (s)	5.8	5.2	5.0	6.3
Degree Utilization, x	0.67	0.53	0.54	0.20
Capacity (veh/h)	609	684	708	520
Control Delay (s)	18.5	12.6	13.7	10.9
Approach Delay (s)	15.8		13.7	10.9
Approach LOS	C		B	B

Intersection Summary				
Delay	14.7			
HCM Level of Service	B			
Intersection Capacity Utilization	57.4%	ICU Level of Service	B	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	31	266	41	159	71	46	158	186	259	19	91	210
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	34	296	46	177	79	51	176	207	288	21	101	233

Direction, Lane #	EB 1	WB 1	SE 1	SE 2	NW 1
Volume Total (vph)	376	307	279	391	356
Volume Left (vph)	34	177	176	0	21
Volume Right (vph)	46	51	0	288	233
Hadj (s)	-0.02	0.05	0.35	-0.48	-0.35
Departure Headway (s)	8.7	9.1	9.3	8.4	8.6
Degree Utilization, x	0.91	0.77	0.72	0.91	0.85
Capacity (veh/h)	402	374	376	416	402
Control Delay (s)	53.9	37.1	31.3	52.3	44.6
Approach Delay (s)	53.9	37.1	43.5		44.6
Approach LOS	F	E	E		E

Intersection Summary				
Delay	44.9			
HCM Level of Service	E			
Intersection Capacity Utilization	83.7%	ICU Level of Service	E	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	45	242	125	103	278	18	41	291	35	140	315	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.98		1.00	0.98	
Flt Protected		0.99			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1777			1828		1770	1833		1770	1816	
Flt Permitted		0.93			0.81		0.41	1.00		0.48	1.00	
Satd. Flow (perm)		1662			1507		764	1833		903	1816	
Peak-hour factor, PHF	0.95	0.95	0.95	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj. Flow (vph)	47	255	132	114	309	20	45	316	38	156	350	70
RTOR Reduction (vph)	0	40	0	0	4	0	0	11	0	0	18	0
Lane Group Flow (vph)	0	394	0	0	439	0	45	343	0	156	402	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			6			2	
Permitted Phases	4			8			6			2		
Actuated Green, G (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Effective Green, g (s)		16.0			16.0		16.0	16.0		16.0	16.0	
Actuated g/C Ratio		0.40			0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		665			603		306	733		361	726	
v/s Ratio Prot								0.19			c0.22	
v/s Ratio Perm		0.24			c0.29		0.06			0.17		
v/c Ratio		0.59			0.73		0.15	0.47		0.43	0.55	
Uniform Delay, d1		9.4			10.2		7.6	8.9		8.7	9.2	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		3.9			7.5		1.0	2.1		3.7	3.0	
Delay (s)		13.3			17.7		8.7	11.0		12.4	12.3	
Level of Service		B			B		A	B		B	B	
Approach Delay (s)		13.3			17.7			10.7			12.3	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	13.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group