UNIVERSITY OF CALIFORNIA, SANTA CRUZ

Marine Science Campus (MSC) Projects

FINAL

ENVIRONMENTAL IMPACT REPORT

Volume II: Appendices

SCH# 2010062090

Prepared by:

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November 2011

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Proposed CLRDP Amendment #1

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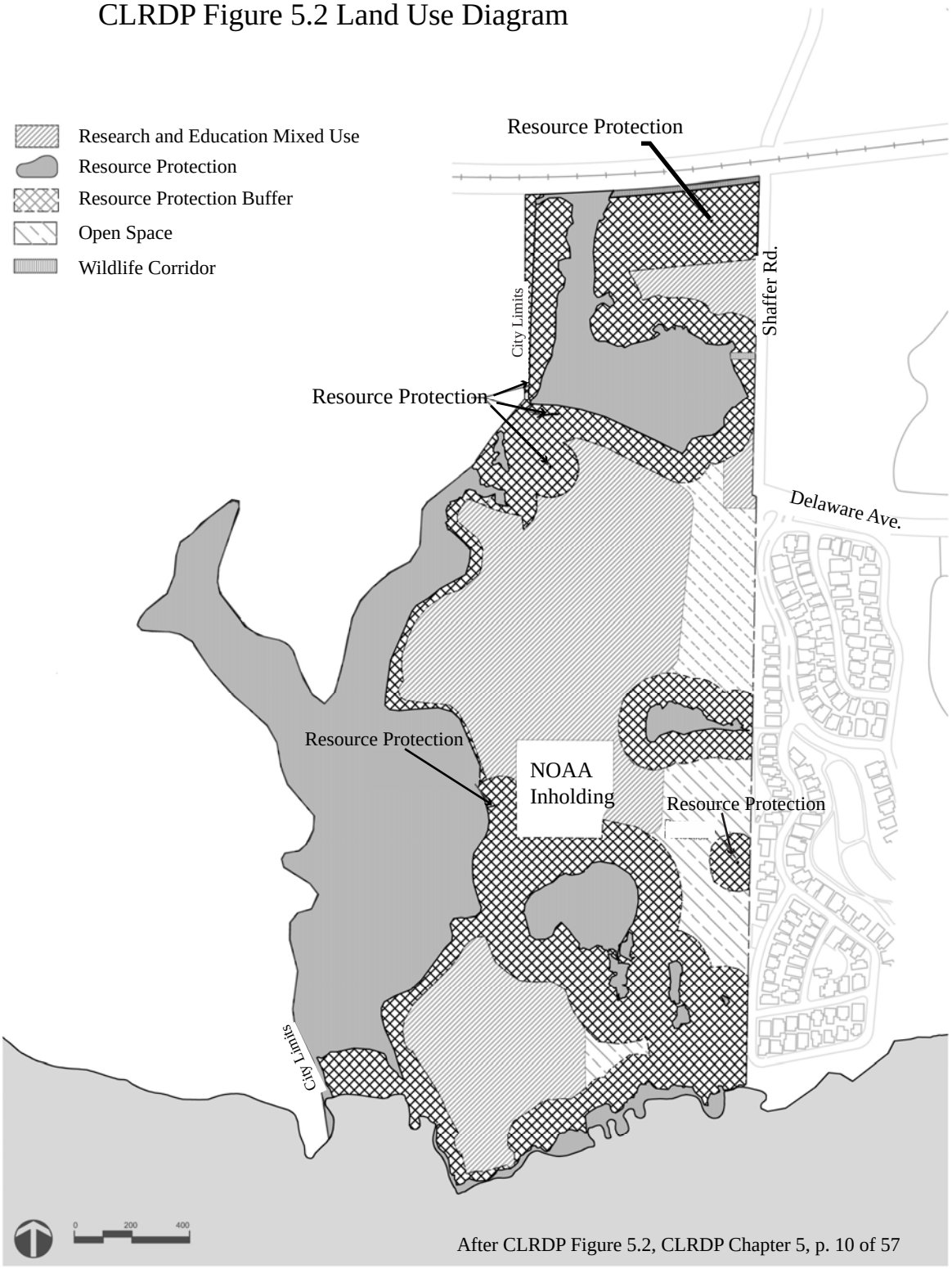
CLRDP Figure 5.2 Land Use Diagram



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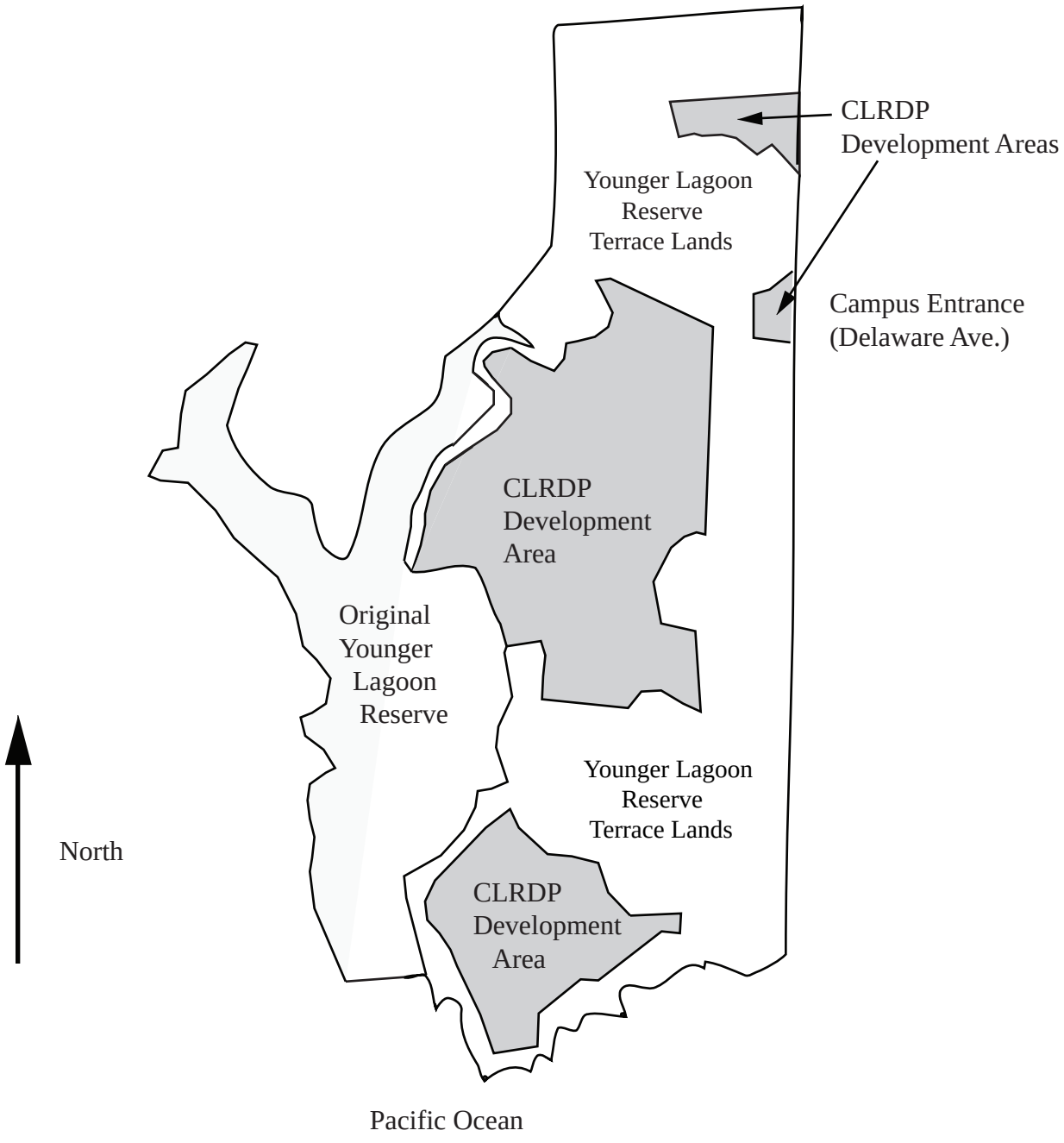
Schematic Diagram of Marine Science Campus
based on CLRDP Figure 5.2 Land Use Diagram



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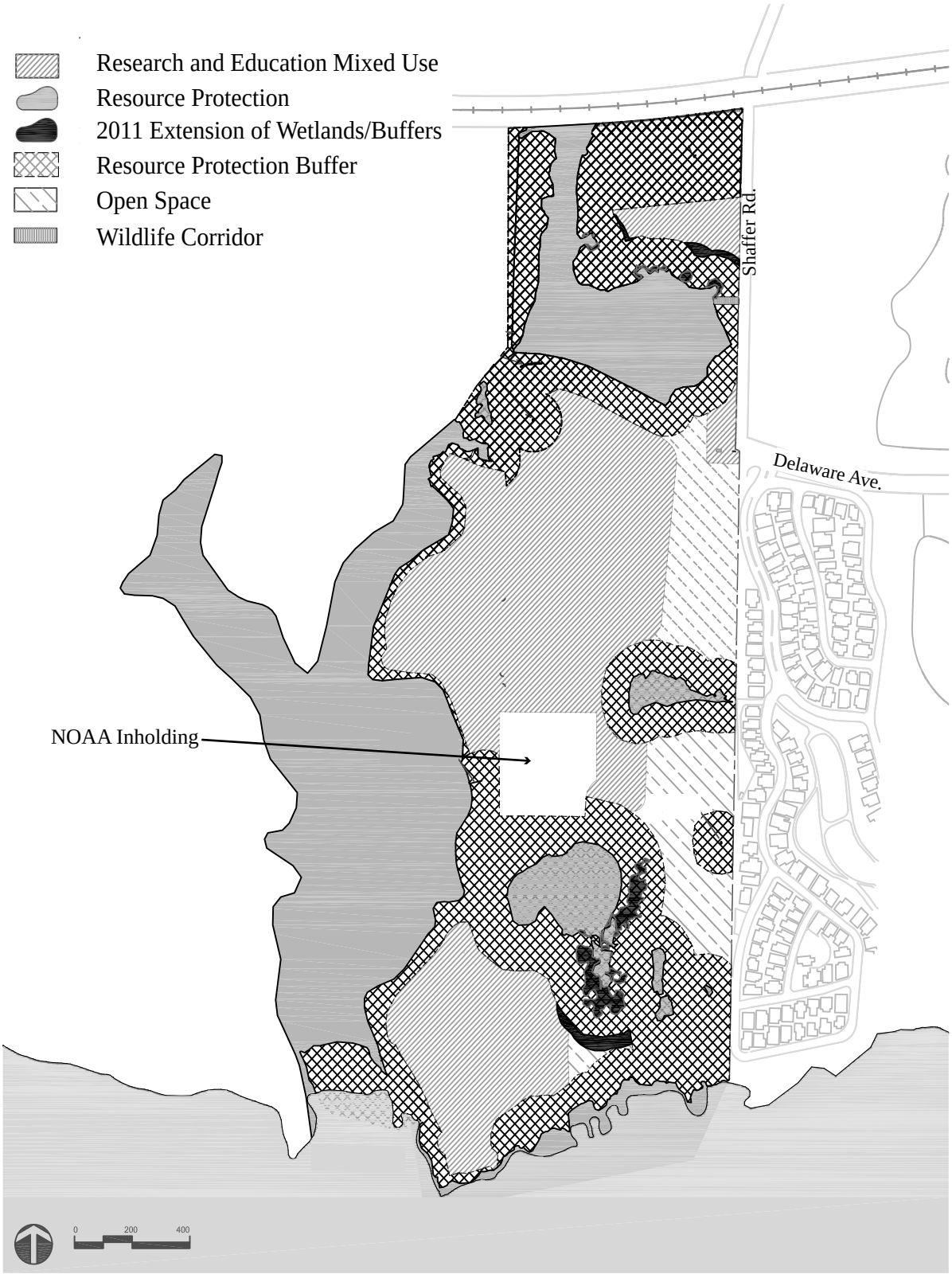
CLRDP Figure 5.2 Land Use Diagram (revised)



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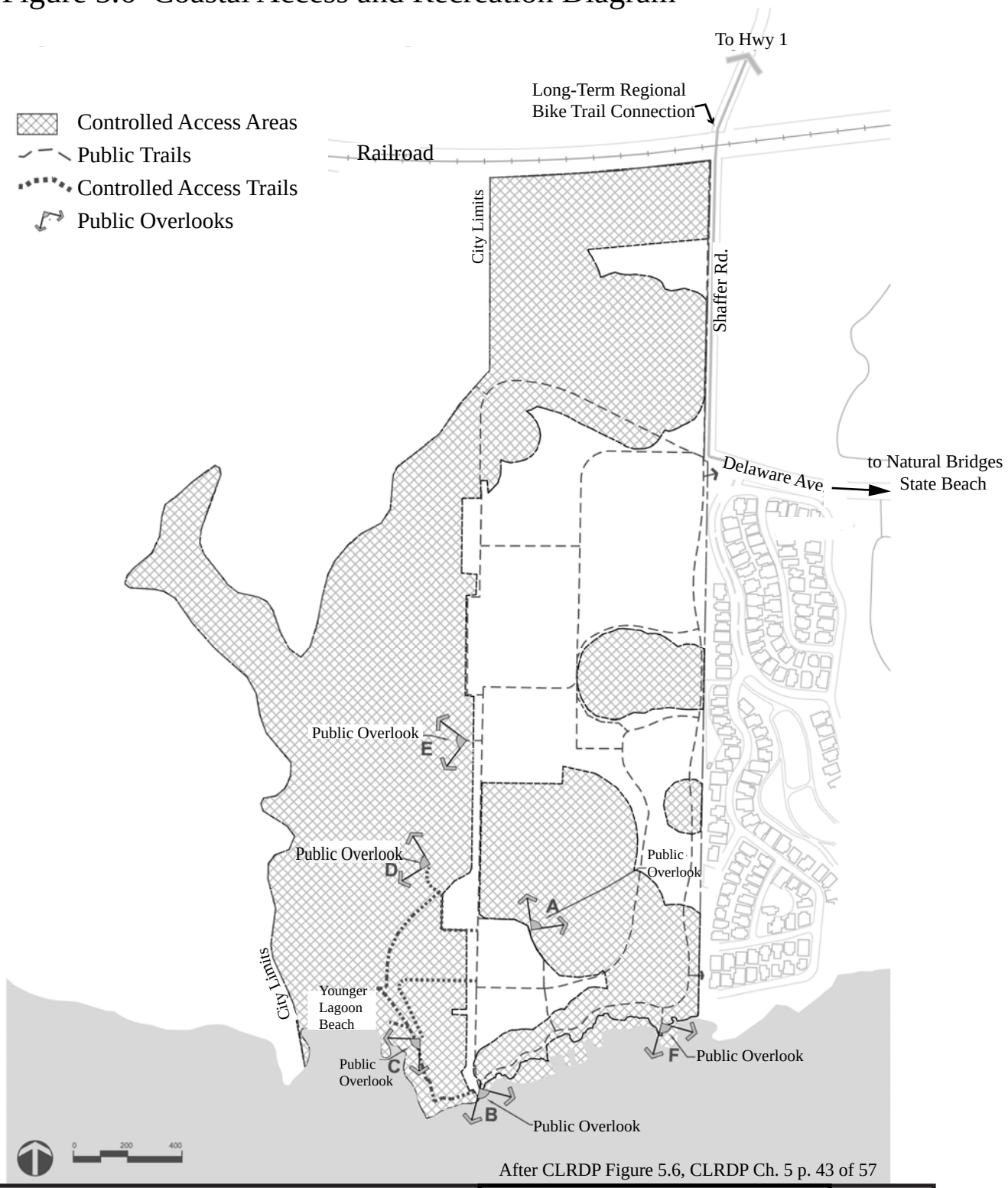

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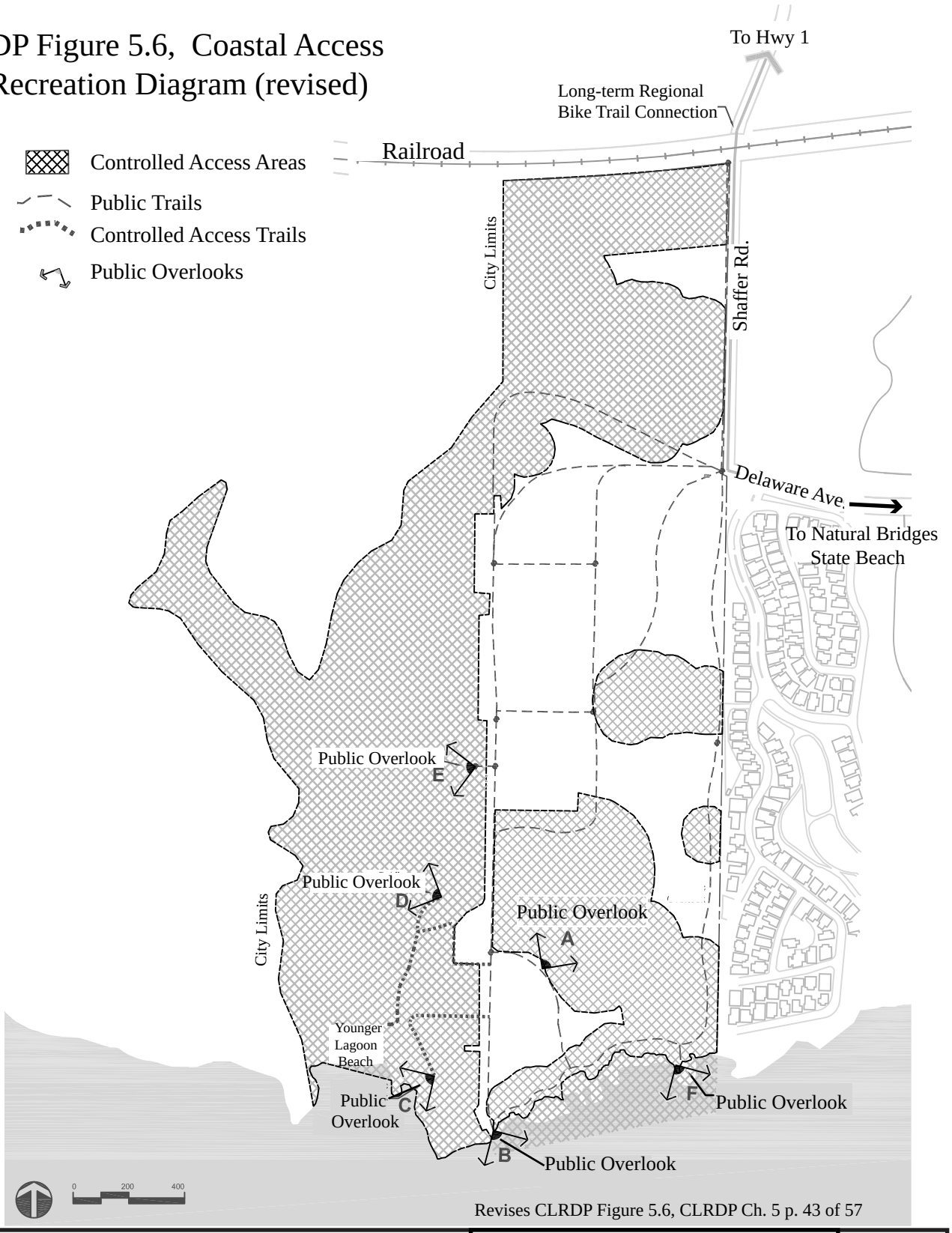
UC Santa Cruz Marine Science Campus Coastal Biology Building and Infrastructure Improvements Final Environmental Impact Report November 2011	CLRDP Figure 5.6 Coastal Access and Recreation Diagram as Previously Approved	Figure A-4

CLRDP Figure 5.6, Coastal Access and Recreation Diagram (revised)



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UC Santa Cruz Marine Science Campus Coastal Biology Building and Infrastructure Improvements Final Environmental Impact Report November 2011	Proposed CLRDP Amendment 1, Action 6 : Revise CLRDP Figure 5.6 Trails	Figure A-5

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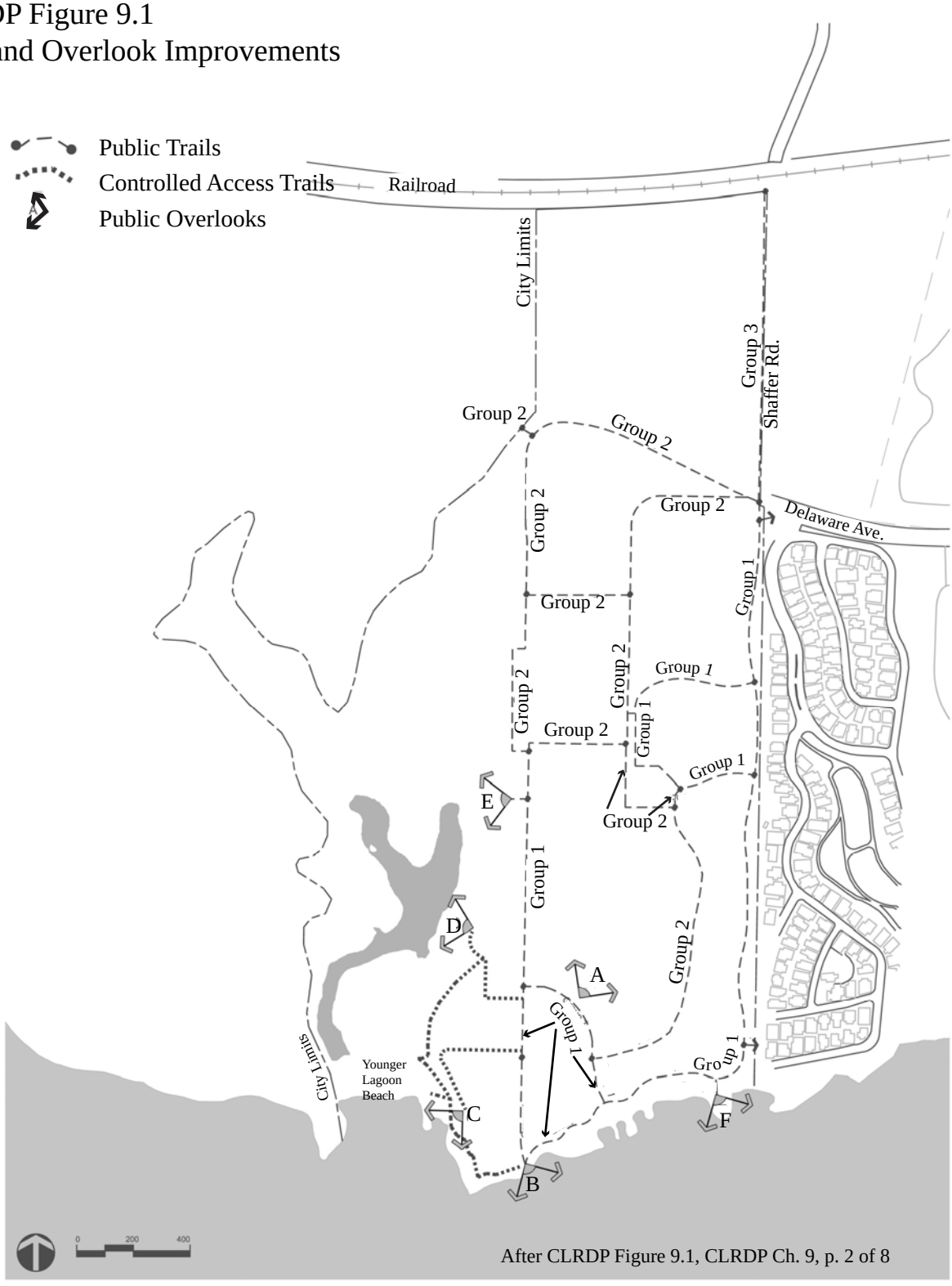

After CLRDP Figure 9.1, CLRDP Ch. 9, p. 2 of 8

UC Santa Cruz Marine Science Campus Coastal Biology Building and Infrastructure Improvements Final Environmental Impact Report November 2011	CLRDP Figure 9.1 Trail and Overlook Improvements as Previously Approved	Figure A-6

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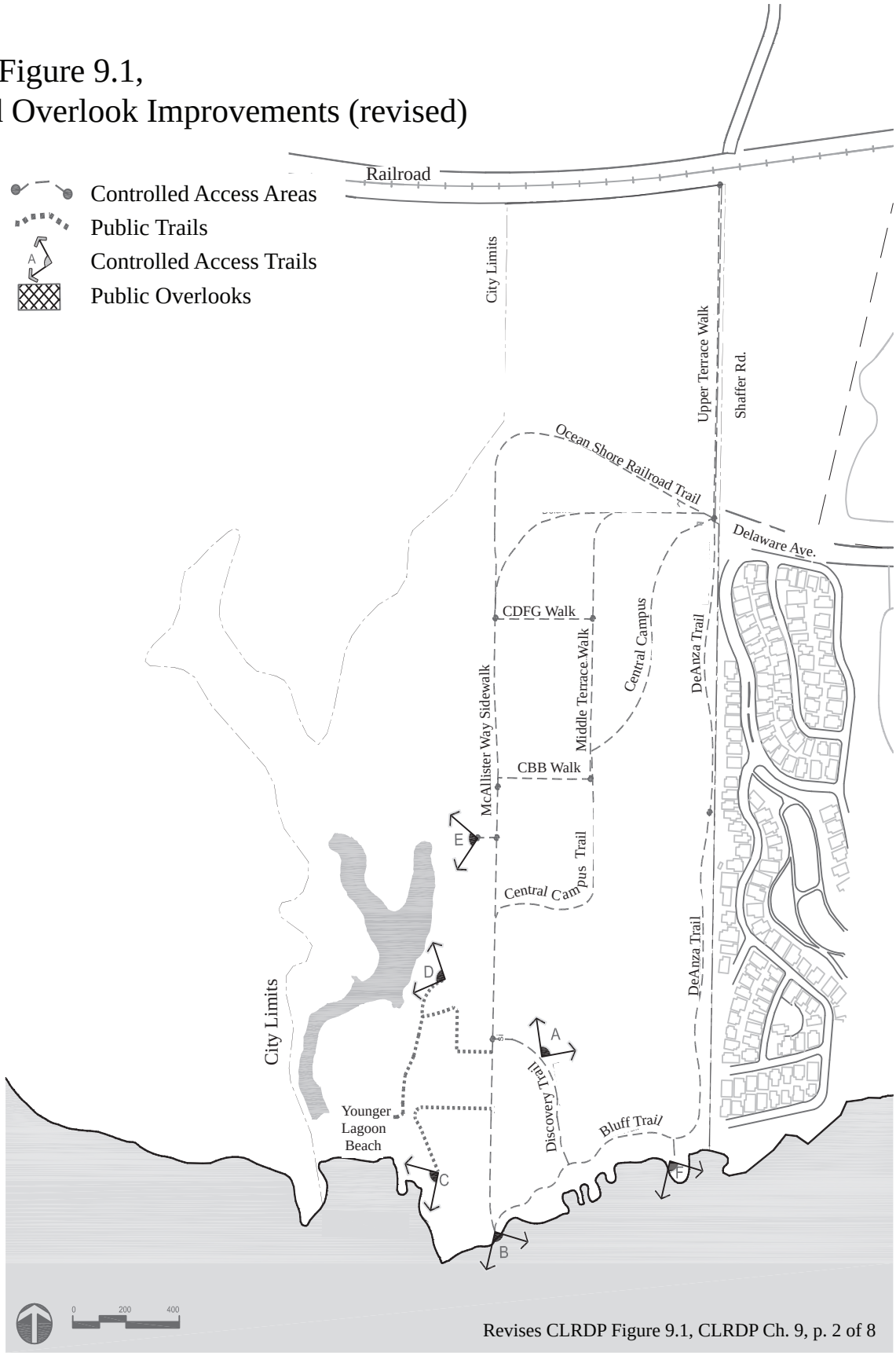
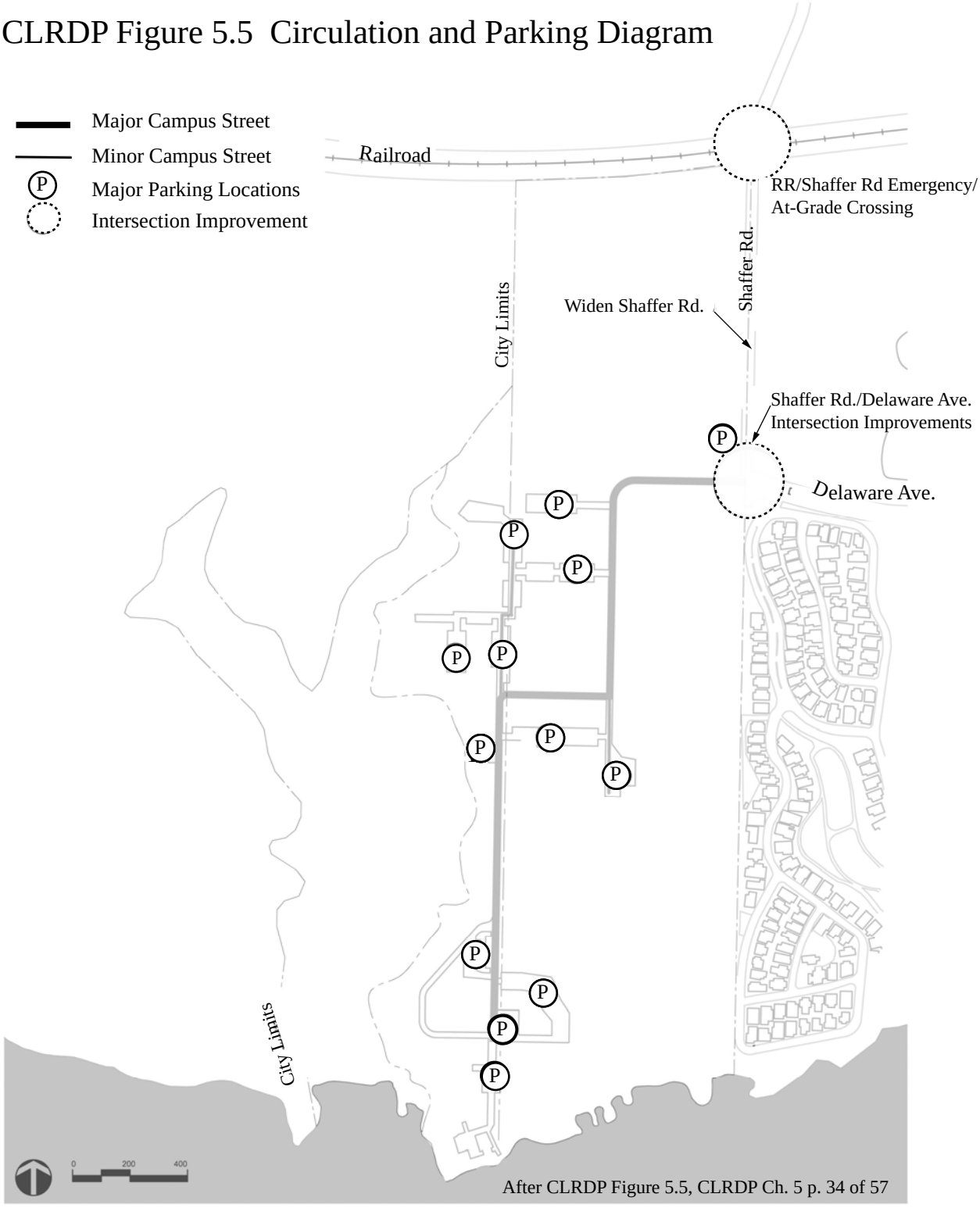


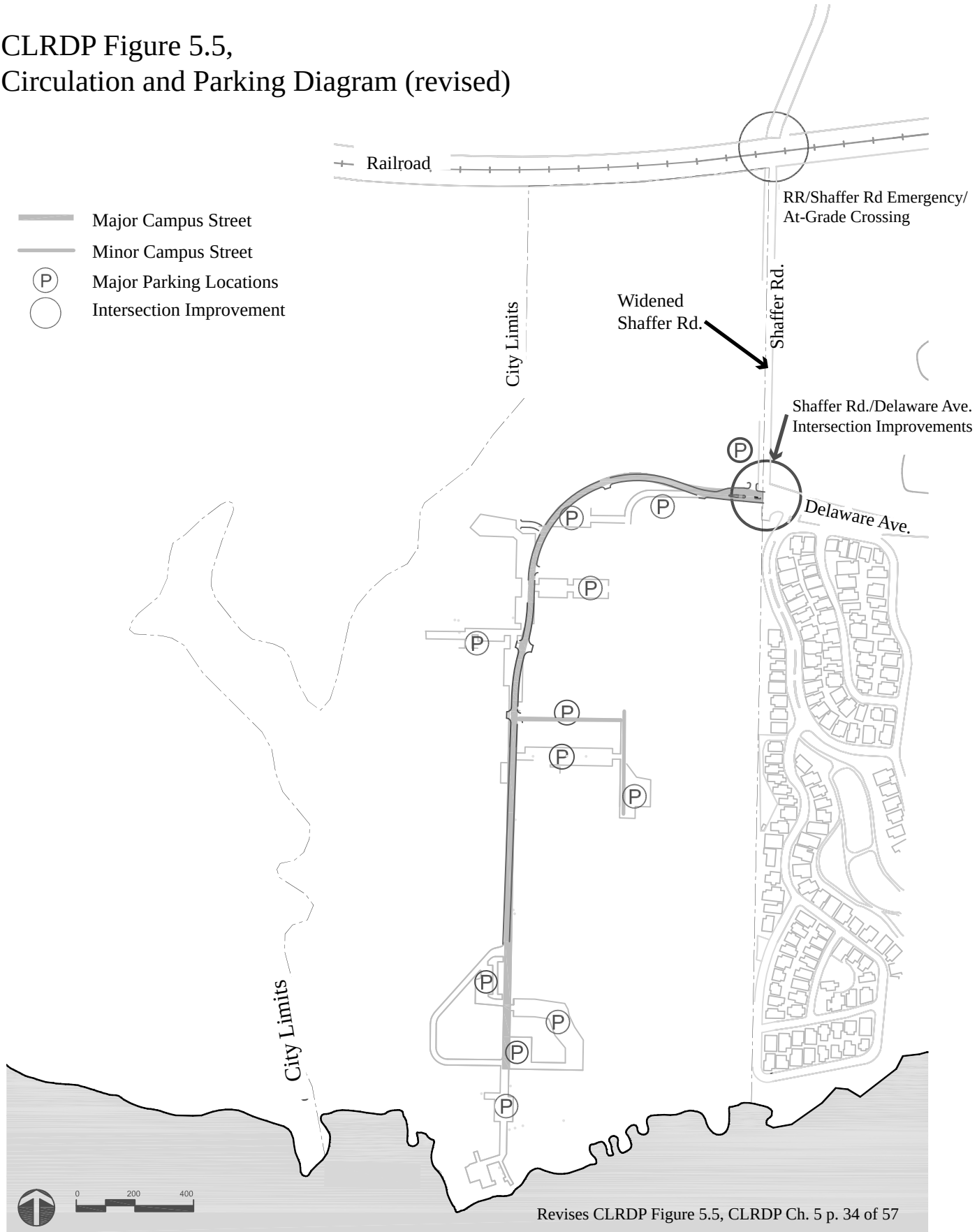
UC Santa Cruz Marine Science Campus Coastal Biology Building and Infrastructure Improvements Final Environmental Impact Report November 2011	Proposed CLRDP Amendment 1, Action 6: Revise CLRDP Figure 9.1 Trail Improvements	Figure A-7

CLRDP Figure 5.5 Circulation and Parking Diagram



UC Santa Cruz Marine Science Campus Coastal Biology Building and Infrastructure Improvements Final Environmental Impact Report November 2011	CLRDP Figure 5.5, Circulation and Parking as Previously Approved	Figure A-8

CLRDP Figure 5.5,
Circulation and Parking Diagram (revised)



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UC Santa Cruz Marine Science Campus Coastal Biology Building and Infrastructure Improvements Final Environmental Impact Report November 2011	Proposed CLRDP Amendment 1, Action 7: Revise CLRDP Figure 5.5 Circulation Routes	Figure A-9

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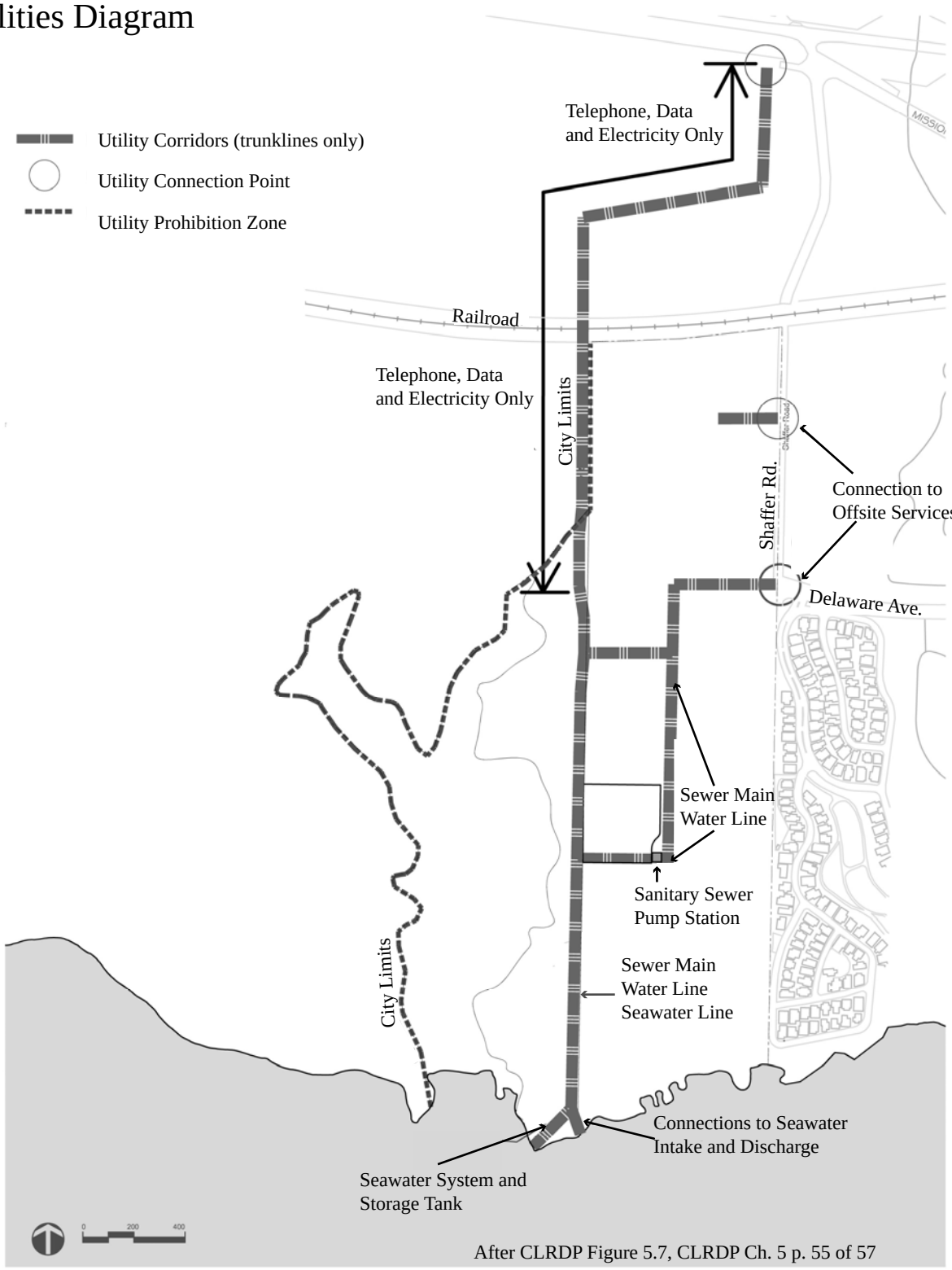
Utilities Diagram



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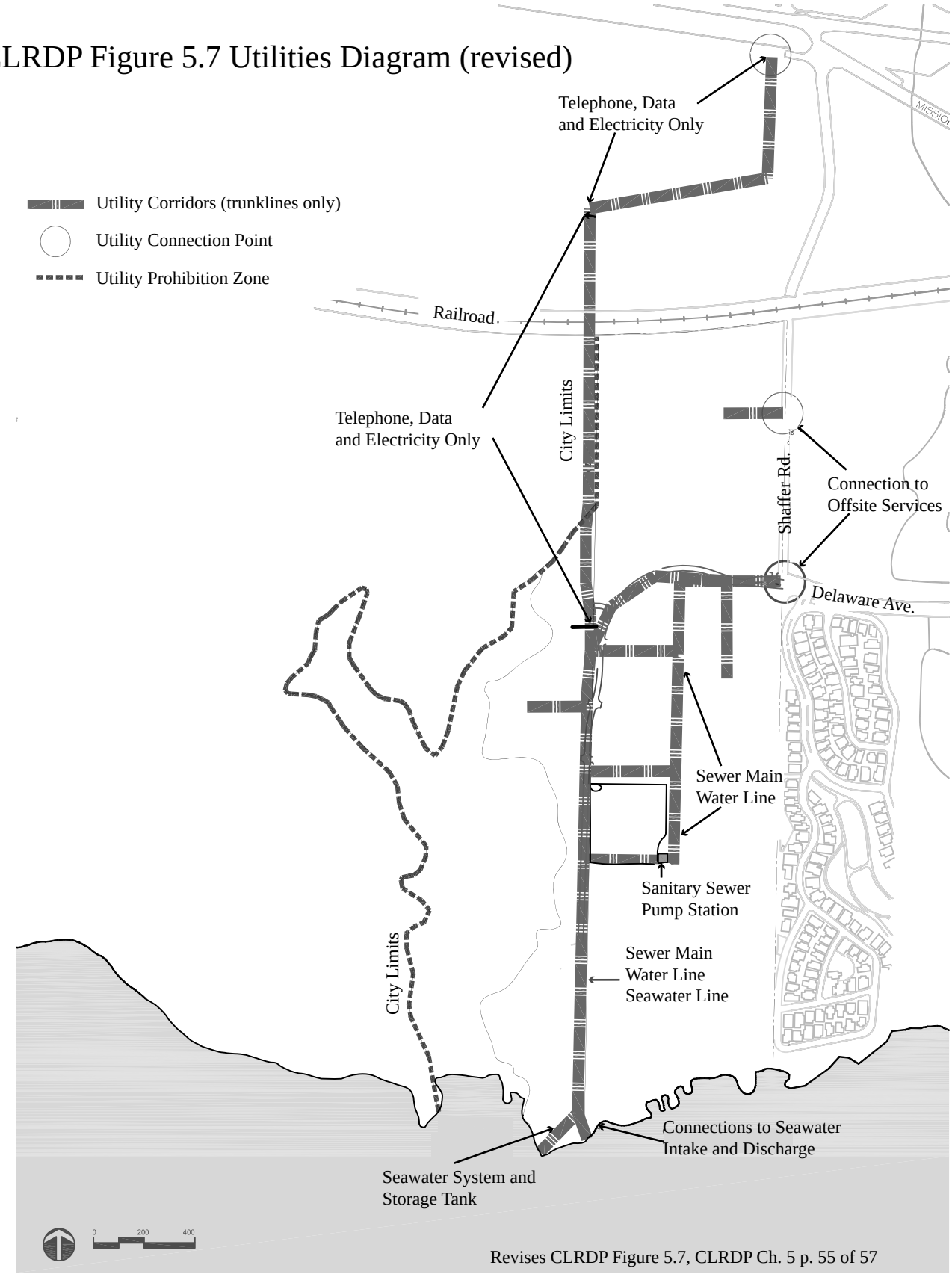
UC Santa Cruz Marine Science Campus Coastal Biology Building and Infrastructure Improvements Final Environmental Impact Report November 2011	CLRDP Figure 5.7 Utilities Diagram as Previously Approved	Figure A-10

CLRDP Figure 5.7 Utilities Diagram (revised)



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UC Santa Cruz Marine Science Campus Coastal Biology Building and Infrastructure Improvements Final Environmental Impact Report November 2011	Proposed Addenum 1, Action 8: Revise CLRDP Figure 5.7 Utilities Routes	Figure A-11

Appendix B

EIR Notice of Preparation

Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P.O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH #

Project Title: UCSC Marine Science Campus Coastal Biology Building, Infrastructure, and Nature Education FacilitiesProjects

Lead Agency: University of California, Santa Cruz — Contact Person: Sally Morgan
Mailing Address: PP&C, UC Santa Cruz, 1156 High Street — Phone: 831-459-1254
City: Santa Cruz — Zip: 95062 — County: Santa Cruz

Project Location: County: Santa Cruz — City/Nearest Community: Santa Cruz
Cross Streets: Delaware Ave./Shaffer Road — Zip Code: 95060
Longitude/Latitude (degrees, minutes and seconds): ____° ____' ____" N / ____° ____' ____" W — Total Acres: 102
Assessor's Parcel No.: 3-321-03, -08, -09, -10, -12 — Section: 22 — Twp.: 11S — Range: 2W — Base: Santa Cruz
Within 2 Miles: State Hwy #: 1 — Waterways: Moore Creek, Wilder Creek
Airports: None — Railways: Union Pacific — Schools: UC Santa Cruz

Document Type:

CEQA: ☑ NOP ☐ Early Cons ☐ Neg Dec ☐ Mit Neg Dec ☐ Draft EIR ☐ Supplement/Subsequent EIR (Prior SCH No.) ____ Other: ____
NEPA: ☐ NOI ☐ EA ☐ Draft EIS ☐ FONSI
Other: ☐ Joint Document ☐ Final Document ☐ Other: ____

Local Action Type:

☐ General Plan Update ☐ General Plan Amendment ☐ General Plan Element ☐ Community Plan
☐ Specific Plan ☐ Master Plan ☐ Planned Unit Development ☐ Site Plan
☐ Rezone ☐ Prezone ☐ Use Permit ☐ Land Division (Subdivision, etc.)
☐ Annexation ☐ Redevelopment ☐ Coastal Permit ☑ Other: UC approval

Development Type:

☐ Residential: Units ____ Acres ____
☐ Office: Sq.ft. ____ Acres ____ Employees ____
☐ Commercial: Sq.ft. ____ Acres ____ Employees ____
☐ Industrial: Sq.ft. ____ Acres ____ Employees ____
☑ Educational: 49,400 sf biology laboratories and greenhouses
☐ Recreational: ____
☐ Water Facilities: Type ____ MGD ____
☑ Transportation: Type Realign internal campus roadway
☐ Mining: Mineral ____
☐ Power: Type ____ MW ____
☐ Waste Treatment: Type ____ MGD ____
☐ Hazardous Waste: Type ____
☑ Other: Campus utilities and public access improvements

Project Issues Discussed in Document:

☑ Aesthetic/Visual
☑ Agricultural Land
☑ Air Quality
☑ Archeological/Historical
☑ Biological Resources
☑ Coastal Zone
☑ Drainage/Absorption
☐ Economic/Jobs
☐ Fiscal
☑ Flood Plain/Flooding
☐ Forest Land/Fire Hazard
☑ Geologic/Seismic
☑ Minerals
☑ Noise
☑ Population/Housing Balance
☑ Public Services/Facilities
☑ Recreation/Parks
☑ Schools/Universities
☐ Septic Systems
☑ Sewer Capacity
☑ Soil Erosion/Compaction/Grading
☑ Solid Waste
☑ Toxic/Hazardous
☑ Traffic/Circulation
☑ Vegetation
☑ Water Quality
☑ Water Supply/Groundwater
☑ Wetland/Riparian
☑ Growth Inducement
☑ Land Use
☑ Cumulative Effects
☑ Other: Climate change

Present Land Use/Zoning/General Plan Designation:

Coastal Long Range Development Plan land use designation is Marine Research and Education

Project Description: *(please use a separate page if necessary)*
See attached notice.

Note: The State Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. Notice of Preparation or previous draft document) please fill in.

Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with and "X".
If you have already sent your document to the agency please denote that with an "S".

X	Air Resources Board		Office of Emergency Services
	Boating & Waterways, Department of		Office of Historic Preservation
	California Highway Patrol		Office of Public School Construction
X	Caltrans District #5	X	Parks & Recreation, Department of
	Caltrans Division of Aeronautics		Pesticide Regulation, Department of
	Caltrans Planning		Public Utilities Commission
	Central Valley Flood Protection Board	X	Regional WQCB #3
	Coachella Valley Mtns. Conservancy		Resources Agency
X	Coastal Commission		S.F. Bay Conservation & Development Comm.
	Colorado River Board		San Gabriel & Lower L.A. Rivers & Mtns. Conservancy
	Conservation, Department of		San Joaquin River Conservancy
	Corrections, Department of		Santa Monica Mtns. Conservancy
	Delta Protection Commission		State Lands Commission
	Education, Department of		SWRCB: Clean Water Grants
	Energy Commission		SWRCB: Water Quality
X	Fish & Game Region #3		SWRCB: Water Rights
	Food & Agriculture, Department of		Tahoe Regional Planning Agency
	Forestry and Fire Protection, Department of		Toxic Substances Control, Department of
	General Services, Department of		Water Resources, Department of
	Health Services, Department of		
	Housing & Community Development		Other:
	Integrated Waste Management Board		Other:
	Native American Heritage Commission		

Local Public Review Period (to be filled in by lead agency)

Starting Date June 30, 2010 Ending Date July 30, 2010

Lead Agency (Complete if applicable):

Consulting Firm: _____
Address: _____
City/State/Zip: _____
Contact: _____
Phone: _____

Applicant: _____
Address: _____
City/State/Zip: _____
Phone: _____

Signature of Lead Agency Representative: Sally Morgan **Date:** 6/29/2010

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

Appendix C

CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

APPENDIX C

CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
IM 1.1.1 Figures of Chapter 5.	Figures 5.1, 5.2, 5.3, and 5.4 show the kinds, locations, and maximum size and intensity of development allowed by this plan if such development is otherwise consistent with Chapters 5, 6, 7, 8, 9, and Appendices A and B. Development shall not be authorized unless it is of a type and location contemplated by Section 5.2. The locations of potential development and the maximum heights shown in Figure 5.4 shall be presumed consistent with Policy 4.1 and IM 4.1.1 with respect to protection of distant, non-campus public views (i.e., views from locations further than ¼ mile from the campus boundaries), if such development is otherwise consistent with the CLRDP.	**X**	**X**	**X**	**X**	
IM 2.1.1 Oversizing of Utility Lines Prohibited	Utilities on the MSC shall be limited to the size necessary to serve only the projected needs of the campus.	**X**	**X**			As discussed in Section 3.16, *Utilities and Service Systems*, the new utility lines would not exceed the capacity required to serve the CLRDP building program.
IM 2.1.2 Utility Prohibition Zone	New sewer and/or water utility lines and/or expansion of existing lines shall be prohibited within the utility prohibition zone at the western edge of the MSC (see Figure 5.7).	**X**	**X**			The proposed sewer and/or water lines are outside the utility prohibition zone (Figure 2-3b).
IM 2.2.1 Setback of Development and Uses from	All caretaker accommodations shall be located no closer than 500 feet from the western MSC property line. All other development and uses shall be located no closer than 300 feet from established crop lines (as shown on Figure 3.15) and no	**X**	**X**	**X**		The CBB Project includes only ancillary unoccupied research support space (greenhouses) within 200 feet from the western property line. All other development

APPENDIX C

CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
Adjacent Agricultural Uses	closer than 200 feet from the western MSC property line, whichever is the greater distance, except that existing (i.e., pre-CLRDP certification) development and uses (and/or redevelopment and/or reuse of same, including; minor expansion of the California Department of Fish and Game facility); ancillary unoccupied structures that support research activities; and public access and recreation facilities and features shown in Figure 5.6 and/or described in Section 5.6 in these agricultural setback areas shall be allowed without restriction with respect to agricultural setback. Short-term accommodations may be located in the area between the 300-foot/200-foot setback and the 500-foot setback only if users of such accommodations are prohibited from staying in the accommodations for more than one week at a time.					would be outside the 200-foot and 300-foot setbacks.
IM 2.3.1 Cluster Development	Except for allowed drainage facilities, development shall be clustered within, and open space shall be preserved outside of, areas designated for Research and Education Mixed Use including through such means as building clustering; building articulation and scale reduction at the boundary of development zones, rural/agricultural building design, limited lighting, and vegetative and other screening of development, as well as by use of agricultural setbacks, habitat buffers, natural habitats, view corridors, and open space areas. Among other things, this siting and design approach is intended to reinforce the sense of urban edge created by the canyon topography of Younger Lagoon Reserve, existing development, and the Santa Cruz city limit.	**X**	**X**			The CBB lab building would be adjacent to the existing NOAA building; new greenhouses and support space would be clustered with existing CDFG structures. Structures at edge of the development area (greenhouse complex and Subarea 2 Utility Yard) would be small and have a low profile. As analyzed in Section 3.1, *Aesthetics*, the visual impacts of the projects would be less than significant.

APPENDIX C

CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
IM 2.3.2 Impervious Coverage	At least 30 percent of land area within the Lower and Middle Terrace development zones shall be maintained in a pervious state and free of impervious surfaces. One hundred percent of the land area within the Upper Terrace and MSC Entrance development zones may be developed with impervious surface as long as water quality standards are met.	**X**	**X**	**X**		With the proposed MSC Projects, approximately 19 percent of the Middle Terrace Development Zone would be impervious. The remaining 81 percent would be pervious.
IM 2.3.3 Windbreak/ Screening Trees	Development sited adjacent to windbreak/screening trees shall include as part of it, installation of and long-term maintenance parameters for the designated windbreak/screening trees.	**X**	**X**			Windscreen consisting of tall, native shrubs is included in landscaping on the west side of CBB, consistent with CLRDP Figure 6.6. As part of CLRDP Amendment #1, as recommended by the Scientific Advisory Committee, the Campus is proposing to revise this measure to change "windbreak/screening trees" to "windbreak/ screening plantings." The SAC has determined that the trees indicated as windbreaks are not native to the site and tend to be invasive and therefore should not be planted on the campus.
IM 2.3.4 Buildout Planning	Development shall not interfere with the ability to site and design future buildings and other development in a manner than can fully conform to the CLRDP, and shall not interfere with the University's ability to meet all commitments identified in the CLRDP.	**X**	**X**			Proposed projects are consistent with MSC Area Plan, which identifies sites for future buildings and utilities.
IM 3.1.2 Discharge of Drainage/ Storm Water	The MSC drainage system shall be maintained and may be expanded consistent with Section 5.7, provided such maintenance/expansion proceeds in a manner that maintains, enhances, and where feasible restores marine resources.	**X**	**X**			As discussed in Section 3.9, *Hydrology and Water Quality*, the drainage systems for the CBB and MSCI projects are consistent with Drainage Concept Plan.

APPENDIX C

CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
IM 3.2.1 Restoration of Wetlands on the Marine Science Campus	As part of the University's comprehensive effort to manage natural resources on the Marine Science Campus, wetlands on the northern part of the site shall be connected, expanded, and restored to enhance their functional values. Such restoration program shall include integrating the hydrology of Wetlands W1 and W2 and expanding this consolidated area to provide enhanced biological values. The areas both east and west of the combined Wetland W1/W2 hydrologic corridor shall be restored as functioning wetland upland/transitional habitat, including as described in Appendix A (Resource Management Plan). The restoration program shall also enhance plant biology in Wetlands W1, W2, and W6 to create a consolidated north-south corridor for wildlife movement to YLR. As part of any development project involving wetland manipulation, a restoration plan shall be prepared consistent with this CLRDP, including its Resource Management Plan (Appendix A), and submitted to the California Coastal Commission, California Department of Fish and Game, and the U.S. Fish and Wildlife Service for review and comment.		**X**		**X**	SRP 1B would implement this measure by integrating the hydrology of wetlands W1 and W2 and improving the native plant mosaic of W 1, 2, 6. Implementation of SRP Phase 1B involved work in jurisdictional wetlands and is expected to require a Clean Water Act permit, under the jurisdiction of the Army Corps of Engineers. Consultation with USFWS will be conducted in the context of that permitting process. UCSC also has provided both USFWS and CDFG with descriptions of the projects and assessment of anticipated biological resources impacts and mitigation measures, for their review and comment.
IM 3.2.2 Management of Terrace Wetlands.	The terrace wetlands shall be protected and enhanced by improving surface water flow, removing non-native and invasive plants, promoting the abundance and diversity of native plant species through small-scale plantings, creating buffers, implementing the Drainage Concept Plan (Appendix B), controlling access by humans and non-native animals, and implementing other enhancement measures in accordance with the provisions of this CLRDP, including its Resource Management Plan (Appendix A).	**X**	**X**	**X**	**X**	The CBB, MSCI and NEF projects include stormwater management features to protect water flow and quality. The MSCI project implements portions of the Drainage Concept plan. The NEF Project includes interpretive signage to control access by humans and domestic animals. The SRP Phase 1B project will implement elements of the RMP to enhance native vegetation and habitat.

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
IM 3.2.3 Protection and Enhancement of Wildlife Movement	Wildlife movement across the site shall be facilitated and enhanced by establishing two enhanced wildlife corridors and associated buffers adjacent to the Upper Terrace development area (as shown in Figure 5.2) that provide enhanced habitat value and wildlife connectivity in the area between Younger Lagoon Reserve and the Moore Creek/Antonelli Pond system east of the MSC. Conditions for wildlife movement in these areas shall be enhanced by eliminating invasive weeds, planting native species to provide better protective cover and visual screening for wildlife than existing vegetation, controlling access by humans and non-native animals, providing fencing/building elements at the development zone boundary that screen Upper Terrace development zone noise, lights, and activities from wildlife in the corridors/buffers, and other enhancement measures in accordance with the provisions of this CLRDP, including its Resource Management Plan (Appendix A). The University shall also coordinate with the owners of the properties immediately east of Shaffer Road and the City of Santa Cruz (in the case of Shaffer Road itself) to promote the extension of the wildlife corridors and wildlife corridor buffers across Shaffer Road and to Moore Creek/Antonelli Pond in the manner most protective of wildlife **(see also RMP, IM 5.1.3 and IM 5.1.4)**		**X**		**X**	Enhancement of wildlife corridors will be carried out by the UC Natural Reserve as part of the Phase 1 Resource Management Plan. Fencing and landscaping are included in the Staging and Storage Yard that would be constructed as part of the MSCI Project. If improvements to Shaffer Road up to the entrance to the proposed Upper Terrace Storage Yard are required for adequate functioning and maintenance of the road under the MSCI Project, the Campus would coordinate with the City and with CDFG regarding the extension of the wildlife corridor across Shaffer Road, as required under RMP MM 29. The Campus has provided CDFG and USFWS with project information and proposed mitigation measures.
IM 3.2.4 Management of Special Status Species Habitat.	Special status animal species and their habitats shall be protected, and their habitats enhanced consistent with the Resource Management Plan (Appendix A), including through protection and enhancement of wetland habitats (including for California red-legged frog) and grassland/scrub-grassland				**X**	SRP Phase 1B would include restoration and enhancement of wetland habitats, consistent with the provision of the RMP.

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	habitats outside of development zones (including for special status bird species), through protection from non-native predators, and through implementation of other enhancement measures in accordance with the provisions of this CLRDP.					
IM 3.2.5 Protect Habitat Areas from Human Intrusion	Habitat areas on the Marine Science Campus shall be protected against degradation from human intrusion by developing trails and interpretive signs, managing trail use, and implementing other enhancement measures in accordance with the provisions of this CLRDP. **General requirement--see other measures for specific requirements.**		**X**	**X**	**X**	The MSCI and NEF projects partially implement this measure through the development of trails and interpretive signs. SRP 1B would enhance wetlands by integrating wetlands W1 and W2 and removing non-native plants and restoring the balance of native vegetation.
IM 3.2.9 Wetland Buffers	Buffers for wetlands delineated at the time of CLRDP certification shall be as shown on Figure 5.2 and in no case shall they be reduced. For any new wetlands identified and delineated pursuant to Implementation Measure 3.3.1, development shall be sited and designed to minimize wetland impacts, and development shall be prohibited within a 100 foot buffer of any such wetlands unless it is development allowed within areas designated Resource Protection Buffer, except that a reduced or greater buffer distance may be applied if supported by a site-specific biological evaluation indicating that a reduced buffer would not result in a significant adverse effect to the wetland, or that a greater buffer distance is needed. To the extent that new wetland areas are identified pursuant to Implementation Measure 3.3.1 and the appropriate buffer area is not already designated Resource Protection Buffer on Figure 5.2, the Resource Protection Buffer designation shall be applied	**X**	**X**	**X**		As discussed in Section 3.4, *Biological Resources*, an evaluation of ESHAs under current site conditions was completed by the Huffman-Broadway Group in February 2011. Proposed CLRDP Amendment #1 includes revisions to the boundaries of wetland 2, 3 and 5 and their associated Resource Protection Buffers to take into account the results of this evaluation. The project would construct trails within the revised wetland buffers, as allowed within areas designated Resource Protection Buffer. The siting of CBB and MSCI project elements are consistent with these revised buffers.

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Measure	**Description**	**Project Applicability**				**Project Consistency/Implementation**
		CBB	**MSCI**	**NEF**	**SRP 1B**	
	to the wetland buffer area.					
IM 3.2.10	Within six (6) months of CLRDP certification, the University in consultation with the Executive Director of the California Coastal Commission shall convene a scientific advisory committee (SAC) to guide the restoration, enhancement, and management of natural areas (i.e., all areas outside defined development zones, except for Younger Lagoon Reserve) on the Marine Science Campus (see Appendix A). Natural areas restoration, enhancement, and management may be completed in up to three phases corresponding to dividing the natural area into thirds (i.e., where Phase 1 accounts for at least one-third of the natural area, Phase 1 plus Phase 2 accounts for at least two-thirds, and all of the three phases together account for all of the natural area). All restoration, enhancement, and management activities shall be guided by Specific Resource Plans developed by the University in accordance with the SAC and the criteria contained in the Resource Management Plan (Appendix A) and current professional standards for such plans. The SAC shall be responsible for guiding development of Specific Resource Plans and shall complete its work on the Specific Resource Plan for Phase I restoration and enhancement efforts within four (4) months of convening. The content of Specific Resource Plans shall be consistent with the performance standards set forth in Appendix A, which may be adapted periodically based on findings from ongoing restoration work. The University shall file a Notice of Impending Development for Phase I work within one (1) year of CLRDP certification. All natural areas restoration and enhancement shall be				**X**	SRP Phase 1B would implement part of Phase 1 of the restoration, enhancement and management of natural areas as described in the measure.

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	completed within 20 years of CLRDP certification, with interim benchmarks that at least one-third of the restoration and enhancement shall be completed within seven years of CLRDP certification and that at least two-thirds shall be completed within 14 years of CLRDP certification.					
IM 3.2.11 CRLF Protection	Surveys for California red-legged frog shall be conducted prior to authorization of any development project within 100 meters of an identified wetland resource. All authorized development shall include construction and post-construction safe passage and other mitigation measures (e.g., barriers along development perimeters) as appropriate.	**X**	**X**	**X**	**X**	CRLF surveys are conducted annually on the campus, as reported in Section 3.4 of this EIR. Mitigation measures to protect CRLF are identified in that section.
IM 3.2.12 USFWS Consultation Required	Development project authorizations shall include either (1) evidence of authorization by the U.S. Fish and Wildlife Service, including but not limited to a Habitat Conservation Plan/incidental take permit; or (2) evidence from the USFWS that no authorization is required.	**X**	**X**	**X**	**X**	As discussed in Section 3.4, *Biological Resources*, and described in relation to IM 3.2.1, above, it is anticipated that consultation with USFWS regarding special status wildlife species that may be affected by the proposed projects will be conducted by the US Army Corps of Engineers in the context of Clean Water Act permitting. In addition, the campus has provided USFWS and CDFG with project descriptions, the project biological resources technical report, and the EIR assessment of biological resources impacts and mitigation measures. This measure will be included in the mitigation monitoring program for each of the proposed projects.
IM 3.2.14	All landscaping and vegetation on the MSC (including	**X**	**X**	**X**	**X**	As recommended by the SAC, as part of

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
Non-Invasive Native Plant Species Required	restoration and enhancement plantings, screening vegetation, storm water system plantings, ornamental plantings, and all other plant material) shall be limited to non-invasive native plant species that are appropriate to the habitat and region and that are grown from seeds or vegetative materials obtained from local natural habitats so as to protect the genetic makeup of natural populations. Horticultural varieties shall not be used. Except for the planting of Monterey cypress, only locally collected seed, cuttings, and/or other propagules shall be used for landscaping. If feasible, materials should be collected from coastal habitats located within approximately one mile of the MSC and seaward of Highway 1.					proposed CLRDP Amendment #1, the Campus is proposing to revise this implementation measures to require that propagules to similar habitats along the coast of western Santa Cruz county and southern San Mateo County (first and lower reaches of the second marine terraces). All proposed landscape and restoration plantings would be consistent with this measure, as amended. This measure will be included in the project mitigation monitoring programs.
IM 3.3.1 Pre-development Evaluation of Wetland Conditions.	An evaluation of the development area shall be conducted prior to each development project. The evaluation shall include any changed site conditions that could affect wetland values protected by this CLRDP. A wetland evaluation shall be completed in the proposed development area (i.e., the proposed development footprint and a surrounding 200-foot buffer area) in consultation with the Executive Director, using the Coastal Act 30121 wetland definition. To the extent wetland areas are identified during this process that are not already designated Resource Protection on Figure 5.2, the Resource Protection designation shall be applied to the newly identified wetland area and uses and development limited in accordance with that designation (see Section 5.2.2, Resource Protection). For any newly identified wetland area, an appropriate buffer shall be established, based upon site-specific conditions in accordance with Implementation Measure 3.2.9.	**X**	**X**	**X**	**X**	As discussed in Section 3.4, *Biological Resources*, an evaluation of wetlands under current site conditions was completed by the Huffman-Broadway Group in February 2011. Proposed CLRDP Amendment #1 would revise the Resource Protection and Resource Protection buffers to reflect the expanded boundaries of the wetlands based on the new evaluation. The expanded buffers are consistent with the buffer widths established by the CLRDP (that is, 100' from the edge of all wetlands, and 150' from portions of Wetland 5).

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
IM 3.3.2 Update CLRDP With Respect to Wetlands	For any wetlands and wetland buffers identified pursuant to implementation measures 3.3.1 and 3.2.9, the University shall amend the CLRDP to reflect the newly identified wetlands and wetland buffers, including all relevant CLRDP text, figures, and use and development restrictions applicable to those areas, and to remove those areas from development zones. The CLRDP amendment shall be submitted to the Coastal Commission before the effective date of the related development project authorization.	**X**	**X**	**X**	**X**	Proposed CLRDP Amendment #1 would update CLRDP Figure 5.6 to reflect the expansion of wetlands and wetland buffers based on the updated wetland evaluation that was completed in compliance with IM 3.3.1, above.
IM 3.4.1 Additional Measures to Protect Habitat Areas	Buffering of sensitive habitat areas shall also be achieved through development restrictions consistent with the policies and programs of this CLRDP, including those that regulate the location of windows, lighting, access, signage, and noise-generating equipment that would disrupt protected habitat values.	**X**	**X**	**X**		The siting and design of the CBB Project facilities, MSCI roads, lighting and utility and storage yard, and NEF trails comply with the CLRDP development restrictions, to protect habitat values, and each project includes measure that would be monitored through the MMP to protect biological resources.
IM 3.4.2 Noise Intrusion into Terrace ESHA	Development shall be sited and designed so that noise sources are no closer than 100 feet from designated Resource Protection areas located in the terrace portion of the MSC (other than development, such as paths, that may include minimal noise sources and that is planned and/or located within 100 feet of these areas and where measures are taken so that noise potentially audible from within these areas is minimized to the maximum extent feasible). Use of Campus facilities shall occur in a manner that does not result in undue noise into designated terrace area Resource Protection areas. Noise shall be monitored periodically or upon complaint and appropriate	**X**	**X**			All noise sources that would be constructed as part of the proposed project, including the generator yard, greenhouses, and CBB, would be within designated development areas and are at least 100 feet from the designated Resource Protection Areas. The project would construct paths and overlook improvements in Resource Protection Buffers, but these would not be sources of significant noise.

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	noise attenuation measures shall be immediately implemented to lower any unacceptable noise generation.					
IM 3.4.3 Noise Intrusion into YLR	YLR shall not be exposed to noise generated by human activity on the terrace portion of the Marine Science Campus in excess of 60 dBA CNEL, as measured at the boundary of the YLR. For the purposes of this measure, "dBA CNEL" means a 24-hour energy equivalent level derived from a variety of single noise events, with weighting factors of 5 and 10 dBA applied to the evening (7pm to 10pm) and nighttime (10pm to 7am) periods, respectively, to allow for the greater sensitivity to noise during these hours.	**X**	**X**			Noise levels at the YLR boundary are analyzed in Section 3.11, *Noise*. Operation of the proposed development would not result in noise levels exceeding 60 dBA CNEL. The proposed CLRDP Amendment #1 would clarify that "YLR" in this IM refers to the original YLR and not to the YLR as expanded to include all lands outside the development areas on the MSC terrace lands, which were included in the expanded YLR as part of the CLRDP approval process.
IM 3.4.4 Pre-development Evaluation of ESHA Conditions.	An evaluation of the development area shall be conducted prior to each development project. The evaluation shall include changed site conditions that may affect ESHA values and new information that was not known at the time of the original ESHA determination. To the extent ESHA areas are identified during this process that are not already designated Resource Protection on Figure 5.2, the Resource Protection designation shall be applied to the newly identified ESHA and uses and development limited in accordance with that designation (see section 5.2.2, Resource Protection). For any newly identified ESHA area, an appropriate buffer shall be established, based on site-specific biological evaluation, and designated as Resource Protection Buffer.	**X**	**X**	**X**	**X**	As discussed in Section 3.4, *Biological Resources*, an evaluation of ESHAs under current site conditions was completed by the Huffman-Broadway Group in February 2011. Proposed CLRDP Amendment #1 would expand the ESHAs and associated Resource Protection buffers based on the new evaluation.
IM 3.4.5	For any ESHA and ESHA buffers identified pursuant to	**X**	**X**	**X**	**X**	Proposed CLRDP Amendment #1 would

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
Update CLRDP with Respect to ESHA	implementation measures 3.4.4, the University shall amend the CLRDP to reflect the newly identified ESHA and ESHA buffers, including all relevant CLRDP text, figures, and use and development restrictions applicable to those areas, and to remove those areas from development zones. The CLRDP amendment shall be submitted to the Coastal Commission before the effective date of the related development project authorization.					update the CLRDP to reflect the results of the ESHA evaluation that was completed in compliance with IM 3.4.4, above.
IM 3.5.1 Protection and Enhancement of YLR Habitats	The native plant and animal habitats of Younger Lagoon Reserve shall be protected and enhanced by controlling and removing non-native and invasive plant species, promoting the abundance and diversity of native plant species through small-scale plantings and re-vegetation of areas where exotics and/or invasives have been removed, implementing the Drainage Concept Plan (Appendix B), maintaining and installing fencing/barriers consistent with this CLRDP to control trespass from the terrace portion of the site into YLR, limiting access by humans (except access otherwise allowed by this CLRDP), prohibiting domestic pets, and other appropriate means that may become available.		**X**	**X**	**X**	The CBB and MSCI Projects would implement elements of the Drainage Concept Plan; MSCI Phase A includes installation of YLR fencing and berms; the NEF Project includes interpretive signage to educate humans regarding the need to prohibit domestic animals on the site; SRP Phase 1B includes control of invasive plants and enhancement of native vegetation.
IM 3.5.2 Protection of Special Status Species in YLR	Habitats for special status animal species that use Younger Lagoon Reserve shall be protected and enhanced.	**X**	**X**	**X**	**X**	All the Projects include measures to protect special status animal species during project construction and operations, as identified in Section 3.5 of this EIR. These would be monitored through the MMP for each project.
IM 3.5.3 Protection of	The biological productivity and quality of YLR shall be protected, including by minimizing the effects of stormwater	**X**	**X**	**X**	**X**	The CBB, MSCI and NEF projects include features to ensure that quality of storm water

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
YLR Resources	discharges and entrainment, controlling runoff, preventing depletion of ground water supplies, maintaining natural vegetation buffers areas and minimizing alteration of natural features.					discharges is protected and natural vegetation and buffers are included in each project; MSCI also includes some stormwater repairs as required by the CLRDP.
IM 3.5.5 Siting of Windbreak/Screening Trees	The windbreak/screening trees required by this CLRDP in connection with new development in the terrace portion of the site (see for example Section 6.5 and Figure 6.6) shall be sited to maximize their ability to screen terrace development as seen from Younger Lagoon Reserve.	**X**	**X**			Windbreak/screening shrubs would be planted in conjunction with construction of the CBB, Greenhouse Complex, and Utility Yard. As part of CLRDP Amendment #1, as recommended by the Scientific Advisory Committee, the Campus proposes a revision of this measure to change "windbreak/screening trees" to "windbreak/ screening vegetation." The SAC has determined that the trees used as windbreaks are not native to the site and tend to be invasive and therefore should not be planted on the campus.
IM 3.5.6 YLR Manager Consultation	Development shall not be authorized by the University without consultation with the YLR Manager. Development shall incorporate measures to address issues and impacts identified through the consultation.	**X**	**X**	**X**	**X**	The YLR Manager has been consulted throughout the project planning and design process.
IM 3.5.7 Movement Not Visible from YLR	Movement associated with development (including within outdoor activity/research areas and buildings, and including all windows in buildings) shall not be visible from within YLR.	**X**	**X**			As discussed in Section 3.4, *Biological Resources,* movement associated with development would not be visible from within the original YLR. As noted above, proposed CLRDP Amendment #1 would clarify the distinction between the original YLR (to

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
						which this IM refers) and the YLR terrace lands, where activity and development, although buffered and screened as prescribed by the CLRDP, would nonetheless be visible due to the proximity of the YLR terrace lands to development areas.
IM 3.5.8 Protective Measures for YLR in Middle Terrace	In conjunction with building construction west of McAllister Way in the Middle Terrace development zone, the University shall construct and/or plant protective barriers along the eastern edge of YLR in Development Subarea #7 and, if feasible and appropriate, extending south to connect to the existing berm. Such barriers may include fencing, dense vegetation, and/or an earthen berm. If an earthen berm is developed, it shall be sized so that no soil importation is required from outside the Marine Science Campus (i.e., the soil required to construct it would be less than or equal to the amount of soil that becomes available within the campus as a result of grading to prepare development sites, unless importation of additional soil is necessary to ensure proper berm function/ configuration; such soil is demonstrably clean and free of contaminants (including foreign seed stock); and its importation is feasible). Any such berm shall be planted with native grasses and herbaceous shrubs consistent with CLRDP Appendix B, Resource Management Plan.	**X**	**X**			The CBB project design includes an earthen berm and plantings of high shrubs in Development Subarea #7 to screen the greenhouses from the YLR. The MSCI Project would extend the berm south to connect to the existing berm. This measure would be included in the mitigation monitoring program for each of the proposed projects.
IM 3.8.2 Agreement to Indemnify and	Prior to start of construction of any CLRDP facilities located north of the designated Lower Terrace Development Zone, the University shall offer to enter into an agreement substantially in	**X**	**X**	**X**		This measure would be implemented before project construction and will be included in the MMPs for the CBB, MSCI and NEF

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
Hold Harmless	conformance with the pre-CLRDP certification agricultural hold harmless and indemnity restrictions that apply to the MSC, to indemnify and hold harmless the owners, lessees, and operators of the property from liability and costs resulting from the effect of normal and necessary farm operations upon the MSC and its employees, students, agents, and invitees. **Also see IM 3.8.1**					projects.
IM 3.9.1 Construction Monitoring—Archaeological/ Paleontological Resources	Should archaeological and/or paleontological resources be encountered during any construction on the Marine Science Campus, all activity that could damage or destroy these resources shall be temporarily suspended until qualified archaeologist/paleontologists and Native American representatives have examined the site and mitigation measures have been developed that address and proportionately offset the impacts of the project on archaeological and/or paleontological resources. Development shall incorporate measures to address issues and impacts identified through any archaeologist/paleontologist and/or Native American consultation.	**X**	**X**	**X**	**X**	This requirement is part of the Campus' standard construction contract template and would be included in the construction contract documents. This measure would be included in the MMP for each project.
IM 3.10.1 Hazardous Materials Management	The University, through the Office of Environmental Health and Safety, shall manage the use, and in the event of spillage the containment and cleanup of, hazardous materials and petroleum on the UCSC Marine Science Campus in compliance with federal and state regulations related to the storage, disposal, and transportation of hazardous substances.	**X**				The Campus has hazardous materials safety procedures in place to address these requirements that are applicable to all construction and operations and are monitored through licensing requirements and oversight by Campus EH&S. This measure would be included in the MMP for each project.
IM 3.11.1	Sustainable design, technology and construction practices shall	**X**	**X**	**X**		The primary axis of the CBB is oriented east-

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
Energy Efficiency in New Construction	be incorporated into, and sustainably produced materials shall be used in the construction of new facilities as feasible.					west to allow for the greatest exposure of each building's façade to natural light, minimize solar heat gain, and reduce the need for artificial lighting. Operable windows would be provided in office spaces, and pervious pavement used in parking lots and pedestrian and bicycle paths. Exterior lighting will be provided only as needed for safety. Indoor lighting will be controlled by occupancy sensors.
Policy 3.13 Natural Resource Protection Analysis Required	For new development that may significantly affect natural resources, individually or cumulatively, the Project Report and other supporting information identified in Chapter 8 shall describe the manner in which the proposed development is consistent with and implements the natural resource protection provisions of this CLRDP, including those in Section 5.3 (Natural Resource Protection), Chapter 9 (Capital Improvement Program), and Appendix A (Resource Management Plan). The Project Report supporting information shall also include a long-term program for monitoring potentially affected natural resources and for maintaining consistency with CLRDP standards.	**X**	**X**	**X**	**X**	Consistency of the proposed development with the natural resource protection provisions of the CLRDP is analyzed in this EIR (Sections 3.4, *Biological Resources*, and 3.9, *Hydrology and Water Quality*). The Campus will prepare a water quality monitoring program for the project as specified in the Drainage Concept Plan. Results of the monitoring would be included in the annual water quality report prepared by the Campus to comply with CLRDP reporting requirements. This measure would be included in the MMP for each project.
IM 3.14.1 Natural Areas Protection	Within two years of CLRDP certification, all MSC natural areas (i.e. all areas outside of the four designated development zones, except for Younger Lagoon Reserve) shall be incorporated into the University of California Natural Reserve		**X**			All of the natural areas outside of the four designated development zones were incorporated into the YLR in 2009, in compliance with this requirement. Proposed

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	System as an integral part of Younger Lagoon Reserve. Within two years and six months of CLRDP certification, the University shall submit to the Coastal Commission an amendment to the CLRDP to update it with respect to the revised configuration of Younger Lagoon Reserve and the natural areas. In addition, if any area within the four designated development zones as they are configured at the time of CLRDP certification is subsequently excluded from the designated development zones in the future (pursuant to Implementation Measures 3.3.1, 3.3.2, 3.4.4, and 3.4.5), then such area shall likewise be incorporated into Younger Lagoon Reserve within the same time frames and pursuant to the same parameters identified above with respect to the initial Reserve incorporation, but timed from the date that the required CLRDP amendment (required pursuant to Implementation Measures 3.3.2 and 3.4.5) is certified by the Coastal Commission.					CLRDP Amendment #1 would amend the CLRDP to indicate that all areas outside of development zones, including new areas excluded from development as a result of the updated wetland delineation (reported in Section 3.4 of this EIR), are now part of the YLR. The size of Development Subarea 1, where the proposed MSCI Project would develop the Upper Terrace Storage Yard, has been reduced by the new wetland delineation, and the portion of the former development area that is now included in the wetland W2/W3 buffers has been incorporated in the YLR.
IM 4.1.1 Location of Development	The Campus shall cluster development on the Marine Science Campus as shown in Figures 5.2 and 5.4 so as to leave ample open space that protects identified public views, including identified public view corridors.	**X**	**X**			Siting of the CBB, greenhouses, support space, and generator yard are consistent with the CLRDP land-use plan, which takes into account public views. Clustering of the proposed development is discussed under IM 2.3.1, above. As analyzed in Section 3.1, *Aesthetics*, the projects would not have significant impacts on scenic resources.
IM 4.2.1 Design Standards and	Decisions on siting, materials, height, clustering, and other aspects of project design shall be consistent with Chapter 5 and Chapter 6 and shall be guided by the Illustrative Campus	**X**	**X**	**X**		Siting of the proposed development is consistent with the CLRDP land-use plan. UCSC has provided design consultants with

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
Illustrative Campus Buildout Site Plan	Buildout Site Plan and the preliminary parameters for selected projects in Chapter 7. With respect to the development of the public overlooks, such overlooks shall be sited and designed consistent with the preliminary parameters identified in Chapter 7 unless alternative siting and design would result in both better public overlook value and better coastal resource protection.					the applicable design guidelines and checks for project consistency at all stages of project design. Description of the proposed building materials and their consistency with the CLRDP design guidelines are provided in Section 3.1, *Aesthetics*. Preliminary parameters for selected projects in Chapter 7 are not applicable to the proposed development.
IM 4.2.2 Alteration of Natural Landforms	Development shall be sited and designed to minimize the alteration of natural landforms.	**X**	**X**	**X**		The proposed development is sited on level land; the alteration of natural landforms would be limited to the construction of drainage swales and detention ponds, which would be consistent with the guidelines in the Drainage Concept Plan.
IM 4.2.3 Building and Other Structure Height	Buildings on the Marine Science Campus shall be no more than two stories tall and shall be no higher, as measured from natural grade to the top of the roof, than the maximum height limits specified in Figure 5.4, except that laboratory buildings located within the Middle Terrace development zone may be as high as 36 feet above natural grade subject to Implementation Measure 4.2.4, and the Phase II wing of the Ocean Health building may be up to 36 feet in height. Except for temporary structures, flat roofs shall be prohibited. Mechanical equipment and any associated screening structures that extend above the roof shall be limited to the maximum extent feasible in height and bulk. Screening structures (or portions thereof) shall only	**X**	**X**			Consistent with this implementation measure, the proposed CBB would be two stories and would have a sloping roof, except for a small area that would be flat to accommodate a vegetated roof. The roof line would be 36 feet above natural grade. Two exhaust stacks would extend 5 feet above the top of the roof line. The proposed greenhouse complex buildings and the regulated waste storage facility in Subarea 2 Utility Yard, which are near the perimeters of development zones, would be one story.

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	be used where such structures will provide better public viewshed protection than leaving such equipment unscreened. If it is not feasible to keep such equipment and/or structures below the maximum height (e.g., by reducing their number and/or size, by locating at a lower elevation than the roof peaks, by reducing building heights, etc.), then such equipment and structures shall not exceed maximum height limits by more than 5 feet, their aggregated length shall not exceed 25 percent of the length of the building's ridgeline, and their aggregated horizontal footprint shall not exceed 25 percent of the area of the aggregate horizontal footprint of the roof. Those portions of buildings that are located nearest the perimeter of the development zones shall be stepped down in height relative to the building to avoid uniform massing at the maximum height limits on the perimeter of development zones (see also Chapter 6). All other (i.e., non-building) structures shall be no higher as measured from natural grade to the topmost element than the maximum height limits specified in Figure 5.4.					
IM 4.2.4 Laboratory Buildings	Laboratory buildings located within the area limited to 30-foot heights may be as high as 36 feet above natural grade if it is not feasible to meet the 30-foot height limit due to the vertical clearance necessary for specialized laboratory requirements (for mechanical systems, ductwork, etc.).	**X**				The CBB would be 36 feet tall; exhaust stacks may extend an additional 5 feet upward.
IM 4.2.5 Maximum building GSF	Individual new buildings shall not exceed 20,000 gross square feet in the Lower Terrace development zone, shall not exceed 37,500 gross square feet in the Upper Terrace development zone, and shall not exceed 40,000 gross square feet in the	**X**	**X**			Consistent with this IM, the CBB would be 40,000 gsf; the greenhouse complex would include five greenhouses at 500 sf each, one 1,200-sf greenhouse, and a 3,900-sf research

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	Middle Terrace development zone.					facility.
IM 4.2.7 Construction Materials	Stained vertical wood siding, roughcast concrete, high-quality shingle roofing, and other materials with compatible appearances (e.g., stone, wood, cor-ten steel, etc.) shall be used for the exterior of all buildings and other structures to ensure design compatibility among all buildings on the Marine Science Campus.	**X**				The CBB would be clad in vertical board and batten wood or wood-like siding and shingle roofing, and may have an exposed concrete surface at the base.
IM 4.2.8 Building Setbacks	New buildings on the Marine Science Campus shall be located no closer than 15 feet from campus streets and no closer than 20 feet from the pavement edge of Shaffer Road, as improved per Implementation Measure 5.1.3.	**X**	**X**			The CBB would be set back 15 feet from McAllister Way. The greenhouses would be more than 100 feet from McAllister Way. The regulated waste storage facility would be approx-imately 40 feet from the new campus road.
IM 4.2.9 Building Length Limitations	New building sections constructed on the Marine Science Campus shall not exceed 175 feet in continuous building length adjacent to a street or parking area.	**X**	**X**			The CBB section facing McAllister Way would be 137 feet long; the section facing the new parking area to the south would be 110 feet long.
IM 4.2.10 Placement of Utility Lines Underground	All utility lines on the Marine Science Campus shall be located underground.	**X**	**X**			All proposed utility lines would be underground.
IM 4.2.11 Windbreak/Screening Trees	The windbreak/screening trees required by this CLRDP in connection with new development in the terrace portion of the site (see Section 6.5 and Figure 6.6) shall be sited to screen development from public view without interfering with that	**X**	**X**			Tall shrubs would be planted as windbreaks along the east side of the CBB site as specified in Section 6.5 and as shown on Figure 6.6 of the CLRDP. As noted above,

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	portion of the public view not encumbered by development (e.g., maintaining ocean/horizon views over and around buildings).					proposed CLRDP Amendment #1 would revise the CLRDP requirement for screening trees to instead specify tall shrubs, as recommended by the SAC.
IM 4.2.12 Development in Northernmost Portion of Middle Terrace	Development in Northernmost Portion of Middle Terrace. Development in that portion of the Middle Terrace development zone that is located in development Subarea #2, as identified in Figure 5.4, shall be sited and designed to minimize impacts to public views as seen from public trail segment PT13, as identified in Figure 9.1.		**X**			As shown in the visual simulations in Section 3.1, *Aesthetics*, the proposed development in Subarea #2 is limited to a generator yard, which has a low profile and would not significantly impact public views as seen from public trail segment PT13.
IM 4.2.15 Building Development West of McAllister Way in Middle Terrace	Development in Subarea #6 shall be limited to uses that would benefit from a more isolated location, and development in Subarea #7 shall be limited to extension of the pre-CLRDP certification earthen berm, overlook improvements, natural drainage system components, fencing, and/or landscaping.	**X**				The greenhouses and greenhouse support space proposed for Subarea #6, and drainage improvements and fencing/landscaping in Subarea #7 are consistent with this measure.
IM 4.2.16 Building Development Outside of Subareas Prohibited	Building development located outside of the subareas shown in Figure 5.4 shall be prohibited. Development located outside of subareas and inside of development zones shall be limited to at-grade development (e.g., streets, parking areas, etc.), unless it is an above-grade development explicitly identified as appropriate in this CLRDP (e.g. an earthen berm extension), where any associated above-grade development and structures (e.g., fencing, light standards, etc.), shall not exceed the scale, including the height, established for such development and structures in the CLRDP.	**X**	**X**	**X**		The proposed CBB, greenhouses and greenhouse support space would be within Subareas #4 and #6. Development outside the subareas and inside of the development zones would include streets, parking areas, and pathways, which would be consistent with this measure.

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Measure	**Description**	**Project Applicability**				**Project Consistency/Implementation**
		CBB	**MSCI**	**NEF**	**SRP 1B**	
IM 4.3.1 Visual Intrusion into YLR	Development adjacent to YLR shall be sited and designed so that activity and direct light will not be visible from within YLR.	**X**				Potential visibility of human activity and light in YLR is analyzed in this EIR in Section 3.4, *Biological Resources*. The EIR identifies CBB Mitigation BIO-11, which would ensure that light from the new greenhouses does not spill over into Younger Lagoon. Proposed CLRDP Amendment #1 would clarify that the reference to YLR in this and other measures is intended to refer to the original YLR, and not necessarily to the YLR terrace lands that were added to the YLR during the final CLRDP approval process. It would not be possible to develop the terrace lands in such a way that no light and activity are visible in the YLR terrace lands, which are immediately adjacent to approved development boundaries.
IM 4.3.2 Visual Intrusion into Terrace ESHA and Other Areas Outside of Development Zones	Development shall be sited and designed so that activity and direct light that may be visible from outside of development zones is minimized to the maximum degree feasible, and so that any activity and/or direct light that is unavoidably visible is minimized in its intensity. In determining the measures needed to minimize visual intrusion to the maximum extent feasible, the University shall consult with the manager of YLR and the California Department of Fish and Game.	**X**	**X**			Potential visibility of human activity and light in Younger Lagoon and the Terrace ESHA are analyzed in this EIR in Section 3.4, *Biological Resources*. The EIR identifies CBB Mitigation BIO-11, which requires that the greenhouses include screening to ensure that light does not spill over into Younger Lagoon. The CBB laboratory building, parking lots and roadways include design elements and lighting intended to minimize light spill and the visibility of activity, including shielded lighting, non-reflective surfaces, and

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
						screening with vegetation and earthen berms where feasible and appropriate. This implementation measure would be included in the MMP for the CBB and MSCI projects.
IM 4.3.3 All Lighting	Lighting on the MSC shall be provided at the lowest footcandle levels necessary to achieve safety and efficient navigation.	**X**	**X**			Lighting for the proposed projects is analyzed in this EIR in Section 3.1, *Aesthetics*. Consistent with this implementation measure, lighting would be provided only as necessary for safety and navigation. This measure would be included in the MMP for the CBB and MSCI projects.
IM 4.3.4 Building Lighting	Exterior lighting shall be located only at building entries and usable interior courtyards. No other exterior lighting of buildings, such as façade or accent lighting, shall be allowed, except where necessary for safety. Interior lighting shall be located so as to minimize the potential for light and glare to be visible from within Resource Protection, Resource Protection Buffer, and Wildlife Corridor areas and be consistent with the Uniform Building Code.	**X**	**X**			Lighting for the proposed projects is described in this EIR in Section 3.1, *Aesthetics*. Consistent with this implementation measure, exterior building lighting would be located only at building entries and courtyards. Potential visibility of human activity and light in YLR is analyzed in Section 3.4, *Biological Resources*. The EIR identifies CBB Mitigation BIO-11, which would ensure that light from the new greenhouses does not spill over into Younger Lagoon. The CBB laboratory building is sited at a sufficient distance that light, even from second story windows, would not spill into the younger lagoon area This measure would be included in the MMP for the CBB and MSCI projects.

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
IM 4.3.5 Street and Trail Lighting	Streets on the Marine Science Campus may only be lighted within the development zones of the campus. Trails shall be lighted only to the extent needed for safety. Only low-intensity lights attached to low-height, wood bollards (i.e., up to 36" maximum height) shall be used for trail lighting, and all trail lighting shall be downward directed.		**X**			The new main road from the campus entrance to the Seymour Center parking lot would be lighted by low bollard-type lighting along the McAllister sidewalk. This lighting would be augmented by taller cut-off shielded lighting only at entrances to parking lots, building entries, and at pedestrian crossings. Parking Lot A would not be used at night and would not be lighted. Other proposed pedestrian and bicycle trails, including the main entry multi-use trail, would not include lighting except as needed for safety, such as at vehicle road and parking lot driveway crossings and intersections of pedestrian paths with the multi-use trail route. This measure would be included in the MMP for the CBB and MSCI projects.
IM 4.3.6 Parking lot and Maintenance yard Lighting	Lighting in parking lots and maintenance yards shall be the lowest lighting intensity levels necessary to provide safety and security. All parking lot and maintenance yard lighting shall be full cut-off type lighting and shall be downward directed. Pole mounted lighting shall be limited to the degree feasible (in number, height, and bulk) and shall not exceed 12 feet in height.	**X**	**X**			The project would construct three parking lots. The coastal access parking at the campus entrance (Parking Lot A) would not include lighting, as its use is limited to daylight hours? Lighting in parking lots B and C would be full cut-off lighting and would pole mounted. This measure would be included in the MMP for the CBB and MSCI projects.
IM 4.3.7 Sign lighting	Sign lighting on campus shall be limited to signs identifying important destinations, restricted areas, and/or dangerous	**X**	**X**	**X**		The project includes sign lighting at the campus entrance and at the CBB Building.

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	terrain. All sign lighting shall be the minimum necessary to achieve design objectives. No backlighting of signs or use of neon shall be allowed.					This measure would be included in the MMP for the CBB and MSCI projects.
IM 4.3.8 Lighting Plan Required	New development that includes lighting shall be authorized by the University only if it includes a lighting plan that details the manner in which the development individually and/or cumulatively is consistent with and implements the lighting parameters of this CLRDP, including Policy 4.3 and its implementing measures, and including long-term lighting system monitoring and maintenance.	**X**	**X**	**X**		A detailed lighting plan for the projects would be prepared during the detailed design process. EIR Figure 2-5 illustrates the proposed locations of signage and lighting, consistent with this measure. This measure would be included in the MMP for the CBB and MSCI projects.
Policy 5.1 Adequate Vehicular Access.	Roadways on the campus will provide adequate site access for regular users and visitors, while minimizing impacts on the natural environment.		**X**			The MSCI Project would develop a new main entry road and a central bicycle/ pedestrian route into the campus to improve campus access for pedestrians and bicycles as well as motor vehicle circulation. These are sited to avoid sensitive natural areas, and would include features to treat and infiltrate storm water.
IM 5.1.1 New Circulation System	The University shall construct a new circulation system for the Marine Science Campus as shown in Figure 5.5.		**X**			As required by this IM, the project would abandon Delaware Avenue Extension and construct a new campus street to replace the abandoned road, and would improve the Shaffer/Delaware Ave. intersection. Proposed CLRDP Amendment #1 would revise CLRDP Figure 5.5 to reflect updated campus planning for improved roadway alignment and function. The alignment of the new campus

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
						entry roadway and associated minor roadways would differ from the alignments shown on CLRDP Figure 5.5, but would accomplish the goal of removing the main entry road from the wetland buffer, and would be consistent with other CLRDP requirements with respect to avoidance of protected areas.
IM 5.1.2 Improve Shaffer Road/ Delaware Ave intersection	The Shaffer Road/Delaware Avenue intersection, at the entrance to the campus, shall be improved in conjunction with other road and development activities, in order to improve the functioning of this intersection (for vehicles, pedestrians, and bicyclists) and its safety.		**X**			The project includes improvements to the Shaffer Road/Delaware Avenue intersection, including relocation of above ground utilities; signage; lighting; and integration with existing and new pedestrian and bicycle routes.
IM 5.1.3 Shaffer Road Improvements	The University shall cooperate with the City of Santa Cruz to evaluate the permanent closure of Shaffer Road between the Upper Terrace development zone and the railroad tracks and conversion of the closed road section into an integral part of the wildlife corridor and its buffer located along the northern portion of the Marine Science Campus. Adjacent to the Marine Science Campus, those sections of Shaffer Road to remain open may be improved the minimum extent necessary to provide access to development authorized in the Upper Terrace development zone.		**X**			According to the terms of the 2008 Comprehensive Settlement Agreement: 1) Campus will pay 100% of the cost of improvements to the MSC entrance at the intersection of Shaffer Road and Delaware Avenue, as well as improvements to Shaffer Road on University property up to the new driveway to Upper Terrace development zone when development occurs in that zone; and 2) As identified in the CLRDP, UCSC will collaborate with the City of Santa Cruz on the construction of an emergency grade crossing over the tracks at such time as the City elects to pursue this project.
IM 5.1.4	The University shall construct adequate passage (e.g., bridge,		**X**			The driveway entrance to the MSCI Project

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
Access for Wildlife Across Shaffer Road (Upper Wildlife Corridor)	underpass, box culverts, etc.) across Shaffer Road north of the Upper Terrace development zone that is specially designed to facilitate wildlife movement, potentially including abandonment of the paved roadway section and reconfiguration of the road area as a habitat corridor. The driveway entrance into the Upper Terrace development zone shall be located in the center of the zone (e.g., as shown on Figure 7.2) so as to avoid the designated wildlife corridor and buffer areas that will be established both to the north and south of the development zone. For work undertaken by the University off its property, the University shall actively pursue and obtain all necessary permissions from any owner of land on which construction will occur. The University shall consult with the United States Fish and Wildlife Service during the design of the Shaffer Road wildlife passage.					Upper Terrace Storage Yard would be located in the center of the development area (EIR Figure 2-3a), and avoids the wildlife corridor and buffer areas. The Campus has initiated consultation with CDFG and USFWS about the proposed Projects, including potential wildlife passage features across Shaffer road north and south of the entrance to the Storage Yard and will construct such features as part of the MSCI project is considered advisable by these agencies.
IM 5.1.6 Use of Former Access Road	The existing (at the time of CLRDP certification) portion of McAllister Way/Delaware Avenue Extension between Shaffer Road and the California Department of Fish and Game facility, shall be abandoned as a campus street and restored as a public trail and habitat buffer area (i.e., the majority of the existing pavement shall be removed in this area except for a curvilinear portion of it that will remain to become a public access pathway; the roadbed fill elevation shall be retained to maintain terrace wetland hydrology; and the disturbed areas shall be replanted with appropriate wetland and wetland buffer plant species). The University shall consult with the U.S. Fish and Wildlife Service and the Executive Director at the time of proposed restoration to evaluate management measures to		**X**			As required by this implementation measure, the project includes abandonment of Delaware Avenue Extension and its restoration as a public trail and habitat buffer area. The Campus has provided USFWS and CDFG with project description, the project biological resources technical report, and a summary of biological resources impact assessment and proposed mitigation measures for the project. It is anticipated that this work and other project elements will be subject to a Clean Water Act Section 404 permitting by the US Army Corps of Engineers, and that formal

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	protect California red-legged frog, such as a prohibition on bicycle use of the trail or construction of safe passage corridors.					consultation with USFWS on CRLF impacts and mitigation measures will be conducted by the Army Corps in this context.
Policy 5.2 Travel Mode Split	The University shall pursue a goal of having at least 40 percent of all person-trips to the Marine Science Campus made using alternatives to the single-occupant automobile.	**X**		X		
IM 5.2.1 Encourage Alternatives to the Single-Occupant Vehicle	The University shall enforce policies and implement measures to encourage alternatives to the single-occupant automobile.	**X**				Section 3.15 of this EIR details TDM measures that currently are implemented by TAPS for all UCSC facilities toward the achievement of this goal, and also identifies mitigation measures to encourage alternatives to the use of single-occupant vehicles at the campus.
IM 5.2.2 Alternatives to the Single-Occupant Vehicle	As part of each development project, the University shall clearly identify the methods to be used to encourage non-single-occupancy vehicle trips for that development in order to meet CLRDP circulation and parking requirements individually and cumulatively.	**X**				Secure bicycle storage and showers for bicycle commuters would be provided at the CBB. The CBB and greenhouses would be served by new pedestrian and bicycle trails.
IM 5.3.2 Public Coastal Access Parking.	Public coastal access parking spaces shall be available on a free or low-cost (see Implementation Measure 5.3.8), first-come, first-serve basis during daylight hours (i.e. one-hour before sunrise to one hour after sunset) for the exclusive use of general public-access visitors to the site and not for use by any others, including not for use by: (a) University or Campus affiliate staff, researchers, students, or their visitors; (b) Campus residents or their visitors; and/or (c) visitors to University or	**X**		**X**		The proposed CBB Project includes a parking lots with five designated coastal access visitor parking spaces and the NEF Project includes a 15-space coastal access visitor lot. These parking spaces will be reserved for and available to visitors as specified in the IM.

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		CBB	MSCI	NEF	SRP 1B	
	Campus affiliate facilities. Public coastal access parking spaces may be time limited, provided such time limits are not for less than a three-hour length of stay; overnight parking in these spaces shall be prohibited. During non-State holiday weekdays between 8:00 am and 5:00 pm only, the Campus may use permits, meters, or other similar methods for managing such public coastal access parking spaces (except for public coastal access parking spaces in the MSC Entrance development zone where such parking shall be provided without such encumbrances) provided such methods are easily understood and followed (including that points of acquisition for any required placards, permits, meter slugs, etc. are conveniently located and operated with respect to public access visitors) and provided such methods provide an easy means of allowing parking space users who arrived prior to 8:00 am to continue to park in the public coastal access parking spaces without being penalized for early arrival. All public coastal access parking spaces are to be provided pursuant to the timing identified in Figure 9.4.					
IM 5.3.3 Campus Entrance Public Coastal Parking	A minimum of 15 public coastal access parking spaces shall be provided adjacent to the intersection of Shaffer Road and Delaware Avenue in the Campus Entrance development zone.			**X**		The NEF project would construct a 15-space public coastal access parking lot adjacent to the campus entrance (Figure 2.3a)
IM 5.3.4 Middle Terrace Public Coastal	A minimum of five public coastal access parking spaces shall be provided: (1) in that portion of Subarea 9 (Figure 5.4) that is adjacent to any Campus support facilities in Subarea 9 and that	**X**				Five spaces in CBB Project Parking Lot D would be designated for public coastal access.

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		CBB	MSCI	NEF	SRP 1B	
Access Parking	provides the easiest and most direct access to the public trails extending outside of the Middle Terrace development zone; or (2) in a location that provides the easiest and most direct access to Overlook E (Figure 9.1) and the public trail connection to Overlook E.					
IM 5.3.5 Lower Terrace Dual Use Parking (Public Coastal Access Parking and Discovery Center Parking)	A minimum of 40 parking spaces in the Lower Terrace Development Zone shall be available and reserved exclusively for public coastal access parking and for parking by visitors to the Seymour Marine Discovery Center.					This measure is not applicable to any of the proposed projects, but its implementation will affect the availability of parking on campus, as discussed in the analysis of Transportation and Traffic, Section 3.15 of this EIR, and contributes to the need for proposed CLRDP Amendment #1, Action 11.
IM 5.3.6 Lower Terrace Public Coastal Access Parking	A minimum of ten public coastal access parking spaces shall be provided in the Lower Terrace Development Zone in a location that provides the easiest and most direct access to public coastal access a [(e.g., in the parking bay along the east side of McAllister Way opposite the Ocean Health Building).					This measure is not applicable to any of the proposed projects, but its implementation will affect the availability of parking on campus, as discussed in the analysis of Transportation and Traffic, Section 3.15 of this EIR, and contributes to the need for proposed CLRDP Amendment #1, Action 11.
IM 5.3.7 Parking Demand Satisfied on Campus	All parking demand shall be satisfied on campus, and new development shall include adequate and enforceable measures to ensure that all parking demand is satisfied on campus.	**X**	**X**			As discussed in Sections 3.10 and 3.15 of this EIR, it is anticipated that, with implementation of the MSCI Project, which would remove some campus parking, and designation of 70 parking spaces for visitors only (as required by CLRDP IMs 5.3.3, 5.3.4, 5.3.5, and 5.3.6), parking demand by MSC

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						affiliates could exceed campus parking supply, even though the CBB and NEF projects would construct three additional parking lots. Proposed CLRDP Amendment #1 would revise IM 5.3.7 to allow some campus parking off-campus, while also preserving the intent of the IM, which is to ensure that sufficient street parking is preserved near the campus for public parking for coastal access. This would be accomplished though monitoring of parking and implementation of additional TDM measures to reduce parking demand as needed. The proposed measures are detailed in Section 3.15.
IM 5.4.1 Development of New Parking	New parking shall be developed as demand warrants up to a maximum of 795 spaces campuswide. No new parking spaces shall be developed until existing parking spaces in a given development zone are greater than or equal to 90 percent utilized (on average). The parking supply requirements of Policy 5.3 and its implementation measures shall be satisfied pursuant to the timing identified in Figure 9.4.	**X**	**X**			The proposed project would bring the total number of parking spaces on the campus to 267. The project would construct the five dedicated public coastal access parking spaces in the Middle Terrace development zone and the MSC public coastal access parking lot. As a separate project, the campus has submitted a NOID to the CCC for implementation of a parking permit program as identified in Figure 9.4.
IM 5.4.3 Distribution &	Parking shall be distributed among the four development zones as necessary to meet facility demand within each zone. Parking	**X**	**X**			The proposed Projects would add 115 parking spaces to the Middle Terrace development

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		CBB	MSCI	NEF	SRP 1B	
Intensity of Parking	areas shall be designed to provide small, discrete parking areas.					zone, in two lots, one adjacent to the proposed CBB laboratory building and one adjacent to the proposed greenhouses. It also would remove about 48 spaces along McAllister Way in the area between the Lower and Middle Terrace development zones. The NEF Project would add one small coastal access parking lot on the Upper Terrace.
IM 5.5.2 Public Coastal Access Parking	Dedicated parking for public coastal access shall be clustered close to coastal access points (see also Policy 5.3 and its implementation measures and Figure 5.5), and clear signage and related measures (e.g., stencils, etc.) shall be provided to indicate that each such public coastal access parking space is for public coastal access parking only.	**X**	**X**			The project would provide 15 public coastal access spaces at the campus entrance, which is close to the head of several trails. The parking design includes the features specified in the IM.
IM 5.6.1 Sheltered and Secure Bike Parking	Sheltered and secured bicycle storage facilities within buildings and/or within ancillary facilities associated with buildings shall be provided for all employees that bicycle to work and that use that building. Buildings and related facilities shall be designed and constructed to provide for an amount of sheltered and secured bicycle storage space adequate to accommodate the estimated number of bicyclist employees, and shall include adequate expansion space and provisions to accommodate any increased demand for such secure employee bicycle storage (up to and including the number of employees for any particular building). Each such secure bicycle storage parking space shall be accessible without moving another bicycle, may be configured	**X**				The proposed CBB Project includes sheltered secure covered bicycle storage for about 27 bicycles, with space reserved to provide a total of up to 96 bicycle storage spaces, as warranted by demand (up to one space for each employee of the facility).

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	vertically (e.g., with hooks for hanging bicycles), and shall include adequate space to allow room for maneuvering.					
IM 5.6.2 Bike Parking Outside Buildings	Secure bicycle racks shall be provided that are conveniently located near the entrances to all buildings on the UCSC Marine Science Campus. Such racks shall be provided at a ratio of at least one bicycle parking space for every ten building users (where all fractions of bicycle parking spaces are rounded to the next highest whole number). Each bicycle parking space shall be accessible without moving another bicycle (i.e., generally allow for 2 feet by 6 feet for each bicycle parking space), and shall include adequate space to allow room for maneuvering (i.e., an aisle at least 5 feet wide behind all bicycle parking spaces).	**X**				Secure bicycle racks for about 40 bicycles also would be provided at various locations around the facility and additional bicycle racks would be added as warranted by demand during the occupancy of the facility.
IM 5.6.3 Personal Lockers and Showers	Lockers and showers shall be provided in conjunction with new building development, in convenient locations for regular users (i.e., not the general public) of the building who choose to bike or walk to the Marine Science Campus. Lockers shall be provided at a ratio of one locker for every twenty building users, and showers shall be provided at a ratio of one shower for every fifty building users (where all fractions of lockers and/or showers are rounded to the next highest whole number). The University may provide the required number of lockers and showers in individual buildings based upon the number of users of each such building, or may provide them in a centralized location or locations within each development zone provided the same ratio of lockers and showers is provided overall within each development zone and are conveniently located for	**X**				Two bicycle showers would be provided in the CBB and CBB occupants would also have access to a third shower in the nearby CDFG facility.

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	users.					
IM 5.6.5 Crosswalk Design	Pedestrian and multi-use trail crossings shall be designed and constructed with crosswalks and signage that ensure public safety, trail continuity, and site aesthetics (e.g., this includes locating crosswalks at intersections or parking area entrances and the use of raised crosswalks, pressed asphalt pavement with integrated color to differentiate pedestrian crossings from other pavement treatments, low-intensity pavement-integrated lights, striping, different materials, combinations of all of these, etc.). Crossings shall be designed to maintain safety and trail continuity in a manner that is also consistent with CLRDP design guidelines.	**X**	**X**	**X**		The pedestrian crossings included in the CBB, MSCI and NEF projects have been designed to meet the specifications of the IM and would include low bollard lighting as needed for safety.
IM 5.6.6 Siting Buildings for Ease of Access	Buildings shall be located in a manner to be easily and conveniently accessible to one another; to paths and roadways; and especially to bus and shuttle stops. Siting shall occur in a manner that promotes pleasing and convenient pedestrian access throughout the MSC.	**X**	**X**			The proposed CBB would be located adjacent to McAllister Way and the sidewalk along that roadway. The new bicycle trail would pass by the eastern edge of the building site.
IM 5.7.2 Expansion of TAPS Shuttle Services.	The University shall provide shuttle service connecting the UCSC Marine Science Campus to the UCSC Main Campus as demand warrants and as necessary to meet the CLRDP's 40 percent travel-mode split goal. Shuttles shall be scheduled to correspond with classes, and class schedules will be developed in coordination with TAPS to minimize operational demands.	**X**				Section 3.15 of this EIR identifies a mitigation measure under which shuttle service would be expanded, as required, if warranted by demand, based on monitoring of parking demand associated with the CBB Project.
IM 5.7.3 Physical	As part of the development of the Marine Science Campus circulation system, paved areas for bus turnarounds and		**X**			Near the entry to the CDFG parking lot, the new entry road described below would rejoin

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
Infrastructure for Transit	covered transit stops for bus and shuttle riders shall be developed at logical locations throughout the Marine Science Campus concurrent with the construction of new roadways, sidewalks, and related circulation improvements in a manner that is consistent with CLRDP design guidelines.					the existing road route. At this point, the pedestrian path would cross the new CDFG driveway to connect with a proposed new sidewalk to be installed along McAllister Way (described below). As required by IM 5.6.5 to ensure public safety and trail continuity, a crosswalk and signage will be provided at the point where the pedestrian trail crosses the CDFG driveway. The pedestrian path would then continue along the east side of the CDFG building to the building's main entry. At this point, another crosswalk across the new entry road would join the pedestrian path to a new sidewalk along the east side of McAllister Way.
Policy 5.8 TDM Coordination	The Campus shall coordinate ridesharing to and from the Marine Science Campus and promote all available forms of alternative transportation to site users and visitors.	**X**		**X**		Section 3.15 of this EIR identifies mitigation measures under which TAPS would ensure that MSC-affiliates are informed of campus TDM programs, including programs promoting ridesharing, transit and other alternative transportation modes.
IM 5.8.2 TDM Coordination	The University shall implement and provide ongoing coordination of a TDM program. TAPS will be responsible for all aspects of transportation management on the UCSC Marine Science Campus, including: parking permit issuance, organization of carpools and vanpools, special event access planning, and enforcement of parking regulations. TAPS and	**X**		**X**		Section 3.15 of this EIR identifies mitigation measures under which TAPS would ensure that MSC-affiliates are informed of campus TDM programs, including proposed parking management.

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	the University shall be prohibited from enforcing and/or managing parking and transportation inconsistent with the provisions of this CLRDP.					
IM 5.8.3 TDM Coordination	TDM Coordination. The University shall widely disseminate transportation information to visitors, staff, faculty and students at the Marine Science Campus through the UCSC Web page. Printed information shall also be made available at central locations on the Marine Science Campus, and new users of the site shall be given an introductory package of information as part of their orientation to the site. All such TDM and other transportation materials shall include clear description of the CLRDP provisions of Section 5.5, including the travel-mode split requirements for the Campus; available shuttle, SCMTD bus, and other alternative transportation programs (including schedules, costs, etc.); availability of secured bicycle storage facilities within buildings for employees; availability of lockers and showers; Campus maps with appropriate facilities identified; etc.	**X**		**X**		Section 3.15 of this EIR identifies mitigation measures under which TAPS would ensure that MSC-affiliates are informed of campus TDM programs, including proposed parking management.
Policy 5.9 Impacts Offset	New development shall include the payment of fair-share fees and/or commitment to construct necessary transportation upgrades attributable to the development's impact on City transportation infrastructure. The City of Santa Cruz shall be consulted regarding any fair-share fees and/or transportation infrastructure upgrades.	**X**				The Campus would pay its fair share of necessary transportation upgrades as specified in the 2008 Comprehensive Settlement Agreement. Mitigation measures are identified in Section 3.5 of this EIR, under which the University's fair share payment would be implemented and monitored.
Policy 5.10 Circulation and	New development shall be evaluated with respect to individual and cumulative parking and circulation supply and demand	**X**	**X**	**X**		Parking and circulation for the proposed projects is described in Section 2.0 and

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
Parking Plan Required	relative to the MSC and immediately surrounding areas in a circulation and parking plan, and shall be required to provide adequate parking and circulation improvements to meet the provisions of this CLRDP. New development shall be authorized by the University only if the circulation and parking plan details the manner in which the development individually and cumulatively is consistent with and implements the circulation and parking parameters of this CLRDP, including those in Section 5.5 (Circulation and Parking) and Chapter 9 (Capital Improvement Program), and including long-term monitoring, maintenance, and management of same.					analyzed in Section 3.15 of this EIR. As discussed above, proposed CLRDP Amendment #1 would revise parking IM 5.3.7 to allow some campus parking to be accommodated off campus, providing that it can be demonstrated that campus-related parking demand would not impede public parking in these areas for coastal access.
IM 6.1.2 Public Access Parking	The University shall construct, provide, and maintain parking spaces that are available to the public consistent with the provisions of Section 5.5, Circulation and Parking, to facilitate public coastal access to the MSC and the adjacent shoreline and coastal area.	**X**	**X**	**X**		The proposed project would construct 15 public coastal access parking spaces at the campus entrance. Five of the spaces in Parking Lot D also would be designated for visitor parking.
IM 6.1.3 Public Access Trails	The University shall construct, provide, and maintain a public pedestrian and bicycle trail system in the alignment depicted in Figure 5.6 to facilitate safe and passable public access within, along, and through the Marine Science Campus. All trails and associated facilities shall be clearly signed for public use. See Section 9.1.1 for details and timing.	**X**	**X**	**X**		The project would construct public pedestrian and bicycle trails throughout the campus. The proposed alignment differs from Figure 5.6, to minimize intrusion into the Resource Protection buffers, based on consultation with the manager of the YLR. Proposed CLRDP Amendment #1 includes revision of Figure 5.6 to reflect the trail system as now proposed and of the grouping of trail development set forth in Figure 9.1. These revisions would result in a public trail system that would provide the

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
						same level of public coastal access on approximately the same schedule as originally proposed.
IM 6.1.4 Public Access Overlooks	The University shall construct, provide, and maintain at least six overlooks to provide the public with visual access to natural resources on and adjacent to the Marine Science Campus such as Younger Lagoon Reserve and the ocean. The location of these overlooks shall be as specified in Figure 5.6, and the Campus shall be guided by the illustrations contained in Chapter 7 of this CLRDP as it designs the overlooks. See Section 9.1.2 for timing.		**X**	**X**		Construction of Overlooks B and F is triggered by construction of the CBB. The Campus will construct these as a separate project that was approved by the University in February 2011. The MSC Projects include construction of Overlook G and a shelter at Overlook A. The design of these improvements would be consistent with the design guidelines in Chapter 7 of the CLRDP. Overlook G is not required by the CLRDP but would be similar to Overlook A, and would provide another visual access point for wetlands 4 and 5.
IM 6.1.7 Interpretive Information	Opportunities for interpretation of the activities occurring at the MSC shall be provided as appropriate. In addition to developed MSC programs, such opportunities shall include interpretive displays, signs, and facilities designed to be easily accessible at and adjacent to public use areas, such as access ways, trails, and overlooks.		**X**	**X**		The NEF and MSCI projects would include interpretive displays and signs.
IM 6.2.10 Public Access Signage	Signage and other media shall be used to provide visitors with information about coastal resources, identify the location of public trails, overlooks, parking, and other MSC access and recreation amenities, and warn of dangers in the environment. Signage shall also be provided to identify Controlled Access		**X**	**X**		The MSCI and NEF projects would provide signs at the trail heads and intersections, Overlook G, and at public access parking areas at the campus entrance and in Parking Lot D.

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	Trails, with information about supervised tours. Signs shall be located, at a minimum: at each trailhead (i.e., where visitors enter the Marine Science Campus); at each trail intersection with another trail or an overlook; at each overlook; at each public coastal access parking area; and at intervals along trails no more than 200 feet apart. Trail signs specifically shall be placed so as to be visible to trail users coming from either direction (e.g., back-to-back signs). Brochures or other media describing MSC public access amenities shall be consistent with all CLRDP provisions and shall be made available at convenient locations for visitors to the MSC (i.e., campus entrance at Delaware Avenue, Seymour Center, public coastal access parking areas, overlooks, etc.).					
IM 6.2.11 Off-Campus Trail Continuity	Public trails on the Marine Science Campus shall be designed to connect to and seamlessly integrate with trails that are located at the boundary of the MSC (see Figure 5.6). Such connecting trail locations at the MSC boundary include existing connections at Delaware Avenue and at the seaward end of De Anza Mobile Home Park, and future connections at the railroad tracks bordering the north of the MSC and to the up-coast Younger Ranch property bordering the west of the campus and Younger Lagoon Reserve should public access be provided and/or allowed on these adjacent properties.		**X**	**X**		The trails proposed under the MSCI and NEF projects would be interconnected, as shown on EIR Figure 2-3a. There currently are no existing trails in adjoining areas off site, but should such trails be developed in the future, connections with campus trails would be permitted.
IM 6.2.2 Public Trail Continuity	Public trails shall follow the alignments shown in Figure 5.6, with minor alignment adjustments as necessary to ensure trail continuity. Examples of situations where such minor adjustments may be necessary include: moving the trail inland		**X**	**X**		As shown on Figure 2.3a, the proposed trails generally follow the alignments shown in Figure 5.6 of the CLRDP, with adjustments to minimize intrusion into the resource

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	if erosion of the coastal bluff threatens the trail; adjusting the trail alignment if the final location of campus buildings and/or facilities dictates adjustment to enhance trail connectivity and use values; adjusting the trail alignment to avoid significant disruption to the habitat values of resource protection areas; and temporary detours in response to construction, temporary special events, etc.					protection buffers. Proposed CLRDP Amendment #1 would revise Figure 5.6 to show the new alignment.
IM 6.2.5 Access to Coastal Bluffs	The University shall provide access to the coastal blufftop edge through existing, enhanced, and new trails and overlooks as shown in Figure 5.6. Except for trails identified in Figure 5.6, the University shall limit access down the face of the bluff to the rocky intertidal area to authorized personnel trained to use rope ladders. The University may install and maintain bluff-top signs in this area warning of the danger of traversing the bluff face and of occupying the rocky intertidal area or surf below. The University may use a combination of devices to protect the coastal bluffs in this area from human intrusion (including fences, walls, berms, and vegetation), provided such devices are consistent with the provisions of this CLRDP. Trail and overlook construction covered by IMs 6.1.3 and 6.1.4, under G-CIP.			**X**		The trails included in the NEF Project provide access to the coastal blufftop (Figure 2.3a). Overlook F, on the coastal bluff, will be constructed as part of a separate, previously approved project.
Policy 6.3 Public Access and Recreation Plan Required	New development that affects public access and recreation shall be authorized by the University only if it includes a public access and recreation plan that clearly details the manner in which the development individually and/or cumulatively is consistent with and implements the public access and recreation parameters of this CLRDP, including those in	**X**	**X**	**X**		Consistency of the project with public access and recreation parameters of the CLRDP is analyzed in this EIR in Section 3.14, *Recreation*. The project would be consistent with these parameters.

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	Section 5.6 (Public Access and Recreation) and Chapter 9 (Capital Improvement Program), and including long-term monitoring, maintenance, and management of same.					
IM 7.1.1 Management of Storm Water and Other Runoff	The storm water and other runoff drainage system on the Marine Science Campus shall be sited and designed using a combination of good site planning, source control, and filtration/treatment best management practices (including engineered storm water treatment systems) to achieve water quality objectives, as detailed in the Drainage Concept Plan (Appendix B). Low Impact Development (LID) BMP strategies and techniques shall be used in all system design (e.g., maximizing infiltration in BMP design, reducing the hydraulic connectivity of impervious surfaces, etc.). The drainage system shall be designed to filter and treat (i.e., to remove typical and expected urban runoff pollutants) all site runoff prior to its use for on-site habitat enhancement, infiltration, and/or landscape irrigation, and/or prior to its discharge otherwise. The drainage system shall be sized to accommodate the volume of runoff produced from all applied water (such as for irrigation) and from each and every storm and/or precipitation event up to and including the 85th percentile 24-hour runoff event for volume-based BMPs. Drainage shall be directed to vegetated storm water basins through vegetated filter strips and swales to further improve water quality prior to its discharge to receiving areas. The drainage system for equipment/vehicle use areas (i.e., parking lots, maintenance and laydown areas, etc.) shall also include engineered treatment systems and/or equivalent systems designed to filter and treat contaminants expected to be	**X**	**X**	**X**		As discussed in Section 3.9, *Hydrology and Water Quality*, the storm water management systems for the proposed CBB, MSCI and NEF Projects are consistent with the requirements of the Drainage Concept Plan and include LID features where practicable.

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	present in the runoff relating to the specific type of equipment/vehicle use.					
IM 7.1.2 Water Quality Standards	Storm water and other site runoff shall be filtered and treated to the extent necessary to meet the minimum water quality requirements set forth in the Drainage Concept Plan (see Drainage Concept Plan, Section B.4.2).	**X**	**X**	**X**		As discussed in Section 3.9, *Hydrology and Water Quality*, the storm water management systems for the proposed CBB, MSCI and NEF Projects meet the water treatment requirements specified in the Drainage Concept Plan.
IM 7.1.3 Pre- and Post-Development Flows	The University shall develop and manage a drainage system on the Marine Science Campus that maintains pre-development drainage patterns and peak flow rates for up to the 25-year return storm in the post-development drainage system to the degree feasible, provided that accommodating such flows does not require drainage system sizing that exceeds 85th percentile storm event requirements (see Appendix B). The one exception to this flow pattern standard is drainage from Basin 10, part of which shall flow to Basin 9 to avoid construction of a new outfall over the coastal bluff (see Drainage Concept Plan in Appendix B) (see Drainage Concept Plan, Sections B.4.1 and B.4.2).	**X**	**X**	**X**		As discussed in Section 3.9, *Hydrology and Water Quality*, the storm water management systems for the proposed CBB, MSCI and NEF Projects meet the flow requirements specified in the Drainage Concept Plan.
IM 7.1.4 Pre-Development Drainage Patterns Defined	"Predevelopment drainage patterns" means the pattern of storm water and other runoff flows prior to certification of this CLRDP, as identified in Drainage Concept Plan.	**X**	**X**	**X**		As discussed in Section 3.9, *Hydrology and Water Quality*, the design criteria for the drainage system are based existing conditions, which have not changed since certification of the CLRDP.

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
IM 7.1.5 Pre-Development Drainage Peak Flow Rates Defined	"Pre-development drainage peak flow rates" means the estimated rates at which storm water and other runoff flowed on the site assuming the site was covered in grassland vegetation, as estimated in the Drainage Concept Plan, with the exception that for drainage Basins 5 and 9 only, it means the estimated rates at which storm water flowed on the site prior to certification of this CLRDP, as estimated in the Drainage Concept Plan (see Drainage Concept Plan, Sections B.2 and B.3).	**X**	**X**	**X**		As discussed in Section 3.9, *Hydrology and Water Quality*, the design criteria for the drainage system are based on existing conditions, which have not changed since certification of the CLRDP.
IM 7.1.6 Groundwater Recharge	The University shall develop and manage a drainage system on the Marine Science Campus that maintains groundwater recharge at pre-CLRDP levels to the maximum extent practicable through the use of infiltration (e.g., in the vegetated storm water basins and swales) (see also Drainage Concept Plan Section B.4.3).	**X**	**X**	**X**		As discussed in Section 3.9, *Hydrology and Water Quality*, the storm water management systems for the proposed CBB, MSCI and NEF Projects includes the use of infiltration, including in vegetated storm water basins and swales, to the maximum extent practicable.
IM 7.1.9 Wastewater	All wastewater generated on the Marine Science Campus shall be discharged to the City of Santa Cruz's sanitary sewer system.	**X**	**X**			The CBB Project includes connections to the City of Santa Cruz sanitary sewer system for all wastewater generated by development of the CBB and greenhouses.
IM 7.1.10 Elements of the Storm Water Treatment Train	The University has identified six primary treatment BMPs in the Drainage Concept Plan (Appendix B) to be used as appropriate in every project-specific drainage plan developed for the Marine Science Campus. Wherever possible, these BMPs shall be used in series as a treatment train, but any combination may be used, depending on what is appropriate in any particular drainage basin, provided a subset of these six BMPs and/or a substitution (of an equally effective BMP) for	**X**	**X**	**X**		As discussed in Section 3.9, *Hydrology and Water Quality*, the storm water management systems for the proposed CBB, MSCI and NEF Projects uses the treatment BMPs identified in the Drainage Concept Plan and combines them in a treatment train where possible.

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	one or more of them would provide equal or better water quality and other resource protection. In every case, engineered storm water treatment systems shall be installed as part of the treatment train where areas subject to vehicular-type pollutant generation (e.g., parking lots, maintenance areas, laydown areas, etc.) are tributary to the treatment train.					
IM 7.1.12 Location of Treatment Train Components	Vegetated storm water basins (except for the forebay) and associated outlet conveyance swales may be sited outside of development zones where such components are: 1) consistent with the Drainage Concept Plan and other CLRDP requirements; 2) sited and designed to minimize resource impacts; 3) designed to minimize landform alteration by utilizing multiple, small vegetated basins (rather than a large, single basin) that closely mimics the existing topographic features; 4) minimized in area to the maximum degree possible; 5) located as far from the resources being buffered and as close to the development zone as possible (unless a different location would result in better resource protection); and 6) limited to areas designated Open Space on Figure 5.2 except in areas adjacent to the Upper Terrace Development Zone and adjacent to the northwestern corner of the Middle Terrace Development Zone where these allowed components may also be allowed within the Resource Protection Buffer designation in two limited instances (as described in the Drainage Concept Plan).	**X**	**X**			The proposed CBB Project includes one vegetated storm water basin, which within the Middle Terrace Development Zone. The MSCI Project includes two vegetated storm water basins in the Upper Terrace, which are located in Open Space, consistent with this implementation measure.
IM 7.1.13 Permeable Hardscape	Hardscape development (such as roads, parking areas, paths, patios, etc.), where feasible and appropriate for water quality protection purposes, shall include permeable materials (e.g.,	**X**	**X**	**X**		The surface of the parking stalls in parking lots C and D would be permeable (pervious asphalt, gravel pavers, or similar materials).

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	permeable pavement/concrete, turfblock, etc.) to maximize infiltration. At a minimum, all parking areas shall be surfaced with porous/permeable materials.					The new minor trails would be surfaced in permeable materials that are compatible with ADA access, such as engineered wood fiber, gravel or grass pavers or permeable asphalt. The new major trail would be surfaced with permeable materials.
IM 7.1.15 Drainage System Interpretive Signs	All drainage improvements shall include as part of them interpretive signs and facilities designed to explain the reason for and the operation of the selected treatment train drainage system components applicable to both the individual development and the MSC overall.	**X**	**X**			Interpretive signs would be provided at the locations shown on EIR Figure 2-5, under the NEF and MSCI projects.
IM 7.1.16 Design of Vegetated Storm Water Basins	Vegetated storm water basins shall be created by constructing low-profile natural looking berms to enclose a land area within which non-native and invasive plant species shall be removed and native grasses and other suitable native vegetation capable of enhancing water quality shall be planted consistent with the Resource Management Plan (CLRDP Appendix A). Any portions of such vegetated storm water basins that are located outside of development zones shall be considered an integral part of the natural open space area within which restoration and management shall apply pursuant to the Resource Management Plan (CLRDP Appendix A), and within which other development is prohibited. The berms to be used to create the enclosed areas defining the vegetated storm water basins shall be no higher than 18 inches from natural grade and shall be no steeper than a three-to-one grade. The berms shall include natural looking spillway areas designed to accommodate the	**X**	**X**			The proposed drainage system for the CBB Project is described in detail in Section 3.9, *Hydrology and Water Quality*. The design of the proposed vegetated storm water basins is consistent with this implementation measure.

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CLRDP Policies and Implementation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
	release of detained runoff that exceeds the maximum capacity of the vegetated storm water basins in a non-erosive manner.					
IM 7.1.17 Designation of Treatment Train	All development projects that include new drainage system components (e.g., development of vegetated filter strips, swales, and storm water basins) or that result in new drainage inputs to established drainage system components shall clearly identify the drainage system components that are designed to accommodate project drainage and address CLRDP water quality requirements. These components shall be considered a "BMP treatment train" for purposes of CLRDP water quality monitoring (see Appendix B). For each BMP treatment train so identified, its final discharge point and a representative initial input point shall be designated for purposes of CLRDP water quality monitoring.	**X**	**X**			The design proposed drainage system for the CBB project, which is described in detail in Section 3.9, *Hydrology and Water Quality*, is consistent with the CLRDP water quality requirements. Water quality monitoring points would be identified during detailed design of the storm water system. This implementation measure would be included in the MMP for the CBB and MSCI projects.
IM 7.3.1 Discharge to YLR	Storm water discharge facilities that discharge into Younger Lagoon Reserve shall be designed to accommodate the 100-year storm event if feasible and otherwise consistent with the provisions of this CLRDP, including the Drainage Concept Plan.	**X**	**X**			The proposed Subarea 7 berm drainage system, which discharges to Younger Lagoon, has been designed to accommodate the 100-year storm even. This implementation measure would be included in the MMP for the CBB and MSCI projects.
IM 7.3.2 Discharge Siting and Design	All discharge points shall be sited and designed to minimize resource impacts.	**X**	**X**			This implementation measure would be included in the MMP for the CBB and MSCI projects and will be implemented during detailed design of the storm water system.
Policy 7.4 Drainage Plan	New development that alters drainage patterns shall be authorized by the University only if it includes a drainage plan	**X**	**X**	**X**		As described in Section 3.9, *Hydrology and Water Quality*, the proposed storm water

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Measure	Description	Project Applicability				Project Consistency/Implementation
		CBB	MSCI	NEF	SRP 1B	
Required	that details the manner in which the development individually and/or cumulatively is consistent with and implements the storm water and other runoff parameters of this CLRDP, including the Drainage Concept Plan, and including long-term drainage system monitoring and maintenance.					drainage systems for the MSC Projects would be consistent with the storm water rand other runoff parameters of the CLRDP.
IM 8.1.1 Sizing of Utilities	Utilities and services to and on the MSC, including water, sanitary sewer service, storm water systems, and electrical and communication lines, shall be sized consistent with and limited to accommodating only the building program set forth in this CLRDP.	**X**	**X**			As discussed in Section 3.16, *Utilities and Service Systems*, the new utility lines would not exceed the capacity required to serve the CLRDP building program.
IM 8.2.1 Installation of New Utility Lines and Related Facilities	New incidental public underground utility lines and related incidental public facilities shall be allowed below wetlands and riparian corridors only when there is no feasible less environ-mentally damaging alternative and where feasible mitigation measures have been provided to both minimize adverse environmental effects and to commensurately offset any unavoidable effects.	**X**	**X**			The project would not construct any new incidental public underground utility lines or public facilities below wetlands or riparian corridors.
Policy 8.3 Water Conservation Required	New development shall include water conservation measures that reduce water use as feasible. Such conservation measures shall be applied to both interior water use (e.g., including but not limited to, ultra low-flow plumbing fixtures, flow restrictors, hot water re-circulation pumps, water pipe insulation, Energy-Star rated appliances, etc.) and exterior water use (e.g., including but not be limited to, drought tolerant landscape species, drip irrigation, cistern collection for irrigation, rain sensitive irrigation systems, overflow prevention mechanisms, automatic shutoff nozzles, etc.). The City of Santa	**X**				The CBB Project would include high-efficiency plumbing fixtures (dual-flush (1.6/1.1gpf) toilets, 0.125-gpf urinals, 0.5-gpm restroom faucets, and 1.5-gpm showerheads). The irrigation controller would be automatically adjust the irrigation schedule to compensate for daily fluctuations in the weather and associated irrigation requirements. The MSCI, NEF, and SRP Phase 1B projects would not create any new

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Measure	**Description**	**Project Applicability**				**Project Consistency/Implementation**
		CBB	**MSCI**	**NEF**	**SRP 1B**	
	Cruz shall be consulted regarding necessary water conservation measures.					water demand.
Policy 8.4 Impacts to City Water and Sewer Systems Offset	New development shall include the payment of fair-share fees and/or commitment to construct necessary water and sewer system upgrades attributable to the development's impact on City water and sewer utility infrastructure. The City of Santa Cruz shall be consulted regarding any fair-share fees and/or water/sewer system upgrades.	**X**				The Campus would pay its fair share of the cost of water and sewer system upgrades according to the terms of existing agreements with the City.
Policy 8.5 Utility Plan Required	New development that requires utilities shall be authorized by the University only if it includes a utility plan that details the manner in which the development individually and/or cumulatively is consistent with and implements the utility parameters of this CLRDP, including Section 5.8 (Utilities), and including long-term monitoring and maintenance of same.	**X**				As described in Section 3.16, *Utilities and Service Systems*, the project is consistent with the utility parameters of the CLRDP.

Appendix D

CLRDP EIR Mitigation Measures Applicable to the Proposed Projects

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CLRDP EIR Mitigation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability			
		CBB	MSCI	NEF	SRP 1B
CLRDP General Mitigation Measure 4.2-1	• UCSC will install a four-foot-high landscaped fence along the Younger Ranch property line that will extend from the bend in the existing access road, northward along the property line. The fence will be sited and constructed to have a uniform gap of 16 inches between a smooth wire defining the bottom of the fence and the ground. This will assure that wildlife passage can continue to occur through the fence. • UCSC will install tree and shrub landscaping approximately 25 feet inside the fence (to minimize shading effects on Younger Ranch crops), consisting of an indigenous, drought-resistant mosaic of mid-level shrubs and taller trees to help dissipate dust generation from the west. Tree and shrub choices will be made in conjunction with the landscape architect experienced in the use of native plants and vegetation. Trees and shrubs will be selected for non-invasive character. Native blackberries are recommended, as they would serve as an access barrier. • UCSC will install the fence and landscaping prior to groundbreaking of any CLRDP project components.	**X**	**X**	**X**	**X**
CLRDP General Mitigation Measure 4.3-1	The University shall require construction contractors to implement a dust abatement program to reduce the contribution of project construction to local respirable particulate matter concentrations. Elements of this program shall include the following as appropriate for each project: • Water all active construction areas at least twice daily. Frequency shall be based on the type of operation, soil, and wind exposure. • Cover all trucks hauling soil, sand, and other loose materials, or require all trucks to maintain at least two feet of freeboard (i.e., the minimum required space between the top of the load and the top of the trailer). • Pave, apply water two times daily, or apply non-toxic soil stabilizers to all unpaved access roads, parking areas, and construction staging areas. • Sweep daily with water sweepers any paved access roads, parking areas, and staging areas at construction sites. • Sweep streets daily with water sweepers if visible soil material is carried onto adjacent public streets. • Hydroseed or apply (non-toxic) soil stabilizers to inactive construction areas or previously graded areas left inactive for ten days or more. • Enclose, cover, water twice daily or apply (non-toxic) soil stabilizers to exposed stockpiles (dirt, sand, etc.). • Limit traffic speeds on unpaved roads to 15 miles per hour. • Install sandbags or other erosion control measures to prevent silt runoff to public roadways.	**X**	**X**	**X**	**X**

APPENDIX D

CLRDP EIR Mitigation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability			
		CBB	MSCI	NEF	SRP 1B
	• Replant vegetation in disturbed areas as quickly as possible. • In the event that grading and excavation at two or more large project sites is proposed to occur concurrently (large sites defined as involving more than 2 acres), install wheel washers at the entrance of the construction sites. • Phase construction projects in such a manner that minimizes the area of surface disturbance (e.g., grading, excavation) and the number of vehicle trips on unpaved surfaces.				
CLRDP General Mitigation Measure 4.4-1	For all projects proposed in the upper terrace under the CLRDP, the University will implement the following: • A preconstruction survey for CRLF will be conducted of all areas proposed for grading and construction by a qualified biologist, approved by the USFWS. If CRLF are observed, grading activities shall be postponed and USFWS shall be consulted to determine appropriate actions to avoid impact. Consultation with the USFWS will result in either a determination of the need to obtain a permit or in the identification of measures to avoid take of the individual(s). • The biological monitor shall also conduct meetings with the contractor(s) and other key construction personnel to describe the importance of the species, the need to restrict work to designated areas, and to discuss procedures for avoiding harm or harassment of wildlife encountered during construction. NOTE THAT MSC PROJECTS MM BIO-3 IS SUBSTITUTED FOR THIS MEASURE, FOR THE MSC PROJECTS.				X
CLRDP General Mitigation Measure 4.4-2	UCSC shall ensure that construction activities avoid disturbing nests of raptors (and other special-status birds). If ground-disturbing activities are scheduled to occur during the breeding season (February 1 through August 31), the following measures are required to avoid potential adverse effects on nesting special-status raptors and other birds: • A qualified wildlife biologist will conduct preconstruction surveys of all potential nesting habitat. For burrowing owls, such surveys will follow the most recent CDFG *Burrowing Owl Survey Protocol and Mitigation Guidelines*. • If active raptor nests are found during preconstruction surveys, a no-disturbance buffer acceptable in size to CDFG will be created around active raptor nests and nests of any other special-status birds during the breeding season, and maintained until it is determined that all young have fledged. Raptor or other bird nests initiated during construction are presumed to be unaffected, and no buffer is necessary. However, the "take" of any individuals will be prohibited.	**X**	**X**	**X**	**X**

APPENDIX D

CLRDP EIR Mitigation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability			
		CBB	MSCI	NEF	SRP 1B
	• If preconstruction surveys indicate that nests are inactive or potential habitat is unoccupied during the construction/restoration period, no further mitigation is required. Trees and shrubs that have been determined to be unoccupied by special-status birds or that are located outside the no-disturbance buffer for active nests may be removed. NOTE THAT MSC PROJECTS MM BIO-4, FOR BURROWING OWLS AND BIO-7A through -7D, FOR NESTING BIRDS, ARE SUBSTITUTED FOR THIS MEASURE, FOR THE MSC PROJECTS.				
CLRDP Project-Specific Mitigation Measure 4.5-1	If human remains are discovered during the construction of a development project under the CLRDP, the University and/or its employees shall notify the Santa Cruz County Coroner's Office immediately. Upon determination by the County Coroner that the remains are Native American, the Coroner shall contact the California Native American Heritage Commission, pursuant to subdivision (c) of Section 7050.5 of the Health and Safety Code, and the County Coordinator of Indian Affairs and appropriate Native American consultation shall be conducted, as outlined by PRC 5097.98. Implementation Measure 3.9.1, Construction Monitoring, as identified in the CLRDP, shall also apply. UCSC will be responsible for implementing this mitigation measure.	**X**	**X**	**X**	**X**
CLRDP Project-Specific Mitigation Measure 4.11-4	Prior to the initiation of construction, the University shall approve a construction noise mitigation program including but not limited to the following: • The University shall require that construction activities be limited to a schedule that minimizes disruption to noise-sensitive uses on the project site and in the vicinity through implementation of the following: – Construction activities during daytime and evening hours (7:00 AM to 10:00 PM) shall not occur within 150 feet of sensitive receptors, when feasible. Construction activities within 500 feet of sensitive receptors activities shall not occur during nighttime hours (10:00 PM to 7:00 AM). – Whenever possible, academic and administrative staff, as well as residents who will be subject to construction noise, shall be informed one week before the start of each construction project. – Loud construction activity as described above within 150 feet of an academic or residential use shall, to the extent feasible, be scheduled during holidays, spring break, or summer break. • To reduce noise impacts from construction, the University shall require that construction contractors muffle or otherwise control noise from construction equipment through implementation of the measures below. The effectiveness of these measures is quantified in Table 4.11-4 above.	**X**	**X**	**X**	**X**

APPENDIX D

CLRDP EIR Mitigation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability			
		CBB	MSCI	NEF	SRP 1B
	– Internal combustion engines used for any purpose at the construction sites shall be equipped with a muffler of a type recommended by the manufacturer. – Equipment used for construction shall utilize the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures, and acoustically-attenuating shields or shrouds, wherever feasible); – Impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for construction shall be hydraulically or electrically powered wherever feasible to avoid noise associated with compressed air exhaust from pneumatically powered tools. However, where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used. Such mufflers can lower noise levels from the exhaust as much as 10 dBA. External jackets on the tools themselves shall be used where feasible, and this could achieve a reduction of 5 dBA. Quieter procedures such as using drilling equipment rather than impact equipment shall be implemented whenever feasible. – Stationary noise sources shall be located as far from sensitive receptors as feasible. If they must be located near sensitive receptors, they shall be muffled to the extent feasible and/or, where practicable, enclosed within temporary sheds. • To reduce noise impacts from construction, the University shall require that construction contractors muffle or otherwise control noise from construction equipment through implementation of the measures below. The effectiveness of these measures is quantified in Table 4.11-4 above. – Internal combustion engines used for any purpose at the construction sites shall be equipped with a muffler of a type recommended by the manufacturer. – Equipment used for construction shall utilize the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures, and acoustically-attenuating shields or shrouds, wherever feasible); – Impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for construction shall be hydraulically or electrically powered wherever feasible to avoid noise associated with compressed air exhaust from pneumatically powered tools. However, where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used. Such mufflers can lower noise levels from the exhaust as much as 10 dBA. External jackets on the tools themselves shall be used where feasible, and this could achieve a reduction of 5 dBA. Quieter procedures such as using drilling equipment rather than impact equipment shall be implemented whenever feasible.				

APPENDIX D

CLRDP EIR Mitigation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability			
		CBB	MSCI	NEF	SRP 1B
	– Stationary noise sources shall be located as far from sensitive receptors as feasible. If they must be located near sensitive receptors, they shall be muffled to the extent feasible and/or, where practicable, enclosed within temporary sheds. • The University shall require that a temporary wooden wall be placed around construction activity areas that are within 150 feet of sensitive receptors to provide additional noise attenuation, where feasible. The wall should impede the direct line of site between the noise sources and sensitive receptors. • The University shall require that construction-related material haul trips access the campus via Natural Bridges Drive and Delaware Avenue in order to minimize noise exposure to residential land uses. • The University shall identify potential noise impacts related to construction of long-term projects proposed under the CLRDP, and develop project-specific noise mitigation measures as may be necessary. The University shall take into account the location of the five campus facilities that will have been developed in the near-term as well as off-campus developments nearby. The analysis shall also take into account the sequence in which long-term projects are to be constructed and shall identify appropriate mitigation, as may be required. These future facilities may be sensitive receptors or may act as barriers to noise approaching other sensitive receptors.				
CLRDP General Mitigation Measure 4.15-1	The University shall contribute its fair share (see definition of fair share on page 4.15-33) toward the cost of improvements to the intersection of Mission and Bay Street which would include re-striping the southbound Bay Street approach (which currently includes a left-turn and shared left-turn/through/right lane) to provide a separate right-turn lane, a shared through-left lane, and a left-turn lane. With this improvement, intersection operations would improve to LOS D with 37.7 second of delay in the peak hour. (MM 4.15-3 and 4.15-5 also implement 4.15-1)	**X**		**X**	
CLRDP General Mitigation Measure 4.15-2	UCSC will contribute its fair-share (see page 4.15-33 for definition of fair share) towards construction of a separate pedestrian path on the north side of Delaware Avenue from Shaffer Road to the existing sidewalk west of Natural Bridges Drive. This improvement could be as simple as installing a raised asphalt curb approximately five to six feet away from the existing curb or edge of pavement with openings to maintain existing drainage. Design and construction of this improvement to close the existing gap in pedestrian facilities in this area can and should completed by the City of Santa Cruz since Delaware Avenue is under its jurisdiction. The University shall contribute its fair share (see page 4.15-33 for definition of fair share) toward the cost of improvements to the Mission Street/Chestnut Street intersection, which would involve the following	**X**			

APPENDIX D

CLRDP EIR Mitigation Measures Applicable to the Proposed Projects

Measure	Description	Project Applicability			
		CBB	MSCI	NEF	SRP 1B
	modifications: (1) convert the southbound dual right-turn lanes on Mission Street to a single-lane "free" right-turn lane and widen of the west leg of the intersection to accommodate a new 500-foot-long, third lane for merging; or (2) install a triple southbound right-turn lane, which would also require the new merge lane. In both cases, the modifications would require major reconstruction of the intersection, and possibly right-of-way acquisition and building modification/relocation.				
CLRDP General Mitigation Measure 4.15-4	The University shall contribute its fair share (see page 4.15-33 for definition of fair share) toward the cost of improvements to the Mission Street/Chestnut Street intersection, which would involve the following modifications: (1) convert the southbound dual right-turn lanes on Mission Street to a single-lane "free" right-turn lane and widen of the west leg of the intersection to accommodate a new 500-foot-long, third lane for merging; or (2) install a triple southbound right-turn lane, which would also require the new merge lane. In both cases, the modifications would require major reconstruction of the intersection, and possibly right-of-way acquisition and building modification/relocation.	**X**		X	
CLRDP General Mitigation Measure 4.15-6	Implement General Mitigation Measures 4.15-1 and 4.15-4. In addition, the University shall contribute its fair share (as defined on page 4.15-33) toward the cost of improvements to the intersections at High Street/Western Drive, Empire Grade/Heller Drive, and State Route 1/River Street (SR 9). Mitigation measures include traffic signals at the High Street/Western Drive and Empire Grade/Heller Drive intersections. Potential improvements for the State Route 1/River Street (SR 9) intersection will be identified by the City of Santa Cruz.	**X**		X	
CLRDP General Mitigation Measure 4.16-1a	All toilets, urinals, showers, and washing machines installed as part of this project shall be specified as low-flush and low-flow in order to reduce onsite water consumption. The University shall install low-flow toilets and urinals that are 1.6 gallon/flush or less and low-flow showers that are 2 gallons per minute (gpm) or less in new development. Further, in all new residential uses washing machines must be certified by the Consortium on Energy Efficiency (CEE) to be water- and energy-efficient (such as those with the Energy Star® label).	**X**			

APPENDIX D CLRDP EIR Mitigation Measures Applicable to the Proposed Projects					
Measure	**Description**	**Project Applicability**			
		CBB	**MSCI**	**NEF**	**SRP 1B**
CLRDP General Mitigation Measure 4.16-1b	If and when the City adopts policies requiring all projects (or all similar institutional or commercial projects) within the water system to offset new water demand or any other water demand reduction policies, the University will consider voluntary compliance with the policy, with appropriate credit being given to account for UCSC's previous water conservation activities (in excess of that accomplished by the similar institutional and/or commercial entities covered by the City policy).	**X**			
CLRDP General Mitigation Measure 4.16-1d	The City can and should identify and develop new water supplies to reliably accommodate increases in water supply due to UCSC Marine Science Campus CLRDP-related growth and other background growth during normal and drought conditions.	**X**			

Appendix E

Climate Change Technical Report

UNIVERSITY OF CALIFORNIA, SANTA CRUZ

MARINE SCIENCE CAMPUS PROJECT

Greenhouse Gas Assessment

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SUMMARY

The greenhouse gas (GHG) emissions assessment for the proposed University of California, Santa Cruz Marine Science Campus Projects ("projects" or "proposed projects") located in Santa Cruz, California, was prepared in accordance with available local, regional, and state guidance. The proposed projects consist of: 1) the Coastal Biology Building (CBB) Project, which would develop a new lab building and greenhouse complex; 2) the Marine Science Campus Infrastructure Improvements (MSCI) Project Phase A, which consists of infrastructure improvements to serve the CBB and other future development on the campus; 3) the NEF Project, which includes improvements to public access trails and overlooks; 4) the Specific Resource Plan (SRP) Phase 1B Wetland Restoration Project; and 5) the MSCI Project Phase B, which includes additional improvements to utilities and roadways. Because they are being designed as one project, the MSCI Project Phase A and the trail and overlook elements of the NEF project are considered in this analysis as one phase. Construction is anticipated to begin in 2012 and be completed in 2014. The project would be in operation in 2014.

Construction and operation of the proposed projects would result in the emission of GHGs. The primary sources of GHGs emissions that would be attributable to the proposed project include: construction equipment and vehicles; motor vehicles; natural gas combustion; electricity consumption; water consumption, wastewater generation, and solid waste generation. Based on the analysis, the projects are estimated to emit 982 $MTCO_2e$ per year from project operations, including mobile, indirect, and area sources, and 263 $MTCO_2e$ per year from stationary sources. Based on the results of the GHG emissions assessment, construction- and operation-related GHG emissions from the proposed projects would not result in a significance impact to global climate.

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Appendix A: Greenhouse Gas Emissions Calculations

Appendix B: Email Communication from MBUAPCD

1.0 INTRODUCTION

This greenhouse gas (GHG) emissions assessment evaluates the potential climate change impacts associated with implementation of the proposed University of California, Santa Cruz ("UCSC" or "University") Marine Science Campus Projects ("projects" or "proposed projects") located Santa Cruz, California. The proposed projects consists of: 1) the Coastal Biology Building (CBB) Project, which would develop a new lab building and greenhouse complex; 2) the Marine Science Campus Infrastructure Improvements (MSCI) Project Phase A, which consists of infrastructure improvements to serve the CBB and other future development on the campus; 3) the NEF Project, which includes improvements to public access trails and overlooks; 4) the Specific Resource Plan (SRP) Phase 1B Wetland Restoration Project; and 5) the MSCI Project Phase B, which includes improvements to utilities and roadways. Because they are being designed as one project and would be constructed concurrently, the MSCI Project Phase A and the trail and overlook elements of the NEF project are considered in this analysis as one phase. Construction is anticipated to begin in 2012 and be completed in 2014. The projects would be in operation in 2014. The assessment provides existing conditions and background information on GHG emissions and climate change as well as global, national, and state inventories. The assessment then describes the methodologies used to estimate the projects' GHG emissions, as well as the assumptions used in the analysis, and shows the expected level of annual GHG emissions at full buildout.

2.0 ENVIRONMENTAL SETTING

2.1 Global Climate Change Background

Global climate change refers to any significant change in climate measurements, such as temperature, precipitation, or wind, lasting for an extended period (i.e., decades or longer).[1] Climate change may result from:

- Natural factors, such as changes in the sun's intensity or slow changes in the Earth's orbit around the sun;
- Natural processes within the climate system (e.g., changes in ocean circulation, reduction in sunlight from the addition of GHG and other gases to the atmosphere from volcanic eruptions); and
- Human activities that change the atmosphere's composition (e.g., through burning fossil fuels) and the land surface (e.g., deforestation, reforestation, urbanization, desertification).

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1 U.S. Environmental Protection Agency, "Glossary of Climate Change Terms," http://www.epa.gov /climatechange/glossary.html#Climate_change. 2008.

The natural process through which heat is retained in the troposphere[2] is called the "greenhouse effect." The greenhouse effect traps heat in the troposphere through a three-fold process as follows: (1) short-wave radiation in the form of visible light emitted by the Sun is absorbed by the Earth as heat; (2) long-wave radiation re-emitted by the Earth; and (3) GHGs in the atmosphere absorbing or trapping the long-wave radiation and re-emitting it back towards the Earth and into space. This third process is the focus of current climate change actions.

While water vapor and carbon dioxide (CO_2) are the most abundant GHG, other trace GHGs have a greater ability to absorb and re-radiate long-wave radiation. To gauge the potency of GHGs, scientists have established a Global Warming Potential (GWP) for each GHG based on its ability to absorb and re-emit long-wave radiation over a specific time period. The GWP of a gas is determined using CO_2 as the reference gas with a GWP of 1 over 100 years. For example, a gas with a GWP of 10 is 10 times more potent than CO_2 over 100 years. The use of GWP allows GHG emissions to be reported using CO_2 as a baseline. The sum of each GHG multiplied by its associated GWP is referred to as carbon dioxide equivalents (CO_2e). This essentially means that 1 metric ton of a GHG with a GWP of 10 has the same climate change impacts as 10 metric tons of CO_2.

The primary effect of global climate change has been a rise in the average global tropospheric temperature of 0.2° Celsius per decade, determined from meteorological measurements world-wide between 1990 and 2005.[3] Climate change modeling using 2000 emission rates shows that further warming is likely to occur, which would induce further changes in the global climate system during the current century.[4] Changes to the global climate system and ecosystems and to California could include:

- Declining sea ice and mountain snowpack levels, thereby increasing sea levels and sea surface evaporation rates with a corresponding increase in tropospheric water vapor due to the atmosphere's ability to hold more water vapor at higher temperatures;[5]
- Rising average global sea levels primarily due to thermal expansion and the melting of glaciers, ice caps, and the Greenland and Antarctic ice sheets;[6]

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2 The troposphere is the bottom layer of the atmosphere, which varies in height from the Earth's surface to 10 to 12 kilometers.

3 Intergovernmental Panel on Climate Change, "Climate Change 2007: The Physical Science Basis, Summary for Policymakers," http://ipcc-wg1.ucar.edu/wg1/docs/WG1AR4_SPM_PlenaryApproved.pdf. 2007.

4 Ibid.

5 Ibid.

6 Ibid.

- Changing weather patterns, including changes to precipitation, ocean salinity, and wind patterns, and more energetic aspects of extreme weather including droughts, heavy precipitation, heat waves, extreme cold, and the intensity of tropical cyclones;[7]

- Declining Sierra snowpack levels, which account for approximately half of the surface water storage in California, by 70 percent to as much as 90 percent over the next 100 years;[8]

- Increasing the number of days conducive to ozone formation by 25 to 85 percent (depending on the future temperature scenario) in high ozone areas located in the Southern California area and the San Joaquin Valley by the end of the 21st century;[9]

- Increasing the potential for erosion of California's coastlines and sea water intrusion into the Sacramento and San Joaquin Delta and associated levee systems due to the rise in sea level;[10]

- Increasing pest infestation making California more susceptible to forest fires;[11] and

- Increasing the demand for electricity by 1 to 3 percent by 2020 due to rising temperatures resulting in hundreds of millions of dollars in extra expenditures.[12]

2.2 Greenhouse Gases

State law defines GHGs to include the following compounds:[13]

- **Carbon Dioxide (CO_2).** CO_2 is primarily generated from fossil fuel combustion from stationary and mobile sources. CO_2 is the most widely emitted GHG and is the reference gas (GWP of 1) for determining the GWPs of other GHGs.

- **Methane (CH_4).** Methane is emitted from biogenic sources (i.e., resulting from the activity of living organisms), incomplete combustion in forest fires, landfills, manure management, and leaks in natural gas pipelines. The GWP of methane is 21.

- **Nitrous Oxide (N_2O).** Is produced by human-related sources including agricultural soil management, animal manure management, sewage treatment, mobile and stationary combustion of fossil fuel, adipic acid production, and nitric acid production. The GWP of nitrous oxide is 310.

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7 Ibid.

8 California Environmental Protection Agency, Climate Action Team, *Climate Action Team Report to Governor Schwarzenegger and the Legislature*, (2006).

9 Ibid.

10 Ibid.

11 Ibid.

12 Ibid.

13 All Global Warming Potentials are given as 100-year values. Unless noted otherwise, all Global Warming Potentials were obtained from the Intergovernmental Panel on Climate Change. *Climate Change 1995: The Science of Climate Change – Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge (UK): Cambridge University Press, 1996.

- **Hydrofluorocarbons (HFCs).** HFCs typically are used as refrigerants in both stationary refrigeration and mobile air conditioning. The use of HFCs for cooling and foam-blowing is growing particularly as the continued phase-out of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) gains momentum. The GWPs of HFCs ranges from 140 for HFC-152a to 11,700 for HFC-23.

- **Perfluorocarbons (PFCs).** Perfluorocarbons are compounds consisting of carbon and fluorine. They are primarily created as a byproduct of aluminum production and semiconductor manufacturing. Perfluorocarbons are potent GHGs with a Global Warming Potential several thousand times that of carbon dioxide, depending on the specific PFC. Another area of concern regarding PFCs is their long atmospheric lifetime (up to 50,000 years).[14] The GWPs of PFCs range from 5,700 to 11,900.

- **Sulfur Hexafluoride (SF_6).** Sulfur hexafluoride is a colorless, odorless, nontoxic, nonflammable gas. It is most commonly used as an electrical insulator in high voltage equipment that transmits and distributes electricity. Sulfur hexafluoride has a GWP of 23,900. However, it is not prevalent in the atmosphere (4 parts per trillion [ppt] in 1990 versus 365 parts per million [ppm] of CO_2).[15]

The primary GHGs of concern relative to the proposed projects are CO_2, CH_4, and N_2O. These three GHGs are generally emitted from combustion activities. The other GHGs listed above are related to specific industrial uses and not anticipated to be emitted in measurable or substantial quantities by the proposed projects.

2.3 Contributions to Greenhouse Gas Emissions

2.3.1 Global

Worldwide anthropogenic (man-made) GHG emissions are tracked for industrialized nations (referred to as Annex I) and developing nations (referred to as Non-Annex I). Man-made GHG emissions for Annex I nations are available through 2007. Man-made GHG emissions for Non-Annex I nations are available through 2005. The sum of these emissions totaled approximately 43,363 million metric tons of CO_2 equivalents ($MMTCO_2e$).[16] It should be noted that global emissions inventory data are not all from the same year and may vary depending on the source of the emissions inventory data.[17] The top five

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14 Energy Information Administration, "Other Gases: Hydrofluorocarbons, Perfluorocarbons, and Sulfur Hexafluoride," http://www.eia.doe.gov/oiaf/1605/gg00rpt/other_gases.html. n.d.

15 U.S. Environmental Protection Agency, "High GWP Gases and Climate Change," http://www epa gov /highgwp/scientific.html#sf6. n.d.

16 The CO_2 equivalent emissions commonly are expressed as "million metric tons of carbon dioxide equivalent ($MMTCO_2e$)." The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP, such that $MMTCO_2E$ = (million metric tons of a GHG) x (GWP of the GHG). For example, the GWP for methane is 21. This means that the emission of one million metric tons of methane is equivalent to the emission of 21 million metric tons of CO_2.

17 The global emissions are the sum of Annex I and non-Annex I countries, without counting Land-Use, Land-Use Change and Forestry (LULUCF). For countries without 2007 data, the data for the most recent year were used.

countries and the European Union accounted for approximately 59 percent of the total global GHG emissions according to the most recently available data (See **Table 1, Top Five GHG Producer Countries and the European Union [Annual]**). The GHG emissions in more recent years may differ from the inventories presented in **Table 4.4-1**; however, the data is representative of currently available global inventory data.

Table 1
Top Five GHG Producer Countries and the European Union (Annual)

Emitting Countries	GHG Emissions ($MMTCO_2e$)
China	7,265
United States	7,217
European Union (EU), 27 Member States	5,403
Russian Federation	2,202
India	1,877
Japan	1,412
Total	**25,376**

Source: World Resources Institute, "Climate Analysis Indicators Tool (CAIT)," http://cait.wri.org/. 2010. Excludes emissions and removals from land use, land-use change and forestry (LULUCF).
Note: Emissions for Annex I nations are based on 2007 data. Emissions for Non-Annex I nations (e.g., China, India) are based on 2005 data).

2.3.2 United States

As noted in **Table 4.6-1**, the United States was the number two producer of global GHG emissions. The primary GHG emitted by human activities in the United States was CO_2, representing approximately 83 percent of total GHG emissions.[18]

2.3.3 State of California

CARB compiles GHG inventories for the State of California. Based on the 2008 GHG inventory data (i.e., the latest year for which data are available), California emitted 474 $MMTCO_2e$ ***including*** emissions resulting from imported electrical power in 2008.[19] Based on the CARB inventory data and GHG inventories compiled by the World Resources Institute, California's total statewide GHG emissions rank

18 U.S. Environmental Protection Agency, "Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2009,"http://www.epa.gov/climatechange/emissions/downloads11/US-GHG-Inventory-2011-Complete_Report.pdf. 2011.

19 California Air Resources Board, "California Greenhouse Gas 2000-2008 Inventory by Scoping Plan Category - Summary," http://www.arb.ca.gov/cc/inventory/data/data.htm. 2010.

second in the United States (Texas is number one) with emissions of 417 $MMTCO_2e$ ***excluding*** emissions related to imported power.[20]

The primary contributors to GHG emissions in California are transportation, electric power production from both in-state and out-of-state sources, industry, agriculture and forestry, and other sources, which include commercial and residential activities. **Table 2, GHG Emissions in California**, provides a summary of GHG emissions reported in California in 1990 and 2008 separated by categories defined by the United Nations Intergovernmental Panel on Climate Change (IPCC).

Table 2
GHG Emissions in California

Source Category	1990 ($MMTCO_2e$)	Percent of Total	2008 ($MMTCO_2e$)	Percent of Total
ENERGY	**386.41**	**89.2%**	**413.80**	**86.6%**
Energy Industries	157.33	36.3%	171.23	35.8%
Manufacturing Industries & Construction	24.24	5.6%	16.67	3.5%
Transport	150.02	34.6%	173.94	36.4%
Other (Residential/Commercial/Institutional)	48.19	11.1%	46.59	9.8%
Non-Specified	1.38	0.3%	0.00	0.0%
Fugitive Emissions from Oil & Natural Gas	2.94	0.7%	3.28	0.7%
Fugitive Emissions from Other Energy Production	2.31	0.5%	2.09	0.4%
INDUSTRIAL PROCESSES & PRODUCT USE	**18.34**	**4.2%**	**30.11**	**6.3%**
Mineral Industry	4.85	1.1%	5.35	1.1%
Chemical Industry	2.34	0.5%	0.06	0.0%
Non-Energy Products from Fuels & Solvent Use	2.29	0.5%	1.97	0.4%
Electronics Industry	0.59	0.1%	0.80	0.2%
Substitutes for Ozone Depleting Substances	0.04	0.0%	13.89	2.9%
Other Product Manufacture and Use	3.18	0.7%	1.66	0.3%
Other	5.05	1.2%	6.39	1.3%
AGRICULTURE, FORESTRY, & OTHER LAND USE	**19.11**	**4.4%**	**24.42**	**5.1%**
Livestock	11.67	2.7%	16.28	3.4%
Land	0.19	0.0%	0.19	0.0%
Aggregate Sources & Non-CO_2 Sources on Land	7.26	1.7%	7.95	1.7%
WASTE	**9.42**	**2.2%**	**9.41**	**2.0%**
Solid Waste Disposal	6.26	1.4%	6.71	1.4%
Wastewater Treatment & Discharge	3.17	0.7%	2.70	0.6%

20 Ibid.

Source Category	1990 ($MMTCO_2e$)	Percent of Total	2008 ($MMTCO_2e$)	Percent of Total
EMISSIONS SUMMARY				
Gross California Emissions	433.29		477.74	
Sinks from Forests and Rangelands	-6.69		-3.98	
Net California Emissions	426.60		473.76	

Sources:

[1] *California Air Resources Board, "California Greenhouse Gas 1990-2004 Inventory by IPCC Category - Summary," http://www.arb.ca.gov/cc/inventory/archive/archive.htm. 2010.*

[2] *California Air Resources Board, "California Greenhouse Gas 2000-2008 Inventory by IPCC Category - Summary," http://www.arb.ca.gov/cc/inventory/data/data.htm. 2010.*

Between 1990 and 2008, the population of California grew by approximately 8.1 million (from 29.8 to 37.9 million).[21] This represents an increase of approximately 27.2 percent from 1990 population levels. In addition, the California economy, measured as gross state product, grew from $788 billon in 1990 to $1.8 trillion in 2008 representing an increase of approximately 128 percent (over twice the 1990 gross state product).[22] Despite the population and economic growth, California's net GHG emissions only grew by approximately 11 percent. The California Energy Commission (CEC) attributes the slow rate of growth to the success of California's renewable energy programs and its commitment to clean air and clean energy.[23]

2.4 Global Ambient CO_2 Concentrations

Air trapped by ice has been extracted from core samples taken from polar ice sheets to determine the global atmospheric variation of carbon dioxide, methane, and nitrous oxide from before the start of the industrialization, around 1750, to over 650,000 years ago. For that period, it was found that carbon dioxide concentrations ranged from 180 ppm to 300 ppm. For the period from around 1750 to the present, global carbon dioxide concentrations increased from a pre-industrialization period concentration of 280 ppm to 379 ppm in 2005, with the 2005 value far exceeding the upper end of the pre-industrial period range.[24] Recent values continue this upward trend. Global methane and nitrous oxide concentrations

21 U.S. Census Bureau, "Data Finders," http://www.census.gov/. 2009; California Department of Finance, "E-5 Population and Housing Estimates for Cities, Counties and the State, 2001-1008, with 2000 Benchmark," http://www.dof.ca.gov/research/demographic/reports/estimates/e-5/2009/. 2010.

22 California Department of Finance, "Financial & Economic Data: Gross Domestic Product, California," http://www.dof.ca.gov/HTML/FS_DATA/LatestEconData/FS_Misc.htm. 2010. Amounts are based on current dollars as of the data of the report (June 2, 2009).

23 California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks 1990 to 2004*, (2006).

24 California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks 1990 to 2004*, (2006).

show similar increases for the same period (see **Table 3, Comparison of Global Pre-Industrial and Current GHG Concentrations**).

Table 3
Comparison of Global Pre-Industrial and Current GHG Concentrations

Greenhouse Gas	Natural Range for Last 650,000 Years[1] (ppm)	Year 1750 Concentrations (Early Industrial Period)[1] (ppm)	Year 2005 Concentrations[1] (ppm)	Year 2010 Concentrations[2,3] (ppm)
Carbon Dioxide (CO_2)	180 to 300	280	379	390
Methane (CH_4)	0.320 to 0.790	0.715	1.774	1.870 / 1.745
Nitrous Oxide (N_2O)	0.180 to 0.260	0.270	0.319	0.323 / 0.322

Sources:
[1] Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis, (2007) 3, 100.
[2] Dr. Pieter Tans, National Oceanic and Atmospheric Administration (NOAA)/Earth System Research Laboratory (ESRL), "Trends in Atmospheric Carbon Dioxide," http://www.esrl.noaa.gov/gmd/ccgg/trends. 2011.
[3] Carbon Dioxide Information Analysis Center, "Recent Greenhouse Gas Concentrations," http://cdiac.ornl.gov/pns/current_ghg.html. 2011. The first value for CH_4 and N_2O represents Mace Head, Ireland, a mid-latitude Northern-Hemisphere site, and the second value represents Cape Grim, Tasmania, a mid-latitude Southern-Hemisphere site.

3.0 REGULATORY SETTING

3.1 U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency adopted a mandatory GHG reporting rule in September 2009. The rule would require suppliers of fossil fuels or entities that emit industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions to submit annual reports to the U.S. EPA beginning in 2011 (covering the 2010 calendar year emission). Vehicle and engine manufacturers would begin reporting GHG emissions for model year 2011.

On September 15, 2009, the U.S. EPA and the Department of Transportation's (DOT) National Highway Traffic Safety Administration (NHTSA) issued a joint proposal to establish a national program consisting of new standards for model year 2012 through 2016 light-duty vehicles that will reduce GHG emissions and improve fuel economy. The proposed standards would be phased in and would require passenger cars and light-duty trucks to comply with a declining emissions standard. In 2012, passenger cars and light-duty trucks would have to meet an average emissions standard of 295 grams of CO_2 per mile and

30.1 miles per gallon.[25] By 2016, the vehicles would have to meet an average standard of 250 grams of CO_2 per mile and 35.5 miles per gallon.[26] The final standards were adopted by the U.S. EPA and DOT on April 1, 2010.

On December 7, 2009, the U.S. EPA Administrator signed two distinct findings regarding GHGs under section 202(a) of the Clean Air Act:

- **Endangerment Finding:** The Administrator finds that the current and projected concentrations of the six key well-mixed GHGs (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) in the atmosphere threaten the public health and welfare of current and future generations.

- **Cause or Contribute Finding:** The Administrator finds that the combined emissions of these well-mixed greenhouse gases from new motor vehicles and new motor vehicle engines contribute to the greenhouse gas pollution which threatens public health and welfare.

While these findings do not impose additional requirements on industry or other entities, this action is a prerequisite to finalizing the U.S. EPA's proposed GHG emissions standards for light-duty vehicles, which were jointly proposed by the U.S. EPA and the NHTSA. On April 1, 2010, the U.S. EPA and NHTSA issued final rules requiring that by the 2016 model-year, manufacturers must achieve a combined average vehicle emission level of 250 grams CO_2 per mile, which is equivalent to 35.5 miles per gallon as measured by U.S. EPA standards.

3.2 State of California

The State of California has enacted regulations that target reductions in GHG emissions. The major regulations, policies, and legislation are provided below in approximate chronological order.

3.2.1 Title 24 Building Standards Code

The CEC first adopted Energy Efficiency Standards for Residential and Nonresidential Buildings (California Code of Regulations, Title 24, Part 6) in 1978 in response to a legislative mandate to reduce energy consumption in the state. Although not originally intended to reduce GHG emissions, increased energy efficiency and reduced consumption of electricity, natural gas, and other fuels would result in fewer GHG emissions from residential and nonresidential buildings subject to the standard. The

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25 U.S. Environmental Protection Agency, "EPA and NHTSA Propose Historic National Program to Reduce Greenhouse Gases and Improve Fuel Economy for Cars and Trucks," http://epa.gov/otaq/climate /regulations/420f09047a.htm. 2009.

26 U.S. EPA, "EPA and NHTSA Propose Historic Nation Program," 2009.

standards are updated periodically to allow for the consideration and inclusion of new energy efficiency technologies and methods. The latest revisions were adopted in 2008 and became effective on January 1, 2010.

Part 11 of the Title 24 Building Standards Code is referred to as the California Green Building Standards Code (CALGreen Code). The purpose of the CALGreen Code is to "improve public health, safety and general welfare by enhancing the design and construction of buildings through the use of building concepts having a positive environmental impact and encouraging sustainable construction practices in the following categories: 1) Planning and design; 2) Energy efficiency; 3) Water efficiency and conservation; 4) Material conservation and resource efficiency; and 5) Environmental air quality."[27] The CALGreen Code is not intended to substitute for or be identified as meeting the certification requirements of any green building program that is not established and adopted by the California Building Standards Commission (CBSC). The CBSC has released a *2010 Draft California Green Building Standards Code* on its website.[28] Part 11 of the Title 24 Building Standards Code became effective on January 1, 2011. Unless otherwise noted in the regulation, all newly constructed buildings in California are subject to the requirements of the CALGreen Code.

3.2.2 Assembly Bill 1493

In response to the transportation sector's contribution of more than half of California's CO_2 emissions, Assembly Bill 1493 (AB 1493, Pavley) was enacted on July 22, 2002. AB 1493 requires CARB to set GHG emission standards for passenger vehicles, light-duty trucks, and other vehicles whose primary use is noncommercial personal transportation. CARB adopted the standards in September 2004. The new standards would phase in during the 2009 through 2016 model years. When fully phased in, the near-term (2009–2012) standards will result in a reduction of about 22 percent in greenhouse gas emissions compared to the emissions from the 2002 fleet, while the mid-term (2013–2016) standards will result in a reduction of about 30 percent.

However, before these regulations could go into effect, the U.S. EPA had to grant California a waiver under the federal CAA, which ordinarily preempts state regulation of motor vehicle emission standards. On June 30, 2009, the U.S. EPA formally approved California's waiver request. On September 15, 2009, the U.S. EPA and the Department of Transportation's (DOT) National Highway Traffic Safety Administration (NHTSA) issued a joint proposal to establish a national program consisting of new standards for model year 2012 through 2016 light-duty vehicles that will reduce GHG emissions and

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27 California Building Standards Commission, 2008 California Green Building Standards Code, (2009) 3.

28 California Building Standards Commission, "CALGreen," http://www.bsc.ca.gov/CALGreen/default.htm. 2010.

improve fuel economy. The proposed standards would be phased in and would require passenger cars and light-duty trucks to comply with a declining emissions standard. In 2012, passenger cars and light-duty trucks would have to meet an average emissions standard of 295 grams of CO_2 per mile and 30.1 miles per gallon.[29] By 2016, the vehicles would have to meet an average standard of 250 grams of CO_2 per mile and 35.5 miles per gallon.[30] These standards were formally adopted by the U.S. EPA and DOT on April 1, 2010. In light of the U.S. EPA and NHTSA standards, California—and states adopting California emissions standards—have agreed to defer to the proposed national standard through model year 2016 if granted a waiver by the U.S. EPA. The 2016 endpoint of the two standards is similar, although the national standard ramps up slightly more slowly than required under the California standard. The Pavley standards require additional reductions in CO_2 emissions beyond 2016 (referred to as Phase II standards), which have not yet been defined.

3.2.3 Executive Order S-3-05 and the Climate Action Team

In June 2005, Governor Schwarzenegger established California's GHG emissions reduction targets in Executive Order S-3-05. The Executive Order established the following goals: GHG emissions should be reduced to 2000 levels by 2010, 1990 levels by 2020, and 80 percent below 1990 levels by 2050. The Secretary of California Environmental Protection Agency (CalEPA) is required to coordinate efforts of various agencies in order to collectively and efficiently reduce GHGs. Some of the agency representatives involved in the GHG reduction plan include the Secretary of the Business, Transportation and Housing Agency, the Secretary of the Department of Food and Agriculture, the Secretary of the Resources Agency, the Chairperson of CARB, the Chairperson of the CEC, and the President of the Public Utilities Commission. Representatives from these agencies comprise the Climate Action Team.

3.2.4 Senate Bill 1078 and 107

In 2002, Senate Bill 1078 (SB 1078, Sher) established California's Renewable Portfolio Standard (RPS) which requires investor-owned utilities, such as Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric, to increase energy production from renewable source 1 percent per year up to a minimum of 20 percent of total energy generation by 2017. SB 107 (Simitian), signed by the Governor on September 26, 2008, accelerated the Renewable Portfolio Standard by requiring investor-owned utilities to meet the 20 percent target by 2010.

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29 U.S. Environmental Protection Agency, "EPA and NHTSA Propose Historic National Program to Reduce Greenhouse Gases and Improve Fuel Economy for Cars and Trucks," http://epa.gov/otaq/climate /regulations/420f09047a.htm. 2009.

30 U.S. EPA, "EPA and NHTSA Propose Historic Nation Program," 2009.

On September 15, 2009, the Governor issued Executive Order S-21-0911 requiring CARB, under its AB 32 authority, to adopt regulations to meet a 33 percent RPS target by 2020. The CARB regulations would use a phased-in or tiered requirement to increase the amount of electricity from eligible renewable sources over an eight year period beginning in 2012. CARB adopted the regulation in September 2010.

3.2.5 Assembly Bill 32

In furtherance of the goals established in Executive Order S-3-05, the Legislature enacted Assembly Bill 32 (AB 32, Nuñez and Pavley), the California Global Warming Solutions Act of 2006, which Governor Schwarzenegger signed on September 27, 2006. AB 32 represents the first enforceable statewide program to limit GHG emissions from all major industries with penalties for noncompliance. AB 32 requires the State to undertake several actions – the major requirements are discussed below:

3.2.5.1 CARB Early Action Measures

CARB is responsible for carrying out and developing the programs and requirements necessary to achieve the goals of AB 32—the reduction of California's GHG emissions to 1990 levels by 2020. The first action under AB 32 resulted in CARB's adoption of a report listing three specific early action greenhouse gas emission reduction measures on June 21, 2007. On October 25, 2007, CARB approved an additional six early action GHG reduction measures under AB 32. CARB has adopted regulations for all early action measures. The original three adopted early action regulations meeting the narrow legal definition of "discrete early action GHG reduction measures" include:

- A low-carbon fuel standard to reduce the "carbon intensity" of California fuels;
- Reduction of refrigerant losses from motor vehicle air conditioning system maintenance to restrict the sale of "do-it-yourself" automotive refrigerants; and
- Increased methane capture from landfills to require broader use of state-of-the-art methane capture technologies.

The additional six early action regulations adopted on October 25, 2007, also meeting the narrow legal definition of "discrete early action GHG reduction measures," include:

- Reduction of aerodynamic drag, and thereby fuel consumption, from existing trucks and trailers through retrofit technology;
- Reduction of auxiliary engine emissions of docked ships by requiring port electrification;
- Reduction of perfluorocarbons from the semiconductor industry;

- Reduction of propellants in consumer products (e.g., aerosols, tire inflators, and dust removal products);
- Require that all tune-up, smog check and oil change mechanics ensure proper tire inflation as part of overall service in order to maintain fuel efficiency; and
- Restriction on the use of sulfur hexafluoride (SF_6) from non-electricity sectors if viable alternatives are available.

3.2.5.2 State of California 1990 Greenhouse Gas Inventory

As required under AB 32, on December 6, 2007, CARB approved the 1990 greenhouse gas emissions inventory, thereby establishing the emissions limit for 2020. The 2020 emissions limit was set at 427 $MMTCO_2e$. The inventory revealed that in 1990 transportation, with 35 percent of the state's total emissions, was the largest single sector generating carbon dioxide, followed by industrial emissions, 24 percent; imported electricity, 14 percent; in-state electricity generation, 11 percent; residential use, 7 percent; agriculture, 5 percent; commercial uses, 3 percent; and forestry emissions (excluding sinks) less than 1 percent. These figures represent the 1990 values. AB 32 does not require individual sectors to meet their individual 1990 GHG emissions inventory; the total statewide emissions are required to meet the 1990 threshold by 2020.

3.2.5.3 CARB Mandatory Reporting Requirements

In addition to the 1990 emissions inventory, CARB also adopted regulations requiring the mandatory reporting of GHG emissions for large facilities on December 6, 2007. The mandatory reporting regulations require annual reporting from the largest facilities in the state, which account for approximately 94 percent of greenhouse gas emissions from industrial and commercial stationary sources in California. About 800 separate sources fall under the new reporting rules and include electricity generating facilities, electricity retail providers and power marketers, oil refineries, hydrogen plants, cement plants, cogeneration facilities, and industrial sources that emit over 25,000 tons of carbon dioxide each year from on-site stationary combustion sources. Transportation sources, which account for 38 percent of California's total greenhouse gas emissions as of the 2002-2004 GHG inventory conducted by CARB,[31] are not covered by these regulations but will continue to be tracked through existing means. Affected facilities began tracking their emissions in 2008, and reported them beginning in 2009, with a phase-in process to allow facilities to develop reporting systems and train personnel in data collection. Emissions for 2008 could be based on best available emission data. Beginning in 2010, however, emissions reporting

[31] California Air Resources Board, "Greenhouse Gas Inventory Data – 2020 Forecast," http://www.arb.ca.gov/cc/inventory/data/forecast.htm. 2009.

requirements became more rigorous and are subject to third-party verification. Verification will take place annually or every three years, depending on the type of facility.

3.2.5.4 AB 32 Climate Change Scoping Plan

As indicated above, AB 32 requires CARB to adopt a scoping plan indicating how reductions in significant GHG sources will be achieved through regulations, market mechanisms, and other actions. CARB released the *Climate Change Scoping Plan* in October 2008, which contained an outline of the proposed State strategies to achieve the 2020 GHG emission limits. The CARB Governing Board approved the *Climate Change Scoping Plan* on December 11, 2008. The *Climate Change Scoping Plan* indicates how emissions reductions will be achieved from significant sources of GHGs via regulations, market mechanism, and other actions. The *Climate Change Scoping Plan* identifies 18 recommended strategies the state should implement to achieve AB 32. As of October 2010, CARB has identified ongoing programs and has adopted regulations for 29 individual measures to reduce GHG emissions in accordance with the *Climate Change Scoping Plan* strategies. CARB will continue to draft additional rule language and conduct public workshops and rulemaking procedures through 2011 and is scheduled to finalize regulations by January 1, 2012.

Key elements of the *Climate Change Scoping Plan* include the following recommendations:

- Expanding and strengthening existing energy efficiency programs as well as building and appliance standards;
- Achieving a statewide renewables energy mix of 33 percent;
- Developing a California cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system;
- Establishing targets for transportation-related greenhouse gas emissions for regions throughout California and pursuing policies and incentives to achieve those targets;
- Adopting and implementing measures pursuant to existing State laws and policies, including California's clean car standards, goods movement measures, and the Low Carbon Fuel Standard; and
- Creating targeted fees, including a public goods charge on water use, fees on high global warming potential gases, and a fee to fund the administrative costs of the State's long-term commitment to AB 32 implementation.

Under the *Climate Change Scoping Plan*, approximately 85 percent of the State's emissions are subject to a cap-and-trade program where covered sectors are placed under a declining emissions cap. The emissions cap incorporates a margin of safety whereby the 2020 emissions limit will still be achieved even in the

event that uncapped sectors do not fully meet their anticipated emission reductions. Emissions reductions will be achieved through regulatory requirements and the option to reduce emissions further or purchase allowances to cover compliance obligations. It is expected that emission reductions from the cap-and-trade program will account for a significant portion of the reductions required by AB 32.

3.2.6 Executive Order S-1-07

On January 18, 2007, California set a new Low Carbon Fuel Standard (LCFS) for transportation fuels sold within the state. Executive Order S-1-07 sets a declining standard for GHG emissions measured in CO_2-equivalent grams per unit of fuel energy sold in California. The target of the LCFS is to reduce the carbon intensity of California passenger vehicle fuels by at least 10 percent by 2020. The LCFS will apply to refiners, blenders, producers, and importers of transportation fuels and will use market-based mechanisms to allow these providers to choose how they reduce emissions during the "fuel cycle" using the most economically feasible methods. CARB identified the LCSF as an early action item under AB 32 and the final regulation was adopted on April 23, 2009.

3.2.7 Senate Bill 97

In August 2007 the legislature enacted SB 97 (Dutton), which directed the Governor's Office of Planning and Research (OPR) to develop guidelines under CEQA for the mitigation of greenhouse gas emissions. A number of actions have taken place under SB 97, which are discussed below:

3.2.7.1 OPR Climate Change Technical Advisory

On June 19, 2008, OPR issued a technical advisory as interim guidance regarding the analysis of GHG emissions in CEQA documents.[32] The advisory indicated that a project's GHG emissions, including those associated with vehicular traffic, energy consumption, water usage, and construction activities, should be identified and estimated. The advisory further recommended that the lead agency determine significance of the impacts and impose all mitigation measures that are necessary to reduce GHG emissions to a less than significant level. The advisory did not recommend a specific threshold of significance. Instead, OPR requested that CARB recommend a method for setting thresholds that lead agencies may adopt.[33]

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32 Office of Planning and Research, *CEQA and Climate Change: Addressing Climate Change Through California Environmental Quality Act (CEQA) Review*, (2008).

33 Office of Planning and Research, *Preliminary Draft CEQA Guideline Amendments for Greenhouse Gas Emissions*, (2009) 4.

3.2.7.2 CEQA Guideline Amendments

In its work to formulate CEQA Guideline Amendments for GHG emissions, OPR submitted the *Proposed Draft CEQA Guideline Amendments for Greenhouse Gas Emissions* to the Secretary for Natural Resources on April 13, 2009. The Natural Resources Agency conducted formal rulemaking procedures and adopted the final CEQA Guideline Amendments on December 30, 2009.

4.0 METHODOLOGY

Development of the proposed projects would generate GHG emissions from stationary, area, and mobile sources. Stationary and area source GHG emissions would be generated by on-site equipment, such as boilers and emergency generators, and the combustion of natural gas once the proposed facilities are occupied. Mobile source GHG emissions would be generated by heavy-duty trucks and passenger vehicles associated with construction activities and occupancy of the proposed development.

The California Climate Action Registry has prepared protocols for calculating and reporting GHG emissions from a number of general and industry-specific activities.[34] The methods described in the California Climate Action Registry's *General Reporting Protocol* has been used to estimate the GHG emissions from the proposed projects; however, it does not define the extent to which direct and indirect emissions resulting from a single proposed development project should be analyzed under CEQA.[35] The Governor's Office of Planning and Research in its technical advisory has recommended that GHG emissions from project-related traffic, energy consumption, water usage, and construction activities, should be identified and estimated. In addition, CARB staff has considered extensively the value of indirect emissions in a mandatory reporting program. CARB believes that indirect energy usage provides a more complete picture of the emissions footprint of a facility: "As facilities consider changes that would affect their emissions – addition of a cogeneration unit to boost overall efficiency even as it increases direct emissions, for example – the relative impact on total (direct plus indirect) emissions by the facility should be monitored. Annually reported indirect energy usage also aids the conservation awareness of the facility and provides information" to CARB to be considered for future strategies by the industrial sector. For these reasons, CARB has proposed requiring the calculation of direct and indirect GHG emissions as part of the AB 32 reporting requirements, and this analysis does so.[36]

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34 California Climate Action Registry, *General Reporting Protocol*, Version 3.1, (2009).

35 Ibid.

36 California Air Resources Board, *Initial Statement of Reasons for Rulemaking, Proposed Regulation for Mandatory Reporting of Greenhouse Gas Emissions Pursuant to the California Global Warming Solutions Act of 2006* (Assembly Bill 32), (2007).

The California Air Pollution Control Officers Association (CAPCOA) has stated that the information needed to characterize GHG emissions from manufacture, transport, and end-of-life of construction materials (often referred to as lifecycle emissions) would be speculative at the CEQA analysis level.[37] Since accurate and reliable data does not exist for estimating lifecycle emissions for the proposed projects, the analysis does not assess such lifecycle GHG emissions.

The data sources and tools used to evaluate the GHG impacts associated with construction and operation of the proposed projects include the URBEMIS2007 Environmental Management Software,[38] and information provided in the *Software User's Guide [for] URBEMIS2007 for Windows*[39] and calculation algorithms supported by the sources listed above. The URBEMIS 2007 model utilizes the EMFAC2007 emissions factor model for on-road motor vehicle sources and the OFFROAD2007 emissions factor model for off-road equipment. Site-specific or project-specific data supplied by the University were used in the URBEMIS2007 model where available. If little or no information was available for the projects, model default values suggested by the Monterey Bay Unified Air Pollution Control District (MBUAPCD) were selected. UCSC has provided a preliminary schedule for construction and the amount of building space to be constructed. The default construction equipment and vehicle mixes generated by URBEMIS2007 were assumed for grading, building construction, and asphalt paving. The number of vendor trips (e.g., transport of building materials) and worker trips were based on default values in the URBEMIS2007 model.

Additional sources consulted for this analysis include data and guidance from the U.S. EPA, the U.S. Energy Information Administration, CARB, the CEC, the California Climate Action Registry's *General Reporting Protocol*, the UCSC Marine Science Campus *Coastal Long Range Development Plan*[40] and the previously certified *CLRDP Environmental Impact Report (EIR)*,[41] and other GHG and global climate change data as referenced. Emission calculations conducted for the proposed projects are contained within **Appendix A**.

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37 California Air Pollution Control Officers Association, *CEQA & Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act*, (2008) 65.

38 Rimpo and Associates, "URBEMIS2007 for Windows," http://www.urbemis.com. 2008.

39 Ibid.

40 University of California, Santa Cruz, Marine Science Campus, *Coastal Long Range Development Plan*, (2008).

41 University of California, Santa Cruz, Marine Science Campus, *CLRDP Environmental Impact Report*, SCH No. 2001112014, (2004).

5.0 THRESHOLDS OF SIGNIFICANCE

In accordance with Senate Bill (SB) 97, the Natural Resources Agency adopted amendments to the *State CEQA Guidelines* on December 30, 2009, which include criteria for evaluating GHG emissions.[42] According to the amended Appendix G of the *State CEQA Guidelines*, a project would have a significant effect on the environment if it would:

- Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment; or
- Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases.

The amended *State CEQA Guidelines* include a new Section 15064.4, which states that, when making a determination regarding the significance of GHG emissions, a lead agency shall have discretion to determine whether to: (1) Use a model or methodology to quantify greenhouse gas emissions resulting from a project, and which model or methodology to use; and/or (2) Rely on a qualitative analysis or performance based standards.

Section 15064.4 also states that a lead agency should consider the following factors when assessing the significance of GHG emissions on the environment: (1) The extent to which the project may increase or reduce greenhouse gas emissions as compared to the existing environmental setting; (2) Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project; and (3) The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of greenhouse gas emissions.

The first Appendix G criterion may be evaluated by performing a direct calculation of the GHG emissions resulting from the proposed projects and comparing the emissions with the available significance thresholds. The MBUAPCD has not established significance thresholds for GHG emissions. However, the MBUAPCD has indicated that the lead agency should establishe a threshold for GHG emissions in accordance with the requirements of CEQA.[43] The Bay Area Air Quality Management District (BAAQMD) adopted thresholds that were designed to capture 90 percent of GHG emissions in the Bay Area, and therefore reflect the types of development projects anticipated in that area. One other air district in California, the South Coast Air Quality Management District (SCAQMD), following a

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42 The adopted amendments may be viewed at the following website: http://ceres.ca.gov/ceqa/guidelines/. 2009.

43 Jean Getchell, Monterey Bay Unified Air Pollution Control District Supervising Planner, email communication with Alisa Klaus, UCSC Associate Environmental Planner, April 13, 2011. A copy of the referenced email is included as **Appendix B**.

methodology similar to that used by the BAAQMD, has drafted an interim numeric screening threshold of 3,000 $MTCO_2e$ per year for residential, commercial, and mixed-use land uses. Alternatively, under the SCAQMD interim guidance, an agency may use the following thresholds by land use type, if they are applied consistently: 3,500 $MTCO_2e$ per year for residential projects, 1,400 $MTCO_2e$ per year for commercial projects, and 3,000 $MTCO_2e$ per year for mixed-use projects. The SCAQMD also uses a threshold of 10,000 $MTCO_2e$ per year for industrial projects.[44] This EIR uses the BAAQMD thresholds as the most conservative of the available numeric thresholds.

The BAAQMD project-level significance thresholds for operational GHG emissions are provided in its *CEQA Air Quality Guidelines*. The BAAQMD's thresholds of significance for operational-related GHG emissions are:

- For land use development projects, the threshold is compliance with a qualified GHG Reduction Strategy; or annual emissions less than 1,100 metric tons CO_2e per year ($MTCO_2e$/yr); or 4.6 MT CO_2e/person/yr (residents plus employees). Land use development projects include residential, commercial, industrial, and public land uses and facilities. This threshold does not include GHG emissions from construction activities.

- For stationary-source projects, the threshold is 10,000 $MTCO_2e$/yr. Stationary-source projects include land uses that would accommodate processes and equipment that emit GHG emissions and would require an Air District permit to operate.

The second Appendix G criterion may be evaluated by demonstrating the projects' compliance with plans, policies, or regulations adopted by local governments to curb GHG emissions. According to the Natural Resources Agency:

> *Provided that such plans contain specific requirements with respect to resources that are within the agency's jurisdiction to avoid or substantially lessen the agency's contributions to GHG emissions, both from its own projects and from private projects it has approved or will approve, such plans may be appropriately relied on in a cumulative impacts analysis* (Natural Resources Agency 2009).

There is no applicable plan that meets the requirements of the CEQA guidelines with respect to this second Appendix G criterion. As a result, this analysis evaluate the potential significance of the projects' GHG emissions under the first Appendix G criterion.

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44 Refer to the following handout from the SCAQMD GHG CEQA Significance Thresholds Working Group: http://www.aqmd.gov/ceqa/handbook/GHG/2010/sept28mtg/wkgp15minutes.pdf.

Under CEQA, "the determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data" (CEQA Section 15064). CEQA grants agencies with the general authority to adopt criteria for determining whether a given impact is "significant" (California Public Resources Code Section 21082). When no guidance exists under CEQA, the agency may look to and assess general compliance with comparable regulatory schemes. The BAAQMD's *CEQA Air Quality Guidelines* represent a comparable regulatory scheme.

Based on the above, the proposed projects' significance with respect to the GHG emissions and global climate change will be assessed based on the BAAQMD's GHG thresholds of significance and on the project features and GHG reduction measures that are recommended to reduce GHG emissions.

6.0 IMPACT ANALYSIS

6.1 Construction Impacts

The proposed projects would result in short-term emissions of GHGs during construction. These emissions, primarily CO_2, CH_4, and N_2O, are the result of fuel combustion by construction equipment and motor vehicles. The other primary GHGs (hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) are typically associated with specific industrial sources and are not expected to be emitted by the proposed projects. The emissions of CO_2 were estimated using URBEMIS2007. However, it does not provide estimates of other GHGs associated with combustion, namely CH_4 and N_2O. Therefore, in order to account for emissions of these compounds, the following adjustments were made to the URBEMIS2007 emission calculations:

- **Construction diesel trucks and equipment**: The CO_2 emissions associated with off-road and on-road equipment were multiplied by a factor based on the assumption that CO_2 represents approximately 99.4 and 99.0 percent, respectively, of the CO_2e emissions. These assumptions were derived from information provided by the California Climate Action Registry[45] and the California Energy Commission.[46]

- **Motor vehicles**: The CO_2 emissions associated with construction worker trips were multiplied by a factor based on the assumption that CO_2 represents 95 percent of the CO_2e emissions associated with

45 California Climate Action Registry, *General Reporting Protocol: Reporting Entity-Wide Greenhouse as Emissions Version 3.1*, (2009) 96, 100.

46 California Energy Commission, *Diesel Use in California*, Remarks by Commissioner James D. Boyd, (2002).

passenger vehicles, which account for most of the project-related trips. This assumption was based on data provided by the U.S. EPA.[47]

Construction activity was modeled based on a starting date in early 2012 and an ending date in early 2014. URBEMIS2007 default values for construction equipment, which represent conservative MBUAPCD-approved assumptions, were used. The majority of the construction equipment and activities are assumed to operate during the workday between 6 and 8 hours. Construction subphases include site preparation (i.e., clearing and grading), pavement and asphalt installation, architectural coating, and construction of the building. **Table 4, Estimated Construction GHG Emissions**, lists the estimated GHG emissions associated with construction of the proposed projects. Refer to **Appendix A** for detailed calculations regarding construction GHG emissions.

Table 4
Estimated Construction Greenhouse Gas Emissions

GHG Emissions Source	Emissions (Metric Tons CO_2e/year)
2012 One-Time Emissions	612.00
2013 One-Time Emissions	227.52
2014 One-Time Emissions	49.32
Total One-Time Construction Emissions	**888.84**

*Source: Impact Sciences, Inc. Emissions calculations are provided in **Appendix A**.*
Totals in table may not appear to add exactly due to rounding.

6.2 Operational Impacts

At full buildout, the projects would result in direct annual emissions of GHGs during operation. These emissions, primarily CO_2, CH_4, and N_2O, are the result of fuel combustion from building heating systems and motor vehicles. Building and motor vehicle air conditioning systems may use HFCs (and HCFCs and CFCs to the extent that they have not been completely phased out at later dates); however, these emissions are not quantified since they would only occur through accidental leaks. It is not possible to estimate the frequency of accidental leaks without some level of speculation. It should be noted that CARB has drafted a proposed "Regulation for Management of High Global Warming Potential Refrigerants" that would reduce emissions of these refrigerants from stationary refrigeration and air-

47 U.S. Environmental Protection Agency, Office of Transportation and Air Quality, *Greenhouse Gas Emissions from a Typical Passenger Vehicle (EPA420-F-05-004)*, (2005) 4.

conditioning systems by requiring persons subject to the rule to reclaim, recover, or recycle refrigerant and to properly repair or replace faulty refrigeration and air conditioning equipment.[48]

6.2.1 Direct Emissions

Direct emissions of CO_2 emitted from operation of the proposed projects are primarily due to natural gas consumption and mobile source emissions. Sources consuming natural gas were divided into two categories, area sources and stationary sources, based on permitting requirements for the MBUAPCD. Area sources are smaller sources that would not require permits to operate within the jurisdiction of the MBUAPCD. These sources include small appliances such as small boilers and water heaters included in the projects. The boilers for the CBB facility and greenhouse were included in this category as they are below the heat rating for boilers that would require a permit to operate. Stationary sources are any sources that would require a permit to operate. For the proposed projects, two generators were categorized as stationary sources since they would require permits to operate due to their horsepower rating.[49]

Area source emissions were calculated using URBEMIS2007 using default assumptions for a university land use type, with the exception of the larger sources with known natural gas consumption rates. These were computed using data supplied by UCSC and standard emission factors for CO_2, CH_4 and N_2O resulting from combustion of natural gas.[50] Stationary source emissions were also calculated using natural gas consumption rates based on the heat rating and operational schedule of the equipment combined with GHG emission factors. Mobile source emissions were calculated using URBEMIS2007, based on trip generation rates based on current trip rates associated with the Marine Science Campus and planned use of the new facilities.[51] As was done for the construction emissions, the direct operational emissions calculated using URBEMIS2007 were adjusted to account for emissions of CH_4 and N_2O using the following methods:

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48 California Air Resources Board, "Stationary Equipment Refrigerant Management Program," http://www.arb.ca.gov/cc/reftrack/reftrack.htm. 2009. This regulation is an early action measure under AB 32.

49 The analysis was based on two standby generators rated at 200 kilowatts (268 horsepower) each and one emergency generator rated at 40 kilowatts (54 horsepower).

50 UCSC estimated natural gas consumption at approximately 59,760 therms per year (approximately 5,976 million British thermal units per year).

51 UCSC estimated that the project would result in approximately 545 average trips per day.

- **Area sources (gasoline-fueled landscaping equipment):** The CO_2 emissions from natural gas consumption and landscaping equipment were adjusted based on emission factors for CO_2, CH_4, and N_2O from URBEMIS2007 and the California Climate Action Registry.[52]

- **Motor vehicles**: The CO_2 emissions associated with project-generated trips were multiplied by a factor based on the assumption that CO_2 represents 95 percent of the CO_2e emissions associated with passenger vehicles, which account for most of the project-related trips. This assumption was based on data provided by the U.S. EPA.[53]

6.2.2 Indirect Emissions

The proposed projects would also result in indirect GHG emissions due to the electricity demands. The emission factor for CO_2 due to electrical demand was obtained from public reports to CCAR for PG&E, the electrical utility serving UCSC.[54] Emission factors for CH_4 and N_2O due to electrical demand were obtained from CARB's *Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories*, which contains GHG emission factors from utility providers in California.[55] The cited factors in the CARB report are based on data collected by the California Climate Action Registry. The emission factors take into account the current mix of energy sources used to generate electricity and the relative carbon intensities of these sources, and includes natural gas, coal, nuclear, large hydroelectric, and other renewable sources of energy. These emission factors do not take into account UCSC's purchase of renewable energy credits from a variety of sources (wind, solar, biogas, small-scale hydropower, and geothermal) to match 84 percent of the campus' electricity demand (the portion of the utility provider's sources from non-renewable sources).[56]

Electricity consumption was based on data provided by the UCSC.[57] In addition to electrical demand, the projects would also result in indirect GHG emissions due to water consumption, wastewater treatment,

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52 California Climate Action Registry, *General Reporting Protocol: Reporting Entity-Wide Greenhouse Gas Emissions* Version 3.1, (2009) 96, 100, 103.

53 U.S. Environmental Protection Agency, Office of Transportation and Air Quality, *Greenhouse Gas Emissions from a Typical Passenger Vehicle (EPA420-F-05-004)*, (2005) 4.

54 California Climate Action Registry, "Climate Action Registry Reporting Online Tool," https://www.climateregistry.org/CARROT/public/reports.aspx. 2010. See 2008 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector, Pacific Gas & Electric.

55 California Air Resources Board, *Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories*, Version 1.1, (2010) 208.

56 Additional information may be found here: http://www.steps.ucsc.edu/climate_report08/appendices%20CAP/UCSC-Assessment-EnergyandClimate-042108reducedsize-MH-FINALdraft.pdf

57 UCSC estimated electricity consumption at approximately 915,400 kilowatt-hours per year.

and solid waste generation.[58] GHG emissions from water consumption are due to the electricity needed to convey, treat, and distribute water. The annual electrical demand factors for potable water were obtained from the California Energy Commission.[59] The projected water consumption was estimated using metered water demand from existing buildings at the Marine Science Campus, cited in the University of California, Santa Cruz *Coastal Long Range Development Plan EIR*.[60] GHG emissions from wastewater are due to the electricity needed to treat wastewater and the treatment process itself, which primarily releases CH_4 into the atmosphere. The City of Santa Cruz Regional Wastewater Treatment Facility uses the methane to generate electricity, thereby reducing the emissions of methane; however, this was not taken into account in calculating the CH_4 emissions from wastewater treatment. Wastewater generation was estimated by multiplying the potable water demand by 80 percent. GHG emission factors for wastewater treatment were obtained from the U.S. EPA.[61] GHG emissions from solid waste generation are due to the decomposition of organic material, which releases CH_4 into the atmosphere. The City of Santa Cruz Resource Recovery Facility is equipped with a landfill gas control and collection system, which is used to generate electricity. The GHG emission factor for solid waste generation was obtained from the U.S. EPA, utilizing the factor for mixed municipal solid waste as disposed in landfills without landfill gas recovery and electric generation as a conservative assumption.[62]

6.2.3 Operational Emissions Summary

The annual GHG emissions associated with the operation of the proposed projects are provided below in **Table 5, Estimated Operational GHG Emissions**. Detailed calculations are provided in **Appendix A.** Direct and indirect emissions operational associated with the proposed projects are compared with the BAAQMD's threshold of significance for land use projects, which is 1,100 MTCO2e per year. Emissions from stationary sources are compared with the threshold for stationary sources, which is 10,000 MTCO2e per year. As shown in **Table 5**, the proposed projects would result in a less than significant impact with respect to GHG emissions.

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58 UCSC estimated potable water demand at approximately 1.94 million gallons per year and solid waste generation at approximately 35.64 tons per year. Wastewater was estimated at 80 percent of the potable water demand (approximately 1.56 million gallons per year).

59 California Energy Commission, *Refining Estimates of Water-Related Energy Use in California, PIER Final Project Report* (CEC-500-2006-118), (2006) 22. Prepared by Navigant Consulting, Inc.

60 University of California, Santa Cruz, *Coastal Long-Range Development Plan EIR*, (2004), 4.16-10.

61 U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors, AP-42,* Fifth Edition, Volume I, Chapter 4.3.5, (1998).

62 U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, *Greenhouse Gas Emission Factors for Management of Selected Materials in Municipal Solid Waste* (EPA-530-R-98-013), (1998).

Table 5
Estimated Operational GHG Emissions

Operational GHG Emissions from Area, and Mobile and Indirect Sources	GHG Emissions ($MTCO_2e$/Year)
Operational (Mobile) Sources	628
Area and Natural Gas Sources	69
Electrical Consumption	270
Solid Waste Generation	12
Water Supply	2
Wastewater Generation	1
Total Annual	**982**
BAAQMD Threshold	**1,100**

Operational GHG Emissions from Stationary Sources	GHG Emissions ($MTCO_2e$/Year)
Standby Generators	262
Emergency Generator	1
Total Annual	**263**
BAAQMD Threshold	**10,000**

Source: Impact Sciences, Inc. Emissions calculations are provided in ***Appendix A.***

6.2.4 GHG Emissions Reductions Measures

The primary GHG emissions regulation in California is AB 32, which is discussed above. As mentioned, the MBUAPCD has not yet adopted any significance thresholds or plan for GHG emissions in its jurisdiction, in which case guidance from the BAAQMD has been used. The BAAQMD GHG significance threshold was specifically designed to ensure compliance with AB 32 emissions reductions requirements in the Bay Area. This was accomplished by estimating growth within the BAAQMD's jurisdiction and determining the GHG emissions allowable from new sources associated with the growth, arriving at the 1,100 $MTCO_2e$ figure. Therefore if a proposed project emits below the significance threshold it can be assumed to comply with AB 32 within the Bay Area. For this analysis, it has been assumed that this would apply to the Monterey Bay region as well. As the projects would emit less than 1,100 $MTCO_2e$ of GHG per year, the projects would not conflict with the state's ability to achieve the reduction targets under AB 32.

The proposed projects would also incorporate required and feasible GHG control measures, and would not hinder, disrupt or delay the implementation of any such control measures. For example, the proposed projects would comply with the *Systemwide Green Building Policy and Clean Energy Standards* approved by The UC Regents in 2003, as well as the *Presidential Policy for Green Building Design and Clean Energy Standards of 2004*. As required by these policies, the projects would adopt the principles of sustainability and energy efficiency to the fullest extent possible, consistent with budgetary constraints and regulatory and programmatic requirements. The UC system has also adopted the American College and University Presidents' Climate Commitment, which includes significant GHG emissions reductions for member universities. In accordance with these policies, UCSC has identified the following specific measures to be adopted for the projects:

- The projects will undergo review under the Savings By Design program to maximize energy efficiency and minimize energy use;
- In the CBB lab building, offices and administrative spaces would be separated from laboratory spaces that require exhausted air, to allow for the use of operable windows for natural ventilation in office spaces, and minimize overall energy consumption related to mechanical ventilation;
- Energy efficient fume hoods would be used, and users would be trained in procedures to minimize unnecessary mechanical ventilation when the hoods are not in use, to further minimize energy demand;
- The long wing of the CBB is oriented east-west, to allow for the greatest exposure to natural light. Uses that would benefit from softer, more uniform indirect lighting would be placed along the northern facade of the building. Southern facades would receive direct sunlight, allowing passive heating during winter days. The installation of solar panels on south-facing roof planes will be considered as a means of supplying a portion of the building's energy demand. Shading devices above windows would minimize overheating during the warm months;
- Bicycle lockers, sheltered bike parking, and showers and lockers for bicycle commuters would be installed at the CBB building;
- Bicycle and pedestrian trails would be constructed to provide access from the campus entrance to the new buildings;
- Plantings would be low-water use, with minimal (if any) turf;
- All interior and exterior lighting will be high efficiency fluorescent, ceramic metal halide, and solid state light sources. Electronic ballast will be used (these reduce energy use for lighting). Energy-efficient halogen sources will be used for specialty display or accent lighting. Exterior lights will be controlled by the campus Energy Management System;
- Toilets will be dual flush (1.6 gpf/1.1 gpf);
- Construction contract will require that at least 75% of construction waste be diverted from landfill.

7.0 CONCLUSION

Based on climate change guidance from various State agencies, this assessment provides estimated GHG emissions due to construction and operation of the proposed projects. The emissions for construction, mobile sources, area sources, natural gas combustion, electricity demand, water demand, wastewater generation, and solid waste generation were estimated using site-specific factors or other factors provided by State and federal agencies. GHG emissions from the manufacture, transport, and end-of-life of construction materials (often referred to as lifecycle emissions) were not estimated because accurate and reliable data does not exist for estimating lifecycle emissions for the proposed projects; therefore such emissions would be speculative at the CEQA analysis level.[63] Based on the analysis, the projects are estimated to emit 982 $MTCO_2e$ per year from project operations, including mobile, indirect, and area sources and 263 $MTCO_2e$ per year from stationary sources.

The emissions associated with the proposed projects represent a conservative assessment of the actual GHG emissions that would result from development of the projects. The construction emissions were based on the assumption that equipment would operate continuously throughout an 8-hour work-day. In reality, construction equipment tends to operate cyclically for only a portion of the work day. As shown in **Table 5**, GHG emissions from motor vehicles represent over half of the total emissions associated with the operation of the proposed projects. As of the date of this report, neither the state nor the federal government regulates tailpipe GHG emissions. However, several regulatory actions have taken place at the federal and state level that would reduce GHG emissions from motor vehicles during future years. Model year 2012 through 2016 vehicles are expected to meet increasingly more stringent fuel economy and GHG emission standards. By 2016, passenger vehicles and light-duty trucks are expected to achieve a Corporate Average Fuel Economy (CAFE) standard of 35.5 miles per gallon and a CO_2 emission standard of 250 grams per mile. This represents an approximately 30 percent reduction in GHG emissions. These reductions were not accounted for in the model. UCSC also purchases renewable energy credits sufficient to cover the amount of electricity purchased from the utility that is not generated by renewable sources. Further, both the City's wastewater and solid waste treatment facilities capture methane emissions and use them for energy, greatly reducing emissions from these facilities. None of these factors were taken into account for this analysis.

The projects would also incorporate several sustainability and GHG reduction measures as required by UC's commitment to both internal and ACUPCC reduction targets. These measures would reduce energy consumption and vehicle traffic to the extent possible, thus ensuring that the projects would not hinder efforts to achieve GHG emissions reductions required under AB 32.

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63 California Air Pollution Control Officers Association, *CEQA & Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act*, (2008) 65.

APPENDIX A

Greenhouse Gas Emission Calculations

CONSTRUCTION GREENHOUSE GAS EMISSIONS

UC Santa Cruz Marine Sciences Campus
Evaluation of Global Climate Change Impacts (Land Use GHG Emissions)

Table GHG-1
Construction Exhaust GHG Emission Factors

Equipment Type	CO_2 Emission Factor[1] (kg/gal)	CH_4 Emission Factor[2,3] (kg/gal)	N_2O Emission Factor[2,3] (kg/gal)	CO_2 to CO_2e Ratio (GWP CH_4 = 21) (GWP N_2O = 310)
Off-Road	10.15	0.00058	0.00026	0.991
On-Road	10.15	0.000031	0.000029	0.999
Vendor	10.15	0.000031	0.000029	0.999
Autos[4]	n/a	n/a	n/a	0.950

Sources:

1. California Climate Action Registry, *General Reporting Protocol: Reporting Entity-Wide Greenhouse Gas Emissions Version 3.1*, (2009) 96.
2. California Climate Action Registry, *General Reporting Protocol: Reporting Entity-Wide Greenhouse as Emissions Version 3.1*, (2009) 98, 100.
3. California Energy Commission, *Diesel Use in California, Remarks by Commissioner James D. Boyd, (*2002). It was assumed that heavy duty on-road trucks have a fuel economy of 6 miles per gallon based on this data source.
4. U.S. Environmental Protection Agency, *Emission Facts - Greenhouse Gas Emissions from a Typical Passenger Vehicle*, (2005) 4. It is assumed that CO_2 accounts for 95% of the greenhouse gas emissions, while CH_4, N_2O, and HFCs account for 5% of emissions.

Table GHG-2
Construction Exhaust GHG Emissions

Construction Year	Equipment Type	Annual CO_2 Emissions[1] (Tons CO_2/yr)	Annual CO_2 Emissions ($MTCO_2$/yr)	CO_2 to CO_2e Ratio	Annual CO_2e Emissions ($MTCO_2e$/yr)
2012	Off-Road	471.49	427.73	0.991	431.64
2012	On-Road	36.95	33.52	0.999	33.55
2012	Vendor	9.22	8.37	0.999	8.38
2012	Worker/Autos	144.96	131.51	0.950	138.43
Total 2012		**662.62**	**601.12**		**611.99**
2013	Off-Road	142.03	128.85	0.991	130.02
2013	On-Road	0.86	0.78	0.999	0.78
2013	Vendor	47.20	42.82	0.999	42.86
2013	Worker/Autos	56.40	51.17	0.950	53.86
Total 2013		**246.49**	**223.61**		**227.52**
2014	Off-Road	16.29	14.78	0.991	14.92
2014	On-Road	0.41	0.38	0.999	0.38
2014	Vendor	1.45	1.31	0.999	1.31
2014	Worker/Autos	34.26	31.08	0.950	32.72
Total 2014		**52.41**	**47.55**		**49.32**

Total Construction Exhaust GHG Emissions	**888.84**
Amortized over "Project Lifetime" (25 years)	**35.55**

Sources:

1. Estimated CO_2 emissions from URBEMIS2007.

Where:

CH_4	Methane	kg	Kilograms
CO_2	Carbon dioxide	MT	Metric ton
CO_2e	Carbon dioxide equivalent	N_2O	Nitrous oxide
gal	Gallons	yr	Year
GWP	Global warming potential		

CONSTRUCTION GREENHOUSE GAS EMISSIONS

Off-Road Equipment and On-Road Truck Calculations

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Urbemis 2007 Version 9.2.4

Combined Annual Emissions Reports (Tons/Year)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Construction\Coastal Biology Building\Coastal Biology Building
Project Name: Coastal Biology Building - Construction Emissions
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	CO2
2012 TOTALS (tons/year unmitigated)	189.64
2012 TOTALS (tons/year mitigated)	189.64
Percent Reduction	0.00
2013 TOTALS (tons/year unmitigated)	214.01
2013 TOTALS (tons/year mitigated)	214.01
Percent Reduction	0.00
2014 TOTALS (tons/year unmitigated)	21.78
2014 TOTALS (tons/year mitigated)	21.78
Percent Reduction	0.00

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Unmitigated

	CO2
2012	189.64
Demolition 07/09/2012-07/20/2012	14.96
Fugitive Dust	0.00
Demo Off Road Diesel	6.20
Demo On Road Diesel	8.10
Demo Worker Trips	0.66
Fine Grading 07/09/2012-07/20/2012	17.76
Fine Grading Dust	0.00
Fine Grading Off Road Diesel	11.24
Fine Grading On Road Diesel	6.00
Fine Grading Worker Trips	0.53

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Trenching 07/23/2012-10/19/2012	115.21
Trenching Off Road Diesel	110.07
Trenching Worker Trips	5.14
Building 10/22/2012-01/10/2014	41.71
Building Off Road Diesel	22.78
Building Vendor Trips	9.22
Building Worker Trips	9.71
2013	214.01
Building 10/22/2012-01/10/2014	213.44
Building Off Road Diesel	116.59
Building Vendor Trips	47.20
Building Worker Trips	49.66
Coating 11/18/2013-12/13/2013	0.57
Architectural Coating	0.00
Coating Worker Trips	0.57
2014	21.78
Building 10/22/2012-01/10/2014	6.54
Building Off Road Diesel	3.57
Building Vendor Trips	1.45
Building Worker Trips	1.52
Asphalt 03/24/2014-04/18/2014	15.24
Paving Off-Gas	0.00
Paving Off Road Diesel	12.72
Paving On Road Diesel	0.41
Paving Worker Trips	2.11

Phase Assumptions

Phase: Demolition 7/9/2012 - 7/20/2012 - Type Your Description Here

Building Volume Total (cubic feet): 272525.9

Building Volume Daily (cubic feet): 27532.92

On Road Truck Travel (VMT): 382.4

Off-Road Equipment:

1 Concrete/Industrial Saws (10 hp) operating at a 0.73 load factor for 8 hours per day

1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 1 hours per day

2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 6 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Fine Grading 7/9/2012 - 7/20/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 3.1
Maximum Daily Acreage Disturbed: 3.1
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 1365.6 cubic yards/day; Offsite Cut/Fill: 203.7 cubic yards/day
On Road Truck Travel (VMT): 283
Off-Road Equipment:
1 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 6 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Trenching 7/23/2012 - 10/19/2012 - Type Your Description Here
Off-Road Equipment:
1 Bore/Drill Rigs (291 hp) operating at a 0.75 load factor for 8 hours per day
1 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day
1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 0 hours per day

Phase: Paving 3/24/2014 - 4/18/2014 - Default Paving Description
Acres to be Paved: 1.1
Off-Road Equipment:
4 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 6 hours per day
1 Pavers (100 hp) operating at a 0.62 load factor for 7 hours per day
1 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day
1 Rollers (95 hp) operating at a 0.56 load factor for 7 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

Phase: Building Construction 10/22/2012 - 1/10/2014 - Default Building Construction Description
Off-Road Equipment:
1 Cranes (399 hp) operating at a 0.43 load factor for 4 hours per day
2 Forklifts (145 hp) operating at a 0.3 load factor for 6 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

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Phase: Architectural Coating 11/18/2013 - 12/13/2013 - Default Architectural Coating Description

Rule: Residential Interior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 100

Rule: Residential Exterior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250

Rule: Nonresidential Interior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250

Rule: Nonresidential Exterior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250

Construction Mitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Mitigated

	CO2
2012	189.64
Demolition 07/09/2012-07/20/2012	14.96
Fugitive Dust	0.00
Demo Off Road Diesel	6.20
Demo On Road Diesel	8.10
Demo Worker Trips	0.66
Fine Grading 07/09/2012-07/20/2012	17.76
Fine Grading Dust	0.00
Fine Grading Off Road Diesel	11.24
Fine Grading On Road Diesel	6.00
Fine Grading Worker Trips	0.53
Trenching 07/23/2012-10/19/2012	115.21
Trenching Off Road Diesel	110.07
Trenching Worker Trips	5.14
Building 10/22/2012-01/10/2014	41.71
Building Off Road Diesel	22.78
Building Vendor Trips	9.22
Building Worker Trips	9.71
2013	214.01
Building 10/22/2012-01/10/2014	213.44
Building Off Road Diesel	116.59
Building Vendor Trips	47.20
Building Worker Trips	49.66
Coating 11/18/2013-12/13/2013	0.57
Architectural Coating	0.00
Coating Worker Trips	0.57

2014	21.78
Building 10/22/2012-01/10/2014	6.54
Building Off Road Diesel	3.57
Building Vendor Trips	1.45
Building Worker Trips	1.52
Asphalt 03/24/2014-04/18/2014	15.24
Paving Off-Gas	0.00
Paving Off Road Diesel	12.72
Paving On Road Diesel	0.41
Paving Worker Trips	2.11

Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/9/2012 - 7/20/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

5/3/2011 02:47:28 PM

Urbemis 2007 Version 9.2.4

Combined Annual Emissions Reports (Tons/Year)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Construction\Infrastruction Improvements\Infrastructure Improvements
Project Name: Infrastructure - Construction Emissions
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	CO2
2012 TOTALS (tons/year unmitigated)	238.47
2012 TOTALS (tons/year mitigated)	238.47
Percent Reduction	0.00
2013 TOTALS (tons/year unmitigated)	25.62
2013 TOTALS (tons/year mitigated)	25.62
Percent Reduction	0.00

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Unmitigated

	CO2
2012	238.47
Demolition 07/09/2012-07/20/2012	0.80
Fugitive Dust	0.00
Demo Off Road Diesel	0.27
Demo On Road Diesel	0.40
Demo Worker Trips	0.13
Fine Grading 07/09/2012-12/07/2012	145.08
Fine Grading Dust	0.00
Fine Grading Off Road Diesel	123.60
Fine Grading On Road Diesel	15.68
Fine Grading Worker Trips	5.80
Trenching 08/06/2012-11/16/2012	80.53
Trenching Off Road Diesel	76.58
Trenching Worker Trips	3.95
Asphalt 12/10/2012-02/15/2013	12.06

Paving Off-Gas	0.00
Paving Off Road Diesel	10.18
Paving On Road Diesel	0.19
Paving Worker Trips	1.69
2013	25.62
Asphalt 12/10/2012-02/15/2013	25.62
Paving Off-Gas	0.00
Paving Off Road Diesel	21.62
Paving On Road Diesel	0.41
Paving Worker Trips	3.58

Phase Assumptions

Phase: Demolition 7/9/2012 - 7/20/2012 - Type Your Description Here
Building Volume Total (cubic feet): 13537.92
Building Volume Daily (cubic feet): 1367.63
On Road Truck Travel (VMT): 18.99
Off-Road Equipment:
1 Concrete/Industrial Saws (10 hp) operating at a 0.73 load factor for 8 hours per day

Phase: Fine Grading 7/9/2012 - 12/7/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 3.5
Maximum Daily Acreage Disturbed: 3.5
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 170.91 cubic yards/day; Offsite Cut/Fill: 7.27 cubic yards/day
On Road Truck Travel (VMT): 67.27
Off-Road Equipment:
1 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 6 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Trenching 8/6/2012 - 11/16/2012 - Type Your Description Here
Off-Road Equipment:
2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day
1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

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Phase: Paving 12/10/2012 - 2/15/2013 - Default Paving Description
Acres to be Paved: 1.6
Off-Road Equipment:
4 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 6 hours per day
1 Pavers (100 hp) operating at a 0.62 load factor for 7 hours per day
1 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day
1 Rollers (95 hp) operating at a 0.56 load factor for 7 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

Construction Mitigated Detail Report:
CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Mitigated

	CO2
2012	238.47
Demolition 07/09/2012-07/20/2012	0.80
Fugitive Dust	0.00
Demo Off Road Diesel	0.27
Demo On Road Diesel	0.40
Demo Worker Trips	0.13
Fine Grading 07/09/2012-12/07/2012	145.08
Fine Grading Dust	0.00
Fine Grading Off Road Diesel	123.60
Fine Grading On Road Diesel	15.68
Fine Grading Worker Trips	5.80
Trenching 08/06/2012-11/16/2012	80.53
Trenching Off Road Diesel	76.58
Trenching Worker Trips	3.95
Asphalt 12/10/2012-02/15/2013	12.06
Paving Off-Gas	0.00
Paving Off Road Diesel	10.18
Paving On Road Diesel	0.19
Paving Worker Trips	1.69

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2013	25.62
Asphalt 12/10/2012-02/15/2013	25.62
Paving Off-Gas	0.00
Paving Off Road Diesel	21.62
Paving On Road Diesel	0.41
Paving Worker Trips	3.58

Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/9/2012 - 12/7/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

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Urbemis 2007 Version 9.2.4

Combined Annual Emissions Reports (Tons/Year)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Construction\Specific Resource Plan\SRP Construction
Project Name: Specific Resource Plan Wetland Restoration
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	CO2
2012 TOTALS (tons/year unmitigated)	68.86
2012 TOTALS (tons/year mitigated)	68.86
Percent Reduction	0.00

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Unmitigated

	CO2
2012	68.86
Fine Grading 07/09/2012-10/15/2012	68.86
Fine Grading Dust	0.00
Fine Grading Off Road Diesel	63.38
Fine Grading On Road Diesel	3.60
Fine Grading Worker Trips	1.87

Phase Assumptions

Phase: Fine Grading 7/9/2012 - 10/15/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 5.5
Maximum Daily Acreage Disturbed: 5.5
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 66.2 cubic yards/day; Offsite Cut/Fill: 2.82 cubic yards/day
On Road Truck Travel (VMT): 23.94
Off-Road Equipment:
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 8 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

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Construction Mitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Mitigated

	CO2
2012	68.86
Fine Grading 07/09/2012-10/15/2012	68.86
Fine Grading Dust	0.00
Fine Grading Off Road Diesel	63.38
Fine Grading On Road Diesel	3.60
Fine Grading Worker Trips	1.87

Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/9/2012 - 10/15/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

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Combined Annual Emissions Reports (Tons/Year)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Phase 4\Phase 4 Infrastructure Emissions.urb924
Project Name: UCSC Marine Science Campus - Phase 4 Infrastructure Construction
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	CO2
2012 TOTALS (tons/year unmitigated)	52.47
2012 TOTALS (tons/year mitigated)	52.47
Percent Reduction	0.00
2013 TOTALS (tons/year unmitigated)	4.90
2013 TOTALS (tons/year mitigated)	4.90
Percent Reduction	0.00

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Unmitigated

	CO2
2012	52.47
Fine Grading 07/20/2012-08/20/2012	28.85
Fine Grading Dust	0.00
Fine Grading Off Road Diesel	24.72
Fine Grading On Road Diesel	2.97
Fine Grading Worker Trips	1.16
Trenching 10/15/2012-11/06/2012	18.25
Trenching Off Road Diesel	17.36
Trenching Worker Trips	0.90
Trenching 12/16/2012-12/23/2012	5.37
Trenching Off Road Diesel	5.11
Trenching Worker Trips	0.26

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2013	4.90
Asphalt 02/15/2013-02/22/2013	4.90
Paving Off-Gas	0.00
Paving Off Road Diesel	3.82
Paving On Road Diesel	0.45
Paving Worker Trips	0.63

Phase Assumptions

Phase: Fine Grading 7/20/2012 - 8/20/2012 - Default Fine Site Grading Description

Total Acres Disturbed: 1.2

Maximum Daily Acreage Disturbed: 0.3

Fugitive Dust Level of Detail: Low

Onsite Cut/Fill: 127.27 cubic yards/day; Offsite Cut/Fill: 63.64 cubic yards/day

On Road Truck Travel (VMT): 63.64

Off-Road Equipment:

1 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day

1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 6 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Trenching 10/15/2012 - 11/6/2012 - Type Your Description Here

Off-Road Equipment:

2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

Phase: Trenching 12/16/2012 - 12/23/2012 - Type Your Description Here

Off-Road Equipment:

2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

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Phase: Paving 2/15/2013 - 2/22/2013 - Default Paving Description

Acres to be Paved: 1.2

Off-Road Equipment:

4 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 6 hours per day

1 Pavers (100 hp) operating at a 0.62 load factor for 7 hours per day

1 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day

1 Rollers (95 hp) operating at a 0.56 load factor for 7 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

Construction Mitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Mitigated

	CO2
2012	52.47
Fine Grading 07/20/2012-08/20/2012	28.85
Fine Grading Dust	0.00
Fine Grading Off Road Diesel	24.72
Fine Grading On Road Diesel	2.97
Fine Grading Worker Trips	1.16
Trenching 10/15/2012-11/06/2012	18.25
Trenching Off Road Diesel	17.36
Trenching Worker Trips	0.90
Trenching 12/16/2012-12/23/2012	5.37
Trenching Off Road Diesel	5.11
Trenching Worker Trips	0.26
2013	4.90
Asphalt 02/15/2013-02/22/2013	4.90
Paving Off-Gas	0.00
Paving Off Road Diesel	3.82
Paving On Road Diesel	0.45
Paving Worker Trips	0.63

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Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/20/2012 - 8/20/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

CONSTRUCTION GREENHOUSE GAS EMISSIONS

Building Construction Worker Trip Calculations (100 Employees)

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Urbemis 2007 Version 9.2.4

Combined Annual Emissions Reports (Tons/Year)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Worker Trips - 100 Employees.urb924
Project Name: Worker Trips - 100 Employees
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Unmitigated

	CO2
Worker Trips	23.19

Phase Assumptions

Phase: Fine Grading 11/30/2012 - 12/31/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 0
Maximum Daily Acreage Disturbed: 0
Fugitive Dust Level of Detail: Default
20 lbs per acre-day
On Road Truck Travel (VMT): 0
Off-Road Equipment:
80 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

CONSTRUCTION GREENHOUSE GAS EMISSIONS

Non-Building Construction Worker Trip Calculations (50 Employees)

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Urbemis 2007 Version 9.2.4

Combined Annual Emissions Reports (Tons/Year)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Worker Trips - 50 Employees.urb924
Project Name: Worker Trips - 50 Employees
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Unmitigated

	CO2
Worker Trips	11.07

Phase Assumptions

Phase: Fine Grading 11/30/2012 - 12/30/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 0
Maximum Daily Acreage Disturbed: 0
Fugitive Dust Level of Detail: Default
20 lbs per acre-day
On Road Truck Travel (VMT): 0
Off-Road Equipment:
40 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

OPERATIONAL GREENHOUSE GAS EMISSIONS

UC Santa Cruz Marine Sciences Campus
Evaluation of Global Climate Change Impacts (Land Use GHG Emissions)

Table GHG-3
Summary of Annual GHG Emissions

	Operational Direct Emissions			Operational Indirect Emissions				Total
Emissions Source	**Motor Vehicles** ($MTCO_2e/yr$)	**Area Sources** ($MTCO_2e/yr$)	**Natural Gas** ($MTCO_2e/yr$)	**Electricity** ($MTCO_2e/yr$)	**Solid Waste** ($MTCO_2e/yr$)	**Water** ($MTCO_2e/yr$)	**Wastewater** ($MTCO_2e/yr$)	**Emissions** **($MTCO_2e/yr$)**
Land Use Emissions	628.36	0.23	68.89	270.12	11.96	1.99	1.14	**982.69**
Stationary Source	—	—	263.25	—	—	—	—	**263.25**

UC Santa Cruz Marine Sciences Campus
Evaluation of Global Climate Change Impacts (Land Use GHG Emissions)

Table GHG-4
Operational Motor Vehicle GHG Emissions

Emissions Scenario	ITE Code	Units	Base Trip Rate[1] (ADT/unit)	Annual CO_2 Emissions[2] (Tons CO_2/yr)	CO_2 to CO_2e Ratio[3]	Annual CO_2e Emissions (MTCO2e/yr)
Proposed Project						
General Light Industry	110	43.00 ksf	12.67	658.02	0.95	628.36
Subtotal				658.02		628.36

Sources:

1. Trip rate provided by the University of California, Santa Cruz.
2. Estimated CO_2 emissions from URBEMIS2007 Environmental Management Software.
3. U.S. Environmental Protection Agency, *Emission Facts - Greenhouse Gas Emissions from a Typical Passenger Vehicle* , (2005) 4. It is assumed that CO_2 accounts for 95% of the greenhouse gas emissions, while CH_4, N_2O, and HFCs account for 5% of the emissions.

Where:

ADT	Average daily trips
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent

UC Santa Cruz Marine Sciences Campus
Evaluation of Global Climate Change Impacts (Land Use GHG Emissions)

Table GHG-5
Area Source GHG Emissions

Emissions Scenario	CO_2 Emission Factor GWP = 1 (kg/MMBtu)	CH_4 Emission Factor GWP = 21 (kg/MMBtu)	N_2O Emission Factor GWP = 310 (kg/MMBtu)	Annual CO_2 Emissions[1] (Tons CO_2/yr)	Annual CO_2e Emissions (MTCO2e/yr)
Proposed Project					
Natural Gas[2] (Non-Res.)	56.06	0.005	0.0001	-	-
Landscape Maintenance[3]	70.88	0.011	0.0006	0.25	0.23
Hearths (Natural Gas)[2]	56.06	0.005	0.0001	-	-
Hearths (Wood)[4]	93.87	0.316	0.0042	-	-
Subtotal				0.25	0.23

Sources:

1. Estimated emissions from URBEMIS2007.
2. Natural gas emissions estimated separately from stationary source equipment. Refer to Table GHG-6.
3. California Climate Action Registry, *General Reporting Protocol: Reporting Entity-Wide Greenhouse Gas Emissions* , Version 3.1, (2009) 101, 103. Landscape maintenance equipment were assumed to be fueled with motor gasoline.
4. California Climate Action Registry, *General Reporting Protocol: Reporting Entity-Wide Greenhouse Gas Emissions* , Version 3.1, (2009) 102, 103.

Where:

CH_4	Methane	MMBtu	Million British thermal units
CO_2	Carbon dioxide	MT	Metric ton
CO_2e	Carbon dioxide equivalent	N_2O	Nitrous oxide
GWP	Global warming potential	yr	Year
kg	Kilogram		

UC Santa Cruz Marine Sciences Campus
Evaluation of Global Climate Change Impacts (Land Use GHG Emissions)

Table GHG-6
Natural Gas Consumption GHG Emissions

Emissions Source	Rating[1]	Greenhouse Gases ($MTCO_2e$)[2]			
		CO_2	CH_4	N_2O	CO_2e
Area Sources[3]					
CBB Boilers	1.50 MMBtu	37.18	0.01	0.00	37.32
Greenhouses Boilers	0.40 MMBtu	7.04	0.00	0.00	7.09
Water Heater #1	0.11 MMBtu	6.26	0.00	0.00	6.28
Water Heater #2	0.12 MMBtu	6.83	0.00	0.00	6.85
Water Heater #3	0.20 MMBtu	11.33	0.00	0.00	11.36
Total					68.89
Stationary Sources[4]					
Standby Generators	200 kW (268 HP)	259.22	—	—	261.83
Emergency Generator	40 kW (54 HP)	1.41	—	—	1.42
Total					263.25

Sources:

1. Equipment specifications provided by the University of California, Santa Cruz.
2. Refer to the stationary source emissions calculations in the Air Quality appendix.
3. These equipment are generally not required to obtain an operating permit from the MBUAPCD. As a result, these emissions are included in the project's land use emissions and compared to the land use significance threshold.
4. These equipment are generally required to obtain an operating permit from the MBUAPCD. As a result, these emissions are included in the project's stationary source emissions and compared to the stationary source significance threshold.

UC Santa Cruz Marine Sciences Campus
Evaluation of Global Climate Change Impacts (Land Use GHG Emissions)

Table GHG-7
Electrical Consumption GHG Emissions

Emissions Scenario	Units	Electricity Consumption Factor[1] (kW-hr/unit/yr)	Annual Consumption Factor (MW-hr/yr)	CO_2 Emission Factor[2] GWP = 1 (lbs/MW-hr)	CH_4 Emission Factor[3] GWP = 21 (lbs/MW-hr)	N_2O Emission Factor[3] GWP = 310 (lbs/MW-hr)	Annual CO_2e Emissions (MTCO2e/yr)
Proposed Project							
University	43,000 sf	21.29	915.40	641.35	0.290	0.010	270.12
Subtotal			915.40				270.12

Sources:

1. Energy consumption provided by the University of California, Santa Cruz.
2. California Climate Action Registry, "Climate Action Registry Reporting Online Tool," https://www.climateregistry.org/CARROT/public/reports.aspx. 2010. See 2008 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector, Pacific Gas & Electric.
   The CO_2 factor is for Pacific Gas & Electric. The CO_2 factor is based on the 2008 value, the latest year for which data is available.
3. The Climate Registry, *Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories*, Version 1.1, (2010) 209.

Where:

CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
gsf	Gross square feet
GWP	Global warming potential
kW-hr	Kilowatt-hour

UC Santa Cruz Marine Sciences Campus
Evaluation of Global Climate Change Impacts (Land Use GHG Emissions)

Table GHG-8
Solid Waste GHG Emissions

Emissions Scenario	Units	Solid Waste Generation[1] (MT/yr)	CO_2e Emission Factor[2] (MT CO_2e/MT waste)	Annual CO_2e Emissions (MT CO_2e/yr)
Proposed Project				
University	43,000 sf	32.33	0.37	11.96
Subtotal		32.33		11.96

Sources:

1. Waste generation rate provided by the University of California, Santa Cruz.
2. U.S. Environmental Protection Agency, *Solid Waste Management and Greenhouse Gases: A Lifecycle Assessment of Emissions and Sinks* (2006) 93. The net CO_2e emission factors are based on mixed municipal solid waste (MSW) as disposed in landfills without landfill gas recovery.

Where:

CO_2e	Carbon dioxide equivalent
gsf	Gross square feet
MT	Metric ton
yr	Year

UC Santa Cruz Marine Sciences Campus
Evaluation of Global Climate Change Impacts (Land Use GHG Emissions)

Table GHG-9
Potable Water Supply, Conveyance, Treatment, and Distribution GHG Emissions

Emissions Scenario	Potable Water Estimate[1] (MG/yr)	Electrical Consumption Factor[2,3,4] (kW-hr/MG)	Annual Electrical Consumption (MW-hr/yr)	CO_2 Emission Factor[5] GWP = 1 (lbs/MW-hr)	CH_4 Emission Factor[6] GWP = 21 (lbs/MW-hr)	N_2O Emission Factor[6] GWP = 310 (lbs/MW-hr)	Annual CO_2e Emissions ($MTCO_2e$/yr)
Proposed Project	1.94						
Supply & Conveyance	1.94	2,117	4.12	641.35	0.029	0.011	1.21
Treatment	1.94	111	0.22	641.35	0.029	0.011	0.06
Distribution	1.94	1,272	2.47	641.35	0.029	0.011	0.72
Recycled Water	-	875	-	641.35	0.029	0.011	-
Subtotal							1.99

Sources:

1. Water demand provided by the University of California, Santa Cruz.
2. California Energy Commission, *California's Water-Energy Relationship, Final Staff Report* , CEC-700-2005-011-SF, (2005) 11.
3. California Energy Commission, *Refining Estimates of Water-Related Energy Use in California, PIER Final Project Report* , CEC-500-2006-118, (2006) 22.
4. R. C. Wilkinson, et. al, California Department of Water Resources, *Water Sources "Powering" Southern California* , n.d.
   Recycled water is estimated to use 285 kW-hr per acre-foot (West Basin Municipal Water District).
5. California Climate Action Registry, "Climate Action Registry Reporting Online Tool," https://www.climateregistry.org/CARROT/public/reports.aspx. 2010. See *2008 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector, Pacific Gas & Electric* .
   The CO_2 factor is for Pacific Gas & Electric. The CO_2 factor is based on the 2008 value, the latest year for which data is available.
6. The Climate Registry, *Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories* , Version 1.1, (2010) 208.

Where:

CH_4	Methane	MG	Million gallons
CO_2	Carbon dioxide	MW-hr	Megawatt-hour
CO_2e	Carbon dioxide equivalent	MT	Metric ton
GWP	Global warming potential	n/a	Not applicable
kW-hr	Kilowatt-hour	N_2O	Nitrous oxide
lbs	Pounds	yr	Year

UC Santa Cruz Marine Sciences Campus
Evaluation of Global Climate Change Impacts (Land Use GHG Emissions)

Table GHG-10
Wasterwater Treatment Electrical Demand GHG Emissions

Emissions Scenario	Net Wastewater Generation Rate[1] (MG/yr)	Electrical Demand Factor[2,3] (kW-hr/MG)	Annual Demand Factor (MW-hr/yr)	CO_2 Emission Factor[4] GWP = 1 (lbs/MW-hr)	CH_4 Emission Factor[5] GWP = 21 (lbs/MW-hr)	N_2O Emission Factor[5] GWP = 310 (lbs/MW-hr)	Annual CO_2e Emissions (MT CO_2e/yr)
Proposed Project							
University	1.56	2,500	3.89	641.35	0.029	0.010	1.14
Subtotal	1.56						1.14

Sources:

1. Wastewater generation was based on an assumption of a 1.25 to 1 ratio of water to wastewater.
2. California Energy Commission, *California's Water-Energy Relationship, Final Staff Report* , CEC-700-2005-011-SF, (2005) 11.
3. California Energy Commission, *Refining Estimates of Water-Related Energy Use in California, PIER Final Project Report (CEC-500-2006-118)* . Prepared by Navigant Consulting, Inc., (2006) 22.
4. California Climate Action Registry, "Climate Action Registry Reporting Online Tool," https://www.climateregistry.org/CARROT/public/reports.aspx. 2010. See *2008 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector, Pacific Gas & Electric.*
   The CO_2 factor is for Pacific Gas & Electric. The CO_2 factor is based on the 2008 value, the latest year for which data is available.
5. The Climate Registry, Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories, Version 1.1, (2010) 208.

Where:

CH_4	Methane	MG	Million gallons
CO_2	Carbon dioxide	MT	Metric ton
CO_2e	Carbon dioxide equivalent	MW-hr	Megawatt-hour
GWP	Global warming potential	N_2O	Nitrous oxide
kW-hr	Kilowatt-hour	yr	Year
lbs	Pounds		

OPERATIONAL GREENHOUSE GAS EMISSIONS

Motor Vehicles and Area Source Calculations

1/21/2011 01:01:45 PM

Urbemis 2007 Version 9.2.4

Combined Annual Emissions Reports (Tons/Year)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Operational\UCSC Marine Campus Operational Emissions.urb924
Project Name: UCSC Marine Science Campus Operational Emissions
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

AREA SOURCE EMISSION ESTIMATES

	CO2
TOTALS (tons/year, unmitigated)	0.25

OPERATIONAL (VEHICLE) EMISSION ESTIMATES

	CO2
TOTALS (tons/year, unmitigated)	658.02

SUM OF AREA SOURCE AND OPERATIONAL EMISSION ESTIMATES

	CO2
TOTALS (tons/year, unmitigated)	658.27

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Annual Tons Per Year, Unmitigated

Source	CO2
Natural Gas	
Hearth	0.00
Landscape	0.25
Consumer Products	
Architectural Coatings	
TOTALS (tons/year, unmitigated)	0.25

Area Source Changes to Defaults

Percentage of residences with wood stoves changed from 35% to 0%
Percentage of residences with wood fireplaces changed from 10% to 0%
Percentage of residences with natural gas fireplaces changed from 55% to 100%

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Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Annual Tons Per Year, Unmitigated

Source	CO2
General light industry	658.02
TOTALS (tons/year, unmitigated)	658.02

Operational Settings:

Includes correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2014 Season: Annual

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
General light industry		12.67	1000 sq ft	43.00	544.81	3,751.02
					544.81	3,751.02

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	44.2	0.5	99.0	0.5
Light Truck < 3750 lbs	17.1	1.2	94.7	4.1
Light Truck 3751-5750 lbs	20.2	0.5	99.0	0.5
Med Truck 5751-8500 lbs	8.4	0.0	100.0	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.4	0.0	71.4	28.6
Lite-Heavy Truck 10,001-14,000 lbs	0.9	0.0	55.6	44.4
Med-Heavy Truck 14,001-33,000 lbs	1.2	0.0	16.7	83.3
Heavy-Heavy Truck 33,001-60,000 lbs	0.7	0.0	0.0	100.0
Other Bus	0.1	0.0	100.0	0.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	4.5	53.3	46.7	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	1.1	0.0	90.9	9.1

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Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	11.8	8.3	7.1	11.8	4.4	4.4
Rural Trip Length (miles)	11.8	8.3	7.1	11.8	4.4	4.4
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
General light industry				50.0	25.0	25.0

OPERATIONAL GREENHOUSE GAS EMISSIONS

Stationary Source Calculations

UCSC Marine Science Campus
Stationary and Area Source Equipment Emissions

Table STA-1
Summary of Stationary and Area Source Equipment Emissions

Equipment	Greenhouse Gases (metric tons per year)	
Emission Source	CO_2	CO_2e
CBB Boilers	37.18	37.32
Greenhouses Boilers	7.04	7.09
Water Heater #1	6.26	6.28
Water Heater #2	6.83	6.85
Water Heater #3	11.33	11.36
Total Area Source	**68.65**	**68.89**
Standby Generators	259.22	261.83
Emergency Generator	1.41	1.42
Total Stationary Source	**260.62**	**263.26**

UCSC Marine Science Campus
CBB Boilers

Boilers		
Nominal Rating per Boiler:	1.5	MMBtu/hr
Number of New Boilers:	2.0	
Operational hours:	16.0	hr/day
	5,840.0	hr/yr
Capacity Factor:	0.2	
Standard Temp	60.0	deg F
Molar Volume	379.7	scf/mole
Heat Content of Natural Gas	1,020.0	Btu/scf

Table STA-2
CBB Boiler Emissions

Units	Greenhouse Gases			
	CO_2	CH_4	N_2O	CO_2e
ppm @ 3% O_2				
lbs/MMBtu	116.98	0.0110	0.0002	117.28
lbs/hr	70.19	0.01	0.00	70.37
lbs/day	224.60	0.02	0.00	4,906.07
lbs/yr	81,977.67	11.59	0.15	82,268.90
tons/yr	40.99	0.01	0.00	41.13
metric tons/yr	37.18	0.01	0.00	37.32

Notes:

1. Emission Factors for ROG, CO, PM_{10}, and SO_X: U.S. Environmental Protection Agency, *AP-42 Compilation of Air Pollutant Emission Factors* , Chapter 1.4, Table 1.4-1 and 1.4-2.
2. Emission factor for $PM_{2.5}$ assumes all PM is less than 1 micron in diameter.
3. Emission factors for CO_2, CH_4, and N_2O: California Climate Action Registry, *General Reporting Protocol* , Version 3.1, (2009) 101, 103.
4. Emissions of CO_2e assumes the following global warming potentials: CO_2 = 1, CH_4 = 21, N_2O = 310.

UCSC Marine Science Campus
Greenhouse Boilers

Boilers		
Nominal Rating per Boiler:	0.4	MMBtu/hr
Number of New Boilers:	1.0	
Operational hours:	8.0	hr/day
	2,920.0	hr/yr
Capacity Factor:	0.3	
Standard Temp	60.0	deg F
Molar Volume	379.7	scf/mole
Heat Content of Natural Gas	1,020.0	Btu/scf

Table STA-3
Greenhouse Boiler Emissions

Units	Greenhouse Gases			
	CO_2	CH_4	N_2O	CO_2e
ppm @ 3% O_2				
lbs/MMBtu	116.98	0.0110	0.0002	117.28
lbs/hr	15.75	0.00	0.00	15.79
lbs/day	42.53	0.00	0.00	4,906.07
lbs/yr	15,524.04	4.39	0.03	15,625.27
tons/yr	7.76	0.00	0.00	7.81
metric tons/yr	7.04	0.00	0.00	7.09

Notes:

1. Emission Factors for ROG, CO, PM_{10}, and SO_X: U.S. Environmental Protection Agency, *AP-42 Compilation of Air Pollutant Emission Factors* , Chapter 1.4, Table 1.4-1 and 1.4-2.
2. Emission factor for $PM_{2.5}$ assumes all PM is less than 1 micron in diameter.
3. Emission factors for CO_2, CH_4, and N_2O: California Climate Action Registry, *General Reporting Protocol* , Version 3.1, (2009) 101, 103.
4. Emissions of CO_2e assumes the following global warming potentials: CO_2 = 1, CH_4 = 21, N_2O = 310.

UCSC Marine Science Campus
Standby Generators

Standby Emergency Generator Rating:	200	kW
	268	HP
Number of Units:	2	
Operating Hours per Unit:	3	hours/day
	927	hours/year

Table STA-4
Standby Generator Emissions

Units	Greenhouse Gases	
	CO_2	CO_2e
g/HP-hr	521.64	526.91
lbs/hr	616.41	622.64
lbs/day	1,565.68	1,581.50
lbs/yr	571,474.01	577,246.48
tons/yr	285.74	288.62
metric tons/yr	259.22	261.83

Notes:

1. Emission factors for all pollutants (except CO_2): U.S. Environmental Protection Agency, AP-42 Compilation of Air Pollutant Emission Factors, Fifth Edition, Section 3.4, Table 3.4-1.
2. Emission factor for CO_2: U.S. Environmental Protection Agency, *AP-42 Compilation of Air Pollutant Emission Factors* , Fifth Edition, Section 3.3, Table 3.3-1.
3. Emissions of CO_2e assume 99% of the greenhouse emissions occur as CO_2. This is consistent with off-road diesel engines.

UCSC Marine Science Campus
Emergency Generator

Standby Emergency Generator		
Rating:	40	kW
	54	HP
Number of Units:	1	
Operating Hours per Unit:	1	hours/day
	50	hours/year

Table STA-5
Emergency Generator Emissions

Units	Greenhouse Gases	
	CO_2	CO_2e
g/HP-hr	521.64	526.91
lbs/hr	62.10	62.73
lbs/day	62.10	62.73
lbs/yr	3,105.05	3,136.42
tons/yr	1.55	1.57
metric tons/yr	1.41	1.42

Notes:

1. Emission factors for all pollutants (except CO_2): U.S. Environmental Protection Agency, AP-42 Compilation of Air Pollutant Emission Factors, Fifth Edition, Section 3.4, Table 3.4-1.
2. Emission factor for CO_2: U.S. Environmental Protection Agency, *AP-42 Compilation of Air Pollutant Emission Factors* , Fifth Edition, Section 3.3, Table 3.3-1.
3. Emissions of CO_2e assume 99% of the greenhouse emissions occur as CO_2. This is consistent with off-road diesel engines.

UCSC Marine Science Campus
Water Heaters

Boilers		
Nominal Rating per Boiler:	0.11	MMBtu/hr
Number of New Boilers:	1.00	
Operational hours:	24.00	hr/day
	8,760.00	hr/yr
Capacity Factor:	0.35	
Standard Temp	60.00	deg F
Molar Volume	379.70	scf/mole
Heat Content of Natural Gas	1,020.00	Btu/scf

Table STA-6
Water Heater Emissions

Units	Greenhouse Gases			
	CO_2	CH_4	N_2O	CO_2e
ppm @ 3% O_2				
lbs/MMBtu	116.98	0.0110	0.0002	117.28
lbs/hr	4.50	0.00	0.00	4.52
lbs/day	37.83	0.00	0.00	4,906.07
lbs/yr	13,808.11	1.30	0.03	13,843.51
tons/yr	6.90	0.00	0.00	6.92
metric tons/yr	6.26	0.00	0.00	6.28

Notes:

1. Emission Factors for ROG, CO, PM_{10}, and SO_X: U.S. Environmental Protection Agency, *AP-42 Compilation of Air Pollutant Emission Factors* , Chapter 1.4, Table 1.4-1 and 1.4-2.
2. Emission factor for $PM_{2.5}$ assumes all PM is less than 1 micron in diameter.
3. Emission factors for CO_2, CH_4, and N_2O: California Climate Action Registry, *General Reporting Protocol* , Version 3.1, (2009) 101, 103.
4. Emissions of CO_2e assumes the following global warming potentials: CO_2 = 1, CH_4 = 21, N_2O = 310.

UCSC Marine Science Campus
Water Heaters

Boilers		
Nominal Rating per Boiler:	0.12	MMBtu/hr
Number of New Boilers:	1.00	
Operational hours:	24.00	hr/day
	8,760.00	hr/yr
Capacity Factor:	0.35	
Standard Temp	60.00	deg F
Molar Volume	379.70	scf/mole
Heat Content of Natural Gas	1,020.00	Btu/scf

Table STA-7
Water Heater Emissions

Units	Greenhouse Gases			
	CO_2	CH_4	N_2O	CO_2e
ppm @ 3% O_2				
lbs/MMBtu	116.98	0.0110	0.0002	117.28
lbs/hr	4.91	0.00	0.00	4.93
lbs/day	41.27	0.00	0.00	4,906.07
lbs/yr	15,063.40	1.42	0.03	15,102.01
tons/yr	7.53	0.00	0.00	7.55
metric tons/yr	6.83	0.00	0.00	6.85

Notes:

1. Emission Factors for ROG, CO, PM_{10}, and SO_X: U.S. Environmental Protection Agency, *AP-42 Compilation of Air Pollutant Emission Factors* , Chapter 1.4, Table 1.4-1 and 1.4-2.
2. Emission factor for $PM_{2.5}$ assumes all PM is less than 1 micron in diameter.
3. Emission factors for CO_2, CH_4, and N_2O: California Climate Action Registry, *General Reporting Protocol* , Version 3.1, (2009) 101, 103.
4. Emissions of CO_2e assumes the following global warming potentials: CO_2 = 1, CH_4 = 21, N_2O = 310.

UCSC Marine Science Campus
Water Heaters

Boilers		
Nominal Rating per Boiler:	0.2	MMBtu/hr
Number of New Boilers:	1	
Operational hours:	24	hr/day
	8,760	hr/yr
Capacity Factor:	0	
Standard Temp	60	deg F
Molar Volume	380	scf/mole
Heat Content of Natural Gas	1,020	Btu/scf

Table STA-8
Water Heater Emissions

Units	Greenhouse Gases			
	CO_2	CH_4	N_2O	CO_2e
ppm @ 3% O_2				
lbs/MMBtu	116.98	0.0110	0.0002	117.28
lbs/hr	8.15	0.00	0.00	8.17
lbs/day	68.44	0.01	0.00	4,906.07
lbs/yr	24,980.13	2.35	0.05	25,044.16
tons/yr	12.49	0.00	0.00	12.52
metric tons/yr	11.33	0.00	0.00	11.36

Notes:

1. Emission Factors for ROG, CO, PM_{10}, and SO_X: U.S. Environmental Protection Agency, *AP-42 Compilation of Air Pollutant Emission Factors* , Chapter 1.4, Table 1.4-1 and 1.4-2.
2. Emission factor for $PM_{2.5}$ assumes all PM is less than 1 micron in diameter.
3. Emission factors for CO_2, CH_4, and N_2O: California Climate Action Registry, *General Reporting Protocol* , Version 3.1, (2009) 101, 103.
4. Emissions of CO_2e assumes the following global warming potentials: CO_2 = 1, CH_4 = 21, N_2O = 310.

APPENDIX B

Email Communication from MBUAPCD

From: Jean Getchell [JGetchell@mbuapcd.org]
Sent: Wednesday, April 13, 2011 12:15 PM
To: Alisa Klaus
Cc: Greg Chee
Subject: RE: Greenhouse gas emission thresholds

Alisa:

The Monterey Bay Unified APCD has not yet adopted thresholds. As to using the Bay Area's thresholds, you have that discretion. Either the efficiency threshold or the "Bright Line" / mass emissions threshold may be used. As the Bay Area specified in its thresholds document, utilizing the Efficiency Threshold for projects with large service populations might accommodate emissions greater than the Bright Line threshold, which might subject the analysis to criticism. However, the lead agency has the discretion to choose a threshold for a particular project.

I urge you to consider the following section from CCR Title 14 / new CEQWA Guidelines in your project analysis.

14 CCR § 15064.4

Cal. Admin. Code tit. 14, § 15064.4

Title 14. Natural Resources
Division 6. Resources Agency
Chapter 3. Guidelines for Implementation of the California Environmental Quality Act
Article 5. Preliminary Review of Projects and Conduct of Initial Study § 15064.4. Determining the Significance of Impacts from Greenhouse Gas Emissions.

(a) The determination of the significance of greenhouse gas emissions calls for a careful judgment by the lead agency consistent with the provisions in section 15064. A lead agency should make a good-faith effort, based to the extent possible on scientific and factual data, to describe, calculate or estimate the amount of greenhouse gas emissions resulting from a project. A lead agency shall have discretion to determine, in the context of a particular project, whether to:

(1) Use a model or methodology to quantify greenhouse gas emissions resulting from a project, and which model or methodology to use. The lead agency has discretion to select the model or methodology it considers most appropriate provided it supports its decision with substantial evidence. The lead agency should explain the limitations of the particular model or methodology selected for use; and/or

(2) Rely on a qualitative analysis or performance based standards.

(b) A lead agency should consider the following factors, among others, when assessing the significance of impacts from greenhouse gas emissions on the environment:

(1) The extent to which the project may increase or reduce greenhouse gas emissions as compared to the existing environmental setting;

(2) Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project.

(3) The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of greenhouse gas emissions. Such requirements must be adopted by the relevant public agency through a public review process and must reduce or mitigate the project's incremental contribution of greenhouse gas emissions. If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding compliance with the adopted regulations or requirements, an EIR must be prepared for the project.

Note: Authority cited: Sections 21083 and 21083.05, Public Resources Code. Reference: Sections 21001, 21002, 21003, 21065, 21068, 21080, 21082, 21082.1, 21082.2, 21083.05 and 21100, Public Resources Code; Eureka Citizens for Responsible Govt. v. City of Eureka (2007) 147 Cal.App.4th 357; Mejia v. City of Los Angeles (2005) 130 Cal.App.4th 322; Protect the Historic Amador Waterways v. Amador Water Agency (2004) 116 Cal.App.4th 1099; Communities for a Better Environment v. California Resources Agency (2002) 103 Cal.App.4th 98; Berkeley Keep Jets Over the Bay Com. v. Board of Port Comm. (2001) 91 Cal.App.4th 1344; and City of Irvine v. Irvine Citizens Against Overdevelopment (1994) 25 Cal.App.4th 868.

-----Original Message-----
From: Alisa Klaus [mailto:aklaus@ucsc.edu]
Sent: Wednesday, April 13, 2011 11:52 AM
To: Jean Getchell
Subject: Greenhouse gas emission thresholds

Jean--Our consultant, Impact Sciences, contacted you last November to ask whether it would be acceptable for us to use the BAAQMD significance threshold for greenhouse gases for the campus' Cogeneration Plant Replacement Project. At that time, you responded that, because the MBUAPCD has not yet adopted thresholds for stationary sources or land use, it would be acceptable for you to reference the Bay Area AQMD's threshold of 10,000 MT/year.
We are preparing an EIR for a lab building and infrastructure project with small stationary sources (standby and emergency generators), but whose greenhouse gas emissions are primarily from area, mobile and indirect sources. Would it be acceptable to use the BAAQMD thresholds for these sources as well as the stationary sources? If so, is there any reason to consider the "efficiency" threshold (4.6 tons/service population/year) vs. the numeric threshold of 1,100 tons/year for the project, to be more transferable to the Monterey Bay region? If not, is there some other threshold that you would recommend using?
Thank you--Alisa Klaus

--
Alisa Klaus
Associate Environmental Planner
Physical Planning & Construction
UC Santa Cruz
831-459-3732
831-459-5517 fax

Appendix F

Project Hydrologic Analysis

Draft Hydrologic Analysis Summary

Detention

Flow values for existing and Phase 1 conditions were calculated and compared to determine whether detention was required. Refer to **Figure 1** for existing conditions and watersheds. Refer to **Figure 2** for Phase 1 condition detention system and watersheds. Where the existing peak flow for a major watershed or group of minor watersheds was less than the developed condition peak flow, detention would be required and must be sized with outlet flow less than or equal to existing flow. In watersheds where little development is planned, imperviousness was compared between existing and Phase 1 conditions. Where the imperviousness is reduced by Phase 1 conditions, as shown in the **Table 1** below, an analysis was not necessary to determine a need for detention.

Table 1. Summary of Reduction of Imperviousness

Proposed Addition of Impervious Area	Proposed Removal of Existing Impervious Area	Net Balance of Impervious Area
Watershed 2-A Parking Lot Road: 3,100 ft^2	Watershed 2, Removal of McAllister Way : 7,405 ft^2	Removal of Impervious Area: 4,305 ft^2
Watershed 3-A Area: 7,021 ft^2	Watershed 3 & 3-B, Removal of McAllister Way: 14,023 ft^2	Removal of Impervious Area: 7,002 ft^2

The 100-year storm was analyzed for watersheds draining to Younger Lagoon Reserve. The 25-year storm was analyzed elsewhere. For larger watersheds and/or where detention was required within a sub-watershed, the TR-55 Method was run using HEC-HMS, the US Army Corps of Engineers Hydrology Modeling System software. For smaller sheds or for watersheds, the Rational Method was used. Methodology is indicated in **Table 2**, which summarizes the results of the hydrologic analyses.

Table 2. Summary of Hydrologic Analysis Performed for Detention Basin Sizing

	Existing Conditions		Phase 1 Developed Conditions		
Storm Event and Hydrologic Methodology	**Watershed**	**Q (cfs)**	**Watershed/ Detention Basin**	**Q_{in} (cfs)**	**Q_{out} or $Q_{undetained}$ (cfs)**
100-year, 24-hour Rational Method			4-West-A5[2]		0.9
100-year, 24-hour Rational Method			4-South-A[3] [5]		2.0
100-year, 24-hour TR-55 Method			7A[4]		1.0
100-year, 24-hour TR-55 Method	8A[1]	8.0	8A[1]		3.9
Drains to YLR	**Total**	**8.0**	**Total**		**7.8**

	Existing Conditions		Phase 1 Developed Conditions		
Storm Event and Hydrologic Methodology	**Watershed**	**Q (cfs)**	**Watershed/ Detention Basin**	**Q_{in} (cfs)**	**Q_{out} or $Q_{undetained}$ (cfs)**
25-year, 24-hour Rational Method	4-South-B	0.2	4-South-B[5]		0.4
			4-West-A/DB1	1.8	
			4-East-B/DB1	0.5	
25-year, 24-hour TR-55 Method	4-West + 4-East-B	1.2	4-West-B/DB1	0.5	
			Detention Basin DB1		0.8
Drains to W4	**Total**	**1.4**	**Total**		**1.2**
100-year, 24-hour TR-55 Method	1A	0.1	1A/DB2	1.1	
			Detention Basin DB2		0.1
Drains to W2	**Total**	**0.1**	**Total**		**0.1**
100-year, 24-hour TR-55 Method	2B	0.4	2B/DB3	3.7	
			Detention Basin DB3		0.4
Drains to W3	**Total**	**0.4**	**Total**		**0.4**

Notes:

(1) Under Phase 1 conditions, the percent of impervious area for Developed Watershed 8A is reduced approximately 30% compared to the existing condition. Therefore, additional runoff from Developed Watersheds 4-West-A5, 4-South-A, and 7A are proposed to be re-routed through Developed Watershed 8A and outflow through the perforated pipe into Younger lagoon Reserve (YLR).

(2) Existing Watershed 4-West-A5 drains to Wetland 4 (W4). Due to site limitations (i.e., roof layout, flat slope, etc.), it was necessary to route the Watershed 4-West-A5 runoff through proposed trench drains crossing McAllister Way, the vegetated swale, and the perforated pipe outlet that discharges into YLR.

(3) Existing Watershed 4-South-A is draining to YLR through the existing underground storm drain pipeline system adjacent to the NOAA building. Developed Watershed 4-South-A is proposed to drain through the proposed trench drain crossing McAllister Way, the vegetated swale, and the perforated pipe that discharges into YLR.

(4) Existing Watershed 7A drains to the ocean through the existing underground Filtered Sea Water Return pipeline system that runs along McAllister Way. As directed by the University, the existing Filtered Sea Water pipeline will not be available for the future runoff from Watershed 7A. Therefore, the runoff from Developed Watershed 7A is proposed to be re-routed through Developed Watershed 8A and outflow through the perforated pipe into YLR.

(5) Existing Watershed 4-South-B drains to W4. Developed Watershed 4-South-B is also proposed to drain into W4. However, to maintain the peak outflow to W4 between the pre- and post- developed conditions, the proposed drainage area for Watershed 4-South-B was reduced while the proposed drainage area for Watershed 4-South-A was increased.

Appendix A presents watershed characteristic calculations used to develop input for HEC-HMS. Following the watershed characteristic table are the HEC-HMS output tables. **Appendix B** includes Rational Method calculations used for watersheds 4-South-B, 4-West-A5, and 4-South-A. Due to the variability of the groundwater at the site, the detention ponds were sized assuming of zero infiltration. This is a conservative analysis to account for periods when the groundwater is close to the surface and all runoff will need to be detained within the detention basin.

Conveyance and Water Quality

For the majority of the Middle Terrace, vegetated swales convey the 25-year storm as overland flow. The drainage conveyance system in watershed 8A was designed for the 100-year storm, per CLRDP requirements, as this flow drains into Younger Lagoon. The watershed 8A system consists of vegetated strip, vegetated swales , and perforated pipes to spread out flow. Rational Method calculations developed to size conveyance features are included in **Appendix C**.

Water quality treatment is required for the surface runoff from the roads, paths, yards, parking lots, and building roofs where pollutants such as sediment, oil/grease, and dissolved metals may be present. Water quality treatment is not required for the surface runoff from the landscaped areas or native undeveloped areas. For water quality analysis, the 85th percentile storm flows and volumes were computed using the Rational Method. These flows and volumes were used to size proposed water quality elements, such as vegetated strips, vegetated swales, infiltration trenches, bioretention, and media filter units. Rational Method calculations developed to size water quality features reside in **Appendix C.**

Figure 3 and detail sheet **DET1** present the proposed conveyance system and the water quality systems.

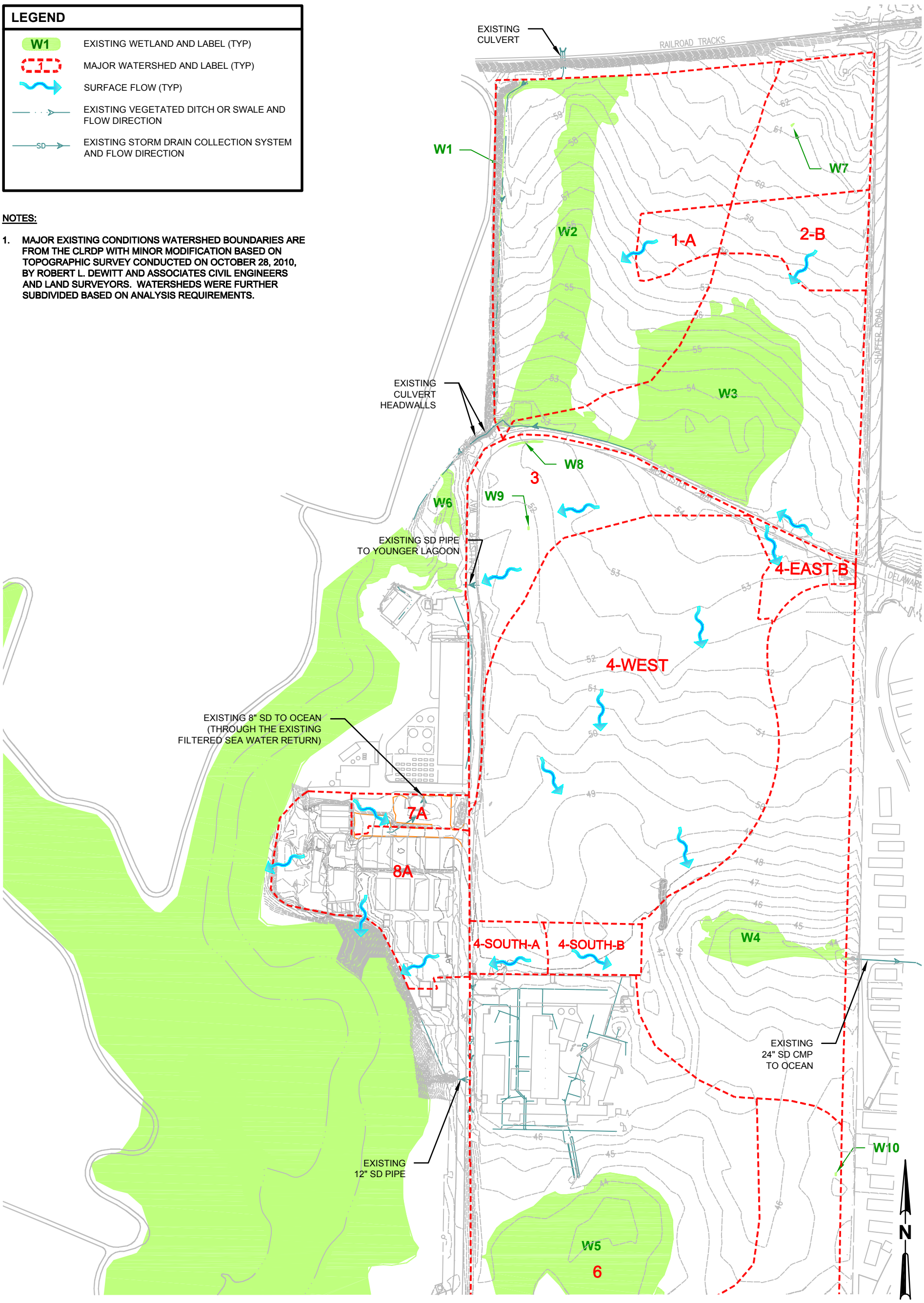
Figures

LEGEND

- W1 — EXISTING WETLAND AND LABEL (TYP)
- 1 — MAJOR WATERSHED AND LABEL (TYP)
- SURFACE FLOW (TYP)
- EXISTING VEGETATED DITCH OR SWALE AND FLOW DIRECTION
- SD — EXISTING STORM DRAIN COLLECTION SYSTEM AND FLOW DIRECTION

NOTES:

1. MAJOR EXISTING CONDITIONS WATERSHED BOUNDARIES ARE FROM THE CLRDP WITH MINOR MODIFICATION BASED ON TOPOGRAPHIC SURVEY CONDUCTED ON OCTOBER 28, 2010, BY ROBERT L. DEWITT AND ASSOCIATES CIVIL ENGINEERS AND LAND SURVEYORS. WATERSHEDS WERE FURTHER SUBDIVIDED BASED ON ANALYSIS REQUIREMENTS.



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MARINE SCIENCE CAMPUS
MIDDLE TERRACE
DRAFT GRADING & DRAINAGE MASTER PLAN

EXISTING CONDITIONS

PROJ NO: 10311-10-007
DRWN: TP | CHKD: TS
DATE: JANUARY, 2011
FIGURE NO: 1

2011-02-28 9:51 AM TPHAM
P:\PROJECTS\10311 UC SANTA CRUZ\10311-10-007 2010 MARINE SCIENCE CAMPUS INFRASTRUCTURE DESIGN DEVELOPMENT\06-CAD\FIGURES\MASTER PLAN FIGURES\10311-10-007-FIG1.DWG

LEGEND

- W1 — EXISTING WETLAND AND LABEL (TYPICAL)
- MAJOR WATERSHED (TYPICAL)
- 6A — MINOR WATERSHED AND LABEL (TYPICAL)
- SURFACE FLOW (TYPICAL)
- EXISTING VEGETATED DITCH OR SWALE AND FLOW DIRECTION
- SD — EXISTING VEGETATED STORM DRAIN COLLECTION SYSTEM AND FLOW DIRECTION
- PHASE 1 STORMWATER DETENTION BASIN AND LABEL (TYPICAL)
- SWALE 14 — PHASE 1 VEGETATED SWALE, LABEL, AND FLOW DIRECTION
- SD — PHASE 1 STORM DRAIN PIPE, LABEL, AND FLOW DIRECTION
- PROPOSED BUILDINGS CONSTRUCTED DURING PHASE 1

EXISTING CULVERT
RAILROAD TRACKS
W1
W7
W2
1-A
2-B
DB2
DB3
6" DISCHARGE PIPE
8" DISCHARGE PIPE
SHAFFER ROAD
EXISTING CULVERT HEADWALLS
W3
W8
W6
W9
3-A
2-A
4-East-B
DELAWARE
EXISTING SD PIPE TO YOUNGER LAGOON
3-B
4-West-A3
4-West-B
APPROXIMATE LOCATION OF INTERIM BERM
7A
4-West-A4
8A
4-West-A5
DB1
10" DISCHARGE PIPE
W4
4-South-A
4-South-B
EXISTING 24" SD CMP TO OCEAN
EXISTING 12" SD PIPE
W10
W5
N

1"=200' 0 200' 400'

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MARINE SCIENCE CAMPUS
MIDDLE TERRACE
DRAFT GRADING & DRAINAGE MASTER PLAN

PHASE 1 SYSTEM
PROPOSED DETENTION

PROJ NO: 10311-10-007
DRWN: TP | CHKD: TS
DATE: JANUARY, 2011
FIGURE NO: 2

2011-02-28 12:19 PM TPHAM
P:\PROJECTS\10311 UC SANTA CRUZ\10311-10-007 2010 MARINE SCIENCE CAMPUS INFRASTRUCTURE DESIGN DEVELOPMENT\06-CAD\FIGURES\MASTER PLAN FIGURES\1031110007-FIG2_PH1.DWG

LEGEND

- W1 — EXISTING WETLAND AND LABEL (TYPICAL)
- MAJOR WATERSHED (TYPICAL)
- 6A — MINOR WATERSHED AND LABEL (TYPICAL)
- EXISTING VEGETATED DITCH OR SWALE AND FLOW DIRECTION
- SD — EXISTING STORM DRAIN COLLECTION SYSTEM AND FLOW DIRECTION
- WATER QUALITY TREATMENT (BIO RETENTION, INFILTRATION TRENCH, VEGETATED STRIP, CDS UNIT)
- PHASE 1 STORMWATER DETENTION BASIN AND LABEL (TYPICAL)
- SWALE 14 — PHASE 1 VEGETATED SWALE, LABEL, AND FLOW DIRECTION
- SD — PHASE 1 STORM DRAIN PIPE, LABEL, AND FLOW DIRECTION
- PROPOSED BUILDINGS CONSTRUCTED DURING PHASE 1

SWALE	BOTTOM WIDTH (FT)	LEFT SIDE SLOPE (H:V)	RIGHT SIDE SLOPE (H:V)	DEPTH (FT)
7	2	3:1	3:1	0.5
14*	2	3:1	3:1	0.5
17	2	3:1	3:1	0.75
18**	2	3:1	3:1	0.5
Box-3***	4	-	-	1

* SWALE IS SIZED FOR INTERIM CONDITION
** TEMPORARY VEGETATED SWALE
*** TRENCH DRAIN

EXISTING CULVERT
RAILROAD TRACKS
W1
W7
BIORETENTION (TYPICAL)
2-B
1-A
W2
DB2
DB3
6" DISCHARGE PIPE
8" DISCHARGE PIPE
SHAFFER ROAD
EXISTING CULVERT HEADWALLS
W3
W8
BIORETENTION (TYPICAL)
PERMEABLE PARKING (TYPICAL)
W6
W9
3-A
2-A
EXISTING SD PIPE TO YOUNGER LAGOON
4-East-B
DELAWARE
VEGETATED STRIP AND BIORETENTION (TYPICAL) SEE DETAIL 2/DET1
3-B
TEMPORARY VEGETATED SWALE
PERMEABLE PARKING (TYPICAL)
4-West-A3
4-West-B
SWALE 18
APPROXIMATE LOCATION OF INTERIM BERM
DB2
VEGETATED SWALE SEE DETAIL 1/DET1
PERFORATED PIPE DISCHARGE TYPICAL - 6 EA SEE DETAIL 4/DET1
7A
SWALE-14
BOX-3
BIORETENTION (TYPICAL)
PROPOSED BERM
4-West-A4
INFILTRATION TRENCH SEE DETAIL 6/DET-1
PROPOSED CATCH BASIN WITH MEDIA FILTER SEE CBB PROJECT FOR GRADING AND DRAINAGE DETAILS
8A
4-West-A5
DB1
10" DISCHARGE PIPE
(2) 4"W x 4.5"D TRENCH DRAIN
W4
12" SD PIPE DISCHARGE TO VEGETATED SWALE
SWALE 17
4-East-A
4-South-A
PERMEABLE PARKING AND BIORETENTION SEE DETAIL 3/DET1. SEE CBB PROJECT FOR GRADING AND DRAINAGE DETAILS
(3) 4"W x 6"D TRENCH DRAIN
(8) 4"W x 6"D TRENCH DRAIN
EXISTING 24" SD CMP TO OCEAN
PROPOSED FORE BAY SEE DETAIL 5/DET-1
EXISTING 12" SD PIPE
W10
BIORETENTION (TYPICAL)
W5
N
0 200' 400'
1"=200'

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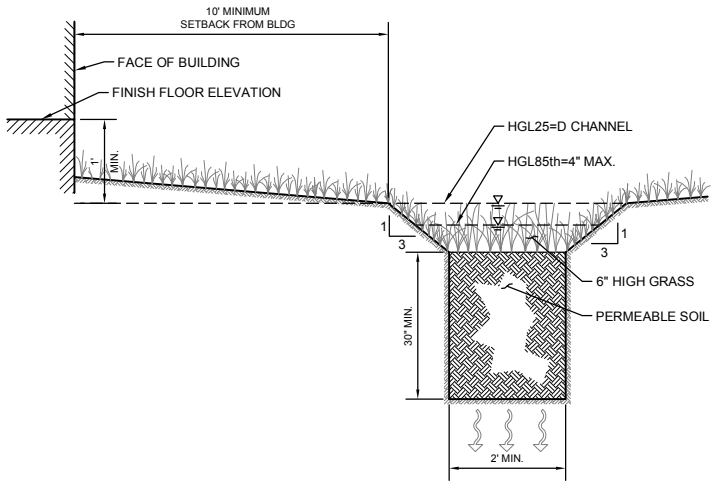
MARINE SCIENCE CAMPUS
MIDDLE TERRACE
DRAFT GRADING & DRAINAGE MASTER PLAN

PHASE 1 SYSTEMS
PROPOSED CONVEYANCE
AND WATER QUALITY

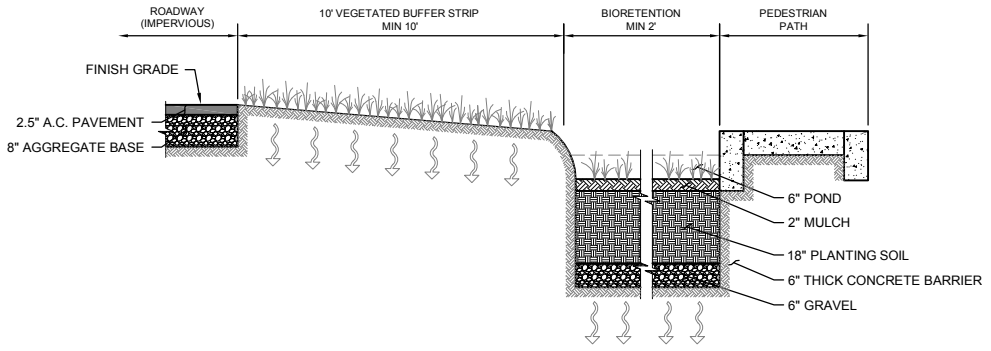
PROJ NO: 10311-10-007
DRWN: TP | CHKD: TS
DATE: JANUARY, 2011
FIGURE NO: 3

2011-02-28 2:14 PM TPHAM
P:\PROJECTS\10311 UC SANTA CRUZ\10311-10-007 2010 MARINE SCIENCE CAMPUS INFRASTRUCTURE DESIGN DEVELOPMENT\06-CAD\FIGURES\MASTER PLAN FIGURES\1031110007-FIG3_PH1.DWG



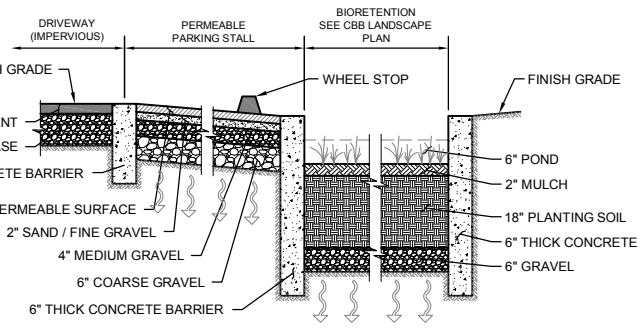
1 TYPICAL VEGETATED SWALE

SCALE: NONE



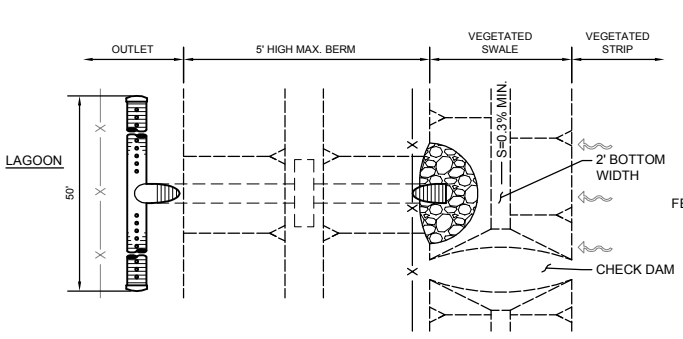
McALLISTER WAY
2 VEGETATED BUFFER STRIP AND BIORETENTION

SCALE: NONE

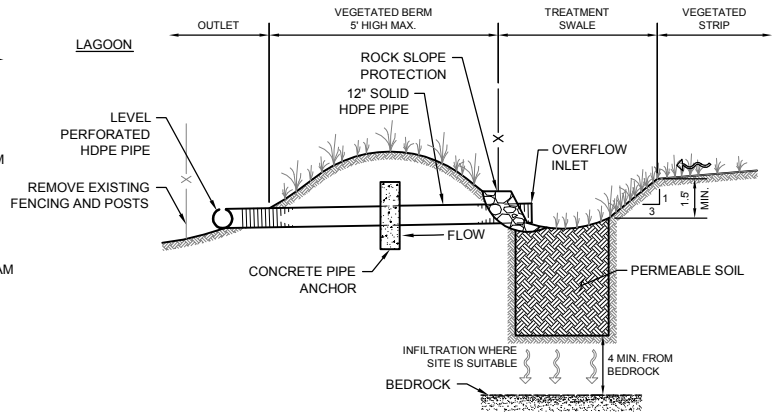


CBB PARKING LOT
3 PERMEABLE PARKING AND BIORETENTION

SCALE: NONE



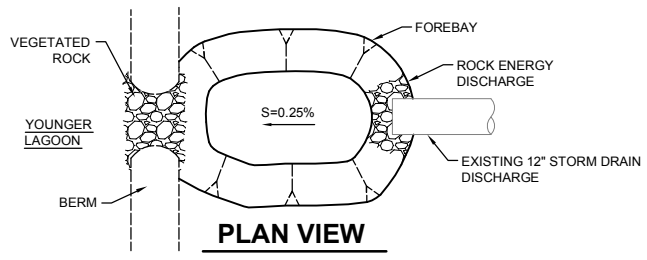
PLAN VIEW



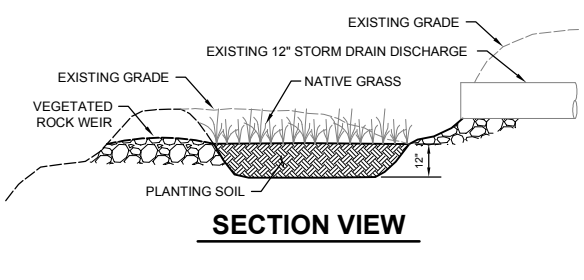
SECTION VIEW

4 TYPICAL DISCHARGE DETAIL

SCALE: NONE



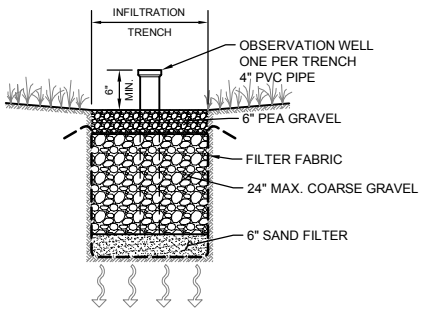
PLAN VIEW



SECTION VIEW

5 EXISTING STORM DRAIN DISCHARGE AND PROPOSED FOREBAY

SCALE: NONE



6 INFILTRATION TRENCH

SCALE: NONE

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DRAFT GRADING & DRAINAGE MASTER PLAN

DETAILS

PROJ NO: 10311-10-007
DRWN: PS | CHKD: TP
DATE: JANUARY, 2011
FIGURE NO:
DET1

2011-02-10 6:51 PM TPHAM
P:\PROJECTS\10311 UC SANTA CRUZ\10311-10-007 2010 MARINE SCIENCE CAMPUS INFRASTRUCTURE DESIGN DEVELOPMENT\06-CAD\FIGURES\MASTER PLAN FIGURES\

Appendix A - Detention System Analysis

HEC-HMS Input/Watershed Characteristics Tables

HEC-HMS Output

UCSC - Phase 1 Detention System
Watershed Characteristics - Existing and Developed Conditions
Land Use

Watershed	Design Storm	Area			Grade				CN (weighted)				Impervious Area							
		Shed Area	Shed Area	Shed Area	L	Zus	Zds	DZ	average slope S	$L_{centroid}$	Soil Type	CN	Building	Yard Space	Imp Path	Road	Impervious Parking	Total Impervious Area	Total Impervious Area	Percent Impervious
		(sf)	(ac)	(sm)	(ft)	(ft)	(ft)	(ft/ft)	(ft/ft)	(ft)			(sf)	(sf)	(sf)			(sf)	(ac)	
Dev 4-West-A	25-yr	285,709	6.6	0.0102	952	53.00	48.00	5	0.0053	440	B	65	17,308	0	7,531	20,156	0	44,995	1.0	16%
Dev 4-West-B	25-yr	183,439	4.2	0.0066	795	54.00	47.10	6.9	0.0087	440	B	57	0	0	6,027	6,581	0	6,091	0.1	3%
Dev 4-East-B	25-yr	24,997	0.6	0.0009	1003	54.00	48.00	6	0.0060	440	B	74	0	0	3,120	8,456	0	11,576	0.3	46%
Ex 4-West & Ex 4-East-B	25-yr	507,854	11.7	0.0182	1003	54.00	48.00	6	0.0060	440	B	57	0	0	0	7,463	0	7,463		2%
Dev 7A	100-yr	17,608	0.4	0.0006	280	49.47	47.82	1.65	0.0059	440	B	76			9,347			9,347		53%
Dev 8A	100-yr	100,977	2.3	0.0036	335	49.02	45.03	3.99	0.0119	440	B	73	22,496		34,435			56,931	1.3	56%
Ex 8A	100-yr	100,977	2.3	0.0036	362	49.50	43.00	6.5	0.0180	440	B	87	30,812		56,156			86,968	2	86%
Ex 1A	100-yr	10321	0.2	0.0004	155.26	59.5	58	1.5	0.009661	440	B	56	0	0	0	0	0	0	0.0	0%
Dev 1A	100-yr	10321	0.2	0.0004	155.26	59.5	58	1.5	0.009661	440	B	89	0	10,321	0	0	0	10,321	0.2	100%
Ex 2B	100-yr	42143	1.0	0.0015	300.56	61.5	58	3.5	0.011645	440	B	56	0	0	0	0	0	0	0.0	0%
Dev 2B	100-yr	42143	1.0	0.0015	300.56	61.5	58	3.5	0.011645	440	B	89	0	42,143	0	0	0	42,143	1.0	100%

Lag Time

Watershed	T_{lag}*	T_{lag}	P
	(hrs)	(min)	(in)
Dev 4-West-A	0.743	44.6	4.40
Dev 4-West-B	0.741	44.5	4.40
Dev 4-East-B	0.320	19.2	4.40
Ex 4-West & Ex 4-East-B	0.971	58.3	4.40
Dev 7A	0.100	6.0	6.17
Dev 8A	0.244	14.6	6.17
Ex 8A	0.103	6.2	6.17
Ex 1A	0.33	20.0	6.17
Dev 1A	0.07	4.3	6.17
Ex 2B	0.54	32.6	6.17
Dev 2B	0.13	7.5	6.17

UCSC - PHASE 1 DEVELOPEMENT

HMS MODEL REPORT

EXISTING 8A

Global Summary Results for Run "Ex 100-yr (Basin 8a)"

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Sub 8A	0.0036	8.0	01Sep2010, 09:59	4.68

UCSC - PHASE 1 DEVELOPEMENT

HMS MODEL REPORT

DEVELOPED 8A

Global Summary Results for Run "Dev 100-yr (Basin 8A)"

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Sub 8A	0.0036	3.9	01Sep2010, 10:08	3.23

UCSC - PHASE 1 DEVELOPEMENT

HMS MODEL REPORT

DEVELOPED 7A

Global Summary Results for Run "Dev 100-yr (Basin 7A)"

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Sub 7A	0.0006	1.0	01Sep2010, 09:59	3.53

UCSC - PHASE 1 DEVELOPEMENT

HMS MODEL REPORT

EXISTING 4-WEST AND 4-EAST-B

Global Summary Results for Run "EX 25-YR (4-West&4-East-B)"

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
4w	0.0182	1.2	01Sep2010, 11:17	0.80

UCSC - PHASE 1 DEVELOPEMENT

HMS MODEL REPORT

DEVELOPED 4-WEST-A, 4-WEST-B, AND 4-EAST-B

Global Summary Results for Run "Ph1_Dev 25-Yr (DB1)"

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
4-West-A	0.0102	1.8	01Sep2010, 10:46	0.69
4-West-B	0.0066	0.5	01Sep2010, 10:56	0.28
4-East-B	0.0009	0.5	01Sep2010, 10:13	0.09
Reach-1	0.0009	0.5	01Sep2010, 10:15	0.09
Junction-1	0.0177	2.5	01Sep2010, 10:46	1.06
DB1 (cbb)	0.0177	0.8	01Sep2010, 15:28	1.09

UCSC - PHASE 1 DEVELOPEMENT
HMS MODEL REPORT
DETENTION BASIN 1 OUTFLOW
Project: HMS

Simulation Run: Ph1_Dev 25-Yr (DB1) Reservoir: DB1 (cbb)

Start of Run:	01Sep2010, 00:00	Basin Model:	Ph1_Dev 25-Yr (DB1)
End of Run:	07Sep2010, 00:01	Meteorologic Model:	25-yr 24-hr
Compute Time:	10Feb2011, 18:26:23	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	2.5 (CFS)	Date/Time of Peak Inflow :	01Sep2010, 10:46
Peak Outflow :	0.8 (CFS)	Date/Time of Peak Outflow :	01Sep2010, 15:28
Total Inflow :	1.06 (AC-FT)	Peak Storage :	0.35 (AC-FT)
Total Outflow :	1.09 (AC-FT)	Peak Elevation :	48.53 (FT)

UCSC - PHASE DEVELOPMENT

HMS MODEL REPORT

EXISTING 1A

Global Summary Results for Run "Ex 100-YR (Basin 1A)"

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
1A	0.0004	0.1	01Sep2010, 10:15	0.04

UCSC - PHASE 1 DEVELOPEMENT
HMS MODEL REPORT
DEVELOPED 1A & DETENTION BASIN 2 OUTFLOW

Project: HMS

Simulation Run: Dev 100-yr (Basin 1A) Reservoir: 1A-Det

Start of Run:	01Sep2010, 00:00	Basin Model:	Dev 100-yr (Basin 1A)
End of Run:	07Sep2010, 00:01	Meteorologic Model:	100-yr 24-hr
Compute Time:	25Feb2011, 10:38:11	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	1.1 (CFS)	Date/Time of Peak Inflow :	01Sep2010, 09:57
Peak Outflow :	0.1 (CFS)	Date/Time of Peak Outflow :	01Sep2010, 10:49
Total Inflow :	0.13 (AC-FT)	Peak Storage :	0.06 (AC-FT)
Total Outflow :	0.13 (AC-FT)	Peak Elevation :	59.00 (FT)

UCSC - PHASE 1 DEVELOPMENT

HMS MODEL REPORT

EXISTING 2B

Global Summary Results for Run "Ex 100-yr (Basin 2B)"

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
2B	0.0015	0.4	01Sep2010, 10:31	1.70

UCSC - PHASE 1 DEVELOPEMENT
HMS MODEL REPORT
DEVELOPED 2B & DETENTION BASIN 3 OUTFLOW

Project: HMS

Simulation Run: Dev 100-yr (Basin 2B) Reservoir: 2B-Det

Start of Run:	01Sep2010, 00:00	Basin Model:	Dev 100-yr (Basin 2B)
End of Run:	07Sep2010, 00:01	Meteorologic Model:	100-yr 24-hr
Compute Time:	25Feb2011, 10:38:18	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	3.7 (CFS)	Date/Time of Peak Inflow :	01Sep2010, 10:00
Peak Outflow :	0.4 (CFS)	Date/Time of Peak Outflow :	01Sep2010, 11:25
Total Inflow :	0.49 (AC-FT)	Peak Storage :	0.24 (AC-FT)
Total Outflow :	0.49 (AC-FT)	Peak Elevation :	59.00 (FT)

Appendix B - Detention System Analysis

Rational Method Calculations

University of California at Santa Cruz
Middle Terrace Phase 1

SUB BASIN:	Interim 4-West-A3				
Q 25-yr, Intensity (IDF from CLRDP)	**I =**	1.56 in/hr	Tc =	25 min	
Q 25-yr, Intensity (interpolated)	**I =**	**1.51** in/hr	Tc =	**27** min	
Q 25-yr, Intensity (IDF from CLRDP)	**I =**	1.44 in/hr	Tc =	30 min	
Q 25-yr (Rational Method)	**Q_{25Yr} = C x I x A/43560**				

Conveyance System - 25-yr Storm

Swale 14 to DB1

SUB BASIN	CAD Layers	Area	Area	C (25-Yr)	Q_{25Yr}
		sf	*ac*		*cfs*
Interim 4-West-A3	L-conc-pad		0.00	0.99	0.00
	L-path-asphalt		0.00	0.88	0.00
	l-path-concrete	11,987	0.28	0.99	0.15
	L-PATH-impervious		0.00	0.99	0.00
	L-patio-courtyard		0.00	0.99	0.00
	L-ROAD	20,156	0.46	0.88	0.62
	L-wall		0.00	0.99	0.00
	L-YARD		0.00	0.99	0.00
	L-BLDG		0.00	0.99	0.00
	L-SWDiagram_WQareas		0.00	0.66	0.00
	L-SWDiagram_DTareas		0.00	0.11	0.00
	L-stormwater-channel		0.00	0.33	0.00
	L-sportscourt		0.00	0.33	0.00
	L-PATH-pervious		0.00	0.66	0.00
	l-path-DG		0.00	0.66	0.00
	L-parking-pervious		0.00	0.66	0.00
	L-Ldsp-area		0.00	0.33	0.00
	L-grass-pave		0.00	0.66	0.00
	L-Ldsp-Natv-area	167,758	3.85	0.33	1.98
	Green Roof	0	0.00	0.33	0.00
	Total	**199,902**	**4.59**	**Total**	**2.7**

University of California at Santa Cruz
Middle Terrace Phase 1

SUB BASIN: 4-West-A5

Q 100-yr, Intensity (IDF from CLRDP) **I =** 4.11 in/hr Tc = 5 min
Q 100-yr, Intensity (interpolated) **I =** **4.11** in/hr Tc = **5** min
Q 100-yr, Intensity (IDF from CLRDP) **I =** 3.04 in/hr Tc = 10 min
Q 100-yr (Rational Method) **Q_{100Yr} = C x I x A/43560**

Conveyance & Detention Systems - 100-yr Storm

Swale-17 to Younger Lagoon

SUB BASIN 4-West-A5

CAD Layers	Area	Area	C (100-Yr)	Q_{100Yr}
	sf	*ac*		*cfs*
L-conc-pad	0	0.00	1.00	0.00
L-path-asphalt	0	0.00	1.00	0.00
l-path-concrete	1,654	0.04	1.00	0.16
L-PATH-impervious	0	0.00	1.00	0.00
L-patio-courtyard	0	0.00	1.00	0.00
L-ROAD	1,514	0.03	1.00	0.14
L-wall	0	0.00	1.00	0.00
L-YARD	0	0.00	1.00	0.00
L-BLDG	4,539	0.10	1.00	0.43
L-SWDiagram_WQareas	0	0.00	0.75	0.00
L-SWDiagram_DTareas	387	0.01	0.13	0.00
L-stormwater-channel	0	0.00	0.38	0.00
L-sportscourt	0	0.00	0.38	0.00
L-PATH-pervious	0	0.00	0.75	0.00
l-path-DG	0	0.00	0.75	0.00
L-parking-pervious	0	0.00	0.75	0.00
L-Ldsp-area	4,803	0.11	0.38	0.17
L-grass-pave	0	0.00	0.75	0.00
L-Ldsp-Natv-area	0	0.00	0.38	0.00
Green Roof	0	0.00	0.38	0.00
Total	**12,896**	**0.30**	**Total**	**0.9**

University of California at Santa Cruz
Middle Terrace Phase 1

SUB BASIN:	**4-South-A**				
Q 100-yr, Intensity (IDF from CLRDP)		**I =**	4.11 in/hr	Tc =	5 min
Q 100-yr, Intensity (interpolated)		**I =**	**3.89** in/hr	Tc =	**6** min
Q 100-yr, Intensity (IDF from CLRDP)		**I =**	3.04 in/hr	Tc =	10 min
Q 100-yr (Rational Method)		**Q_{100Yr} = C x I x A/43560**			

Conveyance & Detention Systems - 100-yr Storm

Swale-17 to Younger Lagoon

SUB BASIN 4-South-A

CAD Layers	Area	Area	C (100-Yr)	Q_{100Yr}
	sf	*ac*		*cfs*
L-conc-pad	0	0.00	1.00	0.00
L-path-asphalt	0	0.00	1.00	0.00
l-path-concrete	505	0.01	1.00	0.05
L-PATH-impervious	0	0.00	1.00	0.00
L-patio-courtyard	0	0.00	1.00	0.00
L-ROAD	14,019	0.32	1.00	1.25
L-wall	0	0.00	1.00	0.00
L-YARD	0	0.00	1.00	0.00
L-BLDG	0	0.00	1.00	0.00
L-SWDiagram_WQareas	0	0.00	0.75	0.00
L-SWDiagram_DTareas	3,905	0.09	0.13	0.04
L-stormwater-channel	0	0.00	0.38	0.00
L-sportscourt	0	0.00	0.38	0.00
L-PATH-pervious	0	0.00	0.75	0.00
l-path-DG	0	0.00	0.75	0.00
L-parking-pervious	9,225	0.21	0.75	0.62
L-Ldsp-area	2,362	0.05	0.38	0.08
L-grass-pave	0	0.00	0.75	0.00
L-Ldsp-Natv-area	0	0.00	0.38	0.00
Green Roof	0	0.00	0.38	0.00
Total	**30,016**	**0.69**	**Total**	**2.0**

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Middle Terrace Phase 1

SUB BASIN: 4-South-B

Q 25-yr, Intensity (IDF from CLRDP)	**I =**	3.12 in/hr	Tc =	5 min
Q 25-yr, Intensity (interpolated)	**I =**	**2.96** in/hr	Tc =	**6** min
Q 25-yr, Intensity (IDF from CLRDP)	**I =**	2.32 in/hr	Tc =	10 min

Q 25-yr (Rational Method) Q_{25Yr} **= C x I x A/43560**

Detention System - 25-yr Storm to Wetland 4

SUB BASIN 4-South-B

CAD Layers	Area	Area	C (25-Yr)	Q_{25Yr}
	sf	*ac*		*cfs*
L-conc-pad	0	0.00	0.99	0.00
L-path-asphalt	0	0.00	0.88	0.00
l-path-concrete	0	0.00	0.99	0.00
L-PATH-impervious	0	0.00	0.99	0.00
L-patio-courtyard	0	0.00	0.99	0.00
L-ROAD	3,237	0.07	0.88	0.19
L-wall	0	0.00	0.99	0.00
L-YARD	0	0.00	0.99	0.00
L-BLDG	0	0.00	0.99	0.00
L-SWDiagram_WQareas	0	0.00	0.66	0.00
L-SWDiagram_DTareas	924	0.02	0.11	0.01
L-stormwater-channel	0	0.00	0.33	0.00
L-sportscourt	0	0.00	0.33	0.00
L-PATH-pervious	0	0.00	0.66	0.00
l-path-DG	2,867	0.07	0.66	0.13
L-parking-pervious	1,005	0.02	0.66	0.05
L-Ldsp-area	1,699	0.04	0.33	0.04
L-grass-pave	0	0.00	0.66	0.00
L-Ldsp-Natv-area	0	0.00	0.33	0.00
Green Roof	0	0.00	0.33	0.00
Total	**9,732**	**0.22**	**Total**	**0.4**

Appendix C - Conveyance and Water Quality System Analysis

Rational Method Calculations

University of California at Santa Cruz
Middle Terrace Phase 1

SUB BASIN: Interim 4-West-A3

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in **V_{WQ} =** **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr **Q_{WQ} =** **C x i x A/43560**

Water Quality System

SUB BASIN Interim 4-West-A3	85th Percentile Storm						Proposed Water Quality Treatment								
CAD Layers	**C (85th)**	**Area**	**Area**	**Q_{WQ}**	**V_{WQ}**		**$\sum Q_{WQ}$**	**$\sum V_{WQ}$**	**Bioreten-tion**	**Green Roof**	**Paver/T urf**	**Veg Strip Width**	**Veg Swale**	**Media Filter**	**Infiltration Trench**
		sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
L-conc-pad	0.90		0.00	0.00	0	**Road**	0.06	1,277	1,437			10			
L-path-asphalt	0.80		0.00	0.00	0										
I-path-concrete	0.90	4,353	0.10	0.02	310	**Path**	0.02	310	349						
L-PATH-impervious	0.90		0.00	0.00	0										
L-patio-courtyard	0.90		0.00	0.00	0	**Yard**	0.00	0							
L-ROAD	0.80	20,156	0.46	0.06	1,277										
L-wall	0.90		0.00	0.00	0	**Landscape**	0.10	2,057	Water Quality Treatment is not required for the Landscape area.						
L-YARD	0.90		0.00	0.00	0										
L-BLDG	0.85		0.00	0.00	0	**Parking**	0.00	0							
L-SWDiagram_WQareas	0.50		0.00	0.00	0										
L-SWDiagram_DTareas	0.08		0.00	0.00	0	**Building**	0.00	0							
L-stormwater-channel	0.20		0.00	0.00	0										
L-sportscourt	0.20		0.00	0.00	0										
L-PATH-pervious	0.50		0.00	0.00	0	**Total**	**0.18**	**3,644**	**1,786**	**0**	**0**	**10**	**0**	**0**	**0**
I-path-DG	0.50		0.00	0.00	0										
L-parking-pervious	0.50		0.00	0.00	0										
L-Ldsp-area	0.20		0.00	0.00	0										
L-grass-pave	0.50		0.00	0.00	0										
L-Ldsp-Natv-area	0.15	173,246	3.98	0.10	2,057										
Green Roof	0.11	0	0.00	0.00	0										
Total		**197,755**	**4.54**	**0.18**	**3,644**										

Notes:
1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.
2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and
3. Infiltration Trench water quality elements.
4. Details of water quality elements are shown on figure DET1.
5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.

SUB BASIN: 4-West-A4

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in **V_{WQ} =** **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr **Q_{WQ} =** **C x i x A/43560**

Water Quality System

SUB BASIN 4-West-A4	85th Percentile Storm						Proposed Water Quality Treatment								
CAD Layers	**C (85th)**	**Area**	**Area**	**Q_{WQ}**	**V_{WQ}**		**$\sum Q_{WQ}$**	**$\sum V_{WQ}$**	**Bioreten-tion**	**Green Roof**	**Paver/T urf**	**Veg Strip Width**	**Veg Swale**	**Media Filter**	**Infiltration Trench**
		sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
L-conc-pad	0.90	0	0.00	0.00	0	**Road**	0.00	41	56			10			
L-path-asphalt	0.80	0	0.00	0.00	0										
I-path-concrete	0.90	1,855	0.04	0.01	132	**Path**	0.01	254	149						
L-PATH-impervious	0.90	0	0.00	0.00	0										
L-patio-courtyard	0.90	0	0.00	0.00	0	**Yard**	0.00	0							
L-ROAD	0.80	646	0.01	0.00	41										
L-wall	0.90	0	0.00	0.00	0	**Landscape**	0.01	167	Water Quality Treatment is not required for the Landscape area.						
L-YARD	0.90	0	0.00	0.00	0										
L-BLDG (A1, A3, A4)	0.85	7,229	0.17	0.02	486	**Parking**	0.00	0							
L-SWDiagram_WQareas	0.50	0	0.00	0.00	0										
L-SWDiagram_DTareas	0.08	675	0.02	0.00	4	**Building**	0.02	486	551						
L-stormwater-channel	0.20	0	0.00	0.00	0										
L-sportscourt	0.20	0	0.00	0.00	0										
L-PATH-pervious	0.50	0	0.00	0.00	0	**Total**	**0.05**	**949**	**756**	**0**	**0**	**10**	**0**	**0**	**0**
I-path-DG	0.50	1,323	0.03	0.00	52										
L-parking-pervious	0.50	0	0.00	0.00	0										
L-Ldsp-area	0.20	10,293	0.24	0.01	163										
L-grass-pave	0.50	1,757	0.04	0.00	70										
L-Ldsp-Natv-area	0.15	0	0.00	0.00	0										
Green Roof	0.11	0	0.00	0.00	0										
Total		**23,778**	**0.55**	**0.05**	**949**										

Notes:
1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.
2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and
3. Infiltration Trench water quality elements.
4. Details of water quality elements are shown on figure DET1.
5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.

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Middle Terrace Phase 1

SUB BASIN: CBB Roof Plan

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in V_{WQ} = **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr Q_{WQ} = **C x i x A/43560**

Water Quality System

		85th Percentile Storm					Proposed Water Quality Treatment									
	CAD Layers	C (85th)	Area	Area	Q_{WQ}	V_{WQ}		$\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/Turf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
			sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
SUB BASIN CBB Roof Plan	A1	0.85	3,801	0.09	0.01	256	**Roof A1**	0.01	256	288						
	A2	0.85	3,862	0.09	0.01	260	**Roof A2**	0.01	260	300						
	A3	0.85	398	0.01	0.00	27	**Roof A3**	0.00	27	30						
	A4	0.85	3,030	0.07	0.01	204	**Roof A4**	0.01	204	230						
	A5	0.85	2,560	0.06	0.01	172	**Roof A5**	0.01	172	200						
	A6	0.85	1,931	0.04	0.01	130	**Roof A6**	0.01	130	140						
	A7	0.85	2,608	0.06	0.01	175	**Roof A7**	0.01	175	210						
	A8	0.85	1,125	0.03	0.00	76	**Roof A8**	0.00	76	90						
	A9	0.85	944	0.02	0.00	64	**Roof A9**	0.00	64	72						
	A10	0.50	1,124	0.03	0.00	44	**Roof A10**	0.00	44	90						
	A11	0.08	464	0.01	0.00	3	**Roof A11**	0.00	3	40						
							Total	**0.07**	**1,411**	**840**	**0**	**0**	**0**	**0**	**0**	**0**
	Total		**21,847**	**0.50**	**0.07**	**1,411**										

Notes:
1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.
2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and
3. Infiltration Trench water quality elements.
4. Details of water quality elements are shown on figure DET1.
5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.

BASIN: 4-West-B

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in V_{WQ} = **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr Q_{WQ} = **C x i x A/43560**

Water Quality System

		85th Percentile Storm					Proposed Water Quality Treatment									
	CAD Layers	C (85th)	Area	Area	Q_{WQ}	V_{WQ}		$\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/Turf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
			sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
BASIN 4-West-B	L-conc-pad	0.90	0	0.00	0.00	0	**Road**	0.02	417	469			10			
	L-path-asphalt	0.80	0	0.00	0.00	0										
	l-path-concrete	0.90	1,596	0.04	0.01	114	**Path**	0.02	352	396				500		
	L-PATH-impervious	0.90	0	0.00	0.00	0										
	L-patio-courtyard	0.90	0	0.00	0.00	0	**Yard**	0.00	0							
	L-ROAD	0.80	6,581	0.15	0.02	417										
	L-wall	0.90	0	0.00	0.00	0	**Landscape**	0.13	2,680	Water Quality Treatment is not required for the Landscape area.						
	L-YARD	0.90	0	0.00	0.00	0										
	L-BLDG	0.85	0	0.00	0.00	0	**Parking**	0.00	0							
	L-SWDiagram_WQareas	0.50	0	0.00	0.00	0										
	L-SWDiagram_DTareas	0.08	0	0.00	0.00	0	**Building**	0.00	0							
	L-stormwater-channel	0.20	0	0.00	0.00	0										
	L-sportscourt	0.20	0	0.00	0.00	0										
	L-PATH-pervious	0.50	0	0.00	0.00	0	**Total**	**0.17**	**3,449**	**865**	**0**	**0**	**10**	**500**	**0**	**0**
	l-path-DG	0.50	6,027	0.14	0.01	239										
	L-parking-pervious	0.50	0	0.00	0.00	0										
	L-Ldsp-area	0.20	169,235	3.89	0.13	2,680										
	L-grass-pave	0.50	0	0.00	0.00	0										
	L-Ldsp-Natv-area	0.15	0	0.00	0.00	0										
	Green Roof	0.11	0	0.00	0.00	0										
	Total		**183,439**	**4.21**	**0.17**	**3,449**										

Notes:
1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.
2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and
3. Infiltration Trench water quality elements.
4. Details of water quality elements are shown on figure DET1.
5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.

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BASIN: 4-East-B

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in **V_{WQ} =** **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr **Q_{WQ} =** **C x i x A/43560**

Water Quality System

BASIN 4-East-B	85th Percentile Storm						Proposed Water Quality Treatment								
CAD Layers	C (85th)	Area	Area	Q_{WQ}	V_{WQ}		$\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/Turf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
		sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
L-conc-pad	0.90		0.00	0.00	0	**Road**	0.03	536	603			10			
L-path-asphalt	0.80		0.00	0.00	0										
I-path-concrete	0.90		0.00	0.00	0	**Path**	0.01	123	138						
L-PATH-impervious	0.90		0.00	0.00	0										
L-patio-courtyard	0.90		0.00	0.00	0	**Yard**	0.00	0							
L-ROAD	0.80	8,456	0.19	0.03	536										
L-wall	0.90		0.00	0.00	0	**Landscape**	0.01	169	Water Quality Treatment is not required for the Landscape area.						
L-YARD	0.90		0.00	0.00	0										
L-BLDG	0.85		0.00	0.00	0	**Parking**	0.00	0							
L-SWDiagram_WQareas	0.50		0.00	0.00	0										
L-SWDiagram_DTareas	0.08		0.00	0.00	0	**Building**	0.00	0							
L-stormwater-channel	0.20		0.00	0.00	0										
L-sportscourt	0.20		0.00	0.00	0										
L-PATH-pervious	0.50		0.00	0.00	0	**Total**	**0.04**	**828**	**741**	**0**	**0**	**10**	**0**	**0**	**0**
I-path-DG	0.50	3,120	0.07	0.01	123										
L-parking-pervious	0.50		0.00	0.00	0										
L-Ldsp-area	0.20	10,696	0.25	0.01	169										
L-grass-pave	0.50		0.00	0.00	0										
L-Ldsp-Natv-area	0.15		0.00	0.00	0										
Green Roof	0.11		0.00	0.00	0										
Total		**22,272**	**0.51**	**0.04**	**828**										

Notes:
1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.
2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and
3. Infiltration Trench water quality elements.
4. Details of water quality elements are shown on figure DET1.
5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.

BASIN: 3-A

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in **V_{WQ} =** **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr **Q_{WQ} =** **C x i x A/43560**

Water Quality System

BASIN 3-A	85th Percentile Storm						Proposed Water Quality Treatment								
CAD Layers	C (85th)	Area	Area	Q_{WQ}	V_{WQ}		$\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/Turf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
		sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
L-conc-pad	0.90	2,564	0.06	0.01	183	**Road**	0.00	0							
L-path-asphalt	0.80	5,513	0.13	0.02	349										
I-path-concrete	0.90		0.00	0.00	0	**Path**	0.02	349	393						
L-PATH-impervious	0.90		0.00	0.00	0										
L-patio-courtyard	0.90		0.00	0.00	0	**Yard**	0.01	183	206						
L-ROAD	0.80		0.00	0.00	0										
L-wall	0.90		0.00	0.00	0	**Landscape**	0.00	69	Water Quality Treatment is not required for the Landscape area.						
L-YARD	0.90		0.00	0.00	0										
L-BLDG	0.85		0.00	0.00	0	**Parking**	0.00	0							
L-SWDiagram_WQareas	0.50		0.00	0.00	0										
L-SWDiagram_DTareas	0.08		0.00	0.00	0	**Building**	0.00	0							
L-stormwater-channel	0.20		0.00	0.00	0										
L-sportscourt	0.20		0.00	0.00	0										
L-PATH-pervious	0.50		0.00	0.00	0	**Total**	**0.03**	**601**	**599**	**0**	**0**	**0**	**0**	**0**	**0**
I-path-DG	0.50		0.00	0.00	0										
L-parking-pervious	0.50		0.00	0.00	0										
L-Ldsp-area	0.20	4,383	0.10	0.00	69										
L-grass-pave	0.50		0.00	0.00	0										
L-Ldsp-Natv-area	0.15		0.00	0.00	0										
Green Roof	0.11		0.00	0.00	0										
Total		**12,461**	**0.29**	**0.03**	**601**										

Notes:
1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.
2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and
3. Infiltration Trench water quality elements.
4. Details of water quality elements are shown on figure DET1.
5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.

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Middle Terrace Phase 1

BASIN: 3-B

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in V_{WQ} = **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr Q_{WQ} = **C x i x A/43560**

Water Quality System

BASIN 3-B	85th Percentile Storm						Proposed Water Quality Treatment								
CAD Layers	C (85th)	Area	Area	Q_{WQ}	V_{WQ}		$\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/Turf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
		sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
L-conc-pad	0.90		0.00	0.00	0	**Road**	0.01	109	123						
L-path-asphalt	0.80		0.00	0.00	0										
I-path-concrete	0.90	1,618	0.04	0.01	115	**Path**	0.01	115	129						
L-PATH-impervious	0.90		0.00	0.00	0										
L-patio-courtyard	0.90		0.00	0.00	0	**Yard**	0.00	0							
L-ROAD	0.80	1,729	0.04	0.01	109										
L-wall	0.90		0.00	0.00	0	**Landscape**	0.01	125	Water Quality Treatment is not required for the Landscape area.						
L-YARD	0.90		0.00	0.00	0										
L-BLDG	0.85		0.00	0.00	0	**Parking**	0.00	0							
L-SWDiagram_WQareas	0.50		0.00	0.00	0										
L-SWDiagram_DTareas	0.08		0.00	0.00	0	**Building**	0.00	0							
L-stormwater-channel	0.20		0.00	0.00	0										
L-sportscourt	0.20		0.00	0.00	0										
L-PATH-pervious	0.50		0.00	0.00	0	**Total**	**0.02**	**350**	**252**	**0**	**0**	**0**	**0**	**0**	**0**
I-path-DG	0.50		0.00	0.00	0										
L-parking-pervious	0.50		0.00	0.00	0										
L-Ldsp-area	0.20	7,920	0.18	0.01	125										
L-grass-pave	0.50		0.00	0.00	0										
L-Ldsp-Natv-area	0.15		0.00	0.00	0										
Green Roof	0.11		0.00	0.00	0										
Total		**11,266**	**0.26**	**0.02**	**350**										

Notes:
1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.
2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and
3. Infiltration Trench water quality elements.
4. Details of water quality elements are shown on figure DET1.
5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.

BASIN: 4-West-A5

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in V_{WQ} = **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr Q_{WQ} = **C x i x A/43560**

Water Quality System

BASIN 4-West-A5	85th Percentile Storm						Proposed Water Quality Treatment								
CAD Layers	C (85th)	Area	Area	Q_{WQ}	V_{WQ}		$\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/Turf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
		sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
L-conc-pad	0.90	0	0.00	0.00	0	**Road**	0.00	96	108						
L-path-asphalt	0.80	0	0.00	0.00	0										
I-path-concrete	0.90	1,654	0.04	0.01	118	**Path**	0.01	118	300						
L-PATH-impervious	0.90	0	0.00	0.00	0										
L-patio-courtyard	0.90	0	0.00	0.00	0	**Yard**	0.00	0							
L-ROAD	0.80	1,514	0.03	0.00	96										
L-wall	0.90	0	0.00	0.00	0	**Landscape**	0.00	78	Water Quality Treatment is not required for the Landscape area.						
L-YARD	0.90	0	0.00	0.00	0										
L-BLDG (A7, A6)	0.85	4,539	0.10	0.02	305	**Parking**	0.00	0							
L-SWDiagram_WQareas	0.50	0	0.00	0.00	0										
L-SWDiagram_DTareas	0.08	387	0.01	0.00	2	**Building**	0.02	305	343						
L-stormwater-channel	0.20	0	0.00	0.00	0										
L-sportscourt	0.20	0	0.00	0.00	0										
L-PATH-pervious	0.50	0	0.00	0.00	0	**Total**	**0.03**	**598**	**751**	**0**	**0**	**0**	**0**	**0**	**0**
I-path-DG	0.50	0	0.00	0.00	0										
L-parking-pervious	0.50	0	0.00	0.00	0										
L-Ldsp-area	0.20	4,803	0.11	0.00	76										
L-grass-pave	0.50	0	0.00	0.00	0										
L-Ldsp-Natv-area	0.15	0	0.00	0.00	0										
Green Roof	0.11	0	0.00	0.00	0										
Total		**12,896**	**0.30**	**0.03**	**598**										

Notes:
1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.
2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and
3. Infiltration Trench water quality elements.
4. Details of water quality elements are shown on figure DET1.
5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.

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BASIN: 4-South-A

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in **V_{WQ} =** **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr **Q_{WQ} =** **C x i x A/43560**

Water Quality System

BASIN 4-South-A	CAD Layers	85th Percentile Storm C (85th)	Area	Area	Q_{WQ}	V_{WQ}		Proposed Water Quality Treatment $\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/Turf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
			sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
	L-conc-pad	0.90	0	0.00	0.00	0	**Road**	0.04	888	999		5,608				
	L-path-asphalt	0.80	0	0.00	0.00	0										
	I-path-concrete	0.90	505	0.01	0.00	36	**Path**	0.00	36	41						
	L-PATH-impervious	0.90	0	0.00	0.00	0										
	L-patio-courtyard	0.90	0	0.00	0.00	0	**Yard**	0.00	0							
	L-ROAD	0.80	14,019	0.32	0.04	888										
	L-wall	0.90	0	0.00	0.00	0	**Landscape**	0.00	62	Water Quality Treatment is not required for the Landscape area.						
	L-YARD	0.90	0	0.00	0.00	0										
	L-BLDG	0.85	0	0.00	0.00	0	**Parking**	0.02	365	411						
	L-SWDiagram_WQareas	0.50	0	0.00	0.00	0										
	L-SWDiagram_DTareas	0.08	3,905	0.09	0.00	25	**Building**	0.00	0							
	L-stormwater-channel	0.20	0	0.00	0.00	0										
	L-sportscourt	0.20	0	0.00	0.00	0										
	L-PATH-pervious	0.50	0	0.00	0.00	0	**Total**	**0.07**	**1,351**	**1,451**	**0**	**5,608**	**0**	**0**	**0**	**0**
	I-path-DG	0.50	0	0.00	0.00	0										
	L-parking-pervious	0.50	9,225	0.21	0.02	365										
	L-Ldsp-area	0.20	2,362	0.05	0.00	37										
	L-grass-pave	0.50	0	0.00	0.00	0										
	L-Ldsp-Natv-area	0.15	0	0.00	0.00	0										
	Green Roof	0.11	0	0.00	0.00	0										
	Total		**30,016**	**0.69**	**0.07**	**1,351**										

Notes:
1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.
2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and
3. Infiltration Trench water quality elements.
4. Details of water quality elements are shown on figure DET1.
5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.

BASIN: 4-South-B

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in **V_{WQ} =** **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr **Q_{WQ} =** **C x i x A/43560**

Water Quality System

BASIN 4-South-B	CAD Layers	85th Percentile Storm C (85th)	Area	Area	Q_{WQ}	V_{WQ}		Proposed Water Quality Treatment $\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/Turf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
			sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
	L-conc-pad	0.90	0	0.00	0.00	0	**Road**	0.01	205	231		1,295				
	L-path-asphalt	0.80	0	0.00	0.00	0										
	I-path-concrete	0.90	0	0.00	0.00	0	**Path**	0.01	113	127						
	L-PATH-impervious	0.90	0	0.00	0.00	0										
	L-patio-courtyard	0.90	0	0.00	0.00	0	**Yard**	0.00	0							
	L-ROAD	0.80	3,237	0.07	0.01	205										
	L-wall	0.90	0	0.00	0.00	0	**Landscape**	0.00	33	Water Quality Treatment is not required for the Landscape area.						
	L-YARD	0.90	0	0.00	0.00	0										
	L-BLDG	0.85	0	0.00	0.00	0	**Parking**	0.00	40	45						
	L-SWDiagram_WQareas	0.50	0	0.00	0.00	0										
	L-SWDiagram_DTareas	0.08	924	0.02	0.00	6	**Building**	0.00	0							
	L-stormwater-channel	0.20	0	0.00	0.00	0										
	L-sportscourt	0.20	0	0.00	0.00	0										
	L-PATH-pervious	0.50	0	0.00	0.00	0	**Total**	**0.02**	**391**	**403**	**0**	**1,295**	**0**	**0**	**0**	**0**
	I-path-DG	0.50	2,867	0.07	0.01	113										
	L-parking-pervious	0.50	1,005	0.02	0.00	40										
	L-Ldsp-area	0.20	1,699	0.04	0.00	27										
	L-grass-pave	0.50	0	0.00	0.00	0										
	L-Ldsp-Natv-area	0.15	0	0.00	0.00	0										
	Green Roof	0.11	0	0.00	0.00	0										
	Total		**9,732**	**0.22**	**0.02**	**391**										

Notes:
1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.
2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and
3. Infiltration Trench water quality elements.
4. Details of water quality elements are shown on figure DET1.
5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.

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BASIN: 7A

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in **V_{WQ} =** **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr **Q_{WQ} =** **C x i x A/43560**

Water Quality System

BASIN 7A	85th Percentile Storm						Proposed Water Quality Treatment								
CAD Layers	C (85th)	Area	Area	Q_{WQ}	V_{WQ}		$\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/Turf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
		sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
L-conc-pad	0.90		0.00	0.00	0	**Road**	0.03	592						10	
L-path-asphalt	0.80		0.00	0.00	0										
I-path-concrete	0.90		0.00	0.00	0	**Path**	0.00	0							
L-PATH-impervious	0.90		0.00	0.00	0										
L-patio-courtyard	0.90		0.00	0.00	0	**Yard**	0.00	0							
L-ROAD	0.80	9,347	0.21	0.03	592										
L-wall	0.90		0.00	0.00	0	**Landscape**	0.00	51	Water Quality Treatment is not required for the Landscape area.						
L-YARD	0.90		0.00	0.00	0										
L-BLDG	0.85		0.00	0.00	0	**Parking**	0.01	200						5	
L-SWDiagram_WQareas	0.50		0.00	0.00	0										
L-SWDiagram_DTareas	0.08		0.00	0.00	0	**Building**	0.00	0							
L-stormwater-channel	0.20		0.00	0.00	0										
L-sportscourt	0.20		0.00	0.00	0										
L-PATH-pervious	0.50		0.00	0.00	0	**Total**	**0.04**	**843**	**0**	**0**	**0**	**0**	**0**	**15**	**0**
I-path-DG	0.50		0.00	0.00	0										
L-parking-pervious	0.50	5,048	0.12	0.01	200	Notes:									
L-Ldsp-area	0.20	3,214	0.07	0.00	51	1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.									
L-grass-pave	0.50		0.00	0.00	0	2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and									
L-Ldsp-Natv-area	0.15		0.00	0.00	0	3. Infiltration Trench water quality elements.									
Green Roof	0.11		0.00	0.00	0	4. Details of water quality elements are shown on figure DET1.									
Total		**17,609**	**0.40**	**0.04**	**843**	5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.									

BASIN: 8A

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in **V_{WQ} =** **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr **Q_{WQ} =** **C x i x A/43560**

Water Quality System

BASIN 8A	85th Percentile Storm						Proposed Water Quality Treatment								
CAD Layers	C (85th)	Area	Area	Q_{WQ}	V_{WQ}		$\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/Turf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
		sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
L-conc-pad	0.90		0.00	0.00	0	**Road**	0.00	0							
L-path-asphalt	0.80		0.00	0.00	0										
I-path-concrete	0.90		0.00	0.00	0	**Path**	0.12	2,453	2,760				806		
L-PATH-impervious	0.90	34,435	0.79	0.12	2,453										
L-patio-courtyard	0.90		0.00	0.00	0	**Yard**	0.00	0							
L-ROAD	0.80		0.00	0.00	0										
L-wall	0.90		0.00	0.00	0	**Landscape**	0.03	697	Water Quality Treatment is not required for the Landscape area.						
L-YARD	0.90		0.00	0.00	0										
L-BLDG	0.85	22,496	0.52	0.07	1,514	**Parking**	0.00	0							
L-SWDiagram_WQareas	0.50		0.00	0.00	0										
L-SWDiagram_DTareas	0.08		0.00	0.00	0	**Building**	0.07	1,514	1,730						
L-stormwater-channel	0.20		0.00	0.00	0										
L-sportscourt	0.20		0.00	0.00	0										
L-PATH-pervious	0.50		0.00	0.00	0	**Total**	**0.23**	**4,665**	**4,490**	**0**	**0**	**0**	**806**	**0**	**0**
I-path-DG	0.50		0.00	0.00	0										
L-parking-pervious	0.50		0.00	0.00	0	Notes:									
L-Ldsp-area	0.20	44,046	1.01	0.03	697	1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.									
L-grass-pave	0.50		0.00	0.00	0	2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and									
L-Ldsp-Natv-area	0.15		0.00	0.00	0	3. Infiltration Trench water quality elements.									
Green Roof	0.11		0.00	0.00	0	4. Details of water quality elements are shown on figure DET1.									
Total	**2.73**	**100,977**	**2.32**	**0.23**	**4,665**	5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.									

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BASIN: 2A

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in **V_{WQ} =** **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr **Q_{WQ} =** **C x i x A/43560**

Water Quality System

		85th Percentile Storm					Proposed Water Quality Treatment									
	CAD Layers	C (85th)	Area	Area	Q_{WQ}	V_{WQ}		$\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/T urf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
			sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
BASIN 2A	L-conc-pad	0.90		0.00	0.00	0	**Road**	0.01	251	282						
	L-path-asphalt	0.80		0.00	0.00	0										
	I-path-concrete	0.90		0.00	0.00	0	**Path**	0.01	178	200						
	L-PATH-impervious	0.90		0.00	0.00	0										
	L-patio-courtyard	0.90		0.00	0.00	0	**Yard**	0.00	0							
	L-ROAD	0.80	3,961	0.09	0.01	251										
	L-wall	0.90		0.00	0.00	0	**Landscape**	0.01	207	Water Quality Treatment is not required for the Landscape area.						
	L-YARD	0.90		0.00	0.00	0										
	L-BLDG	0.85		0.00	0.00	0	**Parking**	0.00	86	97						
	L-SWDiagram_WQareas	0.50		0.00	0.00	0										
	L-SWDiagram_DTareas	0.08		0.00	0.00	0	**Building**	0.00	0							
	L-stormwater-channel	0.20		0.00	0.00	0										
	L-sportscourt	0.20		0.00	0.00	0										
	L-PATH-pervious	0.50		0.00	0.00	0	**Total**	**0.04**	**721**	**579**	**0**	**0**	**0**	**0**	**0**	**0**
	I-path-DG	0.50	4,488	0.10	0.01	178										
	L-parking-pervious	0.50	2,180	0.05	0.00	86	Notes:									
	L-Ldsp-area	0.20	13,042	0.30	0.01	207	1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.									
	L-grass-pave	0.50		0.00	0.00	0	2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and									
	L-Ldsp-Natv-area	0.15		0.00	0.00	0	3. Infiltration Trench water quality elements.									
	Green Roof	0.11		0.00	0.00	0	4. Details of water quality elements are shown on figure DET1.									
	Total		**23,671**	**0.54**	**0.04**	**721**	5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.									

BASIN: 1A

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in **V_{WQ} =** **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr **Q_{WQ} =** **C x i x A/43560**

Water Quality System

		85th Percentile Storm					Proposed Water Quality Treatment									
	CAD Layers	C (85th)	Area	Area	Q_{WQ}	V_{WQ}		$\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/T urf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
			sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
BASIN 1A	L-conc-pad	0.90		0.00	0.00	0	**Road**	0.00	0							
	L-path-asphalt	0.80		0.00	0.00	0										
	I-path-concrete	0.90		0.00	0.00	0	**Path**	0.00	0							
	L-PATH-impervious	0.90		0.00	0.00	0										
	L-patio-courtyard	0.90		0.00	0.00	0	**Yard**	0.04	735	827						
	L-ROAD	0.80		0.00	0.00	0										
	L-wall	0.90		0.00	0.00	0	**Landscape**	0.00	0	Water Quality Treatment is not required for the Landscape area.						
	L-YARD	0.90	10,321	0.24	0.04	735										
	L-BLDG	0.85		0.00	0.00	0	**Parking**	0.00	0							
	L-SWDiagram_WQareas	0.50		0.00	0.00	0										
	L-SWDiagram_DTareas	0.08		0.00	0.00	0	**Building**	0.00	0							
	L-stormwater-channel	0.20		0.00	0.00	0										
	L-sportscourt	0.20		0.00	0.00	0										
	L-PATH-pervious	0.50		0.00	0.00	0	**Total**	**0.04**	**735**	**827**	**0**	**0**	**0**	**0**	**0**	**0**
	I-path-DG	0.50		0.00	0.00	0										
	L-parking-pervious	0.50		0.00	0.00	0	Notes:									
	L-Ldsp-area	0.20		0.00	0.00	0	1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.									
	L-grass-pave	0.50		0.00	0.00	0	2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and									
	L-Ldsp-Natv-area	0.15		0.00	0.00	0	3. Infiltration Trench water quality elements.									
	Green Roof	0.11		0.00	0.00	0	4. Details of water quality elements are shown on figure DET1.									
	Total		**10,321**	**0.24**	**0.04**	**735**	5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.									

University of California at Santa Cruz
Middle Terrace Phase 1

BASIN: 2B

Q 85th, 24-hr storm, 24-hr depth **d =** **0.95** in **V_{WQ} =** **C x A x d/12**
Q 85th, 1-hr storm, Hourly Precipitation **i =** **0.17** in/hr **Q_{WQ} =** **C x i x A/43560**

Water Quality System

		85th Percentile Storm						Proposed Water Quality Treatment							
	CAD Layers	C (85th)	Area	Area	Q_{WQ}	V_{WQ}		$\sum Q_{WQ}$	$\sum V_{WQ}$	Bioreten-tion	Green Roof	Paver/Turf	Veg Strip Width	Veg Swale	Media Filter	Infiltration Trench
			sf	*ac*	*cfs*	*cf*		*cfs*	*cf*	*sf*	*sf*	*sf*	*ft*	*sf*	*sf*	*sf*
BASIN 2B	L-conc-pad	0.90		0.00	0.00	0	**Road**	0.00	0							
	L-path-asphalt	0.80		0.00	0.00	0	**Path**	0.00	0							
	I-path-concrete	0.90		0.00	0.00	0	**Yard**	0.15	3,003	3,378						
	L-PATH-impervious	0.90		0.00	0.00	0	**Landscape**	0.00	0	Water Quality Treatment is not required for the Landscape area.						
	L-patio-courtyard	0.90		0.00	0.00	0	**Parking**	0.00	0							
	L-ROAD	0.80		0.00	0.00	0	**Building**	0.00	0							
	L-wall	0.90		0.00	0.00	0	**Total**	**0.15**	**3,003**	**3,378**	**0**	**0**	**0**	**0**	**0**	**0**
	L-YARD	0.90	42,143	0.97	0.15	3,003										
	L-BLDG	0.85		0.00	0.00	0										
	L-SWDiagram_WQareas	0.50		0.00	0.00	0										
	L-SWDiagram_DTareas	0.08		0.00	0.00	0										
	L-stormwater-channel	0.20		0.00	0.00	0										
	L-sportscourt	0.20		0.00	0.00	0										
	L-PATH-pervious	0.50		0.00	0.00	0										
	I-path-DG	0.50		0.00	0.00	0										
	L-parking-pervious	0.50		0.00	0.00	0										
	L-Ldsp-area	0.20		0.00	0.00	0										
	L-grass-pave	0.50		0.00	0.00	0										
	L-Ldsp-Natv-area	0.15		0.00	0.00	0										
	Green Roof	0.11		0.00	0.00	0										
	Total		**42,143**	**0.97**	**0.15**	**3,003**										

Notes:
1. 85th percentile flow values are used to size Vegetated Swale and Media Filter water quality elements.
2. 85th percentile volume values are used to size Bioretention, Green Roof, pervious pavement, and
3. Infiltration Trench water quality elements.
4. Details of water quality elements are shown on figure DET1.
5. Vegetated Swale: Minimum 2 ft bottom width and 0.5 ft depth, 3:1 side slope.

Appendix G

Noise Impact Technical Report

UNIVERSITY OF CALIFORNIA, SANTA CRUZ

MARINE SCIENCE CAMPUS PROJECT

Acoustical Analysis

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March 2011

SUMMARY

This acoustical analysis describes the existing noise environment in the University of California, Santa Cruz ("UCSC" or "University") Marine Science Campus Project ("project" or "proposed project") area and documents changes in the baseline conditions and the noise impacts associated with the implementation of the proposed project. The proposed project is located in Santa Cruz County, California, and consists of the development of the new Coastal Biology Building (CBB), infrastructure improvements to serve the CBB, and the Specific Resource Plan (SRP) Phase 1B Wetland Restoration project. Construction is anticipated to begin in 2012 and the new facilities would be in operation in 2014.

The certified UCSC Marine Science Campus Coastal Long Range Development Plan (CLRDP) Draft Environmental Impact Report (EIR)[1] relies on the *State Land Use Compatibility Guidelines for Noise* (*State Noise Guidelines*) adopted by the State of California and ordinances adopted by the City of Santa Cruz to evaluate the significance of noise impacts from Campus development. Daytime and evening construction noise levels less than 80 dB(A) over an 8-hour period are considered to result in a less than significant noise impact. With implementation of previously adopted CLRDP EIR mitigation, construction of the proposed projects would not exceed 80 dB(A) during the daytime or evening at the sensitive receptors to the east.

In general, changes in a community noise level of less than 3.0 dB(A) are not typically noticed by the human ear.[2] For the purposes of evaluating the proposed projects' operational noise impacts on human receptors, an increase in the community noise level of 3.0 dB(A) or more would be considered a significant impact for low-density residential areas if the increase, when added to the existing noise levels, exceeds 60 dB(A). For educational facility, the limit is 70 dB(A) CNEL. In addition, the projects would be considered to have a significant impact if they cause noise levels to exceed 60 dB(A) CNEL at the Younger Lagoon Reserve Boundary The acoustical analysis was conducted using the SoundPLAN noise modeling software. SoundPLAN is a three-dimensional noise propagation model that is used to visualize the effects of noise in the environment and is capable of modeling noise from a variety of sources. According to the analysis, additional noise from operation of the proposed project would not result in a perceptible increase in noise above existing ambient conditions at nearby sensitive receptors. The noise increase would be much less than 3.0 dB(A) CNEL at the sensitive receptors to the east. This is considered a less than significant impact.

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1 University of California, Santa Cruz, Marine Science Campus, *CLRDP Environmental Impact Report*, SCH No. 2001112014, (2004).

2 U.S. Department of Transportation, Federal Highway Administration, *Highway Noise Fundamentals*, (1980) 81.

In addition, increased motor vehicle traffic that would result from buildout of the Marine Science Campus, including the proposed project, would result in roadway noise increases at sensitive receptors that are less than the thresholds of significance. This is considered a less than significant impact.

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Appendix A: Construction Noise Modeling Data

Appendix B: Operational Noise Modeling Data

1.0 INTRODUCTION

This acoustical analysis evaluates the potential climate change impacts associated with implementation of the proposed University of California, Santa Cruz ("UCSC" or "University") Marine Science Campus Projects ("projects" or "proposed projects") located in Santa Cruz County, California. The proposed projects consists of: 1) the Coastal Biology Building (CBB) Project, which would develop a new lab building and greenhouse complex; 2) the Infrastructure Improvements Project Phase 3 (IIP 3) Project, which consists of infrastructure improvements to serve the CBB and other future development on the campus; 3) the NEF Project, which includes improvements to public access trails and overlooks; and 4) the Specific Resource Plan (SRP) Phase 1B Wetland Restoration Project. Because they are being designed as one project and would be constructed concurrently, the IIP 3 project and the trail and overlook elements of the NEF project are considered in this analysis as one phase. Construction is anticipated to begin in 2012 and be completed in 2013. The projects would be in operation in 2014. The analysis describes the methodologies used to estimate the projects' noise impacts, as well as the assumptions used in the analysis, and shows the expected noise levels at sensitive land uses while under construction and at full buildout.

1.1 Noise Metrics

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. Noise can be defined as unwanted sound. Sound is characterized by various parameters that include the rate of oscillation of sound waves (frequency), the speed of propagation, and the pressure level or energy content (amplitude). In particular, the sound pressure level is the most common descriptor used to characterize the loudness of an ambient sound level. The decibel (dB) scale is used to quantify sound intensity. Because sound pressure can vary enormously within the range of human hearing, a logarithmic loudness scale is used to keep sound intensity numbers at a convenient and manageable level. The human ear is not equally sensitive to all frequencies in the entire spectrum, so noise measurements are weighted more heavily for frequencies to which humans are sensitive in a process called "A-weighting," written "dB(A)." The A-weighted sound level is measured on a logarithmic scale such that a doubling of sound energy results in a 3.0 dB(A) increase in noise level.[3] In general, changes in a community noise level of less than 3.0 dB(A) are not typically noticed by the human ear.[4] Changes from 3.0 to 5.0 dB(A) may be noticed by some individuals who are extremely sensitive to changes in noise.[5] A greater than 5.0

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3 U.S. Department of Transportation, Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, (2006) 2-3.

4 U.S. Department of Transportation, Federal Highway Administration, *Highway Noise Fundamentals*, (1980) 81.

5 U.S. Department of Transportation, Federal Highway Administration, *Highway Noise Fundamentals*, (1980) 81.

dB(A) increase is readily noticeable, while the human ear perceives a 10.0 dB(A) change in sound level to be a doubling or halving sound.[6]

Different types of metrics are used to characterize the time-varying nature of sound. These metrics include the equivalent sound level (L_{eq}), the minimum and maximum sound levels (L_{min} and L_{max}), the day-night sound level (L_{dn}), and the community noise equivalent level (CNEL). Below are brief definitions of these metrics and other terminology used in this chapter:

- **Sound.** A vibratory disturbance created by a vibrating object which, when transmitted by pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone.
- **Noise.** Sound that is loud, unpleasant, unexpected, or otherwise undesirable.
- **Decibel (dB).** A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure is 20 micro-pascals.
- **A-Weighted Decibel (dB(A)).** An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear.
- **Maximum Sound Level (L_{max}).** The maximum sound level measured during the measurement period.
- **Minimum Sound Level (L_{min}).** The minimum sound level measured during the measurement period.
- **Equivalent Sound Level (L_{eq}).** The equivalent steady state sound level that in a stated period of time would contain the same acoustical energy.
- **Day-Night Level (L_{dn}).** The energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the A-weighted sound levels occurring during the period from 10:00 PM to 7:00 AM
- **Community Noise Equivalent Level (CNEL).** The energy average of the A-weighted sound levels occurring during a 24-hour period with 5 dB added to the A-weighted sound levels occurring during the period from 7:00 PM to 10:00 PM and 10 dB added to the A-weighted sound levels occurring during the period from 10:00 PM to 7:00 AM

L_{dn} and CNEL values differ by less than 1 dB. As a matter of practice, L_{dn} and CNEL values are considered to be equivalent and are treated as such in this assessment.

6 U.S. Department of Transportation, Federal Highway Administration, *Highway Noise Fundamentals*, (1980) 81.

2.0 ENVIRONMENTAL SETTING

2.1 Ambient Noise Levels

To determine the existing noise levels within and near the project site, two locations were selected to conduct 24-hour noise monitoring. Two Larson Davis Model 720 SLM Controller Integrating Sound Level Meters and a Larson Davis Model 820 SLM Controller Integrating Sound Level Meter noise monitor were used to gather existing ambient noise measurements over a 24-hour period on October 6-7, 2010. These meters satisfy the American National Standards Institute standard for general environmental noise measurement instrumentation.[7] Random incidence microphones with windscreens were used given the outdoor (i.e., free field) conditions of the monitoring. The microphones were positioned approximately 1.5 meters above ground level. Wind speeds during noise monitoring ranged from 0 to 10 miles per hour and weather conditions were clear. There were no construction activities or other abnormal noise conditions present during monitoring.

Noise monitoring for Location 1 was conducted at the south side of the intersection of Shaffer Road and Delaware Avenue Extension. Noise monitoring for Location 2 was conducted at the Younger Lagoon Reserve near the existing Temporary Greenhouse buildings. **Figure 1, Noise Monitor Locations**, depicts the locations of the two noise monitors. **Table 1, Noise Monitoring Results**, reports the 24-hour CNEL noise measurements and the peak hour L_{eq} noise measurements for each monitored location.

The certified UCSC Marine Science Campus Coastal Long Range Development Plan (CLRDP) Environmental Impact Report (EIR)[8] estimated the weekday afternoon peak hour traffic noise levels along road segments near the UCSC Marine Science Campus. The nearest roadway segments that were analyzed were on Delaware Avenue east and west of Shaffer Road. Other nearby roadway segments include Shaffer Road north of Delaware Avenue, Natural Bridges Drive north of Delaware Avenue, Delaware Avenue east and west of Natural Bridges Drive, Swanton Boulevard south of Delaware Avenue, and Delaware Avenue east and west of Swanton Boulevard. A summary of the estimated noise along these roadway segments from the USCS Marine Science Campus CLRDP EIR are provided in **Table 2, Summary of Estimated Existing Roadway Noise Near the Project Site**.

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7 Technical specifications regarding the Larson Davis monitors may be obtained from their website: http://www.larsondavis.com.

8 University of California, Santa Cruz, Marine Science Campus, *CLRDP Environmental Impact Report*, SCH No. 2001112014, (2004).

Table 1
Noise Monitoring Results

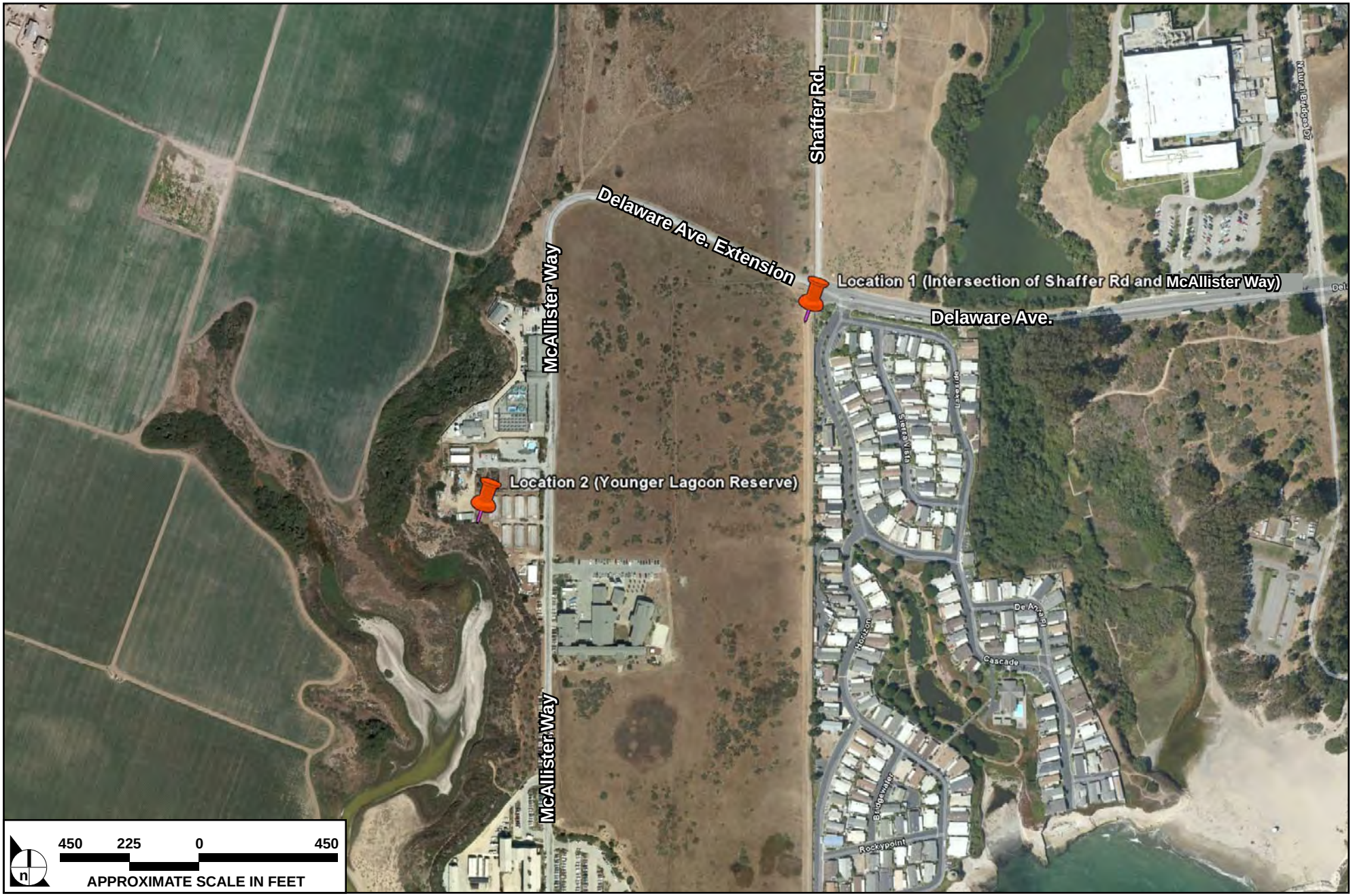
Site ID	Location Description	Measurement Period		Measurement Results (dB(A))		
		Date	Duration (hours)	Peak-Hour L_{eq}	24-Hour L_{eq}	CNEL
1	Intersection of Shaffer Road and (south of) Delaware Avenue Extension	Oct. 6-7, 2010	24	54.4	53.6	59.4
2	Younger Lagoon Reserve adjacent to existing Temporary Greenhouses	Oct. 6-7, 2010	24	45.2	42.0	47.5

Source: Impact Sciences, Inc.

Table 2
Summary of Estimated Existing Roadway Noise Near the Project Site

Segment	Roadway Segment	Peak-Hour Sound Level, Leq (dB(A))
		Existing
1	Shaffer Road north of Delaware Avenue	47.9
2	Delaware Avenue east of Shaffer Road	53.1
3	Delaware Avenue west of Shaffer Road	50.4
4	Natural Bridges Drive north of Delaware Avenue	59.2
5	Delaware Avenue east of Natural Bridges Drive	60.5
6	Delaware Avenue west of Natural Bridges Drive	57.9
7	Swanton Boulevard south of Delaware Avenue	58.1
8	Delaware Avenue east of Swanton Boulevard	61.1
9	Delaware Avenue west of Swanton Boulevard	61.1

Source: University of California, Santa Cruz, Marine Science Campus, CLRDP Environmental Impact Report*, SCH No. 2001112014, (2004) 4.11-13.*



SOURCE: Google Earth – July 2007, Impact Sciences, Inc. – February 2011

FIGURE **1**

Noise Monitoring Locations

680-012•02/11

3.0 REGULATORY ENVIRONMENT

3.1 State

There are no federal noise requirements or regulations that bear directly on local actions of UCSC. The proposed project is located on the central California coast adjacent to the Monterey Bay National Marine Sanctuary, one of the largest protected marine areas in the world, three miles south of the SCSC Main Campus. Since the project is located adjacent to a protected marine area (Younger Lagoon Reserve to the west of the project site) and near existing residential units (homes east of the project site), an acoustical analysis based on pertinent state regulations concerning noise standards is warranted. No other local (city or county) plans and policies apply.

The pertinent State of California regulations are contained in the California Code of Regulations (CCR). Title 24 "Noise Insulation Standards" establish the acceptable interior community noise level for multifamily dwellings (and may be extended by local legislative action to include single-family dwellings). Section 65302(f) of the CCR establishes the requirement that local land use planning jurisdictions prepare a General Plan. The Noise Element is a mandatory component of the General Plan. It includes general community noise guidelines developed by the California Department of Health Services and specific planning guidelines for noise/land use compatibility developed by the local jurisdiction. The state guidelines recommend that the local jurisdiction consider adopting a local nuisance noise control ordinance.

The State of California, Department of Health Services, Environmental Health Division, has published recommended guidelines for noise and land use compatibility referred to as the *State Land Use Compatibility Guidelines for Noise* (*State Noise Guidelines*). The Department of Health Services does not mandate application of this compatibility matrix to development projects; however, each jurisdiction is required to consider the *State Noise Guidelines* when developing its general plan noise element and when determining acceptable noise levels within its community.[9] The *State Noise Guidelines* provides acceptable and unacceptable exterior noise levels based on land use type. Selected relevant levels are as follows:

- **Low-Density Residential:** CNEL below 60 dB(A) is considered normally acceptable.
- **Educational Facilities:** CNEL below 70 dB(A) is considered acceptable.

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9 The *State Noise Guidelines* are published by the Governor's Office and Planning and Research in the State of California General Plan Guidelines (2003).

Under most of the land use categories, overlapping ranges of acceptability and unacceptability are presented, leaving some ambiguity in areas where noise levels fall within the overlapping range. Consideration should be given to the specific land use type and the relative noise sensitivity of the occupants and activities. "Normally acceptable" is defined as satisfactory for the specified land use, assuming that normal conventional construction is used in buildings. "Conditionally acceptable" may require some additional noise attenuation or special study. For example, conditionally acceptable impacts should undergo a more detailed analysis of noise attenuation features included in the project design or incorporated as mitigating features. Exterior noise attenuation features include, but are not limited to, setbacks to place structures outside the conditionally acceptable noise contour, orienting structures so no windows open to the noise source, and/or installation of noise barriers, such as berms and/or solid walls. Within a 65 dB(A) CNEL exterior noise environment, conventional construction with closed windows would typically reduce interior noise levels to acceptable levels (to at least 45 dB(A) CNEL or lower).

The *State Noise Guidelines* do not provide specific recommendations for acceptable or unacceptable exterior noise levels for wetlands, such as the Younger Lagoon Reserve. The CLRDP EIR contains recommendations for assessing noise impacts at the Reserve, which are discussed below.

3.2 Local

3.2.1 CLRDP

The CLRDP is the applicable land use plan for the Marine Science Campus. Although the University, as a state entity, is not subject to local regulations, they are a subject of importance to the University in evaluating impacts. The CLRDP includes two implementation measures that regulate operational noise on the Campus. Implementation Measure 3.4.3 requires that the Younger Lagoon Reserve shall not be exposed to noise generated by human activity on the terrace portion of the Marine Science Campus in excess of 60 dBA CNEL, as measured at the boundary of the Younger Lagoon Reserve. Implementation Measure 3.4.2 requires that development shall be sited and designed so that noise sources are no closer than 100 feet from designated Resource Protection areas located in the terrace portion of the Marine Science Campus (other than development, such as paths, that may include minimal noise sources and that is planned and/or located within 100 feet of these areas and where measures are taken so that noise potentially audible from within these areas is minimized to the maximum extent feasible). Implementation Measure 3.4.2 is addressed by the CLRDP land use plan, which establishes a 100-foot development buffer around Resource Protection areas.

The CLRDP EIR includes guidelines for construction-related noise impacts. The criterion noise level for determining the impact significance of construction noise on sensitive receptors varies according to the

time of day. Construction noise would be considered a significant impact if it is greater than 80 dBA Leq during daytime or evening hours (7:00 AM to 10:00 PM), or 70 dBA Leq period during nighttime hours (10:00 PM to 7:00 AM) at noise sensitive land uses.[10]

The UCSC Marine Science Campus CLRDP EIR also relies on noise guidelines adopted by the City of Santa Cruz to evaluate the significance of noise impacts from Campus development. These guidelines are described below.

3.2.2 City of Santa Cruz

Although the University, as a state entity, is not subject to local regulations, local standards are a subject of importance to the University in evaluating impacts. It is University policy to seek consistency with local plans and policies where feasible. To that end, the UCSC Marine Science Campus CLRDP EIR relies on noise guidelines adopted by the City of Santa Cruz to evaluate the significance of noise impacts from Campus development. More specifically, the CLRDP EIR relies on the construction noise standards found in the City's Municipal Code and land use compatibility guidelines for noise adopted in the City's Noise Element of its General Plan. The following provides a brief description of these standards and guidelines used in the CLRDP EIR.

Construction Standards

Construction noise standards for the City of Santa Cruz are found in the City's Municipal Code. The Municipal code does not provide construction noise limits. However, it does prohibit construction activities between 10:00 PM and 8:00 AM within "one hundred feet of any building or place regularly used for sleeping purposes" or activity that "disturbs, or would tend to disturb, any person within hearing distance" (City of Santa Cruz Municipal Code §9.36.010). Construction activity may occur during these hours with express written permission of the chief building official, public works director, planning and community development director or water department director if such activity is deemed necessary.

Land Use Compatibility Guidelines for Noise

The City of Santa Cruz has adopted planning guidelines for noise and land use compatibility based on the State of California's Office of Planning and Research recommendations. The guidelines have been

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10 University of California, Santa Cruz, Marine Science Campus, *CLRDP Environmental Impact Report*, SCH No. 2001112014, (2004) 4.11-4. According to the CLRDP EIR, "[t]hese standards have been derived from noise ordinances of other jurisdictions."

adopted in the City's Noise Element of its General Plan.[11] The City's guidelines provide acceptable and unacceptable exterior noise levels based on land use type. Selected relevant levels are as follows:

- **Single-Family Residential:** CNEL below 60 dB(A) is considered normally acceptable.
- **Educational Facilities:** CNEL below 70 dB(A) is considered acceptable.

As previously discussed, overlapping ranges of acceptability and unacceptability are presented, leaving some ambiguity in areas where noise levels fall within the overlapping range. Consideration should be given to the specific land use type and the relative noise sensitivity of the occupants and activities. "Normally acceptable" is defined as satisfactory for the specified land use, assuming that normal conventional construction is used in buildings. "Conditionally acceptable" may require some additional noise attenuation or special study.

4.0 METHODOLOGY

Construction of the project would require demolition, grading/excavation, trenching for relocating utilities, building construction, asphalt paving, and architectural coating. These activities typically involve the use of heavy equipment, such as tractors, dozers, and cranes. While construction would be temporary, the use of these types of equipment would generate both steady state and episodic noise that would be heard both on and off the project site. Once the project becomes operational, the permanently installed equipment would generate long-term noise. The level of operational noise would depend on the equipment design specifications and any noise reduction or shielding features. The operational equipment design specifications were provided by the University and are described below.

The construction noise impacts were estimated using data from the U.S. Environmental Protection Agency (EPA) and the Federal Transit Administration (FTA). The U.S. EPA and the FTA have compiled data on the noise-generating characteristics of specific types of construction equipment.[12] Noise levels generated by heavy equipment can range from approximately 70 dB(A) to noise levels in excess of 100 dB(A) when measured at a distance of 50 feet from the noise source. The noise levels diminish rapidly with distance at a rate of approximately 6.0 to 7.5 dB(A) per doubling of distance for acoustically hard and soft sites, respectively. An example of an acoustically hard site would be a parking lot while an acoustically soft site would be a park. Assuming an acoustically hard site, a noise level of 75 dB(A)

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11 State of California, Governor's Office of Planning and Research, *State of California General Plan Guidelines*, Appendix C: Guidelines for the Preparation and Content of Noise Elements of the General Plan, (2003).

12 U.S. Environmental Protection Agency, *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*, (1971); Federal Transit Administration, *Transit Noise and Vibration*, (1995).

measured at 50 feet from the noise source would be reduced to 69 dB(A) at 100 feet and to 63 dB(A) at 200 feet. Construction noise levels at sensitive receptors would tend to vary based on the location of construction activity and the number of equipment in operation. This project consists of three overlapping phases. Therefore, this analysis modeled the maximum construction noise impacts using eleven different scenarios, each scenario representing a likely combination of overlapping activity and equipment mix as each of the three phases are constructed. Construction will not take place at night within 150 feet of any building or place used for sleeping purposes, in accordance with the City of Santa Cruz Municipal Code §9.36.010.

The operational noise impacts were analyzed using a computer-based sound model called SoundPLAN. The SoundPLAN noise modeling software provides a computer simulation of noise situations. SoundPLAN is a three-dimensional noise propagation model that is used to visualize the effects of noise in the environment and is capable of modeling noise from a variety of sources including but not limited to stationary commercial and industrial equipment and motor vehicles. The model can account for source and receptor heights, terrain elevations, barriers, building and surface reflections, noise frequency, time histograms, and more.

5.0 THRESHOLDS OF SIGNIFICANCE

5.1 Construction Noise Standards and Thresholds

As previously discussed, the UCSC Marine Science Campus CLRDP EIR evaluates construction noise based on the standards found in the City of Santa Cruz Municipal Code and the CLRDP EIR. The City of Santa Cruz does not specify a noise threshold for construction activities but rather generally prohibits construction activity between the hours of 10:00 PM and 8:00 AM within 100 feet of a building used for sleeping purposes or activities that would disturb any person within hearing distance. Therefore, construction activities that would occur during these hours within hearing distance of residential buildings would be considered a significant noise impact.

Construction noise usually occurs on a temporary and periodic basis. The CLRDP EIR evaluates construction noise impacts based on the significance thresholds listed below. This analysis also utilizes the same threshold for evaluating the significance of project construction.

- 80 dB(A) Leq (8-hour) during daytime and evening.; and
- 70 dB(A) Leq (8-hour) during nighttime.

5.2 Operational Noise Standards and Thresholds

As previously discussed, the UCSC Marine Science Campus CLRDP EIR evaluates operational noise based on the land use compatibility guidelines for noise adopted in the City of Santa Cruz Noise Element of its General Plan. The City's adopted guidelines are based on the *State Noise Guidelines*, as previously described. The *State Noise Guidelines* lists 60 dB(A) as normally acceptable for low-density residential, 70 dB(A) as acceptable for educational facilities, and 70 dB(A) as normally acceptable for offices. The CLRDP sets a standard of 60 dB(A) CNEL for the Younger Lagoon Reserve. For purposes of evaluating the significance of the noise impacts, the following numeric thresholds were used:

- An increase in noise which causes the significance thresholds (60 dB(A) CNEL for low-density residential and 70 dB(A) CNEL for educational facilities) to be exceeded and the project results in an increase in noise of 3.0 dB(A) or more;
- An increase of 5.0 dB(A), where the noise levels without the project are 50 to 55 dB(A) CNEL for high-density residential uses and 60 to 65 dB(A) CNEL for educational facilities and the increase in noise from the project does not cause the significance thresholds to be exceeded; or
- An increase of 10.0 dB(A), where noise levels without the project are less than 50 dB(A) CNEL for high-density residential uses and less than 60 dB(A) CNEL for educational facilities and the increase in noise from the project does not cause the significance thresholds to be exceeded.
- An increase in noise which causes the significance thresholds (60 dB(A) CNEL for the Younger Lagoon Reserve) to be exceeded at the boundary of the Reserve.

The increase in noise is based on comparing the project and no build conditions within the same time frame. A noise increase of 3.0 dB(A) is considered to be a perceptible increase in noise levels. Increases of 5.0 and 10.0 dB are used to evaluate noise impacts in areas where the ambient or background noise levels without the project are low or moderate. The use of this "sliding scale" is appropriate because where ambient/background levels are low, an increase of 3.0 dB(A) may be perceptible but would not be enough to create an annoyance or nuisance. On the other hand, where the ambient/background noise levels are already moderately high, an increase of 3.0 dB(A) would exacerbate an existing noise problem and would potentially increase the level of annoyance perceived by sensitive receptors.

6.0 IMPACT ANALYSIS

6.1 Construction Noise

The U.S. EPA and the FTA have compiled data on the noise-generating characteristics of specific types of construction equipment.[13] Noise levels generated by heavy equipment can range from approximately 75 dB(A) to noise levels in excess of 100 dB(A) when measured at a distance of 50 feet from the noise source. The noise levels diminish rapidly with distance at a rate of approximately 6.0 to 7.5 dB(A) per doubling of distance for acoustically hard and soft sites, respectively. The noise levels associated with construction of the proposed project are provided below in **Table 3, Estimated Unmitigated Construction Noise Levels**. As discussed in **Section 4.0**, this analysis modeled the construction noise impacts using eleven different scenarios, each scenario representing a likely combination of overlapping activity and equipment mix as each of the three phases are constructed. **Table 3** shows the estimated maximum construction noise levels at the homes to the east. Construction would commence in July 2012 and would be completed in April 2014. These eleven scenarios are representative of the maximum construction noise over the course of the 21-month construction period.

Table 3 indicates that during the 21-month construction period, the sensitive receptors to the east of the project site could be exposed to temporary noise levels ranging from a low of 70.0 dB(A) to a high of 86.0 dB(A). Therefore, construction activities could potentially exceed 80 dB(A) during the daytime at the nearest sensitive receptors, primarily as a result of grading of the De Anza Trail. Specifically, grading of the De Anza trail could result in temporary construction noise levels that exceed 80 dB(A) because of its close proximity to sensitive receptors. The noise levels in **Table 3** are conservative because they do not account for the wall, approximately five feet high, that currently stands on the property line of the nearest residences.

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13 U.S. Environmental Protection Agency, *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*, (1971); Federal Transit Administration, *Transit Noise and Vibration*, (1995).

Table 3
Estimated Unmitigated Construction Noise Levels

Scenario	Construction Phase and Activity	Construction Equipment Modeled	Sensitive Receptors	
			Average Distance (Feet)	Maximum Noise Level (dB(A))
1	CBB -Demolition/Grading	1 Bore/Drill Rig, 1 Cement and Mortar Mixer, 2 Excavators, 1 Other General Equipment, 1 Tractor/Backhoe/Loader	516	86.0
	INF-Excavation/Grading	1 grader, 1 Rubber Tired Dozer, 1 Tractor/Loader/Backhoe, 1 Water Truck	221	
	SRP- Excavation/Grading	1 Rubber Tired Dozer, 1 Water Truck	71	
2	CBB-Trenching/Utilities	1 Bore/Drill Rig, 1 Cement and Mortar Mixer, 2 Excavators, 1 Other General Equipment, 1Tractor/Backhoe/Loader	516	85.0
	INF-Excavation/Grading	2 Excavators, 1 Other General industrial Equipment, 1 Tractor/Loader/Backhoe	221	
	SRP- Excavation Grading	1 Rubber Tired Dozer, 1 Water Truck	71	
3	CBB-Trenching/Utilities	1 Bore/Drill Rig, 1 Cement and Mortar Mixer, 2 Excavators, 1 Other General Equipment, 1Tractor/Backhoe/Loader	516	85.0
	INF-Trenching/Utilities	2 Excavators, 1 Other General industrial Equipment, 1 Tractor/Loader/Backhoe	221	
	SRP-Excavation/Grading	1 Rubber Tired Dozer, 1 Water Truck	71	
4	CBB-Building Construction	1 Crane, 2 Forklifts, 1 Tractor/Loaders/Backhoe	516	78.0
	INF-Trenching/Utilities	2 Excavators, 1 Other General industrial Equipment, 1 Tractor/Loader/Backhoe	221	
5	CBB-Building Construction	1 Crane, 2 Forklifts, 1 Tractor/Loaders/Backhoe	516	78.0
	INF-Excavation and Grading	1 grader, 1 Rubber Tired Dozer, 1 Tractor/Loader/Backhoe, 1 Water Truck	221	

Scenario	Construction Phase and Activity	Construction Equipment Modeled	Sensitive Receptors	
			Average Distance (Feet)	Maximum Noise Level (dB(A))
6	CBB-Building Construction	1 Crane, 2 Forklifts, 1 Tractor/Loaders/Backhoe	516	80.0
	INF-Asphalt Paving	4 Cement and Mortar Mixers, 1 Paver, 1 Paving Equipment, 1 Roller, 1 Tractor/Loader/Backhoe	221	
7	CBB-Building Construction	1 Crane, 2 Forklifts, 1 Tractor/Loaders/Backhoe	516	80.0
	INF-Asphalt Paving	4 Cement and Mortar Mixers, 1 Paver, 1 Paving Equipment, 1 Roller, 1 Tractor/Loader/Backhoe	221	
8	CBB-Architectural Coating and Building Construction	1 Crane, 2 Forklifts, 1 Tractor/Loaders/Backhoe	516	70.0
9	CBB-Building Construction	1 Crane, 2 Forklifts, 1 Tractor/Loaders/Backhoe	516	70.0
10	CBB-Building Construction	1 Crane, 2 Forklifts, 1 Tractor/Loaders/Backhoe	516	70.0
11	CBB-Asphalt Paving	4 Cement and Mortar Mixers, 1 Paver, 1 Paving Equipment, 1 Roller, 1 Tractor/Loader/Backhoe	516	73.0

CBB = Coastal Biology Building; INF = Infrastructure Improvements; SRP = Specific Resource Plan Phase 1B Wetland Restoration
*Source: Impact Sciences, Inc. Construction noise modeling calculations are provided in **Appendix A**.*

In accordance with the UCSC Marine Science Campus CLRDP EIR, the following mitigation measure is applicable and included in the proposed projects.

CLRDP EIR General Mitigation Measure 4.11-4: Prior to the initiation of construction, the University shall approve a construction noise mitigation program including but not limited to the following:

- The University shall require that construction activities be limited to a schedule that minimizes disruption to noise-sensitive uses on the project site and in the vicinity through implementation of the following:
  - Construction activities during daytime and evening hours (7:00 AM to 10:00 PM) shall not occur within 150 feet of sensitive receptors, when feasible. Construction activities within 500 feet of sensitive receptors activities shall not occur during nighttime hours (10:00 PM to 7:00 AM).
  - Whenever possible, academic and administrative staff, as well as residents who will be subject to construction noise, shall be informed one week before the start of each construction project.
- To reduce noise impacts from construction, the University shall require that construction contractors muffle or otherwise control noise from construction equipment through implementation of the measures below. The effectiveness of these measures is quantified in Table 4.11-4 of the CLRDP EIR.
  - Internal combustion engines used for any purpose at the construction sites shall be equipped with a muffler of a type recommended by the manufacturer.
  - Equipment used for construction shall utilize the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures, and acoustically-attenuating shields or shrouds, wherever feasible);
  - Impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for construction shall be hydraulically or electrically powered wherever feasible to avoid noise associated with compressed air exhaust from pneumatically powered tools. However, where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used. Such mufflers can lower noise levels from the exhaust as much as 10 dB(A). External jackets on the tools themselves shall be used where feasible, and this could achieve a reduction of 5 dB(A). Quieter procedures such as using drilling equipment rather than impact equipment shall be implemented whenever feasible.
  - Stationary noise sources shall be located as far from sensitive receptors as feasible. If they must be located near sensitive receptors, they shall be muffled to the extent feasible and/or, where practicable, enclosed within temporary sheds.
- The University shall require that a temporary wooden wall be placed around construction activity areas that are within 150 feet of sensitive receptors to provide additional noise

attenuation, where feasible. The wall should impede the direct line of site between the noise sources and sensitive receptors.

- The University shall require that construction-related material haul trips access the campus via Natural Bridges Drive and Delaware Avenue in order to minimize noise exposure to residential land uses.

According to the U.S. EPA, the use of noise mufflers and other feasible noise reduction features on construction equipment, which is required by CLRDP EIR General Mitigation 4.11-4, would reduce construction-equipment related noise to 80 dB(A) or less measured at 50 feet. When the existing wall along the eastern boundary of the campus is taken into account, noise levels are reduced by a minimum of 6 dB(A). As a result, the maximum construction-related noise level would be reduced from 86.0 dB(A) to 75.6 dB(A) at the sensitive receptors to the east (De Anza residences); this would be below the daytime significance threshold of 80 dB(A). CLRDP EIR General Mitigation 4.11-4 also prohibits construction activities within 500 feet of sensitive receptors during nighttime hours (10:00 PM to 7:00 AM). This would ensure that construction noise does not exceed the nighttime threshold of 70 dB(A). Therefore, with implementation of CLRDP EIR General Mitigation Measure 4.11-4, reduce construction noise impacts on sensitive receptors would not be significant.

The City of Santa Cruz is proposing a desalination plant to be located either on Shaffer Road across from the Marine Science Campus Upper Terrace or several blocks to the east on Delaware Avenue. The City is currently in the process of preparing the environmental documentation for the project. Construction of the proposed desalination plant would generate temporary construction noise, which could occur at the same time as construction noise from the proposed projects. The City's Integrated Water Plan (IWP) EIR, which analyzed the environmental impacts of the desalination plant project at the program level, determined that construction noise impacts for the desalination plant itself would be less than significant with mitigation. IWP EIR Mitigation Measure 5.6-4c requires that, prior to construction of proposed Program facilities, the contractor shall develop and implement a construction noise attenuation plan as needed on a project-by-project basis to reduce noise-related impacts at nearby sensitive receptors to the degree feasible. The IWP EIR determined that construction in public roads of pipelines associated with the desalination plant could result in a significant and unavoidable noise impact if construction had to be done during the night.

Construction activities at the desalination plant site as well as construction of the pipelines associated with the desalination plant project in Delaware Avenue could add to the noise levels generated by construction of the proposed projects, particularly from utility, road and parking lot construction in the campus entrance area. Construction of the proposed Marine Science Campus Projects would not take

place at night within 500 feet of the De Anza Santa Cruz community, and therefore would not exacerbate any significant and unavoidable noise impact of the desalination plant pipelines.

In addition to CLRDP EIR Mitigation Measure 4.11-4, the following project-specific mitigation measure is recommended to further reduce the cumulative noise impact, should the desalination plant be approved for construction at the same time as the proposed projects:

NOISE-1 If construction of the proposed projects overlaps with construction of a desalination plant on the property at the northeast corner of Delaware Avenue and Shaffer Road, the University shall evaluate potential cumulative noise impacts at the residences to the east of the campus. The University shall also coordinate with the City of Santa Cruz on the scheduling of construction activities in the Campus entrance area to minimize the generation of cumulative construction noise. If necessary to reduce noise at the residential receptors to an acceptable, level, the University shall construct a temporary wood sound wall between the campus entrance construction and the eastern boundary of the Campus.

6.2 Operational Noise Sources

The proposed project consists of the development of the CBB, improvement of associated infrastructure, and the construction of the SRP Phase 1B Wetland Restoration project. The operation of the proposed project includes the use of two 7,000 CFM exhaust fans on the roof of the CBB lab building, a 30-ton air-cooled chiller at the CBB lab building loading dock, a 40 kW emergency generator at the CBB lab, four exhaust fans on the roof of the greenhouse research facility, and a direct evaporative cooler for each of the three greenhouses. Other sources of operational noise include the proposed standby generator yard, which would include two standby generators, vehicles operating in Parking Lots A, C and D, and vehicles traveling along local roadways.

6.3 Operational Noise Modeling

The acoustical analysis was conducted using the SoundPLAN noise modeling software. A description of the parameters used for the SoundPLAN noise model is provided below.

- **Ambient Noise:** The SoundPLAN model requires defined area sources to represent the background (i.e., ambient) noise levels. Two area sources were defined, each representing the existing noise levels that were monitored at the intersection of Shaffer Road and Delaware Avenue Extension and at the Younger Lagoon Reserve. One area source was defined for the region east of McAllister Way and was assigned a 24-hour Leq of 53.6 dB(A), as was measured at the intersection of Shaffer Road and Delaware Avenue Extension. The other area source was defined for the region west of McAllister

Way and was assigned a 24-hour L_{eq} of 42.0 dB(A), as was measured at the Younger Lagoon Reserve. These area sources represent the existing ambient noise levels for their respective regions.

- **Sensitive Receptors:** Based on a survey of the project using aerial imagery, 21 mobile homes are located to the east of the proposed project site. These homes were identified as sensitive receptors and were included in the SoundPlan model. The Younger Lagoon Reserve located directly to the west of the project site was considered a receptor, due to the wildlife use of the area. Four receivers were modeled and placed in various locations within the Lagoon footprint in SoundPlan to determine the noise level increase due to operation of the proposed project.

- **Roadways:** The roadway segment that is near the identified sensitive receptors is Delaware Avenue between Shaffer Road and Natural Bridges Drive. This roadway segment was included in the SoundPLAN model as a noise source under existing conditions, future plus project conditions, and cumulative plus project conditions. The average daily trips (ADT) for this roadway segment were obtained from the UCSC Marine Science Campus CLRDP EIR for the following scenarios (1) Existing Conditions, 2,356 ADT; (2) Future Plus Project Conditions, 3,680 ADT; (3) Cumulative Plus Project Conditions, 5,472 ADT. The roadway segment was modeled as one lane in each direction with each lane approximately 9.4 meters wide.

- **Existing On-Site Buildings**: Nearby existing buildings were included in the SoundPLAN model in order to model the existing noise levels and account for any reflection or attenuating effects after project buildout. The existing buildings south of the CBB project site, the existing greenhouses to the west of the CBB project site (two of which would remain after project buildout), and the existing buildings to the north of the proposed Greenhouse Complex were included in the SoundPLAN model.

- **Proposed CBB Building:** The proposed CBB building was included in the SoundPLAN as a potential noise source and modeled as a two-story building with a height of 36 feet. Two 7,000 cubic feet per minute (CFM) exhaust fans were modeled as point sources on the rooftop of the CBB Lab building. Each fan was assumed to operate at full capacity during the daytime and was assigned a noise level of 58.0 dB(A) as measured 10-feet from the source. A 30-ton air-cooled chiller was modeled as a point source at the northwest corner of the CBB building near the loading dock. The chiller was assumed to operate at full capacity during the daytime and was assigned a noise level of 85.0 dB(A) as measured 10-feet from the source.[14] Two boilers were modeled as point sources in the CBB building. Each boiler was assumed to operate at full capacity during the daytime and was assigned a noise level of 59.0 dB(A).[15]

- **Proposed Greenhouse Lab Buildings:** The Greenhouse Lab Buildings were included in the model as potential noise sources and modeled as individual buildings, each one-story with a height of 26-feet. Four exhaust fans were modeled as point sources on the rooftops. Each fan was assumed to operate at full capacity during the daytime and was assigned a noise level of 58.0 dB(A) as measured 10-feet from the source. Four direct evaporative coolers were modeled as point sources on the rooftops. Each

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14 Environmental and Power Control Systems, Unitron, Preconditioned Air System Model ES-3215 30 Ton Electric Unit, Specifications Pamphlet.

15 Stokvls Energy Systems, "Econoflame R6000 Gas Fired Condensing Boilers, Options and Systems Documentation," p. 5. http://www.ribaproductselector.com/Docs/2/19382/external/COL1219382.pdf?ac=.

cooler was assumed to operate at full capacity for 24-hours and was assigned a noise level of 37.5 dB(A) as measured 3-feet from the source. A boiler was modeled as a point source and was assumed to operate at full capacity during the daytime and was assigned a noise level of 59.0 dB(A).[16]

- **Proposed Parking Lots:** The proposed project includes a new surface parking lot (Parking Lot D), which was included in the SoundPLAN model as a potential noise source. Parking Lot D was estimated to have 67 spaces and was conservatively assumed to be 100 percent occupied between 7:00 AM and 5:00 PM and 10 percent occupied between 5:00 PM and 7:00 AM. The Infrastructure Project also includes a new Parking Lot A and Parking Lot C. Parking Lot A was not included in the model because the roadway noise along Delaware Avenue and Delaware Avenue Extension would drown out its contribution to operational noise. Parking Lot C was also not included because it would be similar to the noise generating from vehicles parking in the existing lot, which has already been captured by the noise monitoring.

- **Proposed Standby Generator Yard:** Two stand-by generators were modeled as area sources north of the proposed CBB building. Each generator was assigned with a noise level of 94 dB(A) measured at 23 feet (7 meters) during normal load conditions based on a 200 kW rated power.[17] Since the amount of time that each generator would in operation is unknown, it has been assumed that each generator would operate at full capacity during the daytime for about 2.5 hours for testing and maintenance purposes. This is consistent with the assumptions used for the air quality analysis.

- **Operational Features:** A 40 kW emergency generator was developed as an area source just to the west of the CBB proposed building. This generator was assigned with a noise level of 73.0 dB(A) measured at 15-feet during normal load conditions based on a 50 kW rated power.[18] Since the amount of time that an emergency generator would be in operation is unknown, it has been assumed that the generator would operate at full capacity during the daytime for about one hour for testing and maintenance purposes. This is consistent with the assumptions used for the air quality analysis.

The results of the SoundPLAN modeling analysis are provided in **Table 4, Operational Noise Modeling Results**. The results indicate that the proposed project would not result in a perceptible change in noise levels at the sensitive receptors to the east (De Anza residences) and that noise levels at the Younger Lagoon Reserve would not exceed the level set by the CLRDP. Under cumulative plus project conditions, the noise levels would also not result in a perceptible change at the sensitive receptors to the east (De Anza residences) or at the Younger Lagoon Reserve. Under each analysis situation, the change in noise levels is less than 3 dB(A). This would be considered a less than significant impact.

The modeling results are also presented graphically in **Figure 2, SoundPLAN Noise Modeling Results: Existing**, for the existing conditions, in **Figure 3, SoundPLAN Noise Modeling Results: Future Plus**

16 Stokvls Energy Systems, "Econoflame R6000 Gas Fired Condensing Boilers, Options and Systems Documentation," p. 5. http://www.ribaproductselector.com/Docs/2/19382/external/COL1219382.pdf?ac=.

17 Generac Power Systems, Inc. Sound Test Results, Genset: MG200 13.3L HINO, Standard Weather Enclosure.

18 Guardian by Generac Power Systems, Inc. Automatic Standby Generators Pamphlet

Project, for the future plus project conditions, and in **Figure 4, SoundPLAN Noise Modeling Results: Cumulative Plus Project**, for the cumulative plus project conditions. These figures show the project area, project noise sources, and the noise sensitive receptors. The shaded areas indicate the modeled noise levels in dB(A) CNEL.

Table 4
Operational Noise Modeling Results

Receptor	Existing Noise dB(A) CNEL	Future Project Noise dB(A) CNEL	Cumulative Plus Project dB(A) CNEL
Sensitive (Residential)	61.1	61.2	61.2
Younger Lagoon	55.4	55.8	55.8

Source: Impact Sciences, Inc.

The City of Santa Cruz is proposing a desalination plant to be located either on the east side of Shaffer Road across from the Marine Science Campus Upper Terrace or several blocks to the east on Delaware Avenue. The City is currently in the process of preparing the environmental documentation for the project. According to the City's Integrated Water Plan EIR,[19] which analyzed the environmental impacts of desalination plant construction and operation at a program level, operational noise at the desalination plant would primarily consist of noise from the electric transformer, filtration activities, and water pumps. Noise levels generated from the operation of the equipment would be greatest at close distances, within 25 feet. At distances greater than 200 feet from the equipment noise levels would attenuate below 50 dB(A). Because the final layout of the desalination plant is not known, the EIR concluded that on-site noise levels could exceed applicable thresholds of the City's Noise Element or noise ordinance at the property line of the De Anza Mobile Home Park. Mitigation measures were required to ensure on-site noise levels generated during operation of the plant would comply with local regulations. The nearest proposed location is over 500 feet from the proposed standby generator yard and 800 feet from the CBB facility, depending on the final layout design. However, the De Anza residences are approximately 500 feet from the standby generator yard and CBB facility. As a result, due the distance attenuation of the potential noise, the operational noise from this nearby facility would not cause or contribute to noise levels generated by the proposed projects that would lead to an exceedance of the significance thresholds.

19 City of Santa Cruz, *Draft Integrated Water Plan Program Environmental Impact Report*, SCH No. 2003102140, (2005) 5.6-15 and -16.

6.4 Roadway Noise

Roadway noise levels were evaluated in the UCSC Marine Science Campus CLRDP EIR. The operation of the Marine Science Campus under full buildout, including the proposed project, would result in additional motor vehicle traffic on roadways that provide access to and from the Campus. The CLRDP EIR evaluated the effect of increased traffic resulting from Campus operation using the Federal Highway Administration's (FHWA) noise prediction model and weekday PM peak-hour traffic volume estimates. The estimated noise levels, shown in **Table 5, Summary of Estimated Roadway Noise Near the Project Site**, correspond to a distance of approximately 15 meters (approximately 50 feet) from the centerline of a given road segment. The PM peak-hour Leq typically is equivalent to the CNEL at locations where the predominant source of noise is from traffic sources.[20] Thus, the roadside noise levels shown in **Table 5** are compared to the CNEL significance thresholds for excessive noise exposure, as discussed previously. As shown in **Table 5**, traffic noise along three of the road segments would increase by more than 3.0 dB(A) due to CLRDP-related traffic (indicated in bold-face text).

Table 5
Summary of Estimated Roadway Noise Near the Project Site

		Peak-Hour Sound Level, Leq (dB(A))			
Segment	Roadway Segment	Existing	Existing + 5 Near-Term Projects	Existing + CLRDP	CLRDP + 2020 Background
1	Shaffer Rd north of Delaware Ave	47.9	47.9	47.9	51.4
2	**Delaware Ave east of Shaffer Rd**	**53.1**	**58.7**	**61.6**	**62.0**
3	**Delaware Ave west of Shaffer Rd**	**50.4**	**56.8**	**59.9**	**60.0**
4	Natural Bridges Dr north of Delaware Ave	59.2	60.0	60.9	61.6
5	Delaware Ave east of Natural Bridges Dr	60.5	61.7	62.9	63.6
6	**Delaware Ave west of Natural Bridges Dr**	**57.9**	**60.6**	**62.7**	**63.2**
7	Swanton Blvd south of Delaware Ave	58.1	58.1	58.1	59.0
8	Delaware Ave east of Swanton Blvd	61.1	62.1	63.3	63.9
9	Delaware Ave west of Swanton Blvd	61.1	62.2	63.3	63.9

Source: University of California, Santa Cruz, Marine Science Campus, CLRDP Environmental Impact Report*, SCH No. 2001112014, (2004) 4.11-13.*

[20] California Department of Transportation (Caltrans), *Technical Noise Supplement*, (1998).

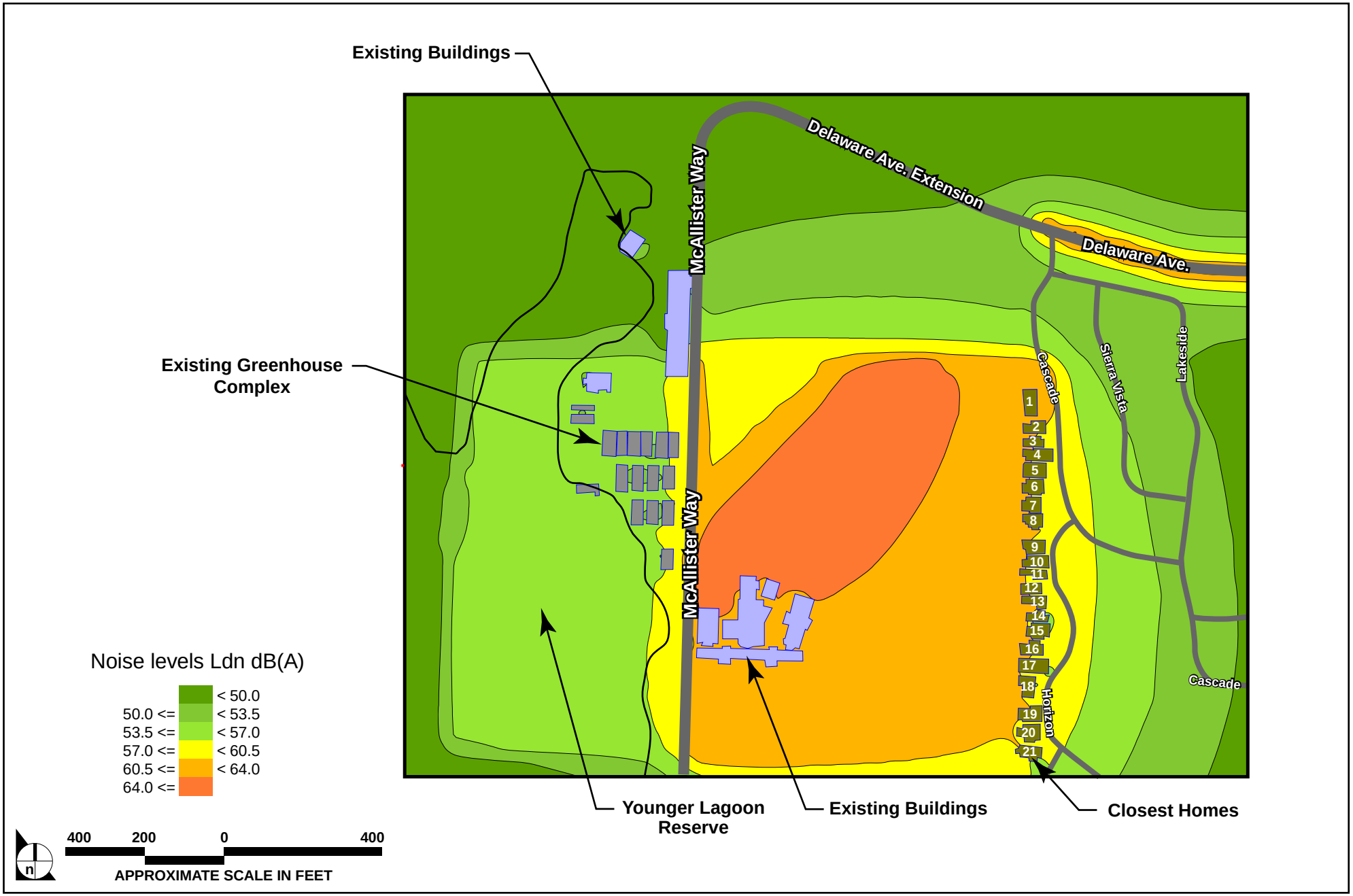
Traffic on Roadway Segment 2 (Delaware Avenue just east of Shaffer Road) would increase the roadside noise level by 8.5 dB(A) to 61.6 DNL at a distance of 50 feet. The nearest sensitive receptors are located to the south, in the De Anza Santa Cruz residential community. These residents would not be exposed to this increase, however. A wooden wall, approximately five feet high, currently stands on the north property line of the nearest mobile home residence and would attenuate the traffic noise by a minimum of 6 dB(A). Thus, the resultant noise level would be approximately 55.6 dB(A) CNEL at the nearest sensitive receptor, which is less than the land use compatibility standard of 60 dB(A) CNEL for low-density residential. Since this level represents an increase that is less than 3.0 dB(A) higher than the existing noise level of 53.2 dB(A), impacts would actually be considered less than significant.

The noise level along Roadway Segment 3 (the extension of Delaware Avenue onto the project site, just east of Shaffer Road) is estimated to increase by 9.5 dB(A) to 59.9 dB(A) CNEL; however, there are currently no receptors along this road segment that would be affected by this increase and no sensitive receptors are planned for this area (although it is currently zoned for residential use). Therefore, impacts would actually be considered less than significant.

The resultant noise level along Roadway Segment 6 (Delaware Avenue west of Natural Bridges Drive) would increase by 4.8 dB(A) to 62.7 dB(A) CNEL. This increase of less than 5 dB(A) would result in a noise level that is less than the land use compatibility standards for the adjacent industrial land use (75 dB(A)) and the adjacent recreational open space (70 dB(A) CNEL). Therefore, impacts would actually be considered less than significant.

7.0 CONCLUSION

This acoustical analysis provides the estimated noise contribution to the existing noise environment from the construction and operation of the proposed project. With the implementation of a previously adopted mitigation measure, construction noise would a less than significant impact. The operational acoustical analysis was conducted using the SoundPLAN noise modeling software. According to the analysis, additional noise from operation of the proposed project would not result in a perceptible increase in noise above existing ambient conditions at nearby sensitive receptors. The noise increase would be much less than 3.0 dB(A) under future plus project and cumulative plus project conditions. This is considered a less than significant impact. In addition, increased motor vehicle traffic that would result from buildout of the Marine Science Campus, including the proposed project, would result in roadway noise increases at sensitive receptors that are less than the thresholds of significance. This is considered a less than significant impact.

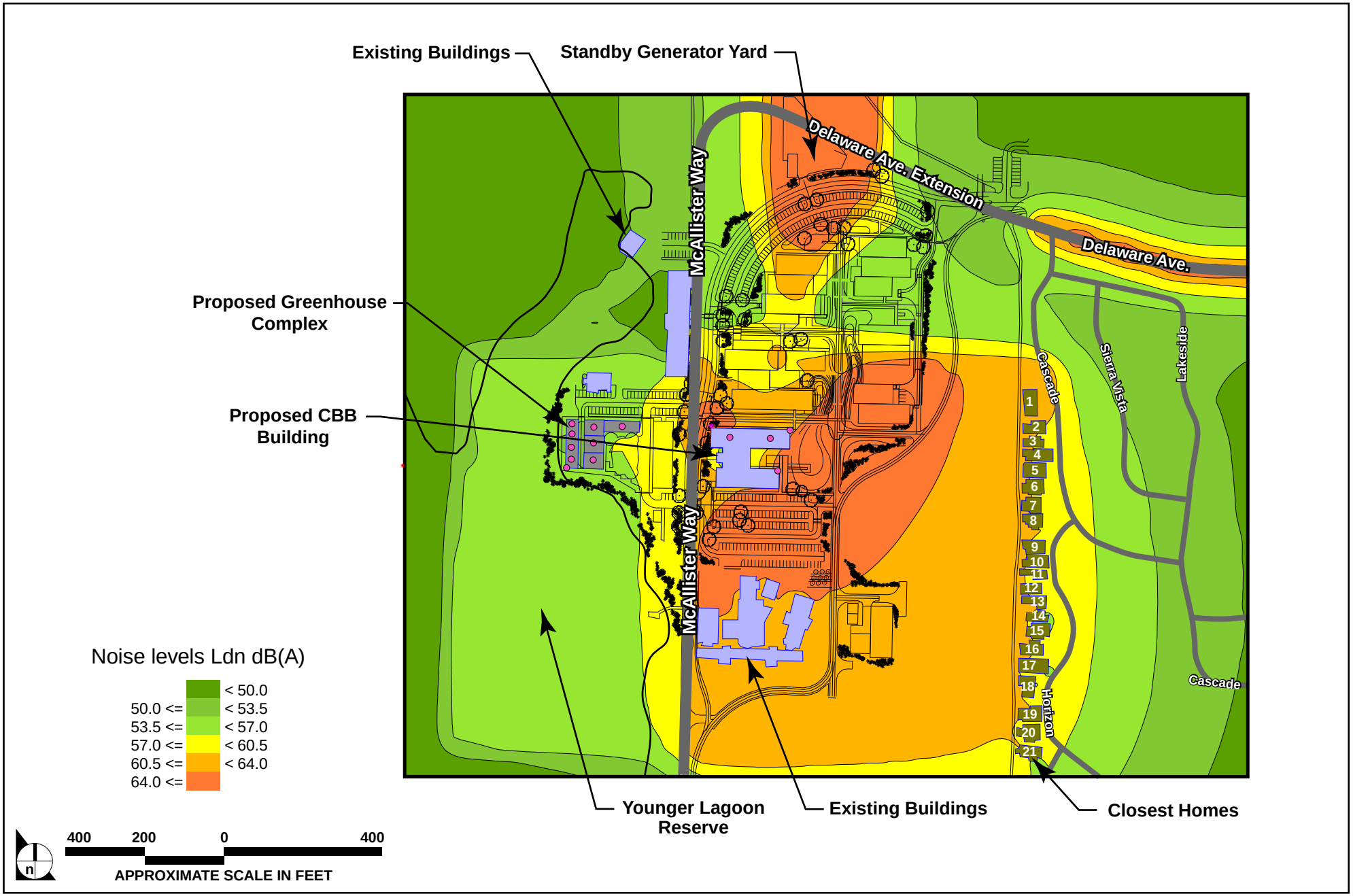


SOURCE: Impact Sciences, Inc. – March 2011

FIGURE **2**

Sound Plan Noise Modeling Results: Existing Conditions

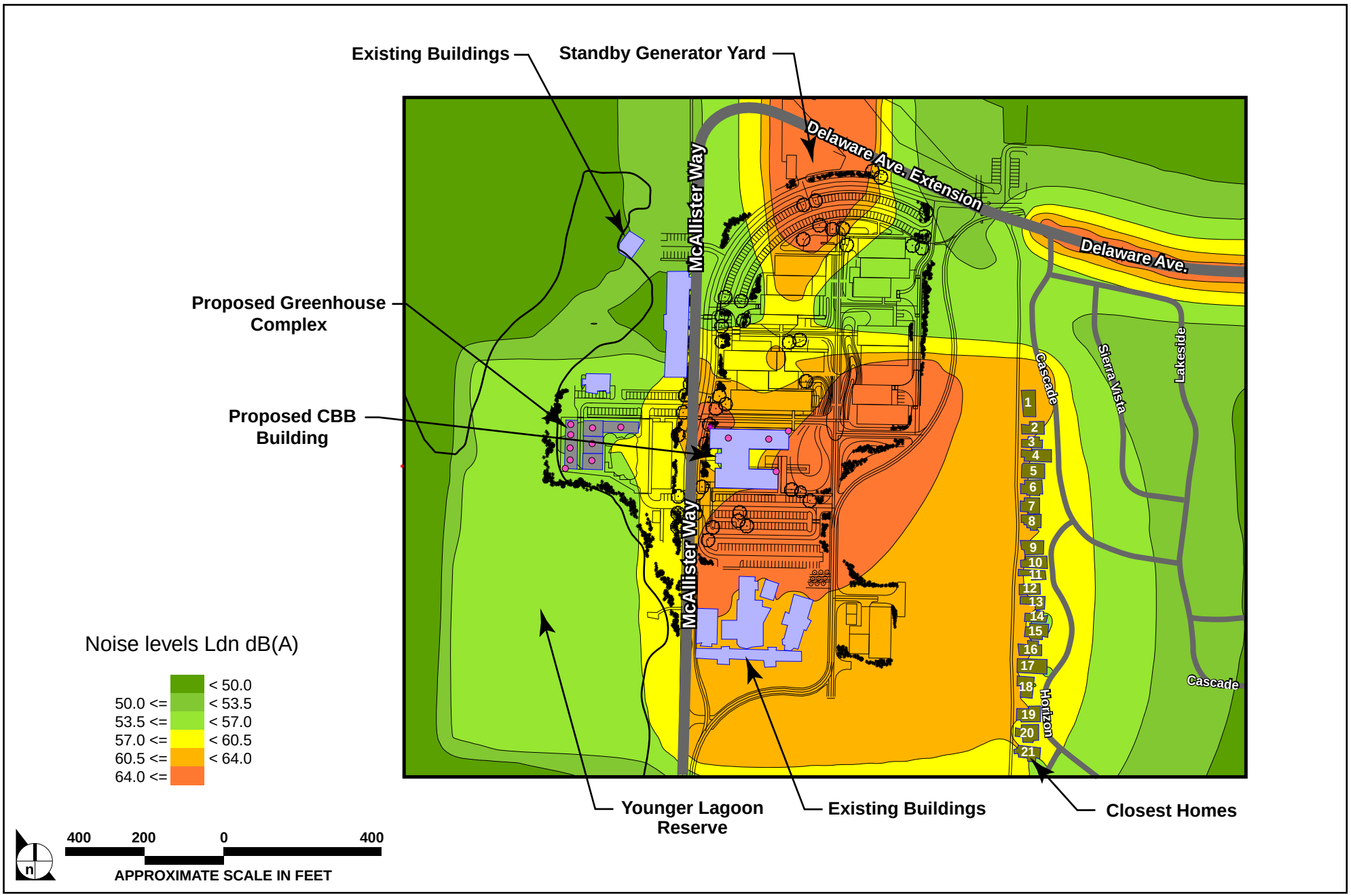
680-012•03/11



SOURCE: Impact Sciences, Inc. – March 2011

FIGURE **3**

Sound Plan Noise Modeling Results: Future Plus Project Conditions



SOURCE: Impact Sciences, Inc. – March 2011

FIGURE **4**

Sound Plan Noise Modeling Results: Cumulative Plus Project Conditions

APPENDIX A

Construction Noise Modeling Data

CONSTRUCTION NOISE AT SENSITIVE RECEPTORS

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 1

Assumed Attenuation: 6 dBA per doubling of distance

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HP	0	0	85	50	#N/A
Auger Drill Rig	0	0	85	50	#N/A
Backhoe - CBB	**2**	**1**	**80**	**516**	**63**
Backhoe - INF	**1**	**1**	**80**	**221**	**67**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground)	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck	0	0	85	50	#N/A
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw-CBB	**1**	**1**	**90**	**516**	**70**
Crane	0	0	85	50	#N/A
Dozer-CBB	**2**	**1**	**85**	**516**	**68**
Dozer-INF	**1**	**1**	**85**	**221**	**72**
Dozer-SRP	**1**	**1**	**85**	**71**	**82**
Drill Rig Truck	0	0	84	50	#N/A
Drum Mixer	0	0	80	50	#N/A
Water Truck-CBB	**2**	**1**	**84**	**516**	**67**
Water Truck - INF	**1**	**1**	**84**	**221**	**71**
Water Truck - SRP	**1**	**1**	**84**	**71**	**81**
Excavator	0	0	85	50	#N/A
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs)	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader-CBB	**1**	**1**	**85**	**516**	**65**
Grader-INF	**1**	**1**	**85**	**221**	**72**
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jack	0	0	80	50	#N/A
Hydra Break Ram	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Man Lift	0	0	85	50	#N/A
Mounted Impact Hammer (hoe ram)	0	0	90	50	#N/A
Pavement Scarifier	0	0	85	50	#N/A
Paver	0	0	85	50	#N/A
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller	0	0	85	50	#N/A
Sand Blasting (single nozzel)	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck)	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixer	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A
TOTAL Leq DURING NORMAL OPERATIONS:					**86**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995), *Transit Noise and Vibration* Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges - Highway Construction Noise Handbook

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 1

MITIGATED (EQUIPMENT MUFFLERS)

Assumed Attenuation: 6 dBA per doubling of distance

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HP	0	0	85	50	#N/A
Auger Drill Rig	0	0	85	50	#N/A
Backhoe - CBB	**2**	**1**	**75**	**516**	**58**
Backhoe - INF	**1**	**1**	**75**	**221**	**62**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground)	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck	0	0	85	50	#N/A
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw-CBB	**1**	**1**	**80**	**516**	**60**
Crane	0	0	85	50	#N/A
Dozer-CBB	**2**	**1**	**75**	**516**	**58**
Dozer-INF	**1**	**1**	**75**	**221**	**62**
Dozer-SRP	**1**	**1**	**75**	**71**	**72**
Drill Rig Truck	0	0	84	50	#N/A
Drum Mixer	0	0	80	50	#N/A
Water Truck-CBB	**2**	**1**	**75**	**516**	**58**
Water Truck - INF	**1**	**1**	**75**	**221**	**62**
Water Truck - SRP	**1**	**1**	**75**	**71**	**72**
Excavator	0	0	85	50	#N/A
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs)	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader-CBB	**1**	**1**	**75**	**516**	**55**
Grader-INF	**1**	**1**	**75**	**221**	**62**
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jack	0	0	80	50	#N/A
Hydra Break Ram	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Man Lift	0	0	85	50	#N/A
Mounted Impact Hammer (hoe ram)	0	0	90	50	#N/A
Pavement Scarifier	0	0	85	50	#N/A
Paver	0	0	85	50	#N/A
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller	0	0	85	50	#N/A
Sand Blasting (single nozzel)	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck)	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixer	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A

TOTAL Leq DURING NORMAL OPERATIONS: **76.1**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995), *Transit Noise and Vibration* Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges - Highway Construction Noise Handbook

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 2

Assumed Attenuation: 6 dBA per doubling of distance

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HP-CBB	1	1	85	516	65
Auger Drill Rig	0	0	85	50	#N/A
Backhoe-CBB	**1**	**1**	**80**	**516**	**60**
Backhoe-INF	**1**	**1**	**80**	**221**	**67**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground)	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck-CBB	**1**	**1**	**85**	**516**	**65**
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw	0	0	90	50	#N/A
Crane	0	0	85	50	#N/A
Dozer-INF	**1**	**1**	**85**	**221**	**72**
Dozer-SRP	**1**	**1**	**85**	**71**	**82**
Dozer	0	0	85	50	#N/A
Drill Rig Truck-CBB	**1**	**1**	**84**	**516**	**64**
Drum Mixer	0	0	80	50	#N/A
Water Truck-INF	**1**	**1**	**84**	**221**	**71**
Water Truck -SRP	**1**	**1**	**84**	**71**	**81**
Water Truck	0	0	84	50	#N/A
Excavator-CBB	**2**	**1**	**85**	**516**	**68**
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs)	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader-INF	**1**	**1**	**85**	**221**	**72**
Grader	0	0	85	50	#N/A
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jack	0	0	80	50	#N/A
Hydra Break Ram	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Man Lift	0	0	85	50	#N/A
Mounted Impact Hammer (hoe ram)	0	0	90	50	#N/A
Pavement Scarifier	0	0	85	50	#N/A
Paver	0	0	85	50	#N/A
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller	0	0	85	50	#N/A
Sand Blasting (single nozzel)	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck)	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixer	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A
TOTAL Leq DURING NORMAL OPERATIONS:					**85**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995), *Transit Noise and Vibration* Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges - Highway Construction Noise Handbook

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 3

Assumed Attenuation: 6 dBA per doubling of distance

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HP-CBB	**1**	**1**	**85**	**516**	**65**
All Other Equipment > 5 HP-INF	**1**	**1**	**85**	**221**	**72**
Auger Drill Rig	0	0	85	50	#N/A
Backhoe - CBB	**1**	**1**	**80**	**516**	**60**
Backhoe-INF	**1**	**1**	**80**	**221**	**67**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground)	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck-CBB	**1**	**1**	**85**	**516**	**65**
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw	0	0	90	50	#N/A
Crane	0	0	85	50	#N/A
Dozer-SRP	**1**	**1**	**85**	**71**	**82**
Dozer	0	0	85	50	#N/A
Dozer	0	0	85	50	#N/A
Drill Rig Truck-CBB	**1**	**1**	**84**	**516**	**64**
Drum Mixer	0	0	80	50	#N/A
Water Truck-SRP	**1**	**1**	**84**	**71**	**81**
Water Truck	0	0	84	50	#N/A
Water Truck	0	0	84	50	#N/A
Excavator-CBB	**2**	**1**	**85**	**516**	**68**
Excavator-INF	**2**	**1**	**85**	**221**	**75**
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs)	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader	0	0	85	50	#N/A
Grader	0	0	85	50	#N/A
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jack	0	0	80	50	#N/A
Hydra Break Ram	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Man Lift	0	0	85	50	#N/A
Mounted Impact Hammer (hoe ram)	0	0	90	50	#N/A
Pavement Scarifier	0	0	85	50	#N/A
Paver	0	0	85	50	#N/A
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller	0	0	85	50	#N/A
Sand Blasting (single nozzel)	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck)	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixer	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A

TOTAL Leq DURING NORMAL OPERATIONS: **85**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995), *Transit Noise and Vibration* Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges - Highway Construction Noise Handbook

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 4

Assumed Attenuation 6 dBA per doubling of distanc

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HP-INF	**1**	**1**	**85**	**221**	**72**
Auger Drill Rig	0	0	85	50	#N/A
Backhoe - CBB	**1**	**1**	**80**	**516**	**60**
Backhoe - INF	**1**	**1**	**80**	**221**	**67**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck	0	0	85	50	#N/A
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw	0	0	90	50	#N/A
Crane-CBB	**1**	**1**	**85**	**516**	**65**
Dozer	0	0	85	50	#N/A
Drill Rig Truck	0	0	84	50	#N/A
Drum Mixer	0	0	80	50	#N/A
Water Truck	0	0	84	50	#N/A
Excavator-INF	**2**	**1**	**85**	**221**	**75**
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader	0	0	85	50	#N/A
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jac	0	0	80	50	#N/A
Hydra Break Ram	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Forklifts - CBB	**2**	**1**	**85**	**516**	**68**
Mounted Impact Hammer (hoe ram	0	0	90	50	#N/A
Pavement Scarifier	0	0	85	50	#N/A
Paver	0	0	85	50	#N/A
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller	0	0	85	50	#N/A
Sand Blasting (single nozzel	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixe	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A
TOTAL Leq DURING NORMAL OPERATIONS					**78**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995)*Transit Noise and Vibration*
Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges
Highway Construction Noise Handboo

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 5

Assumed Attenuation 6 dBA per doubling of distanc

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HI	0	0	85	50	#N/A
Auger Drill Rig	0	0	85	50	#N/A
Backhoe-INF	**1**	**1**	**80**	**221**	**67**
Backhoe - CBB	**1**	**1**	**80**	**516**	**60**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck	0	0	85	50	#N/A
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw	0	0	90	50	#N/A
Crane-CBB	**1**	**1**	**85**	**516**	**65**
Dozer-INF	**1**	**1**	**85**	**221**	**72**
Drill Rig Truck	0	0	84	50	#N/A
Drum Mixer	0	0	80	50	#N/A
Water Truck-INF	**1**	**1**	**84**	**221**	**71**
Excavator	0	0	85	50	#N/A
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader-INF	**1**	**1**	**85**	**221**	**72**
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jac	0	0	80	50	#N/A
Hydra Break Ram	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Forklifts-CBB	**2**	**1**	**85**	**516**	**68**
Mounted Impact Hammer (hoe ram	0	0	90	50	#N/A
Pavement Scarifier	0	0	85	50	#N/A
Paver	0	0	85	50	#N/A
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller	0	0	85	50	#N/A
Sand Blasting (single nozzel	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixer	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A
TOTAL Leq DURING NORMAL OPERATIONS					**78**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995)*Transit Noise and Vibration*
Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges
Highway Construction Noise Handboo

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 6

Assumed Attenuation 6 dBA per doubling of distanc

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HI	0	0	85	50	#N/A
Auger Drill Rig	0	0	85	50	#N/A
Backhoe - CBB	**1**	**1**	**80**	**516**	**60**
Backhoe - INF	**1**	**1**	**80**	**221**	**67**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck-INF	**4**	**1**	**85**	**221**	**78**
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw	0	0	90	50	#N/A
Crane-CBB	**1**	**1**	**85**	**516**	**65**
Dozer	0	0	85	50	#N/A
Drill Rig Truck	0	0	84	50	#N/A
Drum Mixer	0	0	80	50	#N/A
Water Truck	0	0	84	50	#N/A
Excavator	0	0	85	50	#N/A
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader	0	0	85	50	#N/A
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jac	0	0	80	50	#N/A
Hydra Break Ram	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Forklift-CBB	**2**	**1**	**85**	**516**	**68**
Mounted Impact Hammer (hoe ram	0	0	90	50	#N/A
Pavement Equipment-INF	**1**	**1**	**85**	**221**	**72**
Paver-INF	**1**	**1**	**85**	**221**	**72**
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller-INF	**1**	**1**	**85**	**221**	**72**
Sand Blasting (single nozzel	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixer	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A
TOTAL Leq DURING NORMAL OPERATIONS					**80**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995)*Transit Noise and Vibration*
Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges
Highway Construction Noise Handboo

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 7

Assumed Attenuation: 6 dBA per doubling of distance

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HP	0	0	85	50	#N/A
Auger Drill Rig	0	0	85	50	#N/A
Backhoe-CBB	**1**	**1**	**80**	**516**	**60**
Backhoe - INF	**1**	**1**	**80**	**221**	**67**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground)	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck-INF	**4**	**1**	**85**	**221**	**78**
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw	0	0	90	50	#N/A
Crane-CBB	**1**	**1**	**85**	**516**	**65**
Dozer	0	0	85	50	#N/A
Dozer	0	0	85	50	#N/A
Dozer	0	0	85	50	#N/A
Drill Rig Truck	0	0	84	50	#N/A
Drum Mixer	0	0	80	50	#N/A
Water Truck	0	0	84	50	#N/A
Water Truck	0	0	84	50	#N/A
Water Truck	0	0	84	50	#N/A
Excavator	0	0	85	50	#N/A
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs)	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader	0	0	85	50	#N/A
Grader	0	0	85	50	#N/A
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jack	0	0	80	50	#N/A
Hydra Break Ram	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Forklifts-CBB	**2**	**1**	**85**	**516**	**68**
Mounted Impact Hammer (hoe ram)	0	0	90	50	#N/A
Paving Equipment-INF	**1**	**1**	**85**	**221**	**72**
Paver-INF	**1**	**1**	**85**	**221**	**72**
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller-INF	**1**	**1**	**85**	**221**	**72**
Sand Blasting (single nozzel)	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck)	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixer	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A
TOTAL Leq DURING NORMAL OPERATIONS:					**80**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995), *Transit Noise and Vibration* Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges - Highway Construction Noise Handbook

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 8

Assumed Attenuation 6 dBA per doubling of distanc

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HI	0	0	85	50	#N/A
Auger Drill Rig	0	0	85	50	#N/A
Backhoe-CBB	**1**	**1**	**80**	**516**	**60**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck	0	0	85	50	#N/A
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw	0	0	90	50	#N/A
Crane-CBB	**1**	**1**	**85**	**516**	**65**
Dozer	0	0	85	50	#N/A
Drill Rig Truck	0	0	84	50	#N/A
Drum Mixer	0	0	80	50	#N/A
Water Truck	0	0	84	50	#N/A
Excavator	0	0	85	50	#N/A
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader	0	0	85	50	#N/A
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jac	0	0	80	50	#N/A
Hydra Break Ran	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Forklift-CBB	**2**	**1**	**85**	**516**	**68**
Mounted Impact Hammer (hoe ram	0	0	90	50	#N/A
Pavement Scarifier	0	0	85	50	#N/A
Paver	0	0	85	50	#N/A
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller	0	0	85	50	#N/A
Sand Blasting (single nozzel	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixe	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A
TOTAL Leq DURING NORMAL OPERATIONS					**70**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995)*Transit Noise and Vibration*
Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges
Highway Construction Noise Handboo

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 9

Assumed Attenuation 6 dBA per doubling of distanc

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HI	0	0	85	50	#N/A
Auger Drill Rig	0	0	85	50	#N/A
Backhoe-CBB	**1**	**1**	**80**	**516**	**60**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck	0	0	85	50	#N/A
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw	0	0	90	50	#N/A
Crane-CBB	**1**	**1**	**85**	**516**	**65**
Dozer	0	0	85	50	#N/A
Drill Rig Truck	0	0	84	50	#N/A
Drum Mixer	0	0	80	50	#N/A
Water Truck	0	0	84	50	#N/A
Excavator	0	0	85	50	#N/A
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader	0	0	85	50	#N/A
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jac	0	0	80	50	#N/A
Hydra Break Ram	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Forklift-CBB	**2**	**1**	**85**	**516**	**68**
Mounted Impact Hammer (hoe ram	0	0	90	50	#N/A
Pavement Scarifier	0	0	85	50	#N/A
Paver	0	0	85	50	#N/A
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller	0	0	85	50	#N/A
Sand Blasting (single nozzel	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixer	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A
TOTAL Leq DURING NORMAL OPERATIONS					**70**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995)*Transit Noise and Vibration*
Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges
Highway Construction Noise Handboo

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 10

Assumed Attenuation 6 dBA per doubling of distanc

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HI	0	0	85	50	#N/A
Auger Drill Rig	0	0	85	50	#N/A
Backhoe-CBB	**1**	**1**	**80**	**516**	**60**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck	0	0	85	50	#N/A
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw	0	0	90	50	#N/A
Crane-CBB	**1**	**1**	**85**	**516**	**65**
Dozer	0	0	85	50	#N/A
Drill Rig Truck	0	0	84	50	#N/A
Drum Mixer	0	0	80	50	#N/A
Water Truck	0	0	84	50	#N/A
Excavator	0	0	85	50	#N/A
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader	0	0	85	50	#N/A
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jac	0	0	80	50	#N/A
Hydra Break Ram	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Forklift-CBB	**2**	**1**	**85**	**516**	**68**
Mounted Impact Hammer (hoe ram	0	0	90	50	#N/A
Pavement Scarifier	0	0	85	50	#N/A
Paver	0	0	85	50	#N/A
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller	0	0	85	50	#N/A
Sand Blasting (single nozzel	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixer	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A
TOTAL Leq DURING NORMAL OPERATIONS					**70**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995)*Transit Noise and Vibration*
Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges
Highway Construction Noise Handboo

UCSC Marine Science Center
Construction Equipment Noise Model
Scenario 11

Assumed Attenuation 6 dBA per doubling of distanc

NOISE SOURCE	NUMBER OF UNITS	ASSUMED USE FACTOR	Lmax Noise LEVEL @ 50 FT (dBA)	DISTANCE (Feet)	NOISE LEVEL Leq (dBA)
All Other Equipment > 5 HI	0	0	85	50	#N/A
Auger Drill Rig	0	0	85	50	#N/A
Backhoe-CBB	**1**	**1**	**80**	**516**	**60**
Bar Bender	0	0	80	50	#N/A
Blasting	0	0	94	50	#N/A
Boring Jack Powe Unit	0	0	80	50	#N/A
Chain Saw	0	0	85	50	#N/A
Clam Shovel (dropping)	0	0	93	50	#N/A
Compactor (ground	0	0	80	50	#N/A
Compressor (air)	0	0	80	50	#N/A
Concrete Batch Plant	0	0	83	50	#N/A
Concrete Mixer Truck-CBB	**4**	**1**	**85**	**516**	**71**
Concrete Pump Truck	0	0	82	50	#N/A
Concrete Saw	0	0	90	50	#N/A
Crane	0	0	85	50	#N/A
Dozer	0	0	85	50	#N/A
Drill Rig Truck	0	0	84	50	#N/A
Drum Mixer	0	0	80	50	#N/A
Water Truck	0	0	84	50	#N/A
Excavator	0	0	85	50	#N/A
Flat Bed Truck	0	0	84	50	#N/A
Front End Loader	0	0	80	50	#N/A
Generator	0	0	82	50	#N/A
Generator (< 25KVA, VMS Signs	0	0	70	50	#N/A
Gradall	0	0	85	50	#N/A
Grader	0	0	85	50	#N/A
Grapple (on backhoe)	0	0	85	50	#N/A
Horizontal Boring Hydraulic Jac	0	0	80	50	#N/A
Hydra Break Ram	0	0	90	50	#N/A
Impact Pile Driver	0	0	95	50	#N/A
Jackhammer	0	0	85	50	#N/A
Forklift	0	0	85	50	#N/A
Mounted Impact Hammer (hoe ram	0	0	90	50	#N/A
Paving Equipment-CBB	**1**	**1**	**85**	**516**	**65**
Paver-CBB	**1**	**1**	**85**	**516**	**65**
Pickup Truck	0	0	55	50	#N/A
Pneumatic Tools	0	0	85	50	#N/A
Pumps	0	0	77	50	#N/A
Refrigerator Unit	0	0	82	50	#N/A
Rivit Buster/Chipping Gun	0	0	85	50	#N/A
Rock Drill	0	0	85	50	#N/A
Roller-CBB	**1**	**1**	**85**	**516**	**65**
Sand Blasting (single nozzel	0	0	85	50	#N/A
Scraper	0	0	85	50	#N/A
Sheers (on backhoe)	0	0	85	50	#N/A
Slurry Plant	0	0	78	50	#N/A
Slurry Trenching Machine	0	0	82	50	#N/A
Soil Mix Drill Rig	0	0	80	50	#N/A
Tractor	0	0	84	50	#N/A
Vacuum Excavator (Vac-Truck	0	0	85	50	#N/A
Vacuum Street Sweeper	0	0	80	50	#N/A
Ventiliation Fan	0	0	85	50	#N/A
Vibrating Hopper	0	0	85	50	#N/A
Vibratory Concrete Mixer	0	0	80	50	#N/A
Vibratory Pile Driver	0	0	95	50	#N/A
Warning Horn	0	0	85	50	#N/A
Welder/Torch	0	0	73	50	#N/A
TOTAL Leq DURING NORMAL OPERATIONS					**73**

Note: NA = Not Applicable
Sources: Federal Transit Adminidstration (April 1995)*Transit Noise and Vibration*
Impact Asessment, p. 12-3. and FWWA Construction Equipment Noise Levels and Ranges
Highway Construction Noise Handboo

APPENDIX B

Operational Noise Modeling Data

UCSC Marine Science Center
Assessed receiver levels - Existing

Name	Usage	Floor	Ldn dB(A)	Ld dB(A)	
Lagoon 4	GR	1. Floor	55.1	48.7	
Lagoon 2	PP	1. Floor	55.4	49.0	
Lagoon 1	PP	1. Floor	55.4	49.0	
Sensitive Receptor	PP	1. Floor	54.3	47.9	
Home 1	GR	1. Floor	61.0	54.6	
Home 2	GR	1. Floor	61.1	54.7	
Home 3	GR	1. Floor	61.1	54.7	
Home 4	GR	1. Floor	61.1	54.7	
Home 5	GR	1. Floor	61.0	54.6	
Home 6	GR	1. Floor	61.1	54.7	
Home 7	GR	1. Floor	61.0	54.6	
Home 8	GR	1. Floor	61.0	54.6	
Home 9	GR	1. Floor	61.0	54.6	
Home 10	GR	1. Floor	60.8	54.4	
Home 11	GR	1. Floor	60.9	54.5	
Home 12	GR	1. Floor	60.7	54.3	
Home 13	GR	1. Floor	60.7	54.2	
Home 14	GR	1. Floor	60.4	54.0	
Home 15	GR	1. Floor	60.5	54.1	
Home 16	GR	1. Floor	60.4	54.0	
Home 17	GR	1. Floor	60.3	53.9	
Home 18	GR	1. Floor	60.1	53.7	
Home 19	GR	1. Floor	59.6	53.2	
Home 20	GR	1. Floor	59.2	52.8	
Home 21	GR	1. Floor	58.6	52.1	

UCSC Marine Science Center
Assessed receiver levels - Future Plus Project

Name	Usage	Floor	Ldn dB(A)	Ld dB(A)	
Lagoon 4	GR	1. Floor	54.7	48.6	
Lagoon 1	PP	1. Floor	55.8	50.1	
Lagoon 2	PP	1. Floor	55.4	49.2	
Lagoon 3	PP	1. Floor	54.4	48.5	
Home 1	GR	1. Floor	61.1	55.2	
Home 2	GR	1. Floor	61.2	55.2	
Home 3	GR	1. Floor	61.2	55.1	
Home 4	GR	1. Floor	61.2	55.1	
Home 5	GR	1. Floor	61.1	55.0	
Home 6	GR	1. Floor	61.1	55.0	
Home 7	GR	1. Floor	61.0	54.9	
Home 8	GR	1. Floor	61.0	54.9	
Home 9	GR	1. Floor	61.0	54.8	
Home 10	GR	1. Floor	60.9	54.7	
Home 11	GR	1. Floor	60.9	54.7	
Home 12	GR	1. Floor	60.8	54.6	
Home 13	GR	1. Floor	60.7	54.5	
Home 14	GR	1. Floor	60.5	54.2	
Home 15	GR	1. Floor	60.5	54.3	
Home 16	GR	1. Floor	60.4	54.2	
Home 17	GR	1. Floor	60.3	54.1	
Home 18	GR	1. Floor	60.1	53.9	
Home 19	GR	1. Floor	59.6	53.4	
Home 20	GR	1. Floor	59.3	53.0	
Home 21	GR	1. Floor	58.6	52.3	

UCSC Marine Science Center
Assessed receiver levels - Cumulative Plus Project

Name	Usage	Floor	Ldn dB(A)	Ld dB(A)	
Lagoon 4	GR	1. Floor	54.7	48.6	
Lagoon 2	PP	1. Floor	55.4	49.2	
Lagoon 1	PP	1. Floor	55.8	50.1	
Lagoon 3	PP	1. Floor	54.4	48.5	
Home 1	GR	1. Floor	61.1	55.2	
Home 2	GR	1. Floor	61.2	55.2	
Home 3	GR	1. Floor	61.2	55.1	
Home 4	GR	1. Floor	61.2	55.1	
Home 5	GR	1. Floor	61.1	55.0	
Home 6	GR	1. Floor	61.1	55.0	
Home 7	GR	1. Floor	61.0	54.9	
Home 8	GR	1. Floor	61.0	54.9	
Home 9	GR	1. Floor	61.0	54.8	
Home 10	GR	1. Floor	60.9	54.7	
Home 11	GR	1. Floor	60.9	54.7	
Home 12	GR	1. Floor	60.8	54.6	
Home 13	GR	1. Floor	60.7	54.5	
Home 14	GR	1. Floor	60.5	54.2	
Home 15	GR	1. Floor	60.5	54.3	
Home 16	GR	1. Floor	60.4	54.2	
Home 17	GR	1. Floor	60.3	54.1	
Home 18	GR	1. Floor	60.1	53.9	
Home 19	GR	1. Floor	59.6	53.4	
Home 20	GR	1. Floor	59.3	53.0	
Home 21	GR	1. Floor	58.6	52.4	

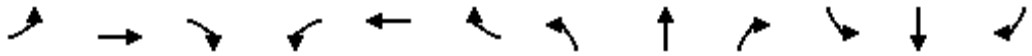
Appendix H

Intersection Level of Service Calculations

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	229	43	35	392	89	70
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	260	49	40	445	101	80
Pedestrians					5	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			314		815	290
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			314		815	290
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		70	89
cM capacity (veh/h)			1241		335	746

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	309	40	445	181
Volume Left	0	40	0	101
Volume Right	49	0	0	80
cSH	1700	1241	1700	442
Volume to Capacity	0.18	0.03	0.26	0.41
Queue Length 95th (ft)	0	2	0	49
Control Delay (s)	0.0	8.0	0.0	18.7
Lane LOS		A		C
Approach Delay (s)	0.0	0.7		18.7
Approach LOS				C

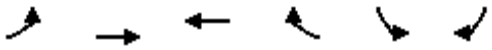
Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	39.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			0.99			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.96			0.96			0.98	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.97	
Satd. Flow (prot)	1770	1837		1770	1770			1755			1776	
Flt Permitted	0.95	1.00		0.95	1.00			0.94			0.84	
Satd. Flow (perm)	1770	1837		1770	1770			1666			1530	
Volume (vph)	36	224	19	74	271	106	15	36	22	108	72	28
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	41	255	22	84	308	120	17	41	25	123	82	32
RTOR Reduction (vph)	0	3	0	0	13	0	0	17	0	0	6	0
Lane Group Flow (vph)	41	274	0	84	415	0	0	66	0	0	231	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Actuated Green, G (s)	2.6	24.1		5.1	26.6			11.9			11.9	
Effective Green, g (s)	3.6	25.1		6.1	27.6			12.9			12.9	
Actuated g/C Ratio	0.07	0.47		0.11	0.52			0.24			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)	120	868		203	920			405			372	
v/s Ratio Prot	0.02	0.15		c0.05	c0.23							
v/s Ratio Perm								0.04			c0.15	
v/c Ratio	0.34	0.32		0.41	0.45			0.16			0.62	
Uniform Delay, d1	23.6	8.7		21.8	8.0			15.8			17.9	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	1.7	0.2		1.4	0.4			0.2			3.2	
Delay (s)	25.3	8.9		23.2	8.3			16.0			21.1	
Level of Service	C	A		C	A			B			C	
Approach Delay (s)		11.0			10.8			16.0			21.1	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	13.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	53.1	Sum of lost time (s)	6.0
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		

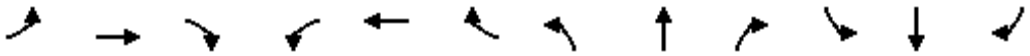
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Stop	Stop		Stop	
Volume (vph)	22	37	113	79	51	24
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Hourly flow rate (vph)	28	46	141	99	64	30

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total (vph)	74	240	94
Volume Left (vph)	28	0	64
Volume Right (vph)	0	99	30
Hadj (s)	0.11	-0.21	-0.02
Departure Headway (s)	4.5	4.0	4.5
Degree Utilization, x	0.09	0.27	0.12
Capacity (veh/h)	776	879	739
Control Delay (s)	7.9	8.4	8.2
Approach Delay (s)	7.9	8.4	8.2
Approach LOS	A	A	A

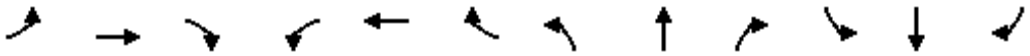
Intersection Summary			
Delay	8.3		
HCM Level of Service	A		
Intersection Capacity Utilization	28.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	45	41	4	36	162	59	15	129	22	22	170	137
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	53	48	5	42	191	69	18	152	26	26	200	161

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	106	302	195	387
Volume Left (vph)	53	42	18	26
Volume Right (vph)	5	69	26	161
Hadj (s)	0.11	-0.08	-0.03	-0.20
Departure Headway (s)	6.2	5.6	5.7	5.3
Degree Utilization, x	0.18	0.47	0.31	0.57
Capacity (veh/h)	488	590	561	646
Control Delay (s)	10.6	13.6	11.3	14.9
Approach Delay (s)	10.6	13.6	11.3	14.9
Approach LOS	B	B	B	B

Intersection Summary				
Delay	13.4			
HCM Level of Service	B			
Intersection Capacity Utilization	44.1%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.98		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frt	1.00	1.00		1.00	0.99			1.00	0.85		0.99	
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00		0.97	
Satd. Flow (prot)	1770	1855		1770	1840			1790	1559		1784	
Flt Permitted	0.95	1.00		0.95	1.00			0.78	1.00		0.75	
Satd. Flow (perm)	1770	1855		1770	1840			1444	1559		1386	
Volume (vph)	4	299	7	371	334	24	61	15	145	71	23	5
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	4	308	7	382	344	25	63	15	149	73	24	5
RTOR Reduction (vph)	0	1	0	0	2	0	0	0	124	0	2	0
Lane Group Flow (vph)	4	314	0	382	367	0	0	78	25	0	100	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		
Actuated Green, G (s)	0.7	22.7		17.8	39.8			9.3	9.3		9.3	
Effective Green, g (s)	1.7	23.7		18.8	40.8			10.3	10.3		10.3	
Actuated g/C Ratio	0.03	0.38		0.30	0.66			0.17	0.17		0.17	
Clearance Time (s)	4.0	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		3.0	
Lane Grp Cap (vph)	49	711		538	1215			241	260		231	
v/s Ratio Prot	0.00	c0.17		c0.22	0.20							
v/s Ratio Perm								0.05	0.02		c0.07	
v/c Ratio	0.08	0.44		0.71	0.30			0.32	0.10		0.43	
Uniform Delay, d1	29.3	14.1		19.1	4.5			22.7	21.8		23.1	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	0.7	0.4		4.4	0.1			0.8	0.2		1.3	
Delay (s)	30.0	14.6		23.5	4.6			23.5	22.0		24.4	
Level of Service	C	B		C	A			C	C		C	
Approach Delay (s)		14.8			14.2			22.5			24.4	
Approach LOS		B			B			C			C	

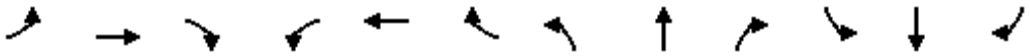
Intersection Summary			
HCM Average Control Delay	16.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	61.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	EBR2	WBL2	WBL	WBT	NBL	NBR	NBR2	NWL2	NWL	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0				3.0	3.0	3.0	3.0		3.0	3.0	
Lane Util. Factor	0.95				1.00	0.95	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	0.99				1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Frt	0.98				1.00	1.00	1.00	0.85		1.00	0.95	
Flt Protected	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (prot)	3457				1770	3539	1770	1583		1770	1695	
Flt Permitted	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (perm)	3457				1770	3539	1770	1583		1770	1695	
Volume (vph)	714	60	34	15	104	746	51	87	8	2	33	16
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	785	66	37	16	114	820	56	96	9	2	36	18
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	17	0
Lane Group Flow (vph)	888	0	0	0	130	820	56	105	0	2	37	0
Confl. Peds. (#/hr)		5	5					5	5			5
Turn Type				Prot	Prot			Prot		Split		
Protected Phases	4			3	3	8	1	1		2	2	
Permitted Phases												
Actuated Green, G (s)	38.1				9.4	51.5	10.1	10.1		5.1	5.1	
Effective Green, g (s)	39.1				10.4	52.5	11.1	11.1		6.1	6.1	
Actuated g/C Ratio	0.50				0.13	0.67	0.14	0.14		0.08	0.08	
Clearance Time (s)	4.0				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	3.0	
Lane Grp Cap (vph)	1718				234	2361	250	223		137	131	
v/s Ratio Prot	c0.26				c0.07	0.23	0.03	c0.07		0.00	c0.02	
v/s Ratio Perm												
v/c Ratio	0.52				0.56	0.35	0.22	0.47		0.01	0.29	
Uniform Delay, d1	13.4				32.0	5.7	30.0	31.1		33.5	34.2	
Progression Factor	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3				2.8	0.1	0.5	1.6		0.0	1.2	
Delay (s)	13.7				34.8	5.8	30.4	32.7		33.6	35.4	
Level of Service	B				C	A	C	C		C	D	
Approach Delay (s)	13.7					9.7	31.9				35.4	
Approach LOS	B					A	C				D	

Intersection Summary			
HCM Average Control Delay	13.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	78.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.7%	ICU Level of Service	A
Analysis Period (min)	15		

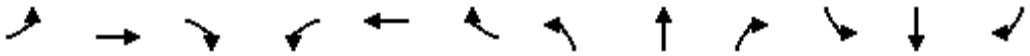
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	0.94		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3483		1770	3434		1770	3321		1681	1650	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3483		1770	3434		1770	3321		1681	1650	
Volume (vph)	60	685	67	127	877	189	60	123	86	136	91	62
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	65	737	72	137	943	203	65	132	92	146	98	67
RTOR Reduction (vph)	0	7	0	0	17	0	0	82	0	0	26	0
Lane Group Flow (vph)	65	802	0	137	1129	0	65	142	0	146	139	0
Confl. Peds. (#/hr)			5			5						5
Turn Type	Prot			Prot			Split			Split		
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases												
Actuated Green, G (s)	3.3	25.1		8.1	29.9		6.5	6.5		12.3	12.3	
Effective Green, g (s)	4.3	26.1		9.1	30.9		7.5	7.5		13.3	13.3	
Actuated g/C Ratio	0.06	0.38		0.13	0.45		0.11	0.11		0.20	0.20	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	112	1337		237	1560		195	366		329	323	
v/s Ratio Prot	0.04	0.23		c0.08	c0.33		0.04	c0.04		c0.09	0.08	
v/s Ratio Perm												
v/c Ratio	0.58	0.60		0.58	0.72		0.33	0.39		0.44	0.43	
Uniform Delay, d1	31.0	16.8		27.6	15.1		27.9	28.1		24.1	24.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	7.4	0.8		3.4	1.7		1.0	0.7		1.0	0.9	
Delay (s)	38.4	17.5		31.0	16.8		29.0	28.8		25.0	25.0	
Level of Service	D	B		C	B		C	C		C	C	
Approach Delay (s)		19.1			18.3			28.8			25.0	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM Average Control Delay	20.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	68.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	62.7%	ICU Level of Service	B
Analysis Period (min)	15		

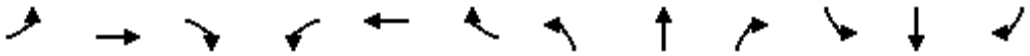
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.96		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1844		1770	1770		1770	3476		1770	3528	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1844		1770	1770		1770	3476		1770	3528	
Volume (vph)	80	102	7	290	151	64	13	1038	111	37	1004	18
Peak-hour factor, PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj. Flow (vph)	96	123	8	349	182	77	16	1251	134	45	1210	22
RTOR Reduction (vph)	0	3	0	0	13	0	0	6	0	0	1	0
Lane Group Flow (vph)	96	128	0	349	246	0	16	1379	0	45	1231	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	11.0	11.9		20.4	21.3		1.4	39.9		5.9	44.4	
Effective Green, g (s)	12.0	12.9		21.4	22.3		2.4	40.9		6.9	45.4	
Actuated g/C Ratio	0.13	0.14		0.23	0.24		0.03	0.43		0.07	0.48	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	226	253		403	419		45	1511		130	1702	
v/s Ratio Prot	0.05	0.07		c0.20	c0.14		0.01	c0.40		c0.03	c0.35	
v/s Ratio Perm												
v/c Ratio	0.42	0.51		0.87	0.59		0.36	0.91		0.35	0.72	
Uniform Delay, d1	37.9	37.7		35.0	31.8		45.1	24.9		41.5	19.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.3	1.6		17.4	2.1		4.8	8.7		1.6	1.6	
Delay (s)	39.2	39.3		52.4	33.9		49.9	33.6		43.1	20.9	
Level of Service	D	D		D	C		D	C		D	C	
Approach Delay (s)		39.2			44.5			33.8			21.7	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	31.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	94.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		

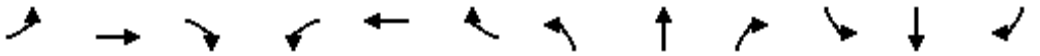
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Util. Factor	0.95	0.95			1.00			0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Frt	1.00	0.99			0.94			1.00		1.00	0.98	
Flt Protected	0.95	0.96			0.99			1.00		0.95	1.00	
Satd. Flow (prot)	1681	1668			1734			3539		1770	3457	
Flt Permitted	0.95	0.96			0.99			1.00		0.95	1.00	
Satd. Flow (perm)	1681	1668			1734			3539		1770	3457	
Volume (vph)	651	0	27	2	6	7	0	1261	1	34	1109	157
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)	723	0	30	2	7	8	0	1401	1	38	1232	174
RTOR Reduction (vph)	0	3	0	0	8	0	0	0	0	0	8	0
Lane Group Flow (vph)	400	350	0	0	9	0	0	1402	0	38	1398	0
Confl. Peds. (#/hr)			5						5			5
Turn Type	Split			Split						Prot		
Protected Phases	4	4		8	8			2		1	6	
Permitted Phases												
Actuated Green, G (s)	29.4	29.4			1.8			61.3		2.2	67.5	
Effective Green, g (s)	30.4	30.4			2.8			62.3		3.2	68.5	
Actuated g/C Ratio	0.27	0.27			0.03			0.56		0.03	0.62	
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)	462	458			44			1992		51	2139	
v/s Ratio Prot	c0.24	0.21			c0.01			c0.40		0.02	c0.40	
v/s Ratio Perm												
v/c Ratio	0.87	0.76			0.21			0.70		0.75	0.65	
Uniform Delay, d1	38.2	36.9			52.9			17.5		53.3	13.5	
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2	15.5	7.4			2.4			2.1		44.3	1.6	
Delay (s)	53.7	44.3			55.2			19.6		97.7	15.1	
Level of Service	D	D			E			B		F	B	
Approach Delay (s)		49.3			55.2			19.6			17.3	
Approach LOS		D			E			B			B	

Intersection Summary			
HCM Average Control Delay	25.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	110.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

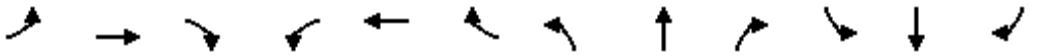


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.91	0.91	1.00		0.95	1.00	1.00	0.95		1.00	0.95	0.88
Frpb, ped/bikes	1.00	1.00	1.00		1.00	0.99	1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1610	3281	1583		3532	1562	1770	3494		1770	3539	2749
Flt Permitted	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1610	3281	1583		3532	1562	1770	3494		1770	3539	2749
Volume (vph)	1470	369	77	14	321	42	62	296	25	39	239	1410
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	1709	429	90	16	373	49	72	344	29	45	278	1640
RTOR Reduction (vph)	0	0	43	0	0	0	0	8	0	0	0	0
Lane Group Flow (vph)	855	1283	47	0	389	49	72	365	0	45	278	1640
Confl. Peds. (#/hr)						5			5			5
Turn Type	Split		Perm	Split		Free	Prot			Prot		Free
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4			Free						Free
Actuated Green, G (s)	35.7	35.7	35.7		9.2	80.7	3.1	17.0		2.8	16.7	80.7
Effective Green, g (s)	36.7	36.7	36.7		10.2	80.7	4.1	18.0		3.8	17.7	80.7
Actuated g/C Ratio	0.45	0.45	0.45		0.13	1.00	0.05	0.22		0.05	0.22	1.00
Clearance Time (s)	4.0	4.0	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		3.0	3.0	
Lane Grp Cap (vph)	732	1492	720		446	1562	90	779		83	776	2749
v/s Ratio Prot	c0.53	0.39			c0.11		0.04	0.10		0.03	0.08	
v/s Ratio Perm			0.03			0.03						c0.60
v/c Ratio	1.17	1.10dl	0.07		0.87	0.03	0.80	0.47		0.54	0.36	0.60
Uniform Delay, d1	22.0	19.7	12.4		34.6	0.0	37.9	27.2		37.6	26.7	0.0
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	90.0	5.2	0.0		16.9	0.0	38.2	0.4		7.1	0.3	1.0
Delay (s)	112.0	24.9	12.4		51.5	0.0	76.1	27.6		44.7	27.0	1.0
Level of Service	F	C	B		D	A	E	C		D	C	A
Approach Delay (s)		57.8			45.7			35.5			5.6	
Approach LOS		E			D			D			A	

Intersection Summary			
HCM Average Control Delay	34.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	80.7	Sum of lost time (s)	6.0
Intersection Capacity Utilization	78.5%	ICU Level of Service	D
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	0.88	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Volume (vph)	199	1587	56	373	1480	726	25	166	148	530	117	204
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	219	1744	62	410	1626	798	27	182	163	582	129	224
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	91	0	0	150
Lane Group Flow (vph)	219	1744	62	410	1626	798	27	182	72	582	129	74
Confl. Peds. (#/hr)												5
Turn Type	Prot		Free	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			6
Actuated Green, G (s)	20.4	51.6	136.1	19.4	50.6	136.1	5.0	21.0	21.0	28.1	44.1	44.1
Effective Green, g (s)	21.4	52.6	136.1	20.4	51.6	136.1	6.0	22.0	22.0	29.1	45.1	45.1
Actuated g/C Ratio	0.16	0.39	1.00	0.15	0.38	1.00	0.04	0.16	0.16	0.21	0.33	0.33
Clearance Time (s)	4.0	4.0		4.0	4.0		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	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	278	1965	1583	515	1928	1583	78	301	451	734	617	516
v/s Ratio Prot	c0.12	c0.34		0.12	0.32		0.02	c0.10		c0.17	0.07	
v/s Ratio Perm			0.04			c0.50			0.03			0.05
v/c Ratio	0.79	0.89	0.04	0.80	0.84	0.50	0.35	0.60	0.16	0.79	0.21	0.14
Uniform Delay, d1	55.2	39.0	0.0	55.8	38.6	0.0	63.1	53.0	49.1	50.6	32.7	31.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.7	5.3	0.0	8.3	3.6	1.1	11.7	8.7	0.8	8.6	0.8	0.6
Delay (s)	68.9	44.3	0.0	64.2	42.1	1.1	74.9	61.7	49.8	59.2	33.5	32.5
Level of Service	E	D	A	E	D	A	E	E	D	E	C	C
Approach Delay (s)		45.6			33.8			57.5			49.3	
Approach LOS		D			C			E			D	

Intersection Summary			
HCM Average Control Delay	41.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	136.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	91.3%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	425	122	88	265	104	52
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	472	136	98	294	116	58
Pedestrians					5	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			613		1035	545
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			613		1035	545
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			90		50	89
cM capacity (veh/h)			962		230	536

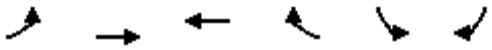
Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	608	98	294	173
Volume Left	0	98	0	116
Volume Right	136	0	0	58
cSH	1700	962	1700	284
Volume to Capacity	0.36	0.10	0.17	0.61
Queue Length 95th (ft)	0	8	0	93
Control Delay (s)	0.0	9.2	0.0	35.7
Lane LOS		A		E
Approach Delay (s)	0.0	2.3		35.7
Approach LOS				E

Intersection Summary			
Average Delay	6.0		
Intersection Capacity Utilization	57.6%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			0.99			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.95			0.94			0.99	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.97	
Satd. Flow (prot)	1770	1837		1770	1753			1721			1774	
Flt Permitted	0.95	1.00		0.95	1.00			0.95			0.71	
Satd. Flow (perm)	1770	1837		1770	1753			1647			1299	
Volume (vph)	21	389	33	30	322	160	17	59	60	149	49	21
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	22	409	35	32	339	168	18	62	63	157	52	22
RTOR Reduction (vph)	0	2	0	0	16	0	0	30	0	0	4	0
Lane Group Flow (vph)	22	442	0	32	491	0	0	113	0	0	227	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Actuated Green, G (s)	1.0	27.3		2.4	28.7			13.7			13.7	
Effective Green, g (s)	2.0	28.3		3.4	29.7			14.7			14.7	
Actuated g/C Ratio	0.04	0.51		0.06	0.54			0.27			0.27	
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)	64	938		109	940			437			345	
v/s Ratio Prot	0.01	0.24		c0.02	c0.28							
v/s Ratio Perm								0.07			c0.17	
v/c Ratio	0.34	0.47		0.29	0.52			0.26			0.66	
Uniform Delay, d1	26.1	8.7		24.9	8.3			16.1			18.1	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	3.2	0.4		1.5	0.5			0.3			4.5	
Delay (s)	29.3	9.1		26.4	8.8			16.4			22.6	
Level of Service	C	A		C	A			B			C	
Approach Delay (s)		10.1			9.8			16.4			22.6	
Approach LOS		B			A			B			C	

Intersection Summary			
HCM Average Control Delay	12.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	55.4	Sum of lost time (s)	6.0
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		

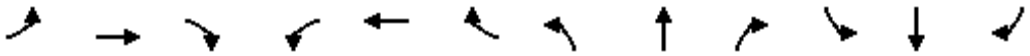
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Stop	Stop		Stop	
Volume (vph)	30	152	57	59	82	22
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	36	181	68	70	98	26

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total (vph)	217	138	124
Volume Left (vph)	36	0	98
Volume Right (vph)	0	70	26
Hadj (s)	0.07	-0.27	0.06
Departure Headway (s)	4.4	4.2	4.8
Degree Utilization, x	0.27	0.16	0.16
Capacity (veh/h)	789	817	707
Control Delay (s)	9.0	8.0	8.7
Approach Delay (s)	9.0	8.0	8.7
Approach LOS	A	A	A

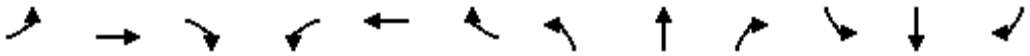
Intersection Summary			
Delay	8.6		
HCM Level of Service	A		
Intersection Capacity Utilization	28.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	160	191	20	37	48	42	2	125	28	47	127	77
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	180	215	22	42	54	47	2	140	31	53	143	87

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	417	143	174	282
Volume Left (vph)	180	42	2	53
Volume Right (vph)	22	47	31	87
Hadj (s)	0.09	-0.11	-0.07	-0.11
Departure Headway (s)	5.6	6.0	6.0	5.8
Degree Utilization, x	0.65	0.24	0.29	0.45
Capacity (veh/h)	610	520	524	570
Control Delay (s)	18.5	10.8	11.5	13.5
Approach Delay (s)	18.5	10.8	11.5	13.5
Approach LOS	C	B	B	B

Intersection Summary				
Delay	14.8			
HCM Level of Service	B			
Intersection Capacity Utilization	60.2%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.98		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frt	1.00	1.00		1.00	0.98			1.00	0.85		0.99	
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.97	
Satd. Flow (prot)	1770	1858		1770	1813			1804	1558		1786	
Flt Permitted	0.95	1.00		0.95	1.00			0.80	1.00		0.74	
Satd. Flow (perm)	1770	1858		1770	1813			1483	1558		1361	
Volume (vph)	5	517	8	208	430	75	82	44	328	69	22	4
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	5	533	8	214	443	77	85	45	338	71	23	4
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	272	0	2	0
Lane Group Flow (vph)	5	541	0	214	516	0	0	130	66	0	96	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		
Actuated Green, G (s)	0.9	34.0		11.1	44.2			12.7	12.7		12.7	
Effective Green, g (s)	1.9	35.0		12.1	45.2			13.7	13.7		13.7	
Actuated g/C Ratio	0.03	0.50		0.17	0.65			0.20	0.20		0.20	
Clearance Time (s)	4.0	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		3.0	
Lane Grp Cap (vph)	48	932		307	1174			291	306		267	
v/s Ratio Prot	0.00	c0.29		c0.12	0.28							
v/s Ratio Perm								c0.09	0.04		0.07	
v/c Ratio	0.10	0.58		0.70	0.44			0.45	0.22		0.36	
Uniform Delay, d1	33.1	12.2		27.1	6.1			24.7	23.5		24.3	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	1.0	0.9		6.7	0.3			1.1	0.4		0.8	
Delay (s)	34.1	13.1		33.9	6.3			25.8	23.9		25.1	
Level of Service	C	B		C	A			C	C		C	
Approach Delay (s)		13.3			14.4			24.4			25.1	
Approach LOS		B			B			C			C	

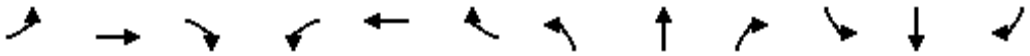
Intersection Summary			
HCM Average Control Delay	17.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	69.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	66.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	EBR2	WBL2	WBL	WBT	NBL	NBR	NBR2	NWL2	NWL	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0				3.0	3.0	3.0	3.0		3.0	3.0	
Lane Util. Factor	0.95				1.00	0.95	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Frt	0.99				1.00	1.00	1.00	0.85		1.00	0.94	
Flt Protected	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (prot)	3486				1770	3539	1770	1583		1770	1685	
Flt Permitted	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (perm)	3486				1770	3539	1770	1583		1770	1685	
Volume (vph)	908	58	17	36	191	801	59	142	14	1	30	21
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	936	60	18	37	197	826	61	146	14	1	31	22
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	19	0
Lane Group Flow (vph)	1014	0	0	0	234	826	61	160	0	1	34	0
Confl. Peds. (#/hr)		5	5					5	5			5
Turn Type				Prot	Prot			Prot		Split		
Protected Phases	4			3	3	8	1	1		2	2	
Permitted Phases												
Actuated Green, G (s)	24.4				5.4	33.8	8.4	8.4		7.2	7.2	
Effective Green, g (s)	25.4				6.4	34.8	9.4	9.4		8.2	8.2	
Actuated g/C Ratio	0.41				0.10	0.57	0.15	0.15		0.13	0.13	
Clearance Time (s)	4.0				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	3.0	
Lane Grp Cap (vph)	1442				184	2006	271	242		236	225	
v/s Ratio Prot	c0.29				c0.13	0.23	0.03	c0.10		0.00	c0.02	
v/s Ratio Perm												
v/c Ratio	0.70				1.27	0.41	0.23	0.66		0.00	0.15	
Uniform Delay, d1	14.9				27.5	7.5	22.8	24.5		23.1	23.5	
Progression Factor	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.6				157.8	0.1	0.4	6.6		0.0	0.3	
Delay (s)	16.5				185.3	7.7	23.2	31.1		23.1	23.8	
Level of Service	B				F	A	C	C		C	C	
Approach Delay (s)	16.5					46.9	28.9				23.8	
Approach LOS	B					D	C				C	

Intersection Summary			
HCM Average Control Delay	31.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	61.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		

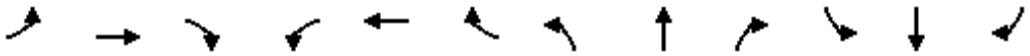
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.98		1.00	0.94		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3515		1770	3449		1770	3341		1681	1657	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3515		1770	3449		1770	3341		1681	1657	
Volume (vph)	106	948	37	122	975	173	64	123	74	231	149	91
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	115	1030	40	133	1060	188	70	134	80	251	162	99
RTOR Reduction (vph)	0	2	0	0	14	0	0	71	0	0	22	0
Lane Group Flow (vph)	115	1068	0	133	1234	0	70	143	0	251	239	0
Confl. Peds. (#/hr)			5			5						5
Turn Type	Prot			Prot			Split			Split		
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases												
Actuated Green, G (s)	7.2	33.7		9.1	35.6		8.9	8.9		16.3	16.3	
Effective Green, g (s)	8.2	34.7		10.1	36.6		9.9	9.9		17.3	17.3	
Actuated g/C Ratio	0.10	0.41		0.12	0.44		0.12	0.12		0.21	0.21	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	173	1452		213	1503		209	394		346	341	
v/s Ratio Prot	c0.06	0.30		0.08	c0.36		0.04	c0.04		c0.15	0.14	
v/s Ratio Perm												
v/c Ratio	0.66	0.74		0.62	0.82		0.33	0.36		0.73	0.70	
Uniform Delay, d1	36.6	20.8		35.1	20.8		34.0	34.1		31.1	30.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	9.3	2.0		5.6	3.7		1.0	0.6		7.4	6.4	
Delay (s)	45.8	22.8		40.7	24.6		35.0	34.7		38.5	37.3	
Level of Service	D	C		D	C		C	C		D	D	
Approach Delay (s)		25.0			26.1			34.8			37.9	
Approach LOS		C			C			C			D	

Intersection Summary			
HCM Average Control Delay	28.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	84.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	71.2%	ICU Level of Service	C
Analysis Period (min)	15		

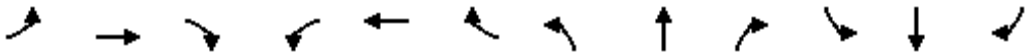
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1836		1770	1809		1770	3397		1770	3522	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1836		1770	1809		1770	3397		1770	3522	
Volume (vph)	44	207	19	329	169	35	22	973	272	70	1151	30
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	46	218	20	346	178	37	23	1024	286	74	1212	32
RTOR Reduction (vph)	0	3	0	0	6	0	0	21	0	0	2	0
Lane Group Flow (vph)	46	235	0	346	209	0	23	1289	0	74	1242	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	9.6	16.3		20.3	27.0		1.5	40.9		8.4	47.8	
Effective Green, g (s)	10.6	17.3		21.3	28.0		2.5	41.9		9.4	48.8	
Actuated g/C Ratio	0.10	0.17		0.21	0.27		0.02	0.41		0.09	0.48	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	184	312		370	497		43	1397		163	1687	
v/s Ratio Prot	0.03	c0.13		c0.20	0.12		0.01	c0.38		c0.04	c0.35	
v/s Ratio Perm												
v/c Ratio	0.25	0.75		0.94	0.42		0.53	0.92		0.45	0.74	
Uniform Delay, d1	42.0	40.3		39.6	30.3		49.1	28.5		43.8	21.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.7	9.8		30.5	0.6		12.2	10.3		2.0	1.7	
Delay (s)	42.7	50.1		70.1	30.9		61.3	38.8		45.8	23.1	
Level of Service	D	D		E	C		E	D		D	C	
Approach Delay (s)		48.9			55.1			39.2			24.4	
Approach LOS		D			E			D			C	

Intersection Summary			
HCM Average Control Delay	36.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	101.9	Sum of lost time (s)	15.0
Intersection Capacity Utilization	83.9%	ICU Level of Service	E
Analysis Period (min)	15		

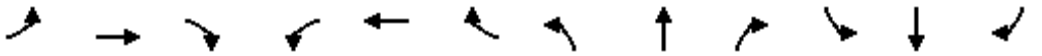
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Util. Factor	0.95	0.95			1.00			0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Frt	1.00	1.00			0.91			1.00		1.00	0.98	
Flt Protected	0.95	0.95			0.99			1.00		0.95	1.00	
Satd. Flow (prot)	1681	1683			1672			3536		1770	3445	
Flt Permitted	0.95	0.95			0.99			1.00		0.95	1.00	
Satd. Flow (perm)	1681	1683			1672			3536		1770	3445	
Volume (vph)	759	1	5	6	3	19	0	1180	7	57	1121	184
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	791	1	5	6	3	20	0	1229	7	59	1168	192
RTOR Reduction (vph)	0	1	0	0	19	0	0	0	0	0	10	0
Lane Group Flow (vph)	418	378	0	0	10	0	0	1236	0	59	1350	0
Confl. Peds. (#/hr)			5						5			5
Turn Type	Split			Split						Prot		
Protected Phases	4	4		8	8			2		1	6	
Permitted Phases												
Actuated Green, G (s)	31.0	31.0			2.8			59.6		3.1	66.7	
Effective Green, g (s)	32.0	32.0			3.8			60.6		4.1	67.7	
Actuated g/C Ratio	0.28	0.28			0.03			0.54		0.04	0.60	
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)	478	479			56			1905		65	2073	
v/s Ratio Prot	c0.25	0.22			c0.01			0.35		c0.03	c0.39	
v/s Ratio Perm												
v/c Ratio	0.87	0.79			0.17			0.65		0.91	0.65	
Uniform Delay, d1	38.3	37.1			52.8			18.4		54.0	14.7	
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2	16.2	8.4			1.5			1.7		78.9	1.6	
Delay (s)	54.5	45.6			54.3			20.1		132.9	16.3	
Level of Service	D	D			D			C		F	B	
Approach Delay (s)		50.3			54.3			20.1			21.1	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	27.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	112.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	74.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

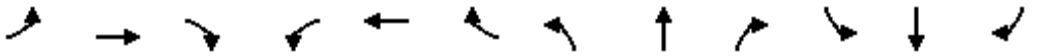


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.91	0.91	1.00		0.95	1.00	1.00	0.95		1.00	0.95	0.88
Frpb, ped/bikes	1.00	1.00	1.00		1.00	0.99	1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1610	3293	1583		3537	1562	1770	3476		1770	3539	2749
Flt Permitted	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1610	3293	1583		3537	1562	1770	3476		1770	3539	2749
Volume (vph)	1315	454	75	7	435	41	108	225	27	49	268	1435
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	1399	483	80	7	463	44	115	239	29	52	285	1527
RTOR Reduction (vph)	0	0	42	0	0	0	0	12	0	0	0	0
Lane Group Flow (vph)	700	1182	38	0	470	44	115	256	0	52	285	1527
Confl. Peds. (#/hr)						5			5			5
Turn Type	Split		Perm	Split		Free	Prot			Prot		Free
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4			Free						Free
Actuated Green, G (s)	35.5	35.5	35.5		9.1	81.1	4.1	17.6		2.9	16.4	81.1
Effective Green, g (s)	36.5	36.5	36.5		10.1	81.1	5.1	18.6		3.9	17.4	81.1
Actuated g/C Ratio	0.45	0.45	0.45		0.12	1.00	0.06	0.23		0.05	0.21	1.00
Clearance Time (s)	4.0	4.0	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		3.0	3.0	
Lane Grp Cap (vph)	725	1482	712		440	1562	111	797		85	759	2749
v/s Ratio Prot	c0.43	0.36			c0.13		c0.06	0.07		0.03	0.08	
v/s Ratio Perm			0.02			0.03						c0.56
v/c Ratio	0.97	0.91dl	0.05		1.07	0.03	1.04	0.32		0.61	0.38	0.56
Uniform Delay, d1	21.7	19.1	12.6		35.5	0.0	38.0	26.0		37.9	27.2	0.0
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	25.0	3.1	0.0		62.3	0.0	95.4	0.2		12.3	0.3	0.8
Delay (s)	46.6	22.2	12.6		97.8	0.0	133.4	26.2		50.2	27.5	0.8
Level of Service	D	C	B		F	A	F	C		D	C	A
Approach Delay (s)		30.5			89.4			58.4			6.3	
Approach LOS		C			F			E			A	

Intersection Summary			
HCM Average Control Delay	29.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	81.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	78.9%	ICU Level of Service	D
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	0.88	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Volume (vph)	220	1229	74	509	1510	397	87	231	388	831	242	154
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	242	1351	81	559	1659	436	96	254	426	913	266	169
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	171	0	0	113
Lane Group Flow (vph)	242	1351	81	559	1659	436	96	254	255	913	266	57
Confl. Peds. (#/hr)												5
Turn Type	Prot		Free	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			6
Actuated Green, G (s)	21.4	48.9	135.2	21.1	48.6	135.2	5.0	21.1	21.1	28.1	44.2	44.2
Effective Green, g (s)	22.4	49.9	135.2	22.1	49.6	135.2	6.0	22.1	22.1	29.1	45.2	45.2
Actuated g/C Ratio	0.17	0.37	1.00	0.16	0.37	1.00	0.04	0.16	0.16	0.22	0.33	0.33
Clearance Time (s)	4.0	4.0		4.0	4.0		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	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	293	1877	1583	561	1866	1583	79	305	456	739	623	520
v/s Ratio Prot	0.14	0.27		c0.16	c0.33		0.05	c0.14		c0.27	0.14	
v/s Ratio Perm			0.05			c0.28			0.09			0.04
v/c Ratio	0.83	0.72	0.05	1.00	0.89	0.28	1.22	0.83	0.56	1.24	0.43	0.11
Uniform Delay, d1	54.5	36.6	0.0	56.5	40.2	0.0	64.6	54.8	52.1	53.0	34.9	31.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	17.0	1.4	0.1	36.8	5.6	0.4	170.1	22.6	4.9	117.5	2.1	0.4
Delay (s)	71.6	38.0	0.1	93.3	45.8	0.4	234.7	77.4	56.9	170.5	37.1	31.5
Level of Service	E	D	A	F	D	A	F	E	E	F	D	C
Approach Delay (s)		41.0			48.4			85.6			126.8	
Approach LOS		D			D			F			F	

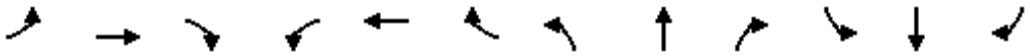
Intersection Summary			
HCM Average Control Delay	67.3	HCM Level of Service	E
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	135.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	92.9%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	229	69	48	392	92	71
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	260	78	55	445	105	81
Pedestrians					5	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			344		859	304
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			344		859	304
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		66	89
cM capacity (veh/h)			1210		311	732

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	339	55	445	185
Volume Left	0	55	0	105
Volume Right	78	0	0	81
cSH	1700	1210	1700	415
Volume to Capacity	0.20	0.05	0.26	0.45
Queue Length 95th (ft)	0	4	0	56
Control Delay (s)	0.0	8.1	0.0	20.5
Lane LOS		A		C
Approach Delay (s)	0.0	0.9		20.5
Approach LOS				C

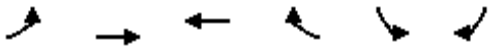
Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	41.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			0.99			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.96			0.96			0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.98	
Satd. Flow (prot)	1770	1837		1770	1779			1755			1744	
Flt Permitted	0.95	1.00		0.95	1.00			0.92			0.83	
Satd. Flow (perm)	1770	1837		1770	1779			1637			1484	
Volume (vph)	40	228	19	74	312	106	15	36	22	108	72	67
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	45	259	22	84	355	120	17	41	25	123	82	76
RTOR Reduction (vph)	0	3	0	0	13	0	0	16	0	0	14	0
Lane Group Flow (vph)	45	278	0	84	462	0	0	67	0	0	267	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Actuated Green, G (s)	2.5	22.3		5.0	24.8			14.6			14.6	
Effective Green, g (s)	3.5	23.3		6.0	25.8			15.6			15.6	
Actuated g/C Ratio	0.06	0.43		0.11	0.48			0.29			0.29	
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)	115	794		197	852			474			430	
v/s Ratio Prot	0.03	0.15		c0.05	c0.26							
v/s Ratio Perm								0.04			c0.18	
v/c Ratio	0.39	0.35		0.43	0.54			0.14			0.62	
Uniform Delay, d1	24.2	10.2		22.3	9.9			14.2			16.6	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	2.2	0.3		1.5	0.7			0.1			2.8	
Delay (s)	26.4	10.5		23.8	10.6			14.3			19.4	
Level of Service	C	B		C	B			B			B	
Approach Delay (s)		12.7			12.6			14.3			19.4	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	14.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	53.9	Sum of lost time (s)	6.0
Intersection Capacity Utilization	57.0%	ICU Level of Service	B
Analysis Period (min)	15		

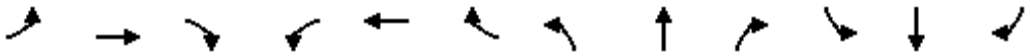
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Stop	Stop		Stop	
Volume (vph)	22	38	126	79	51	24
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Hourly flow rate (vph)	28	48	158	99	64	30

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total (vph)	75	256	94
Volume Left (vph)	28	0	64
Volume Right (vph)	0	99	30
Hadj (s)	0.11	-0.20	-0.02
Departure Headway (s)	4.5	4.0	4.6
Degree Utilization, x	0.09	0.29	0.12
Capacity (veh/h)	773	876	731
Control Delay (s)	8.0	8.6	8.2
Approach Delay (s)	8.0	8.6	8.2
Approach LOS	A	A	A

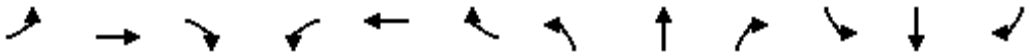
Intersection Summary			
Delay	8.4		
HCM Level of Service	A		
Intersection Capacity Utilization	29.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	46	41	4	36	164	59	15	129	22	33	170	148
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	54	48	5	42	193	69	18	152	26	39	200	174

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	107	305	195	413
Volume Left (vph)	54	42	18	39
Volume Right (vph)	5	69	26	174
Hadj (s)	0.11	-0.07	-0.03	-0.20
Departure Headway (s)	6.3	5.7	5.8	5.3
Degree Utilization, x	0.19	0.49	0.32	0.61
Capacity (veh/h)	478	578	552	644
Control Delay (s)	10.8	14.0	11.5	16.2
Approach Delay (s)	10.8	14.0	11.5	16.2
Approach LOS	B	B	B	C

Intersection Summary			
Delay	14.1		
HCM Level of Service	B		
Intersection Capacity Utilization	47.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.98		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frt	1.00	1.00		1.00	0.99			1.00	0.85		0.99	
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00		0.97	
Satd. Flow (prot)	1770	1855		1770	1842			1790	1559		1784	
Flt Permitted	0.95	1.00		0.95	1.00			0.77	1.00		0.75	
Satd. Flow (perm)	1770	1855		1770	1842			1442	1559		1385	
Volume (vph)	4	303	7	382	374	24	61	15	146	71	23	5
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	4	312	7	394	386	25	63	15	151	73	24	5
RTOR Reduction (vph)	0	1	0	0	1	0	0	0	126	0	2	0
Lane Group Flow (vph)	4	318	0	394	410	0	0	78	25	0	100	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		
Actuated Green, G (s)	0.7	22.7		18.5	40.5			9.3	9.3		9.3	
Effective Green, g (s)	1.7	23.7		19.5	41.5			10.3	10.3		10.3	
Actuated g/C Ratio	0.03	0.38		0.31	0.66			0.16	0.16		0.16	
Clearance Time (s)	4.0	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		3.0	
Lane Grp Cap (vph)	48	703		552	1223			238	257		228	
v/s Ratio Prot	0.00	c0.17		c0.22	0.22							
v/s Ratio Perm								0.05	0.02		c0.07	
v/c Ratio	0.08	0.45		0.71	0.33			0.33	0.10		0.44	
Uniform Delay, d1	29.6	14.5		19.0	4.5			23.0	22.2		23.5	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	0.7	0.5		4.4	0.2			0.8	0.2		1.4	
Delay (s)	30.4	15.0		23.4	4.7			23.9	22.3		24.9	
Level of Service	C	B		C	A			C	C		C	
Approach Delay (s)		15.2			13.8			22.8			24.9	
Approach LOS		B			B			C			C	

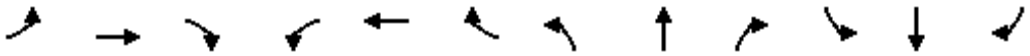
Intersection Summary			
HCM Average Control Delay	16.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	62.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	61.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	EBR2	WBL2	WBL	WBT	NBL	NBR	NBR2	NWL2	NWL	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0				3.0	3.0	3.0	3.0		3.0	3.0	
Lane Util. Factor	0.95				1.00	0.95	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	0.99				1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Frt	0.98				1.00	1.00	1.00	0.85		1.00	0.95	
Flt Protected	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (prot)	3457				1770	3539	1770	1583		1770	1695	
Flt Permitted	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (perm)	3457				1770	3539	1770	1583		1770	1695	
Volume (vph)	719	60	34	15	104	797	51	87	8	2	33	16
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	790	66	37	16	114	876	56	96	9	2	36	18
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	17	0
Lane Group Flow (vph)	893	0	0	0	130	876	56	105	0	2	37	0
Confl. Peds. (#/hr)		5	5					5	5			5
Turn Type				Prot	Prot			Prot		Split		
Protected Phases	4			3	3	8	1	1		2	2	
Permitted Phases												
Actuated Green, G (s)	38.3				9.4	51.7	10.1	10.1		5.1	5.1	
Effective Green, g (s)	39.3				10.4	52.7	11.1	11.1		6.1	6.1	
Actuated g/C Ratio	0.50				0.13	0.67	0.14	0.14		0.08	0.08	
Clearance Time (s)	4.0				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	3.0	
Lane Grp Cap (vph)	1722				233	2364	249	223		137	131	
v/s Ratio Prot	c0.26				c0.07	0.25	0.03	c0.07		0.00	c0.02	
v/s Ratio Perm												
v/c Ratio	0.52				0.56	0.37	0.22	0.47		0.01	0.29	
Uniform Delay, d1	13.4				32.1	5.8	30.1	31.2		33.6	34.3	
Progression Factor	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3				2.9	0.1	0.5	1.6		0.0	1.2	
Delay (s)	13.7				35.0	5.9	30.5	32.8		33.7	35.5	
Level of Service	B				C	A	C	C		C	D	
Approach Delay (s)	13.7					9.6	32.0				35.5	
Approach LOS	B					A	C				D	

Intersection Summary			
HCM Average Control Delay	13.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	78.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.8%	ICU Level of Service	A
Analysis Period (min)	15		

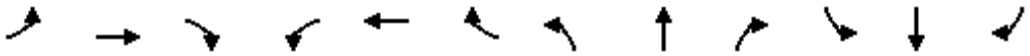
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	0.94		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3483		1770	3439		1770	3321		1681	1648	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3483		1770	3439		1770	3321		1681	1648	
Volume (vph)	60	690	67	127	926	189	60	123	86	136	91	64
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	65	742	72	137	996	203	65	132	92	146	98	69
RTOR Reduction (vph)	0	7	0	0	16	0	0	82	0	0	26	0
Lane Group Flow (vph)	65	807	0	137	1183	0	65	142	0	146	141	0
Confl. Peds. (#/hr)			5			5						5
Turn Type	Prot			Prot			Split			Split		
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases												
Actuated Green, G (s)	3.3	26.4		8.1	31.2		6.5	6.5		12.4	12.4	
Effective Green, g (s)	4.3	27.4		9.1	32.2		7.5	7.5		13.4	13.4	
Actuated g/C Ratio	0.06	0.39		0.13	0.46		0.11	0.11		0.19	0.19	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	110	1375		232	1596		191	359		325	318	
v/s Ratio Prot	0.04	0.23		c0.08	c0.34		0.04	c0.04		c0.09	0.09	
v/s Ratio Perm												
v/c Ratio	0.59	0.59		0.59	0.74		0.34	0.40		0.45	0.44	
Uniform Delay, d1	31.7	16.5		28.4	15.2		28.7	28.8		24.7	24.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.2	0.6		4.0	1.9		1.1	0.7		1.0	1.0	
Delay (s)	39.9	17.2		32.4	17.1		29.7	29.6		25.7	25.7	
Level of Service	D	B		C	B		C	C		C	C	
Approach Delay (s)		18.9			18.7			29.6			25.7	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	69.4	Sum of lost time (s)	9.0
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		

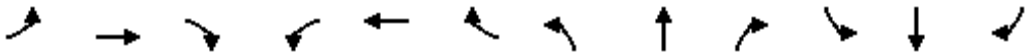
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.96		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1844		1770	1770		1770	3476		1770	3528	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1844		1770	1770		1770	3476		1770	3528	
Volume (vph)	80	102	7	295	151	64	13	1043	112	37	1048	18
Peak-hour factor, PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj. Flow (vph)	96	123	8	355	182	77	16	1257	135	45	1263	22
RTOR Reduction (vph)	0	3	0	0	13	0	0	6	0	0	1	0
Lane Group Flow (vph)	96	128	0	355	246	0	16	1386	0	45	1284	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	11.0	11.9		20.4	21.3		1.4	40.4		5.9	44.9	
Effective Green, g (s)	12.0	12.9		21.4	22.3		2.4	41.4		6.9	45.9	
Actuated g/C Ratio	0.13	0.14		0.23	0.24		0.03	0.44		0.07	0.49	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	225	251		400	417		45	1521		129	1712	
v/s Ratio Prot	0.05	0.07		c0.20	c0.14		0.01	c0.40		c0.03	c0.36	
v/s Ratio Perm												
v/c Ratio	0.43	0.51		0.89	0.59		0.36	0.91		0.35	0.75	
Uniform Delay, d1	38.1	37.9		35.4	32.1		45.3	24.9		41.7	19.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.3	1.8		20.4	2.1		4.8	8.6		1.6	1.8	
Delay (s)	39.4	39.7		55.9	34.2		50.1	33.4		43.3	21.6	
Level of Service	D	D		E	C		D	C		D	C	
Approach Delay (s)		39.6			46.7			33.6			22.3	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	32.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	94.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.3%	ICU Level of Service	C
Analysis Period (min)	15		

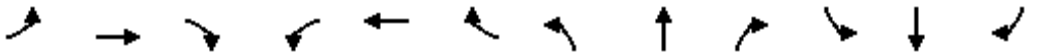
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Util. Factor	0.95	0.95			1.00			0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Frt	1.00	0.99			0.94			1.00		1.00	0.98	
Flt Protected	0.95	0.96			0.99			1.00		0.95	1.00	
Satd. Flow (prot)	1681	1668			1734			3539		1770	3459	
Flt Permitted	0.95	0.96			0.99			1.00		0.95	1.00	
Satd. Flow (perm)	1681	1668			1734			3539		1770	3459	
Volume (vph)	651	0	27	2	6	7	0	1265	1	34	1148	157
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)	723	0	30	2	7	8	0	1406	1	38	1276	174
RTOR Reduction (vph)	0	3	0	0	8	0	0	0	0	0	8	0
Lane Group Flow (vph)	400	350	0	0	9	0	0	1407	0	38	1442	0
Confl. Peds. (#/hr)			5						5			5
Turn Type	Split			Split						Prot		
Protected Phases	4	4		8	8			2		1	6	
Permitted Phases												
Actuated Green, G (s)	29.4	29.4			1.8			61.3		2.2	67.5	
Effective Green, g (s)	30.4	30.4			2.8			62.3		3.2	68.5	
Actuated g/C Ratio	0.27	0.27			0.03			0.56		0.03	0.62	
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)	462	458			44			1992		51	2140	
v/s Ratio Prot	c0.24	0.21			c0.01			c0.40		0.02	c0.42	
v/s Ratio Perm												
v/c Ratio	0.87	0.76			0.21			0.71		0.75	0.67	
Uniform Delay, d1	38.2	36.9			52.9			17.6		53.3	13.8	
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2	15.5	7.4			2.4			2.1		44.3	1.7	
Delay (s)	53.7	44.3			55.2			19.7		97.7	15.5	
Level of Service	D	D			E			B		F	B	
Approach Delay (s)		49.3			55.2			19.7			17.6	
Approach LOS		D			E			B			B	

Intersection Summary			
HCM Average Control Delay	25.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	110.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

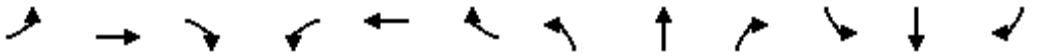


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.91	0.91	1.00		0.95	1.00	1.00	0.95		1.00	0.95	0.88
Frpb, ped/bikes	1.00	1.00	1.00		1.00	0.99	1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1610	3281	1583		3532	1562	1770	3494		1770	3539	2749
Flt Permitted	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1610	3281	1583		3532	1562	1770	3494		1770	3539	2749
Volume (vph)	1474	370	77	14	326	42	62	296	25	39	239	1444
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	1714	430	90	16	379	49	72	344	29	45	278	1679
RTOR Reduction (vph)	0	0	43	0	0	0	0	8	0	0	0	0
Lane Group Flow (vph)	857	1287	47	0	395	49	72	365	0	45	278	1679
Confl. Peds. (#/hr)						5			5			5
Turn Type	Split		Perm	Split		Free	Prot			Prot		Free
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4			Free						Free
Actuated Green, G (s)	35.7	35.7	35.7		9.2	80.7	3.1	17.0		2.8	16.7	80.7
Effective Green, g (s)	36.7	36.7	36.7		10.2	80.7	4.1	18.0		3.8	17.7	80.7
Actuated g/C Ratio	0.45	0.45	0.45		0.13	1.00	0.05	0.22		0.05	0.22	1.00
Clearance Time (s)	4.0	4.0	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		3.0	3.0	
Lane Grp Cap (vph)	732	1492	720		446	1562	90	779		83	776	2749
v/s Ratio Prot	c0.53	0.39			c0.11		0.04	0.10		0.03	0.08	
v/s Ratio Perm			0.03			0.03						c0.61
v/c Ratio	1.17	1.10dl	0.07		0.89	0.03	0.80	0.47		0.54	0.36	0.61
Uniform Delay, d1	22.0	19.7	12.4		34.7	0.0	37.9	27.2		37.6	26.7	0.0
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	91.1	5.4	0.0		18.6	0.0	38.2	0.4		7.1	0.3	1.0
Delay (s)	113.1	25.1	12.4		53.2	0.0	76.1	27.6		44.7	27.0	1.0
Level of Service	F	C	B		D	A	E	C		D	C	A
Approach Delay (s)		58.4			47.4			35.5			5.6	
Approach LOS		E			D			D			A	

Intersection Summary			
HCM Average Control Delay	34.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	80.7	Sum of lost time (s)	6.0
Intersection Capacity Utilization	78.7%	ICU Level of Service	D
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	0.88	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Volume (vph)	199	1587	61	402	1480	726	26	166	151	530	117	209
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	219	1744	67	442	1626	798	29	182	166	582	129	230
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	93	0	0	154
Lane Group Flow (vph)	219	1744	67	442	1626	798	29	182	73	582	129	76
Confl. Peds. (#/hr)												5
Turn Type	Prot		Free	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			6
Actuated Green, G (s)	20.4	51.9	137.1	20.1	51.6	137.1	5.0	21.1	21.1	28.0	44.1	44.1
Effective Green, g (s)	21.4	52.9	137.1	21.1	52.6	137.1	6.0	22.1	22.1	29.0	45.1	45.1
Actuated g/C Ratio	0.16	0.39	1.00	0.15	0.38	1.00	0.04	0.16	0.16	0.21	0.33	0.33
Clearance Time (s)	4.0	4.0		4.0	4.0		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	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	276	1962	1583	528	1951	1583	77	300	449	726	613	512
v/s Ratio Prot	0.12	c0.34		c0.13	0.32		0.02	c0.10		c0.17	0.07	
v/s Ratio Perm			0.04			c0.50			0.03			0.05
v/c Ratio	0.79	0.89	0.04	0.84	0.83	0.50	0.38	0.61	0.16	0.80	0.21	0.15
Uniform Delay, d1	55.7	39.4	0.0	56.3	38.3	0.0	63.7	53.5	49.5	51.3	33.2	32.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.4	5.4	0.1	11.1	3.2	1.1	13.5	8.8	0.8	9.1	0.8	0.6
Delay (s)	70.2	44.7	0.1	67.4	41.5	1.1	77.2	62.3	50.3	60.4	33.9	33.1
Level of Service	E	D	A	E	D	A	E	E	D	E	C	C
Approach Delay (s)		46.0			34.3			58.2			50.1	
Approach LOS		D			C			E			D	

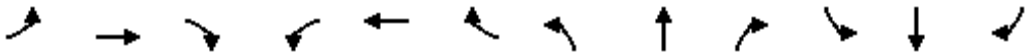
Intersection Summary			
HCM Average Control Delay	41.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	137.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	92.1%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	425	125	88	265	131	63
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	472	139	98	294	146	70
Pedestrians					5	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			616		1037	547
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			616		1037	547
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			90		36	87
cM capacity (veh/h)			960		229	535

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	611	98	294	216
Volume Left	0	98	0	146
Volume Right	139	0	0	70
cSH	1700	960	1700	281
Volume to Capacity	0.36	0.10	0.17	0.77
Queue Length 95th (ft)	0	8	0	144
Control Delay (s)	0.0	9.2	0.0	49.9
Lane LOS		A		E
Approach Delay (s)	0.0	2.3		49.9
Approach LOS				E

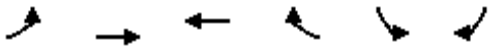
Intersection Summary			
Average Delay	9.6		
Intersection Capacity Utilization	60.2%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			0.99			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.95			0.94			0.99	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.97	
Satd. Flow (prot)	1770	1839		1770	1754			1721			1770	
Flt Permitted	0.95	1.00		0.95	1.00			0.96			0.69	
Satd. Flow (perm)	1770	1839		1770	1754			1659			1261	
Volume (vph)	59	428	33	30	326	160	17	59	60	149	49	25
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	62	451	35	32	343	168	18	62	63	157	52	26
RTOR Reduction (vph)	0	2	0	0	17	0	0	31	0	0	4	0
Lane Group Flow (vph)	62	484	0	32	494	0	0	112	0	0	231	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Actuated Green, G (s)	4.3	31.8		2.4	29.9			14.2			14.2	
Effective Green, g (s)	5.3	32.8		3.4	30.9			15.2			15.2	
Actuated g/C Ratio	0.09	0.54		0.06	0.51			0.25			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)	155	999		100	897			417			317	
v/s Ratio Prot	c0.04	0.26		0.02	c0.28							
v/s Ratio Perm								0.07			c0.18	
v/c Ratio	0.40	0.48		0.32	0.55			0.27			0.73	
Uniform Delay, d1	26.0	8.6		27.4	10.0			18.1			20.7	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	1.7	0.4		1.9	0.7			0.3			8.1	
Delay (s)	27.7	8.9		29.2	10.8			18.5			28.8	
Level of Service	C	A		C	B			B			C	
Approach Delay (s)		11.1			11.9			18.5			28.8	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	14.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	60.4	Sum of lost time (s)	9.0
Intersection Capacity Utilization	59.5%	ICU Level of Service	B
Analysis Period (min)	15		

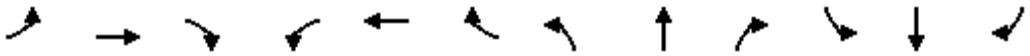
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Stop	Stop		Stop	
Volume (vph)	30	164	58	59	82	22
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	36	195	69	70	98	26

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total (vph)	231	139	124
Volume Left (vph)	36	0	98
Volume Right (vph)	0	70	26
Hadj (s)	0.06	-0.27	0.06
Departure Headway (s)	4.4	4.2	4.8
Degree Utilization, x	0.28	0.16	0.16
Capacity (veh/h)	789	813	700
Control Delay (s)	9.2	8.0	8.7
Approach Delay (s)	9.2	8.0	8.7
Approach LOS	A	A	A

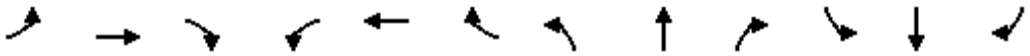
Intersection Summary			
Delay	8.7		
HCM Level of Service	A		
Intersection Capacity Utilization	29.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	171	193	20	37	48	42	2	125	28	47	127	78
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	192	217	22	42	54	47	2	140	31	53	143	88

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	431	143	174	283
Volume Left (vph)	192	42	2	53
Volume Right (vph)	22	47	31	88
Hadj (s)	0.09	-0.11	-0.07	-0.11
Departure Headway (s)	5.6	6.0	6.1	5.8
Degree Utilization, x	0.68	0.24	0.30	0.46
Capacity (veh/h)	610	515	517	565
Control Delay (s)	19.7	10.9	11.6	13.7
Approach Delay (s)	19.7	10.9	11.6	13.7
Approach LOS	C	B	B	B

Intersection Summary			
Delay	15.4		
HCM Level of Service	C		
Intersection Capacity Utilization	61.0%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.98		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frt	1.00	1.00		1.00	0.98			1.00	0.85		0.99	
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.97	
Satd. Flow (prot)	1770	1858		1770	1813			1804	1557		1786	
Flt Permitted	0.95	1.00		0.95	1.00			0.79	1.00		0.70	
Satd. Flow (perm)	1770	1858		1770	1813			1469	1557		1299	
Volume (vph)	5	556	8	209	434	75	82	44	339	69	22	4
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	5	573	8	215	447	77	85	45	349	71	23	4
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	285	0	2	0
Lane Group Flow (vph)	5	581	0	215	520	0	0	130	64	0	96	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		
Actuated Green, G (s)	1.0	38.2		14.1	51.3			13.3	13.3		13.3	
Effective Green, g (s)	2.0	39.2		15.1	52.3			14.3	14.3		14.3	
Actuated g/C Ratio	0.03	0.51		0.19	0.67			0.18	0.18		0.18	
Clearance Time (s)	4.0	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		3.0	
Lane Grp Cap (vph)	46	939		344	1222			271	287		239	
v/s Ratio Prot	0.00	c0.31		c0.12	0.29							
v/s Ratio Perm								c0.09	0.04		0.07	
v/c Ratio	0.11	0.62		0.62	0.43			0.48	0.22		0.40	
Uniform Delay, d1	36.9	13.8		28.7	5.8			28.3	26.9		27.9	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	1.0	1.2		3.5	0.2			1.3	0.4		1.1	
Delay (s)	38.0	15.0		32.2	6.0			29.7	27.3		29.0	
Level of Service	D	B		C	A			C	C		C	
Approach Delay (s)		15.2			13.6			28.0			29.0	
Approach LOS		B			B			C			C	

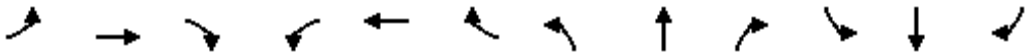
Intersection Summary			
HCM Average Control Delay	18.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	77.6	Sum of lost time (s)	9.0
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	EBR2	WBL2	WBL	WBT	NBL	NBR	NBR2	NWL2	NWL	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0				3.0	3.0	3.0	3.0		3.0	3.0	
Lane Util. Factor	0.95				1.00	0.95	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Frt	0.99				1.00	1.00	1.00	0.85		1.00	0.94	
Flt Protected	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (prot)	3489				1770	3539	1770	1583		1770	1685	
Flt Permitted	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (perm)	3489				1770	3539	1770	1583		1770	1685	
Volume (vph)	958	58	17	36	191	806	59	142	14	1	30	21
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	988	60	18	37	197	831	61	146	14	1	31	22
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	19	0
Lane Group Flow (vph)	1066	0	0	0	234	831	61	160	0	1	34	0
Confl. Peds. (#/hr)		5	5					5	5			5
Turn Type				Prot	Prot			Prot		Split		
Protected Phases	4			3	3	8	1	1		2	2	
Permitted Phases												
Actuated Green, G (s)	26.1				5.5	35.6	8.4	8.4		7.3	7.3	
Effective Green, g (s)	27.1				6.5	36.6	9.4	9.4		8.3	8.3	
Actuated g/C Ratio	0.43				0.10	0.58	0.15	0.15		0.13	0.13	
Clearance Time (s)	4.0				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	3.0	
Lane Grp Cap (vph)	1494				182	2046	263	235		232	221	
v/s Ratio Prot	c0.31				c0.13	0.23	0.03	c0.10		0.00	c0.02	
v/s Ratio Perm												
v/c Ratio	0.71				1.29	0.41	0.23	0.68		0.00	0.15	
Uniform Delay, d1	14.9				28.4	7.4	23.8	25.5		23.9	24.4	
Progression Factor	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.6				163.6	0.1	0.5	7.9		0.0	0.3	
Delay (s)	16.5				192.0	7.5	24.2	33.4		23.9	24.7	
Level of Service	B				F	A	C	C		C	C	
Approach Delay (s)	16.5					48.0	30.9				24.7	
Approach LOS	B					D	C				C	

Intersection Summary			
HCM Average Control Delay	32.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	63.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		

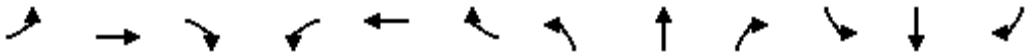
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.98		1.00	0.94		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3516		1770	3450		1770	3341		1681	1657	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3516		1770	3450		1770	3341		1681	1657	
Volume (vph)	108	996	37	122	980	173	64	123	74	231	149	91
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	117	1083	40	133	1065	188	70	134	80	251	162	99
RTOR Reduction (vph)	0	2	0	0	14	0	0	71	0	0	22	0
Lane Group Flow (vph)	117	1121	0	133	1239	0	70	143	0	251	239	0
Confl. Peds. (#/hr)			5			5						5
Turn Type	Prot			Prot			Split			Split		
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases												
Actuated Green, G (s)	7.2	33.8		9.1	35.7		8.9	8.9		16.3	16.3	
Effective Green, g (s)	8.2	34.8		10.1	36.7		9.9	9.9		17.3	17.3	
Actuated g/C Ratio	0.10	0.41		0.12	0.44		0.12	0.12		0.21	0.21	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	173	1455		213	1506		208	393		346	341	
v/s Ratio Prot	c0.07	0.32		0.08	c0.36		0.04	c0.04		c0.15	0.14	
v/s Ratio Perm												
v/c Ratio	0.68	0.77		0.62	0.82		0.34	0.36		0.73	0.70	
Uniform Delay, d1	36.7	21.2		35.2	20.8		34.1	34.2		31.2	31.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	10.0	2.6		5.6	3.8		1.0	0.6		7.4	6.4	
Delay (s)	46.7	23.8		40.8	24.6		35.0	34.8		38.6	37.4	
Level of Service	D	C		D	C		D	C		D	D	
Approach Delay (s)		26.0			26.2			34.8			37.9	
Approach LOS		C			C			C			D	

Intersection Summary			
HCM Average Control Delay	28.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	84.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	71.5%	ICU Level of Service	C
Analysis Period (min)	15		

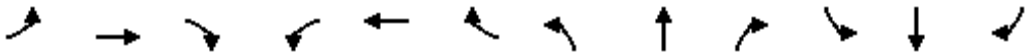
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1836		1770	1809		1770	3399		1770	3522	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1836		1770	1809		1770	3399		1770	3522	
Volume (vph)	44	207	19	329	169	35	22	1016	277	70	1155	30
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	46	218	20	346	178	37	23	1069	292	74	1216	32
RTOR Reduction (vph)	0	3	0	0	6	0	0	21	0	0	2	0
Lane Group Flow (vph)	46	235	0	346	209	0	23	1340	0	74	1246	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	9.6	16.3		20.3	27.0		1.5	41.0		8.4	47.9	
Effective Green, g (s)	10.6	17.3		21.3	28.0		2.5	42.0		9.4	48.9	
Actuated g/C Ratio	0.10	0.17		0.21	0.27		0.02	0.41		0.09	0.48	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	184	311		370	497		43	1400		163	1688	
v/s Ratio Prot	0.03	c0.13		c0.20	0.12		0.01	c0.39		c0.04	c0.35	
v/s Ratio Perm												
v/c Ratio	0.25	0.75		0.94	0.42		0.53	0.96		0.45	0.74	
Uniform Delay, d1	42.0	40.3		39.7	30.3		49.2	29.1		43.9	21.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.7	10.0		30.5	0.6		12.2	14.9		2.0	1.7	
Delay (s)	42.8	50.3		70.1	30.9		61.4	44.1		45.9	23.1	
Level of Service	D	D		E	C		E	D		D	C	
Approach Delay (s)		49.1			55.1			44.4			24.4	
Approach LOS		D			E			D			C	

Intersection Summary			
HCM Average Control Delay	39.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	102.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	85.3%	ICU Level of Service	E
Analysis Period (min)	15		

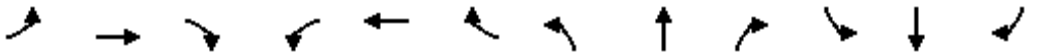
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Util. Factor	0.95	0.95			1.00			0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Frt	1.00	1.00			0.91			1.00		1.00	0.98	
Flt Protected	0.95	0.95			0.99			1.00		0.95	1.00	
Satd. Flow (prot)	1681	1683			1672			3536		1770	3445	
Flt Permitted	0.95	0.95			0.99			1.00		0.95	1.00	
Satd. Flow (perm)	1681	1683			1672			3536		1770	3445	
Volume (vph)	759	1	5	6	3	19	0	1218	7	57	1125	184
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	791	1	5	6	3	20	0	1269	7	59	1172	192
RTOR Reduction (vph)	0	1	0	0	19	0	0	0	0	0	10	0
Lane Group Flow (vph)	418	378	0	0	10	0	0	1276	0	59	1354	0
Confl. Peds. (#/hr)			5						5			5
Turn Type	Split			Split						Prot		
Protected Phases	4	4		8	8			2		1	6	
Permitted Phases												
Actuated Green, G (s)	31.0	31.0			2.8			59.6		3.1	66.7	
Effective Green, g (s)	32.0	32.0			3.8			60.6		4.1	67.7	
Actuated g/C Ratio	0.28	0.28			0.03			0.54		0.04	0.60	
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)	478	479			56			1905		65	2073	
v/s Ratio Prot	c0.25	0.22			c0.01			0.36		c0.03	c0.39	
v/s Ratio Perm												
v/c Ratio	0.87	0.79			0.17			0.67		0.91	0.65	
Uniform Delay, d1	38.3	37.1			52.8			18.7		54.0	14.7	
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2	16.2	8.4			1.5			1.9		78.9	1.6	
Delay (s)	54.5	45.6			54.3			20.6		132.9	16.3	
Level of Service	D	D			D			C		F	B	
Approach Delay (s)		50.3			54.3			20.6			21.2	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	27.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	112.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	75.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

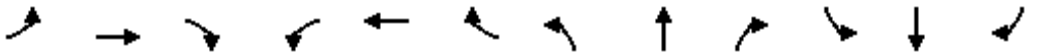


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.91	0.91	1.00		0.95	1.00	1.00	0.95		1.00	0.95	0.88
Frpb, ped/bikes	1.00	1.00	1.00		1.00	0.99	1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1610	3292	1583		3537	1562	1770	3476		1770	3539	2749
Flt Permitted	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1610	3292	1583		3537	1562	1770	3476		1770	3539	2749
Volume (vph)	1348	459	75	7	435	41	108	225	27	49	268	1438
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	1434	488	80	7	463	44	115	239	29	52	285	1530
RTOR Reduction (vph)	0	0	41	0	0	0	0	12	0	0	0	0
Lane Group Flow (vph)	717	1205	39	0	470	44	115	256	0	52	285	1530
Confl. Peds. (#/hr)						5			5			5
Turn Type	Split		Perm	Split		Free	Prot			Prot		Free
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4			Free						Free
Actuated Green, G (s)	35.5	35.5	35.5		9.1	81.1	4.1	17.6		2.9	16.4	81.1
Effective Green, g (s)	36.5	36.5	36.5		10.1	81.1	5.1	18.6		3.9	17.4	81.1
Actuated g/C Ratio	0.45	0.45	0.45		0.12	1.00	0.06	0.23		0.05	0.21	1.00
Clearance Time (s)	4.0	4.0	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		3.0	3.0	
Lane Grp Cap (vph)	725	1482	712		440	1562	111	797		85	759	2749
v/s Ratio Prot	c0.45	0.37			c0.13		c0.06	0.07		0.03	0.08	
v/s Ratio Perm			0.02			0.03						c0.56
v/c Ratio	0.99	0.93dl	0.05		1.07	0.03	1.04	0.32		0.61	0.38	0.56
Uniform Delay, d1	22.1	19.3	12.6		35.5	0.0	38.0	26.0		37.9	27.2	0.0
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	30.3	3.5	0.0		62.3	0.0	95.4	0.2		12.3	0.3	0.8
Delay (s)	52.4	22.9	12.6		97.8	0.0	133.4	26.2		50.2	27.5	0.8
Level of Service	D	C	B		F	A	F	C		D	C	A
Approach Delay (s)		33.0			89.4			58.4			6.3	
Approach LOS		C			F			E			A	

Intersection Summary			
HCM Average Control Delay	30.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	81.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	79.8%	ICU Level of Service	D
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	0.88	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Volume (vph)	220	1229	74	512	1510	397	92	231	417	831	242	154
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	242	1351	81	563	1659	436	101	254	458	913	266	169
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	184	0	0	113
Lane Group Flow (vph)	242	1351	81	563	1659	436	101	254	274	913	266	57
Confl. Peds. (#/hr)												5
Turn Type	Prot		Free	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			6
Actuated Green, G (s)	21.4	48.9	135.2	21.1	48.6	135.2	5.0	21.1	21.1	28.1	44.2	44.2
Effective Green, g (s)	22.4	49.9	135.2	22.1	49.6	135.2	6.0	22.1	22.1	29.1	45.2	45.2
Actuated g/C Ratio	0.17	0.37	1.00	0.16	0.37	1.00	0.04	0.16	0.16	0.22	0.33	0.33
Clearance Time (s)	4.0	4.0		4.0	4.0		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	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	293	1877	1583	561	1866	1583	79	305	456	739	623	520
v/s Ratio Prot	0.14	0.27		c0.16	c0.33		0.06	c0.14		c0.27	0.14	
v/s Ratio Perm			0.05			c0.28			0.10			0.04
v/c Ratio	0.83	0.72	0.05	1.00	0.89	0.28	1.28	0.83	0.60	1.24	0.43	0.11
Uniform Delay, d1	54.5	36.6	0.0	56.5	40.2	0.0	64.6	54.8	52.5	53.0	34.9	31.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	17.0	1.4	0.1	38.9	5.6	0.4	193.2	22.6	5.8	117.5	2.1	0.4
Delay (s)	71.6	38.0	0.1	95.4	45.8	0.4	257.8	77.4	58.2	170.5	37.1	31.5
Level of Service	E	D	A	F	D	A	F	E	E	F	D	C
Approach Delay (s)		41.0			48.9			89.0			126.8	
Approach LOS		D			D			F			F	

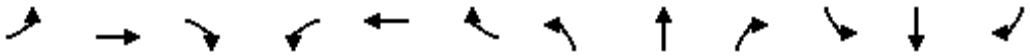
Intersection Summary			
HCM Average Control Delay	68.0	HCM Level of Service	E
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	135.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	93.1%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	276	54	37	447	99	74
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	291	57	39	471	104	78
Pedestrians					5	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			352		872	324
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			352		872	324
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		66	89
cM capacity (veh/h)			1201		309	714

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	347	39	471	182
Volume Left	0	39	0	104
Volume Right	57	0	0	78
cSH	1700	1201	1700	408
Volume to Capacity	0.20	0.03	0.28	0.45
Queue Length 95th (ft)	0	3	0	56
Control Delay (s)	0.0	8.1	0.0	20.7
Lane LOS		A		C
Approach Delay (s)	0.0	0.6		20.7
Approach LOS				C

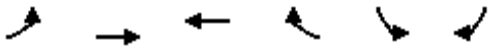
Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	43.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			0.99			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.96			0.96			0.98	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.97	
Satd. Flow (prot)	1770	1832		1770	1776			1757			1775	
Flt Permitted	0.95	1.00		0.95	1.00			0.92			0.84	
Satd. Flow (perm)	1770	1832		1770	1776			1642			1528	
Volume (vph)	38	271	28	79	319	113	21	38	23	115	76	30
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	40	285	29	83	336	119	22	40	24	121	80	32
RTOR Reduction (vph)	0	3	0	0	12	0	0	15	0	0	6	0
Lane Group Flow (vph)	40	311	0	83	443	0	0	71	0	0	227	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Actuated Green, G (s)	2.6	25.1		5.1	27.6			11.9			11.9	
Effective Green, g (s)	3.6	26.1		6.1	28.6			12.9			12.9	
Actuated g/C Ratio	0.07	0.48		0.11	0.53			0.24			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)	118	884		200	939			392			364	
v/s Ratio Prot	0.02	0.17		c0.05	c0.25							
v/s Ratio Perm								0.04			c0.15	
v/c Ratio	0.34	0.35		0.41	0.47			0.18			0.62	
Uniform Delay, d1	24.1	8.7		22.3	8.0			16.4			18.4	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	1.7	0.2		1.4	0.4			0.2			3.3	
Delay (s)	25.8	9.0		23.7	8.4			16.6			21.7	
Level of Service	C	A		C	A			B			C	
Approach Delay (s)		10.9			10.8			16.6			21.7	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	13.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	54.1	Sum of lost time (s)	6.0
Intersection Capacity Utilization	56.1%	ICU Level of Service	B
Analysis Period (min)	15		

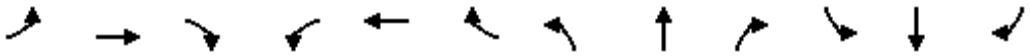
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Stop	Stop		Stop	
Volume (vph)	24	86	333	89	65	30
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	25	91	351	94	68	32

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total (vph)	116	444	100
Volume Left (vph)	25	0	68
Volume Right (vph)	0	94	32
Hadj (s)	0.08	-0.09	-0.02
Departure Headway (s)	4.7	4.2	5.1
Degree Utilization, x	0.15	0.52	0.14
Capacity (veh/h)	732	831	638
Control Delay (s)	8.6	11.7	9.0
Approach Delay (s)	8.6	11.7	9.0
Approach LOS	A	B	A

Intersection Summary			
Delay	10.7		
HCM Level of Service	B		
Intersection Capacity Utilization	37.4%	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)	90	57	7	38	194	63	21	154	23	23	196	336
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	95	60	7	40	204	66	22	162	24	24	206	354

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	162	311	208	584
Volume Left (vph)	95	40	22	24
Volume Right (vph)	7	66	24	354
Hadj (s)	0.12	-0.07	-0.01	-0.32
Departure Headway (s)	7.3	6.7	6.8	5.7
Degree Utilization, x	0.33	0.58	0.39	0.93
Capacity (veh/h)	449	514	490	609
Control Delay (s)	13.9	18.5	14.2	44.8
Approach Delay (s)	13.9	18.5	14.2	44.8
Approach LOS	B	C	B	E

Intersection Summary				
Delay	29.3			
HCM Level of Service	D			
Intersection Capacity Utilization	69.8%	ICU Level of Service	C	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.98		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frt	1.00	0.99		1.00	0.99			1.00	0.85		0.99	
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00		0.96	
Satd. Flow (prot)	1770	1846		1770	1832			1794	1556		1786	
Flt Permitted	0.95	1.00		0.95	1.00			0.75	1.00		0.71	
Satd. Flow (perm)	1770	1846		1770	1832			1404	1556		1307	
Volume (vph)	4	361	19	621	396	40	69	20	290	91	29	5
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	4	372	20	640	408	41	71	21	299	94	30	5
RTOR Reduction (vph)	0	1	0	0	2	0	0	0	247	0	2	0
Lane Group Flow (vph)	4	391	0	640	447	0	0	92	52	0	127	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		
Actuated Green, G (s)	0.6	26.2		35.4	61.0			14.3	14.3		14.3	
Effective Green, g (s)	1.6	27.2		36.4	62.0			15.3	15.3		15.3	
Actuated g/C Ratio	0.02	0.31		0.41	0.71			0.17	0.17		0.17	
Clearance Time (s)	4.0	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		3.0	
Lane Grp Cap (vph)	32	571		733	1292			244	271		227	
v/s Ratio Prot	0.00	c0.21		c0.36	0.24							
v/s Ratio Perm								0.07	0.03		c0.10	
v/c Ratio	0.12	0.68		0.87	0.35			0.38	0.19		0.56	
Uniform Delay, d1	42.5	26.6		23.6	5.0			32.1	31.0		33.2	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	1.8	3.4		11.2	0.2			1.0	0.3		3.2	
Delay (s)	44.2	30.0		34.8	5.2			33.1	31.4		36.4	
Level of Service	D	C		C	A			C	C		D	
Approach Delay (s)		30.1			22.6			31.8			36.4	
Approach LOS		C			C			C			D	

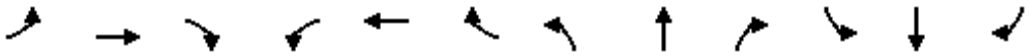
Intersection Summary			
HCM Average Control Delay	26.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	87.9	Sum of lost time (s)	9.0
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	EBR2	WBL2	WBL	WBT	NBL	NBR	NBR2	NWL2	NWL	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0				3.0	3.0	3.0	3.0		3.0	3.0	
Lane Util. Factor	0.95				1.00	0.95	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Frt	0.99				1.00	1.00	1.00	0.85		1.00	0.95	
Flt Protected	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (prot)	3472				1770	3539	1770	1583		1770	1695	
Flt Permitted	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (perm)	3472				1770	3539	1770	1583		1770	1695	
Volume (vph)	954	64	36	16	143	1075	54	126	8	2	35	17
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1004	67	38	17	151	1132	57	133	8	2	37	18
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	17	0
Lane Group Flow (vph)	1109	0	0	0	168	1132	57	141	0	2	38	0
Confl. Peds. (#/hr)		5	5					5	5			5
Turn Type				Prot	Prot			Prot		Split		
Protected Phases	4			3	3	8	1	1		2	2	
Permitted Phases												
Actuated Green, G (s)	36.6				10.3	50.9	10.3	10.3		4.5	4.5	
Effective Green, g (s)	37.6				11.3	51.9	11.3	11.3		5.5	5.5	
Actuated g/C Ratio	0.48				0.15	0.67	0.15	0.15		0.07	0.07	
Clearance Time (s)	4.0				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	3.0	
Lane Grp Cap (vph)	1680				257	2364	257	230		125	120	
v/s Ratio Prot	c0.32				c0.09	0.32	0.03	c0.09		0.00	c0.02	
v/s Ratio Perm												
v/c Ratio	0.66				0.65	0.48	0.22	0.61		0.02	0.32	
Uniform Delay, d1	15.2				31.4	6.3	29.3	31.1		33.6	34.3	
Progression Factor	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.0				5.9	0.2	0.4	4.8		0.1	1.5	
Delay (s)	16.2				37.2	6.5	29.8	35.9		33.6	35.9	
Level of Service	B				D	A	C	D		C	D	
Approach Delay (s)	16.2					10.4	34.2				35.8	
Approach LOS	B					B	C				D	

Intersection Summary			
HCM Average Control Delay	15.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	77.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.7%	ICU Level of Service	B
Analysis Period (min)	15		

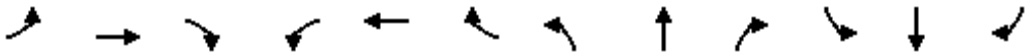
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3492		1770	3435		1770	3284		1681	1641	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3492		1770	3435		1770	3284		1681	1641	
Volume (vph)	72	945	74	167	1228	258	65	134	124	202	104	84
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	76	995	78	176	1293	272	68	141	131	213	109	88
RTOR Reduction (vph)	0	5	0	0	15	0	0	115	0	0	27	0
Lane Group Flow (vph)	76	1068	0	176	1550	0	68	157	0	200	183	0
Confl. Peds. (#/hr)			5			5						5
Turn Type	Prot			Prot			Split			Split		
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases												
Actuated Green, G (s)	5.3	34.1		12.0	40.8		9.2	9.2		14.8	14.8	
Effective Green, g (s)	6.3	35.1		13.0	41.8		10.2	10.2		15.8	15.8	
Actuated g/C Ratio	0.07	0.41		0.15	0.49		0.12	0.12		0.18	0.18	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	130	1424		267	1668		210	389		308	301	
v/s Ratio Prot	0.04	0.31		c0.10	c0.45		0.04	c0.05		c0.12	0.11	
v/s Ratio Perm												
v/c Ratio	0.58	0.75		0.66	0.93		0.32	0.40		0.65	0.61	
Uniform Delay, d1	38.6	21.8		34.5	20.8		34.8	35.1		32.6	32.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.6	2.2		5.8	9.5		0.9	0.7		4.7	3.5	
Delay (s)	45.2	24.0		40.2	30.3		35.7	35.8		37.2	35.8	
Level of Service	D	C		D	C		D	D		D	D	
Approach Delay (s)		25.4			31.3			35.8			36.5	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	30.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	86.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	79.1%	ICU Level of Service	D
Analysis Period (min)	15		

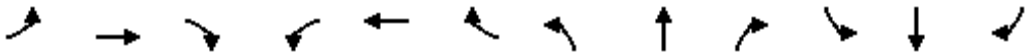
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.93		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1844		1770	1721		1770	3474		1770	3530	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1844		1770	1721		1770	3474		1770	3530	
Volume (vph)	85	108	7	348	160	132	14	1376	153	97	1412	19
Peak-hour factor, PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj. Flow (vph)	102	130	8	419	193	159	17	1658	184	117	1701	23
RTOR Reduction (vph)	0	2	0	0	26	0	0	7	0	0	1	0
Lane Group Flow (vph)	102	136	0	419	326	0	17	1835	0	117	1723	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	11.6	12.8		20.1	21.3		1.5	42.9		10.0	51.4	
Effective Green, g (s)	12.6	13.8		21.1	22.3		2.5	43.9		11.0	52.4	
Actuated g/C Ratio	0.12	0.14		0.21	0.22		0.02	0.43		0.11	0.51	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	219	250		367	377		43	1498		191	1817	
v/s Ratio Prot	0.06	0.07		c0.24	c0.19		0.01	c0.53		c0.07	c0.49	
v/s Ratio Perm												
v/c Ratio	0.47	0.55		1.14	0.87		0.40	1.23		0.61	0.95	
Uniform Delay, d1	41.5	41.1		40.3	38.3		48.9	28.9		43.4	23.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.6	2.4		91.3	18.3		5.9	107.5		5.7	11.1	
Delay (s)	43.0	43.5		131.7	56.6		54.8	136.4		49.1	34.5	
Level of Service	D	D		F	E		D	F		D	C	
Approach Delay (s)		43.3			97.4			135.7			35.5	
Approach LOS		D			F			F			D	

Intersection Summary			
HCM Average Control Delay	85.5	HCM Level of Service	F
HCM Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	101.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.7%	ICU Level of Service	E
Analysis Period (min)	15		

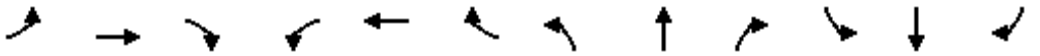
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Util. Factor	0.95	0.95			1.00			0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Frt	1.00	0.99			0.94			1.00		1.00	0.99	
Flt Protected	0.95	0.96			0.99			1.00		0.95	1.00	
Satd. Flow (prot)	1681	1668			1734			3539		1770	3475	
Flt Permitted	0.95	0.96			0.99			1.00		0.95	1.00	
Satd. Flow (perm)	1681	1668			1734			3539		1770	3475	
Volume (vph)	691	0	29	2	6	7	0	1683	1	36	1574	167
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)	768	0	32	2	7	8	0	1870	1	40	1749	186
RTOR Reduction (vph)	0	3	0	0	8	0	0	0	0	0	6	0
Lane Group Flow (vph)	425	372	0	0	9	0	0	1871	0	40	1929	0
Confl. Peds. (#/hr)			5						5			5
Turn Type	Split			Split						Prot		
Protected Phases	4	4		8	8			2		1	6	
Permitted Phases												
Actuated Green, G (s)	30.8	30.8			1.8			61.2		2.3	67.5	
Effective Green, g (s)	31.8	31.8			2.8			62.2		3.3	68.5	
Actuated g/C Ratio	0.28	0.28			0.02			0.55		0.03	0.61	
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)	477	473			43			1964		52	2123	
v/s Ratio Prot	c0.25	0.22			c0.01			c0.53		0.02	c0.56	
v/s Ratio Perm												
v/c Ratio	0.89	0.79			0.21			0.95		0.77	0.91	
Uniform Delay, d1	38.5	37.0			53.6			23.6		54.0	19.1	
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2	18.5	8.4			2.5			11.8		48.9	7.2	
Delay (s)	57.0	45.4			56.1			35.4		103.0	26.2	
Level of Service	E	D			E			D		F	C	
Approach Delay (s)		51.6			56.1			35.4			27.8	
Approach LOS		D			E			D			C	

Intersection Summary			
HCM Average Control Delay	35.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	112.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

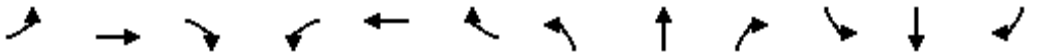


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.91	0.91	1.00		0.95	1.00	1.00	0.95		1.00	0.95	0.88
Frpb, ped/bikes	1.00	1.00	1.00		1.00	0.99	1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1610	3276	1583		3533	1562	1770	3493		1770	3539	2749
Flt Permitted	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1610	3276	1583		3533	1562	1770	3493		1770	3539	2749
Volume (vph)	1907	411	82	15	374	45	66	314	27	41	254	1881
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	2217	478	95	17	435	52	77	365	31	48	295	2187
RTOR Reduction (vph)	0	0	37	0	0	0	0	8	0	0	0	0
Lane Group Flow (vph)	1109	1586	58	0	452	52	77	388	0	48	295	2187
Confl. Peds. (#/hr)						5			5			5
Turn Type	Split		Perm	Split		Free	Prot			Prot		Free
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4			Free						Free
Actuated Green, G (s)	38.5	38.5	38.5		6.1	83.0	4.0	19.0		3.4	18.4	83.0
Effective Green, g (s)	39.5	39.5	39.5		7.1	83.0	5.0	20.0		4.4	19.4	83.0
Actuated g/C Ratio	0.48	0.48	0.48		0.09	1.00	0.06	0.24		0.05	0.23	1.00
Clearance Time (s)	4.0	4.0	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		3.0	3.0	
Lane Grp Cap (vph)	766	1559	753		302	1562	107	842		94	827	2749
v/s Ratio Prot	c0.69	0.48			c0.13		0.04	0.11		0.03	0.08	
v/s Ratio Perm			0.04			0.03						c0.80
v/c Ratio	1.45	1.36dl	0.08		1.50	0.03	0.72	0.46		0.51	0.36	0.80
Uniform Delay, d1	21.8	21.8	11.8		38.0	0.0	38.3	26.9		38.3	26.6	0.0
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	208.8	27.2	0.0		240.2	0.0	20.6	0.4		4.6	0.3	2.5
Delay (s)	230.6	49.0	11.9		278.2	0.0	58.9	27.3		42.9	26.8	2.5
Level of Service	F	D	B		F	A	E	C		D	C	A
Approach Delay (s)		119.9			249.5			32.4			6.1	
Approach LOS		F			F			C			A	

Intersection Summary			
HCM Average Control Delay	78.0	HCM Level of Service	E
HCM Volume to Capacity ratio	1.19		
Actuated Cycle Length (s)	83.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	92.4%	ICU Level of Service	F
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	0.88	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Volume (vph)	481	1762	59	396	1703	1155	27	278	157	912	218	468
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	529	1936	65	435	1871	1269	30	305	173	1002	240	514
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	58	0	0	323
Lane Group Flow (vph)	529	1936	65	435	1871	1269	30	305	115	1002	240	191
Confl. Peds. (#/hr)												5
Turn Type	Prot		Free	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			6
Actuated Green, G (s)	32.0	55.0	140.0	17.0	40.0	140.0	9.0	21.0	21.0	31.0	43.0	43.0
Effective Green, g (s)	33.0	56.0	140.0	18.0	41.0	140.0	10.0	22.0	22.0	32.0	44.0	44.0
Actuated g/C Ratio	0.24	0.40	1.00	0.13	0.29	1.00	0.07	0.16	0.16	0.23	0.31	0.31
Clearance Time (s)	4.0	4.0		4.0	4.0		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	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	417	2034	1583	441	1489	1583	126	293	438	785	586	489
v/s Ratio Prot	c0.30	0.38		0.13	c0.37		0.02	c0.16		c0.29	0.13	
v/s Ratio Perm			0.04			0.80			0.04			0.12
v/c Ratio	1.27	0.95	0.04	0.99	1.26	0.80	0.24	1.04	0.26	1.28	0.41	0.39
Uniform Delay, d1	53.5	40.7	0.0	60.9	49.5	0.0	61.4	59.0	51.9	54.0	37.8	37.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	138.6	10.8	0.0	38.9	121.1	4.4	4.4	63.6	1.5	134.2	2.1	2.3
Delay (s)	192.1	51.4	0.0	99.8	170.6	4.4	65.8	122.6	53.3	188.2	39.9	39.9
Level of Service	F	D	A	F	F	A	E	F	D	F	D	D
Approach Delay (s)		79.5			103.0			95.7			124.5	
Approach LOS		E			F			F			F	

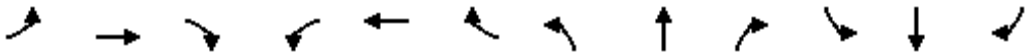
Intersection Summary			
HCM Average Control Delay	100.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.23		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	113.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	490	135	93	320	120	55
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	516	142	98	337	126	58
Pedestrians					5	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			663		1124	592
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			663		1124	592
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			89		37	89
cM capacity (veh/h)			922		202	504

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	658	98	337	184
Volume Left	0	98	0	126
Volume Right	142	0	0	58
cSH	1700	922	1700	249
Volume to Capacity	0.39	0.11	0.20	0.74
Queue Length 95th (ft)	0	9	0	130
Control Delay (s)	0.0	9.4	0.0	51.7
Lane LOS		A		F
Approach Delay (s)	0.0	2.1		51.7
Approach LOS				F

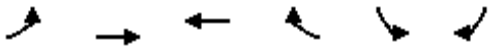
Intersection Summary			
Average Delay	8.2		
Intersection Capacity Utilization	63.7%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			0.99			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.95			0.94			0.99	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.97	
Satd. Flow (prot)	1770	1840		1770	1762			1721			1772	
Flt Permitted	0.95	1.00		0.95	1.00			0.96			0.67	
Satd. Flow (perm)	1770	1840		1770	1762			1658			1230	
Volume (vph)	25	467	35	32	401	176	18	63	64	161	52	24
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	26	492	37	34	422	185	19	66	67	169	55	25
RTOR Reduction (vph)	0	2	0	0	14	0	0	30	0	0	4	0
Lane Group Flow (vph)	26	527	0	34	593	0	0	122	0	0	245	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Actuated Green, G (s)	2.2	32.3		2.3	32.4			14.9			14.9	
Effective Green, g (s)	3.2	33.3		3.3	33.4			15.9			15.9	
Actuated g/C Ratio	0.05	0.54		0.05	0.54			0.26			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)	92	996		95	957			429			318	
v/s Ratio Prot	0.01	0.29		c0.02	c0.34							
v/s Ratio Perm								0.07			c0.20	
v/c Ratio	0.28	0.53		0.36	0.62			0.28			0.77	
Uniform Delay, d1	28.0	9.1		28.1	9.7			18.2			21.1	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	1.7	0.5		2.3	1.2			0.4			10.7	
Delay (s)	29.7	9.6		30.4	10.9			18.6			31.8	
Level of Service	C	A		C	B			B			C	
Approach Delay (s)		10.5			11.9			18.6			31.8	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	15.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	61.5	Sum of lost time (s)	6.0
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		

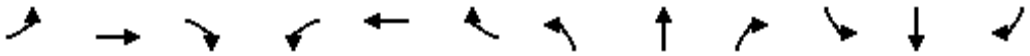
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Stop	Stop		Stop	
Volume (vph)	37	402	118	74	94	24
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	39	423	124	78	99	25

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total (vph)	462	202	124
Volume Left (vph)	39	0	99
Volume Right (vph)	0	78	25
Hadj (s)	0.05	-0.20	0.07
Departure Headway (s)	4.6	4.6	5.5
Degree Utilization, x	0.58	0.26	0.19
Capacity (veh/h)	766	745	583
Control Delay (s)	13.7	9.2	9.8
Approach Delay (s)	13.7	9.2	9.8
Approach LOS	B	A	A

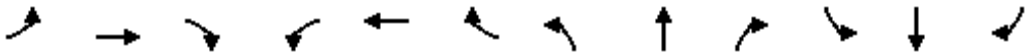
Intersection Summary			
Delay	11.9		
HCM Level of Service	B		
Intersection Capacity Utilization	50.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	385	228	27	39	65	45	5	152	30	50	155	133
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	405	240	28	41	68	47	5	160	32	53	163	140

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	674	157	197	356
Volume Left (vph)	405	41	5	53
Volume Right (vph)	28	47	32	140
Hadj (s)	0.13	-0.09	-0.06	-0.17
Departure Headway (s)	6.3	7.1	7.1	6.6
Degree Utilization, x	1.19	0.31	0.39	0.65
Capacity (veh/h)	561	461	470	530
Control Delay (s)	122.9	13.2	14.6	21.1
Approach Delay (s)	122.9	13.2	14.6	21.1
Approach LOS	F	B	B	C

Intersection Summary				
Delay	68.9			
HCM Level of Service	F			
Intersection Capacity Utilization	81.6%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			1.00	0.98		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frt	1.00	1.00		1.00	0.97			1.00	0.85		1.00	
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.96	
Satd. Flow (prot)	1770	1856		1770	1806			1804	1556		1786	
Flt Permitted	0.95	1.00		0.95	1.00			0.77	1.00		0.55	
Satd. Flow (perm)	1770	1856		1770	1806			1438	1556		1028	
Volume (vph)	5	601	13	371	508	102	100	54	614	96	27	4
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	5	620	13	382	524	105	103	56	633	99	28	4
RTOR Reduction (vph)	0	1	0	0	4	0	0	0	481	0	1	0
Lane Group Flow (vph)	5	632	0	382	625	0	0	159	152	0	130	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		
Actuated Green, G (s)	1.0	38.9		23.6	61.5			16.7	16.7		16.7	
Effective Green, g (s)	2.0	39.9		24.6	62.5			17.7	17.7		17.7	
Actuated g/C Ratio	0.02	0.44		0.27	0.69			0.19	0.19		0.19	
Clearance Time (s)	4.0	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		3.0	
Lane Grp Cap (vph)	39	812		477	1238			279	302		200	
v/s Ratio Prot	0.00	c0.34		c0.22	0.35							
v/s Ratio Perm								0.11	0.10		c0.13	
v/c Ratio	0.13	0.78		0.80	0.50			0.57	0.50		0.65	
Uniform Delay, d1	43.7	21.9		31.0	6.9			33.3	32.8		33.9	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	1.5	4.8		9.3	0.3			2.7	1.3		7.4	
Delay (s)	45.2	26.6		40.4	7.2			36.0	34.1		41.3	
Level of Service	D	C		D	A			D	C		D	
Approach Delay (s)		26.8			19.7			34.5			41.3	
Approach LOS		C			B			C			D	

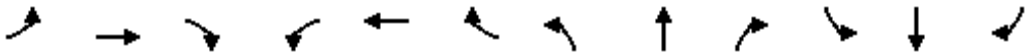
Intersection Summary			
HCM Average Control Delay	27.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	91.2	Sum of lost time (s)	9.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	EBR2	WBL2	WBL	WBT	NBL	NBR	NBR2	NWL2	NWL	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0				3.0	3.0	3.0	3.0		3.0	3.0	
Lane Util. Factor	0.95				1.00	0.95	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Frt	0.99				1.00	1.00	1.00	0.85		1.00	0.94	
Flt Protected	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (prot)	3497				1770	3539	1770	1583		1770	1679	
Flt Permitted	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (perm)	3497				1770	3539	1770	1583		1770	1679	
Volume (vph)	1305	62	18	38	240	1074	63	186	15	1	32	22
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1374	65	19	40	253	1131	66	196	16	1	34	23
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	21	0
Lane Group Flow (vph)	1458	0	0	0	293	1131	66	212	0	1	36	0
Confl. Peds. (#/hr)		5	5					5	5			5
Turn Type				Prot	Prot			Prot		Split		
Protected Phases	4			3	3	8	1	1		2	2	
Permitted Phases												
Actuated Green, G (s)	40.2				13.2	57.4	12.1	12.1		6.1	6.1	
Effective Green, g (s)	41.2				14.2	58.4	13.1	13.1		7.1	7.1	
Actuated g/C Ratio	0.47				0.16	0.67	0.15	0.15		0.08	0.08	
Clearance Time (s)	4.0				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	3.0	
Lane Grp Cap (vph)	1645				287	2359	265	237		143	136	
v/s Ratio Prot	c0.42				c0.17	0.32	0.04	c0.13		0.00	c0.02	
v/s Ratio Perm												
v/c Ratio	0.89				1.02	0.48	0.25	0.89		0.01	0.26	
Uniform Delay, d1	21.1				36.7	7.2	32.9	36.6		37.0	37.8	
Progression Factor	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.2				58.6	0.2	0.5	31.8		0.0	1.0	
Delay (s)	27.2				95.3	7.3	33.4	68.4		37.0	38.8	
Level of Service	C				F	A	C	E		D	D	
Approach Delay (s)	27.2					25.4	60.1				38.8	
Approach LOS	C					C	E				D	

Intersection Summary			
HCM Average Control Delay	29.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	87.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	77.3%	ICU Level of Service	D
Analysis Period (min)	15		

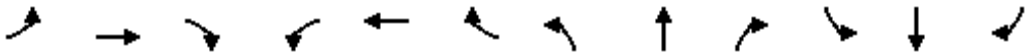
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	0.98		1.00	0.93		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3520		1770	3440		1770	3300		1681	1656	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3520		1770	3440		1770	3300		1681	1656	
Volume (vph)	134	1359	42	166	1284	255	71	138	113	319	164	106
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	141	1431	44	175	1352	268	75	145	119	336	173	112
RTOR Reduction (vph)	0	2	0	0	15	0	0	105	0	0	19	0
Lane Group Flow (vph)	141	1473	0	175	1605	0	75	159	0	305	297	0
Confl. Peds. (#/hr)			5			5						5
Turn Type	Prot			Prot			Split			Split		
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases												
Actuated Green, G (s)	6.0	39.1		8.0	41.1		9.5	9.5		19.2	19.2	
Effective Green, g (s)	7.0	40.1		9.0	42.1		10.5	10.5		20.2	20.2	
Actuated g/C Ratio	0.08	0.44		0.10	0.46		0.11	0.11		0.22	0.22	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	135	1538		174	1578		202	377		370	364	
v/s Ratio Prot	0.08	0.42		c0.10	c0.47		0.04	c0.05		c0.18	0.18	
v/s Ratio Perm												
v/c Ratio	1.04	0.96		1.01	1.02		0.37	0.42		0.82	0.81	
Uniform Delay, d1	42.4	25.0		41.4	24.8		37.6	37.8		34.1	34.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	89.8	14.0		69.7	27.0		1.2	0.8		13.8	13.1	
Delay (s)	132.2	39.0		111.1	51.8		38.8	38.6		47.9	47.1	
Level of Service	F	D		F	D		D	D		D	D	
Approach Delay (s)		47.2			57.6			38.6			47.5	
Approach LOS		D			E			D			D	

Intersection Summary			
HCM Average Control Delay	50.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	91.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	88.4%	ICU Level of Service	E
Analysis Period (min)	15		

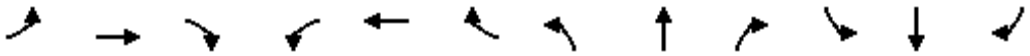
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.95		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1836		1770	1753		1770	3411		1770	3526	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1836		1770	1753		1770	3411		1770	3526	
Volume (vph)	47	220	20	396	179	96	23	1433	349	140	1530	32
Peak-hour factor, PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj. Flow (vph)	57	265	24	477	216	116	28	1727	420	169	1843	39
RTOR Reduction (vph)	0	3	0	0	16	0	0	19	0	0	1	0
Lane Group Flow (vph)	57	286	0	477	316	0	28	2128	0	169	1881	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	10.1	18.7		20.0	28.6		2.3	39.9		13.8	51.4	
Effective Green, g (s)	11.1	19.7		21.0	29.6		3.3	40.9		14.8	52.4	
Actuated g/C Ratio	0.10	0.18		0.19	0.27		0.03	0.38		0.14	0.48	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	181	334		343	479		54	1287		242	1704	
v/s Ratio Prot	0.03	c0.16		c0.27	0.18		0.02	c0.62		c0.10	c0.53	
v/s Ratio Perm												
v/c Ratio	0.31	0.86		1.39	0.66		0.52	1.65		0.70	1.10	
Uniform Delay, d1	45.1	43.0		43.7	34.9		51.8	33.8		44.7	28.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.0	18.8		192.8	3.3		8.2	297.7		8.5	56.1	
Delay (s)	46.1	61.8		236.5	38.2		59.9	331.4		53.2	84.1	
Level of Service	D	E		F	D		E	F		D	F	
Approach Delay (s)		59.2			155.1			327.9			81.5	
Approach LOS		E			F			F			F	

Intersection Summary			
HCM Average Control Delay	190.8	HCM Level of Service	F
HCM Volume to Capacity ratio	1.35		
Actuated Cycle Length (s)	108.4	Sum of lost time (s)	15.0
Intersection Capacity Utilization	107.3%	ICU Level of Service	G
Analysis Period (min)	15		

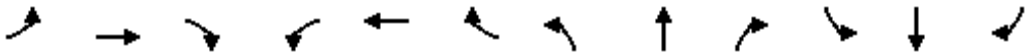
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Util. Factor	0.95	0.95			1.00			0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Frt	1.00	1.00			0.91			1.00		1.00	0.98	
Flt Protected	0.95	0.95			0.99			1.00		0.95	1.00	
Satd. Flow (prot)	1681	1683			1672			3537		1770	3465	
Flt Permitted	0.95	0.95			0.99			1.00		0.95	1.00	
Satd. Flow (perm)	1681	1683			1672			3537		1770	3465	
Volume (vph)	806	1	5	6	3	20	0	1702	7	61	1568	195
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)	896	1	6	7	3	22	0	1891	8	68	1742	217
RTOR Reduction (vph)	0	1	0	0	21	0	0	0	0	0	8	0
Lane Group Flow (vph)	474	428	0	0	11	0	0	1899	0	68	1951	0
Confl. Peds. (#/hr)			5						5			5
Turn Type	Split			Split						Prot		
Protected Phases	4	4		8	8			2		1	6	
Permitted Phases												
Actuated Green, G (s)	33.0	33.0			2.9			62.1		4.0	70.1	
Effective Green, g (s)	34.0	34.0			3.9			63.1		5.0	71.1	
Actuated g/C Ratio	0.29	0.29			0.03			0.53		0.04	0.60	
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)	484	485			55			1891		75	2088	
v/s Ratio Prot	c0.28	0.25			c0.01			c0.54		0.04	c0.56	
v/s Ratio Perm												
v/c Ratio	0.98	0.88			0.20			1.00		0.91	0.93	
Uniform Delay, d1	41.7	40.1			55.5			27.4		56.3	21.3	
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2	35.1	17.1			1.7			21.7		72.1	9.3	
Delay (s)	76.8	57.2			57.3			49.1		128.4	30.7	
Level of Service	E	E			E			D		F	C	
Approach Delay (s)		67.5			57.3			49.1			33.9	
Approach LOS		E			E			D			C	

Intersection Summary			
HCM Average Control Delay	46.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	118.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

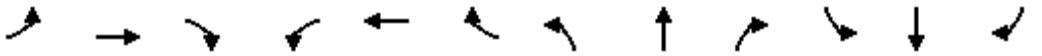


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.91	0.91	1.00		0.95	1.00	1.00	0.95		1.00	0.95	0.88
Frpb, ped/bikes	1.00	1.00	1.00		1.00	0.99	1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1610	3287	1583		3537	1562	1770	3475		1770	3539	2749
Flt Permitted	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1610	3287	1583		3537	1562	1770	3475		1770	3539	2749
Volume (vph)	1809	529	80	7	495	44	115	239	29	52	284	1883
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	2103	615	93	8	576	51	134	278	34	60	330	2190
RTOR Reduction (vph)	0	0	35	0	0	0	0	12	0	0	0	0
Lane Group Flow (vph)	1052	1666	58	0	584	51	134	300	0	60	330	2190
Confl. Peds. (#/hr)						5			5			5
Turn Type	Split		Perm	Split		Free	Prot			Prot		Free
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4			Free						Free
Actuated Green, G (s)	35.4	35.4	35.4		9.1	81.1	4.0	16.6		4.0	16.6	81.1
Effective Green, g (s)	36.4	36.4	36.4		10.1	81.1	5.0	17.6		5.0	17.6	81.1
Actuated g/C Ratio	0.45	0.45	0.45		0.12	1.00	0.06	0.22		0.06	0.22	1.00
Clearance Time (s)	4.0	4.0	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		3.0	3.0	
Lane Grp Cap (vph)	723	1475	710		440	1562	109	754		109	768	2749
v/s Ratio Prot	c0.65	0.51			c0.17		0.08	0.09		0.03	0.09	
v/s Ratio Perm			0.04			0.03						c0.80
v/c Ratio	1.46	1.38dl	0.08		1.33	0.03	1.23	0.40		0.55	0.43	0.80
Uniform Delay, d1	22.3	22.3	12.8		35.5	0.0	38.0	27.2		37.0	27.4	0.0
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	212.4	67.5	0.0		162.3	0.0	160.2	0.3		5.9	0.4	2.5
Delay (s)	234.8	89.8	12.8		197.8	0.0	198.3	27.6		42.9	27.8	2.5
Level of Service	F	F	B		F	A	F	C		D	C	A
Approach Delay (s)		141.5			181.9			78.9			6.7	
Approach LOS		F			F			E			A	

Intersection Summary			
HCM Average Control Delay	87.4	HCM Level of Service	F
HCM Volume to Capacity ratio	1.19		
Actuated Cycle Length (s)	81.1	Sum of lost time (s)	6.0
Intersection Capacity Utilization	94.8%	ICU Level of Service	F
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	0.88	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	3433	5085	1583	1770	1863	2787	3433	1863	1556
Volume (vph)	491	1461	79	540	1687	775	92	350	412	1274	374	439
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	540	1605	87	593	1854	852	101	385	453	1400	411	482
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	121	0	0	204
Lane Group Flow (vph)	540	1605	87	593	1854	852	101	385	332	1400	411	278
Confl. Peds. (#/hr)												5
Turn Type	Prot		Free	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			6
Actuated Green, G (s)	24.0	54.0	140.0	21.0	51.0	140.0	5.0	21.0	21.0	28.0	44.0	44.0
Effective Green, g (s)	25.0	55.0	140.0	22.0	52.0	140.0	6.0	22.0	22.0	29.0	45.0	45.0
Actuated g/C Ratio	0.18	0.39	1.00	0.16	0.37	1.00	0.04	0.16	0.16	0.21	0.32	0.32
Clearance Time (s)	4.0	4.0		4.0	4.0		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	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	316	1998	1583	539	1889	1583	76	293	438	711	599	500
v/s Ratio Prot	c0.31	0.32		0.17	c0.36		0.06	c0.21		c0.41	0.22	
v/s Ratio Perm			0.05			c0.54			0.12			0.18
v/c Ratio	1.71	0.80	0.05	1.10	0.98	0.54	1.33	1.31	0.76	1.97	0.69	0.56
Uniform Delay, d1	57.5	37.7	0.0	59.0	43.5	0.0	67.0	59.0	56.4	55.5	41.4	39.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	332.2	2.4	0.1	69.0	16.4	1.3	214.2	163.5	11.6	441.2	6.3	4.4
Delay (s)	389.7	40.1	0.1	128.0	60.0	1.3	281.2	222.5	68.0	496.7	47.6	43.6
Level of Service	F	D	A	F	E	A	F	F	E	F	D	D
Approach Delay (s)		123.1			57.1			154.3			321.0	
Approach LOS		F			E			F			F	

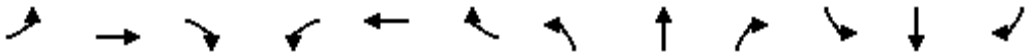
Intersection Summary			
HCM Average Control Delay	153.4	HCM Level of Service	F
HCM Volume to Capacity ratio	1.38		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	127.9%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	276	81	49	447	102	75
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	291	85	52	471	107	79
Pedestrians					5	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			381		912	338
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			381		912	338
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		63	89
cM capacity (veh/h)			1173		290	701

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	376	52	471	186
Volume Left	0	52	0	107
Volume Right	85	0	0	79
cSH	1700	1173	1700	385
Volume to Capacity	0.22	0.04	0.28	0.48
Queue Length 95th (ft)	0	3	0	64
Control Delay (s)	0.0	8.2	0.0	22.8
Lane LOS		A		C
Approach Delay (s)	0.0	0.8		22.8
Approach LOS				C

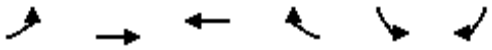
Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	45.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			0.99			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.96			0.96			0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.98	
Satd. Flow (prot)	1770	1833		1770	1784			1757			1744	
Flt Permitted	0.95	1.00		0.95	1.00			0.92			0.86	
Satd. Flow (perm)	1770	1833		1770	1784			1629			1527	
Volume (vph)	42	275	28	79	360	113	21	38	23	115	76	69
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	44	289	29	83	379	119	22	40	24	121	80	73
RTOR Reduction (vph)	0	3	0	0	10	0	0	15	0	0	14	0
Lane Group Flow (vph)	44	315	0	83	488	0	0	71	0	0	260	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Actuated Green, G (s)	2.5	25.3		4.9	27.7			12.6			12.6	
Effective Green, g (s)	3.5	26.3		5.9	28.7			13.6			13.6	
Actuated g/C Ratio	0.06	0.48		0.11	0.52			0.25			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)	113	880		191	934			404			379	
v/s Ratio Prot	0.02	0.17		c0.05	c0.27							
v/s Ratio Perm								0.04			c0.17	
v/c Ratio	0.39	0.36		0.43	0.52			0.18			0.69	
Uniform Delay, d1	24.6	8.9		22.9	8.6			16.2			18.7	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	2.2	0.3		1.6	0.5			0.2			5.1	
Delay (s)	26.8	9.2		24.5	9.1			16.4			23.7	
Level of Service	C	A		C	A			B			C	
Approach Delay (s)		11.3			11.3			16.4			23.7	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	14.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	54.8	Sum of lost time (s)	6.0
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

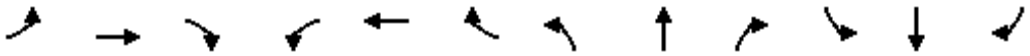
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Stop	Stop		Stop	
Volume (vph)	24	87	346	89	65	30
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	25	92	364	94	68	32

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total (vph)	117	458	100
Volume Left (vph)	25	0	68
Volume Right (vph)	0	94	32
Hadj (s)	0.08	-0.09	-0.02
Departure Headway (s)	4.7	4.2	5.2
Degree Utilization, x	0.15	0.54	0.14
Capacity (veh/h)	729	831	633
Control Delay (s)	8.6	12.0	9.0
Approach Delay (s)	8.6	12.0	9.0
Approach LOS	A	B	A

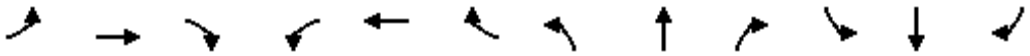
Intersection Summary			
Delay	11.0		
HCM Level of Service	B		
Intersection Capacity Utilization	37.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	91	57	7	38	196	63	21	154	23	23	196	347
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	96	60	7	40	206	66	22	162	24	24	206	365

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	163	313	208	596
Volume Left (vph)	96	40	22	24
Volume Right (vph)	7	66	24	365
Hadj (s)	0.12	-0.07	-0.01	-0.33
Departure Headway (s)	7.5	6.8	6.9	5.8
Degree Utilization, x	0.34	0.59	0.40	0.96
Capacity (veh/h)	447	514	487	609
Control Delay (s)	14.2	19.2	14.5	50.6
Approach Delay (s)	14.2	19.2	14.5	50.6
Approach LOS	B	C	B	F

Intersection Summary			
Delay	32.4		
HCM Level of Service	D		
Intersection Capacity Utilization	70.9%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.98		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frt	1.00	0.99		1.00	0.99			1.00	0.85		0.99	
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00		0.96	
Satd. Flow (prot)	1770	1846		1770	1834			1794	1555		1786	
Flt Permitted	0.95	1.00		0.95	1.00			0.75	1.00		0.68	
Satd. Flow (perm)	1770	1846		1770	1834			1400	1555		1252	
Volume (vph)	4	365	19	632	436	40	69	20	291	91	29	5
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	4	376	20	652	449	41	71	21	300	94	30	5
RTOR Reduction (vph)	0	1	0	0	2	0	0	0	251	0	2	0
Lane Group Flow (vph)	4	395	0	652	488	0	0	92	49	0	127	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		
Actuated Green, G (s)	1.0	27.2		42.0	68.2			14.7	14.7		14.7	
Effective Green, g (s)	2.0	28.2		43.0	69.2			15.7	15.7		15.7	
Actuated g/C Ratio	0.02	0.29		0.45	0.72			0.16	0.16		0.16	
Clearance Time (s)	4.0	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		3.0	
Lane Grp Cap (vph)	37	543		794	1323			229	255		205	
v/s Ratio Prot	0.00	c0.21		c0.37	0.27							
v/s Ratio Perm								0.07	0.03		c0.10	
v/c Ratio	0.11	0.73		0.82	0.37			0.40	0.19		0.62	
Uniform Delay, d1	46.1	30.4		23.1	5.1			35.9	34.6		37.3	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	1.3	4.8		6.8	0.2			1.2	0.4		5.7	
Delay (s)	47.4	35.2		29.9	5.2			37.1	35.0		43.1	
Level of Service	D	D		C	A			D	C		D	
Approach Delay (s)		35.3			19.3			35.5			43.1	
Approach LOS		D			B			D			D	

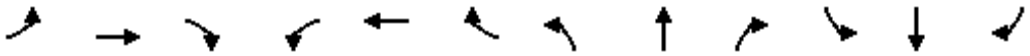
Intersection Summary			
HCM Average Control Delay	27.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	95.9	Sum of lost time (s)	9.0
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	EBR2	WBL2	WBL	WBT	NBL	NBR	NBR2	NWL2	NWL	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0				3.0	3.0	3.0	3.0		3.0	3.0	
Lane Util. Factor	0.95				1.00	0.95	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Frt	0.99				1.00	1.00	1.00	0.85		1.00	0.95	
Flt Protected	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (prot)	3472				1770	3539	1770	1583		1770	1695	
Flt Permitted	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (perm)	3472				1770	3539	1770	1583		1770	1695	
Volume (vph)	959	64	36	16	143	1126	54	126	8	2	35	17
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1009	67	38	17	151	1185	57	133	8	2	37	18
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	17	0
Lane Group Flow (vph)	1114	0	0	0	168	1185	57	141	0	2	38	0
Confl. Peds. (#/hr)		5	5					5	5			5
Turn Type				Prot	Prot			Prot		Split		
Protected Phases	4			3	3	8	1	1		2	2	
Permitted Phases												
Actuated Green, G (s)	36.7				10.3	51.0	10.3	10.3		4.5	4.5	
Effective Green, g (s)	37.7				11.3	52.0	11.3	11.3		5.5	5.5	
Actuated g/C Ratio	0.48				0.15	0.67	0.15	0.15		0.07	0.07	
Clearance Time (s)	4.0				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	3.0	
Lane Grp Cap (vph)	1682				257	2365	257	230		125	120	
v/s Ratio Prot	c0.32				c0.09	0.33	0.03	c0.09		0.00	c0.02	
v/s Ratio Perm												
v/c Ratio	0.66				0.65	0.50	0.22	0.61		0.02	0.32	
Uniform Delay, d1	15.2				31.4	6.4	29.4	31.2		33.6	34.4	
Progression Factor	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.0				5.9	0.2	0.4	4.8		0.1	1.5	
Delay (s)	16.2				37.3	6.6	29.8	36.0		33.7	35.9	
Level of Service	B				D	A	C	D		C	D	
Approach Delay (s)	16.2					10.4	34.2				35.8	
Approach LOS	B					B	C				D	

Intersection Summary			
HCM Average Control Delay	15.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	77.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.8%	ICU Level of Service	B
Analysis Period (min)	15		

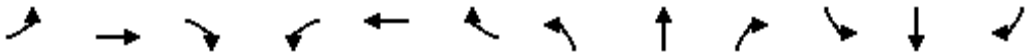
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3492		1770	3439		1770	3284		1681	1638	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3492		1770	3439		1770	3284		1681	1638	
Volume (vph)	72	950	74	167	1277	258	65	134	124	202	104	86
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	76	1000	78	176	1344	272	68	141	131	213	109	91
RTOR Reduction (vph)	0	5	0	0	15	0	0	115	0	0	29	0
Lane Group Flow (vph)	76	1073	0	176	1601	0	68	157	0	202	182	0
Confl. Peds. (#/hr)			5			5						5
Turn Type	Prot			Prot			Split			Split		
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases												
Actuated Green, G (s)	5.3	34.1		12.0	40.8		9.2	9.2		14.9	14.9	
Effective Green, g (s)	6.3	35.1		13.0	41.8		10.2	10.2		15.9	15.9	
Actuated g/C Ratio	0.07	0.41		0.15	0.48		0.12	0.12		0.18	0.18	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	129	1422		267	1668		209	389		310	302	
v/s Ratio Prot	0.04	0.31		c0.10	c0.47		0.04	c0.05		c0.12	0.11	
v/s Ratio Perm												
v/c Ratio	0.59	0.75		0.66	0.96		0.33	0.40		0.65	0.60	
Uniform Delay, d1	38.7	21.9		34.5	21.4		34.8	35.2		32.6	32.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.7	2.3		5.8	13.6		0.9	0.7		4.8	3.4	
Delay (s)	45.4	24.2		40.3	35.0		35.8	35.9		37.4	35.7	
Level of Service	D	C		D	C		D	D		D	D	
Approach Delay (s)		25.6			35.5			35.8			36.5	
Approach LOS		C			D			D			D	

Intersection Summary			
HCM Average Control Delay	32.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	86.2	Sum of lost time (s)	9.0
Intersection Capacity Utilization	80.6%	ICU Level of Service	D
Analysis Period (min)	15		

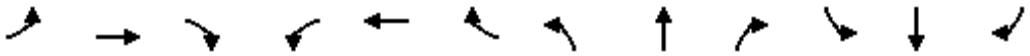
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.93		1.00	0.98		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1844		1770	1719		1770	3471		1770	3530	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1844		1770	1719		1770	3471		1770	3530	
Volume (vph)	85	108	7	353	160	132	14	1381	154	97	1456	19
Peak-hour factor, PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj. Flow (vph)	102	130	8	425	193	159	17	1664	186	117	1754	23
RTOR Reduction (vph)	0	2	0	0	19	0	0	5	0	0	0	0
Lane Group Flow (vph)	102	136	0	425	333	0	17	1845	0	117	1777	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	13.6	15.3		31.1	32.8		1.5	69.5		13.5	81.5	
Effective Green, g (s)	14.6	16.3		32.1	33.8		2.5	70.5		14.5	82.5	
Actuated g/C Ratio	0.10	0.11		0.22	0.23		0.02	0.48		0.10	0.57	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	178	207		391	400		30	1683		177	2003	
v/s Ratio Prot	0.06	0.07		c0.24	c0.19		0.01	c0.53		c0.07	c0.50	
v/s Ratio Perm												
v/c Ratio	0.57	0.66		1.09	0.83		0.57	1.10		0.66	0.89	
Uniform Delay, d1	62.4	61.9		56.6	53.1		70.9	37.5		63.1	27.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.4	7.3		70.9	13.7		22.3	53.2		8.9	5.2	
Delay (s)	66.8	69.2		127.5	66.8		93.2	90.6		72.0	32.6	
Level of Service	E	E		F	E		F	F		E	C	
Approach Delay (s)		68.2			100.0			90.7			35.0	
Approach LOS		E			F			F			C	

Intersection Summary			
HCM Average Control Delay	69.0	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	145.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.2%	ICU Level of Service	E
Analysis Period (min)	15		

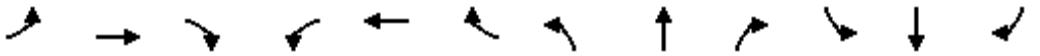
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Util. Factor	0.95	0.95			1.00			0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Frt	1.00	0.99			0.94			1.00		1.00	0.99	
Flt Protected	0.95	0.96			0.99			1.00		0.95	1.00	
Satd. Flow (prot)	1681	1668			1734			3539		1770	3476	
Flt Permitted	0.95	0.96			0.99			1.00		0.95	1.00	
Satd. Flow (perm)	1681	1668			1734			3539		1770	3476	
Volume (vph)	691	0	29	2	6	7	0	1687	1	36	1613	167
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)	768	0	32	2	7	8	0	1874	1	40	1792	186
RTOR Reduction (vph)	0	3	0	0	8	0	0	0	0	0	6	0
Lane Group Flow (vph)	425	372	0	0	9	0	0	1875	0	40	1972	0
Confl. Peds. (#/hr)			5						5			5
Turn Type	Split			Split						Prot		
Protected Phases	4	4		8	8			2		1	6	
Permitted Phases												
Actuated Green, G (s)	30.0	30.0			1.9			66.7		3.2	73.9	
Effective Green, g (s)	31.0	31.0			2.9			67.7		4.2	74.9	
Actuated g/C Ratio	0.26	0.26			0.02			0.57		0.04	0.64	
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)	442	439			43			2034		63	2210	
v/s Ratio Prot	c0.25	0.22			c0.01			0.53		0.02	c0.57	
v/s Ratio Perm												
v/c Ratio	0.96	0.85			0.21			0.92		0.63	0.89	
Uniform Delay, d1	42.8	41.2			56.3			22.7		56.0	18.1	
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2	32.9	14.1			2.5			8.4		19.1	6.0	
Delay (s)	75.7	55.2			58.8			31.1		75.1	24.1	
Level of Service	E	E			E			C		E	C	
Approach Delay (s)		66.1			58.8			31.1			25.1	
Approach LOS		E			E			C			C	

Intersection Summary			
HCM Average Control Delay	34.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	117.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	83.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

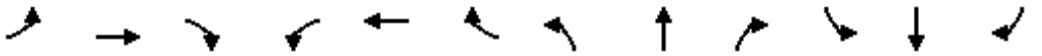


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.91	0.91	1.00		0.95	1.00	1.00	0.95		1.00	0.95	0.88
Frpb, ped/bikes	1.00	1.00	1.00		1.00	0.99	1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1610	3276	1583		3533	1562	1770	3493		1770	3539	2749
Flt Permitted	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1610	3276	1583		3533	1562	1770	3493		1770	3539	2749
Volume (vph)	1911	412	82	15	379	45	66	314	27	41	254	1915
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	2222	479	95	17	441	52	77	365	31	48	295	2227
RTOR Reduction (vph)	0	0	37	0	0	0	0	8	0	0	0	0
Lane Group Flow (vph)	1111	1590	58	0	458	52	77	388	0	48	295	2227
Confl. Peds. (#/hr)						5			5			5
Turn Type	Split		Perm	Split		Free	Prot			Prot		Free
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4			Free						Free
Actuated Green, G (s)	38.5	38.5	38.5		6.1	83.0	4.0	19.0		3.4	18.4	83.0
Effective Green, g (s)	39.5	39.5	39.5		7.1	83.0	5.0	20.0		4.4	19.4	83.0
Actuated g/C Ratio	0.48	0.48	0.48		0.09	1.00	0.06	0.24		0.05	0.23	1.00
Clearance Time (s)	4.0	4.0	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		3.0	3.0	
Lane Grp Cap (vph)	766	1559	753		302	1562	107	842		94	827	2749
v/s Ratio Prot	c0.69	0.49			c0.13		0.04	0.11		0.03	0.08	
v/s Ratio Perm			0.04			0.03						c0.81
v/c Ratio	1.45	1.36dl	0.08		1.52	0.03	0.72	0.46		0.51	0.36	0.81
Uniform Delay, d1	21.8	21.8	11.8		38.0	0.0	38.3	26.9		38.3	26.6	0.0
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	210.0	27.9	0.0		248.8	0.0	20.6	0.4		4.6	0.3	2.7
Delay (s)	231.7	49.7	11.9		286.7	0.0	58.9	27.3		42.9	26.8	2.7
Level of Service	F	D	B		F	A	E	C		D	C	A
Approach Delay (s)		120.7			257.5			32.4			6.2	
Approach LOS		F			F			C			A	

Intersection Summary			
HCM Average Control Delay	78.8	HCM Level of Service	E
HCM Volume to Capacity ratio	1.20		
Actuated Cycle Length (s)	83.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	92.6%	ICU Level of Service	F
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	0.88	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.65	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1034	3433	5085	1583	1770	1863	2787	3433	1863	1556
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1034	3433	5085	1583	1770	1863	2787	3433	1863	1556
Volume (vph)	481	1762	64	425	1703	1155	28	278	160	912	218	468
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	529	1936	70	467	1871	1269	31	305	176	1002	240	514
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	59	0	0	221
Lane Group Flow (vph)	529	1936	70	467	1871	1269	31	305	117	1002	240	293
Confl. Peds. (#/hr)	515		1700	68								5
Turn Type	Prot		Free	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			6
Actuated Green, G (s)	24.0	54.4	140.0	20.6	51.0	140.0	5.0	21.0	21.0	28.0	44.0	44.0
Effective Green, g (s)	25.0	55.4	140.0	21.6	52.0	140.0	6.0	22.0	22.0	29.0	45.0	45.0
Actuated g/C Ratio	0.18	0.40	1.00	0.15	0.37	1.00	0.04	0.16	0.16	0.21	0.32	0.32
Clearance Time (s)	4.0	4.0		4.0	4.0		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	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	316	2012	1034	530	1889	1583	76	293	438	711	599	500
v/s Ratio Prot	c0.30	c0.38		0.14	0.37		0.02	c0.16		c0.29	0.13	
v/s Ratio Perm			0.07			0.80			0.04			0.19
v/c Ratio	1.67	0.96	0.07	0.88	0.99	0.80	0.41	1.04	0.27	1.41	0.40	0.59
Uniform Delay, d1	57.5	41.3	0.0	57.9	43.8	0.0	65.3	59.0	51.9	55.5	37.0	39.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	316.9	12.4	0.1	15.7	18.4	4.4	15.4	63.6	1.5	192.5	2.0	5.0
Delay (s)	374.4	53.6	0.1	73.7	62.2	4.4	80.7	122.6	53.4	248.0	39.0	44.7
Level of Service	F	D	A	E	E	A	F	F	D	F	D	D
Approach Delay (s)		119.1			43.3			96.3			159.9	
Approach LOS		F			D			F			F	

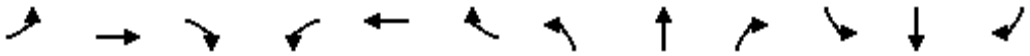
Intersection Summary			
HCM Average Control Delay	93.7	HCM Level of Service	F
HCM Volume to Capacity ratio	1.21		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	113.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	490	138	94	320	147	66
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	516	145	99	337	155	69
Pedestrians					5	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			666		1128	593
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			666		1128	593
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			89		23	86
cM capacity (veh/h)			919		201	503

Direction, Lane #	EB 1	WB 1	WB 2	NB 1
Volume Total	661	99	337	224
Volume Left	0	99	0	155
Volume Right	145	0	0	69
cSH	1700	919	1700	247
Volume to Capacity	0.39	0.11	0.20	0.91
Queue Length 95th (ft)	0	9	0	197
Control Delay (s)	0.0	9.4	0.0	79.0
Lane LOS		A		F
Approach Delay (s)	0.0	2.1		79.0
Approach LOS				F

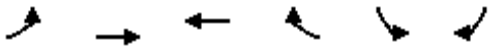
Intersection Summary			
Average Delay	14.1		
Intersection Capacity Utilization	66.3%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			0.99			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.95			0.94			0.98	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.97	
Satd. Flow (prot)	1770	1841		1770	1762			1720			1769	
Flt Permitted	0.95	1.00		0.95	1.00			0.95			0.68	
Satd. Flow (perm)	1770	1841		1770	1762			1645			1238	
Volume (vph)	63	506	35	32	405	176	18	63	64	161	52	28
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	66	533	37	34	426	185	19	66	67	169	55	29
RTOR Reduction (vph)	0	2	0	0	15	0	0	29	0	0	5	0
Lane Group Flow (vph)	66	568	0	34	596	0	0	123	0	0	248	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Actuated Green, G (s)	4.4	34.7		2.4	32.7			18.1			18.1	
Effective Green, g (s)	5.4	35.7		3.4	33.7			19.1			19.1	
Actuated g/C Ratio	0.08	0.53		0.05	0.50			0.28			0.28	
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)	142	978		90	884			468			352	
v/s Ratio Prot	c0.04	0.31		0.02	c0.34							
v/s Ratio Perm								0.07			c0.20	
v/c Ratio	0.46	0.58		0.38	0.67			0.26			0.70	
Uniform Delay, d1	29.5	10.7		30.9	12.6			18.6			21.5	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	2.4	0.9		2.6	2.0			0.3			6.3	
Delay (s)	31.9	11.6		33.5	14.7			18.9			27.8	
Level of Service	C	B		C	B			B			C	
Approach Delay (s)		13.7			15.6			18.9			27.8	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	17.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	67.2	Sum of lost time (s)	9.0
Intersection Capacity Utilization	73.0%	ICU Level of Service	D
Analysis Period (min)	15		

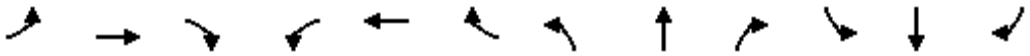
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Stop	Stop		Stop	
Volume (vph)	37	414	119	74	94	24
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	39	436	125	78	99	25

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total (vph)	475	203	124
Volume Left (vph)	39	0	99
Volume Right (vph)	0	78	25
Hadj (s)	0.05	-0.20	0.07
Departure Headway (s)	4.6	4.6	5.5
Degree Utilization, x	0.60	0.26	0.19
Capacity (veh/h)	766	742	579
Control Delay (s)	14.2	9.2	9.8
Approach Delay (s)	14.2	9.2	9.8
Approach LOS	B	A	A

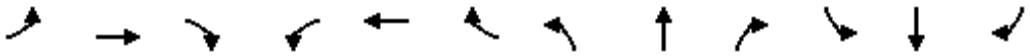
Intersection Summary			
Delay	12.2		
HCM Level of Service	B		
Intersection Capacity Utilization	51.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	396	230	27	39	65	45	5	152	30	50	155	134
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	417	242	28	41	68	47	5	160	32	53	163	141

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	687	157	197	357
Volume Left (vph)	417	41	5	53
Volume Right (vph)	28	47	32	141
Hadj (s)	0.13	-0.09	-0.06	-0.17
Departure Headway (s)	6.3	7.1	7.1	6.6
Degree Utilization, x	1.21	0.31	0.39	0.65
Capacity (veh/h)	561	460	470	530
Control Delay (s)	132.8	13.2	14.7	21.2
Approach Delay (s)	132.8	13.2	14.7	21.2
Approach LOS	F	B	B	C

Intersection Summary			
Delay	74.2		
HCM Level of Service	F		
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00		1.00	0.99			1.00	0.98		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Frt	1.00	1.00		1.00	0.98			1.00	0.85		1.00	
Flt Protected	0.95	1.00		0.95	1.00			0.97	1.00		0.96	
Satd. Flow (prot)	1770	1856		1770	1806			1804	1556		1786	
Flt Permitted	0.95	1.00		0.95	1.00			0.77	1.00		0.55	
Satd. Flow (perm)	1770	1856		1770	1806			1438	1556		1027	
Volume (vph)	5	640	13	372	512	102	100	54	625	96	27	4
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	5	660	13	384	528	105	103	56	644	99	28	4
RTOR Reduction (vph)	0	1	0	0	4	0	0	0	477	0	1	0
Lane Group Flow (vph)	5	672	0	384	629	0	0	159	167	0	130	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Perm		Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		
Actuated Green, G (s)	1.0	38.9		23.7	61.6			16.7	16.7		16.7	
Effective Green, g (s)	2.0	39.9		24.7	62.6			17.7	17.7		17.7	
Actuated g/C Ratio	0.02	0.44		0.27	0.69			0.19	0.19		0.19	
Clearance Time (s)	4.0	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		3.0	
Lane Grp Cap (vph)	39	811		479	1238			279	302		199	
v/s Ratio Prot	0.00	c0.36		c0.22	0.35							
v/s Ratio Perm								0.11	0.11		c0.13	
v/c Ratio	0.13	0.83		0.80	0.51			0.57	0.55		0.65	
Uniform Delay, d1	43.8	22.7		31.0	6.9			33.4	33.2		34.0	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	1.5	7.0		9.3	0.3			2.7	2.2		7.5	
Delay (s)	45.3	29.7		40.4	7.2			36.0	35.4		41.5	
Level of Service	D	C		D	A			D	D		D	
Approach Delay (s)		29.8			19.8			35.5			41.5	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM Average Control Delay	28.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	91.3	Sum of lost time (s)	9.0
Intersection Capacity Utilization	93.5%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	EBR2	WBL2	WBL	WBT	NBL	NBR	NBR2	NWL2	NWL	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0				3.0	3.0	3.0	3.0		3.0	3.0	
Lane Util. Factor	0.95				1.00	0.95	1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Frt	0.99				1.00	1.00	1.00	0.85		1.00	0.94	
Flt Protected	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (prot)	3499				1770	3539	1770	1583		1770	1679	
Flt Permitted	1.00				0.95	1.00	0.95	1.00		0.95	0.97	
Satd. Flow (perm)	3499				1770	3539	1770	1583		1770	1679	
Volume (vph)	1355	62	18	38	240	1079	63	186	15	1	32	22
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1426	65	19	40	253	1136	66	196	16	1	34	23
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	21	0
Lane Group Flow (vph)	1510	0	0	0	293	1136	66	212	0	1	36	0
Confl. Peds. (#/hr)		5	5					5	5			5
Turn Type				Prot	Prot			Prot		Split		
Protected Phases	4			3	3	8	1	1		2	2	
Permitted Phases												
Actuated Green, G (s)	41.7				13.1	58.8	12.1	12.1		6.2	6.2	
Effective Green, g (s)	42.7				14.1	59.8	13.1	13.1		7.2	7.2	
Actuated g/C Ratio	0.48				0.16	0.67	0.15	0.15		0.08	0.08	
Clearance Time (s)	4.0				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	3.0	
Lane Grp Cap (vph)	1677				280	2375	260	233		143	136	
v/s Ratio Prot	c0.43				c0.17	0.32	0.04	c0.13		0.00	c0.02	
v/s Ratio Perm												
v/c Ratio	0.90				1.05	0.48	0.25	0.91		0.01	0.26	
Uniform Delay, d1	21.3				37.5	7.1	33.7	37.4		37.7	38.5	
Progression Factor	1.00				1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	7.0				66.4	0.2	0.5	35.1		0.0	1.0	
Delay (s)	28.3				103.9	7.2	34.2	72.5		37.7	39.5	
Level of Service	C				F	A	C	E		D	D	
Approach Delay (s)	28.3					27.1	63.4				39.5	
Approach LOS	C					C	E				D	

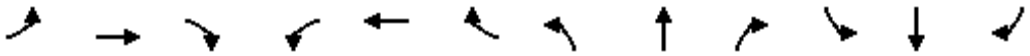
Intersection Summary			
HCM Average Control Delay	30.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	89.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	0.98		1.00	0.93		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3520		1770	3440		1770	3300		1681	1656	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3520		1770	3440		1770	3300		1681	1656	
Volume (vph)	136	1407	42	166	1289	255	71	138	113	319	164	106
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	143	1481	44	175	1357	268	75	145	119	336	173	112
RTOR Reduction (vph)	0	2	0	0	15	0	0	105	0	0	19	0
Lane Group Flow (vph)	143	1523	0	175	1610	0	75	159	0	305	297	0
Confl. Peds. (#/hr)			5			5						5
Turn Type	Prot			Prot			Split			Split		
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases												
Actuated Green, G (s)	6.0	39.1		8.0	41.1		9.5	9.5		19.2	19.2	
Effective Green, g (s)	7.0	40.1		9.0	42.1		10.5	10.5		20.2	20.2	
Actuated g/C Ratio	0.08	0.44		0.10	0.46		0.11	0.11		0.22	0.22	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	135	1538		174	1578		202	377		370	364	
v/s Ratio Prot	0.08	0.43		c0.10	c0.47		0.04	c0.05		c0.18	0.18	
v/s Ratio Perm												
v/c Ratio	1.06	0.99		1.01	1.02		0.37	0.42		0.82	0.81	
Uniform Delay, d1	42.4	25.7		41.4	24.8		37.6	37.8		34.1	34.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	94.2	20.6		69.7	27.9		1.2	0.8		13.8	13.1	
Delay (s)	136.6	46.3		111.1	52.7		38.8	38.6		47.9	47.1	
Level of Service	F	D		F	D		D	D		D	D	
Approach Delay (s)		54.0			58.4			38.6			47.5	
Approach LOS		D			E			D			D	

Intersection Summary			
HCM Average Control Delay	53.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	91.8	Sum of lost time (s)	9.0
Intersection Capacity Utilization	88.7%	ICU Level of Service	E
Analysis Period (min)	15		

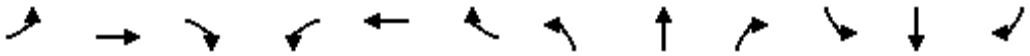
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.95		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1836		1770	1753		1770	3412		1770	3526	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1836		1770	1753		1770	3412		1770	3526	
Volume (vph)	47	220	20	396	179	96	23	1476	354	140	1534	32
Peak-hour factor, PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj. Flow (vph)	57	265	24	477	216	116	28	1778	427	169	1848	39
RTOR Reduction (vph)	0	3	0	0	16	0	0	18	0	0	1	0
Lane Group Flow (vph)	57	286	0	477	316	0	28	2187	0	169	1886	0
Confl. Peds. (#/hr)			5			5			5			5
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	10.1	18.7		20.0	28.6		2.3	39.9		13.8	51.4	
Effective Green, g (s)	11.1	19.7		21.0	29.6		3.3	40.9		14.8	52.4	
Actuated g/C Ratio	0.10	0.18		0.19	0.27		0.03	0.38		0.14	0.48	
Clearance Time (s)	4.0	4.0		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		3.0	3.0	
Lane Grp Cap (vph)	181	334		343	479		54	1287		242	1704	
v/s Ratio Prot	0.03	c0.16		c0.27	0.18		0.02	c0.64		c0.10	c0.53	
v/s Ratio Perm												
v/c Ratio	0.31	0.86		1.39	0.66		0.52	1.70		0.70	1.11	
Uniform Delay, d1	45.1	43.0		43.7	34.9		51.8	33.8		44.7	28.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.0	18.8		192.8	3.3		8.2	318.0		8.5	57.2	
Delay (s)	46.1	61.8		236.5	38.2		59.9	351.8		53.2	85.2	
Level of Service	D	E		F	D		E	F		D	F	
Approach Delay (s)		59.2			155.1			348.1			82.6	
Approach LOS		E			F			F			F	

Intersection Summary			
HCM Average Control Delay	200.8	HCM Level of Service	F
HCM Volume to Capacity ratio	1.37		
Actuated Cycle Length (s)	108.4	Sum of lost time (s)	15.0
Intersection Capacity Utilization	108.7%	ICU Level of Service	G
Analysis Period (min)	15		

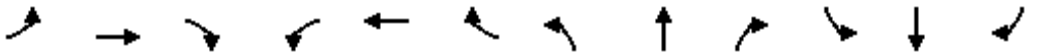
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Util. Factor	0.95	0.95			1.00			0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00			1.00			1.00		1.00	1.00	
Frt	1.00	1.00			0.91			1.00		1.00	0.98	
Flt Protected	0.95	0.95			0.99			1.00		0.95	1.00	
Satd. Flow (prot)	1681	1683			1672			3537		1770	3465	
Flt Permitted	0.95	0.95			0.99			1.00		0.95	1.00	
Satd. Flow (perm)	1681	1683			1672			3537		1770	3465	
Volume (vph)	806	1	5	6	3	20	0	1740	7	61	1572	195
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)	896	1	6	7	3	22	0	1933	8	68	1747	217
RTOR Reduction (vph)	0	1	0	0	21	0	0	0	0	0	8	0
Lane Group Flow (vph)	475	427	0	0	11	0	0	1941	0	68	1956	0
Confl. Peds. (#/hr)			5						5			5
Turn Type	Split			Split						Prot		
Protected Phases	4	4		8	8			2		1	6	
Permitted Phases												
Actuated Green, G (s)	32.0	32.0			2.9			63.1		4.0	71.1	
Effective Green, g (s)	33.0	33.0			3.9			64.1		5.0	72.1	
Actuated g/C Ratio	0.28	0.28			0.03			0.54		0.04	0.61	
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)	470	471			55			1921		75	2117	
v/s Ratio Prot	c0.28	0.25			c0.01			c0.55		0.04	c0.56	
v/s Ratio Perm												
v/c Ratio	1.01	0.91			0.20			1.01		0.91	0.92	
Uniform Delay, d1	42.5	41.0			55.5			27.0		56.3	20.5	
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2	44.2	20.9			1.7			23.1		72.1	8.3	
Delay (s)	86.7	61.9			57.3			50.0		128.4	28.8	
Level of Service	F	E			E			D		F	C	
Approach Delay (s)		75.0			57.3			50.0			32.2	
Approach LOS		E			E			D			C	

Intersection Summary			
HCM Average Control Delay	47.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	118.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

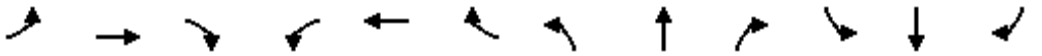


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	0.91	0.91	1.00		0.95	1.00	1.00	0.95		1.00	0.95	0.88
Frpb, ped/bikes	1.00	1.00	1.00		1.00	0.99	1.00	1.00		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1610	3286	1583		3537	1562	1770	3475		1770	3539	2749
Flt Permitted	0.95	0.97	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1610	3286	1583		3537	1562	1770	3475		1770	3539	2749
Volume (vph)	1842	534	80	7	495	44	115	239	29	52	284	1886
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	2142	621	93	8	576	51	134	278	34	60	330	2193
RTOR Reduction (vph)	0	0	34	0	0	0	0	12	0	0	0	0
Lane Group Flow (vph)	1071	1692	59	0	584	51	134	300	0	60	330	2193
Confl. Peds. (#/hr)						5			5			5
Turn Type	Split		Perm	Split		Free	Prot			Prot		Free
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4			Free						Free
Actuated Green, G (s)	35.4	35.4	35.4		9.1	81.1	4.0	16.6		4.0	16.6	81.1
Effective Green, g (s)	36.4	36.4	36.4		10.1	81.1	5.0	17.6		5.0	17.6	81.1
Actuated g/C Ratio	0.45	0.45	0.45		0.12	1.00	0.06	0.22		0.06	0.22	1.00
Clearance Time (s)	4.0	4.0	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		3.0	3.0	
Lane Grp Cap (vph)	723	1475	710		440	1562	109	754		109	768	2749
v/s Ratio Prot	c0.67	0.51			c0.17		0.08	0.09		0.03	0.09	
v/s Ratio Perm			0.04			0.03						c0.80
v/c Ratio	1.48	1.41dl	0.08		1.33	0.03	1.23	0.40		0.55	0.43	0.80
Uniform Delay, d1	22.3	22.3	12.8		35.5	0.0	38.0	27.2		37.0	27.4	0.0
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	224.0	74.6	0.1		162.3	0.0	160.2	0.3		5.9	0.4	2.5
Delay (s)	246.4	97.0	12.8		197.8	0.0	198.3	27.6		42.9	27.8	2.5
Level of Service	F	F	B		F	A	F	C		D	C	A
Approach Delay (s)		150.3			181.9			78.9			6.7	
Approach LOS		F			F			E			A	

Intersection Summary			
HCM Average Control Delay	91.6	HCM Level of Service	F
HCM Volume to Capacity ratio	1.20		
Actuated Cycle Length (s)	81.1	Sum of lost time (s)	6.0
Intersection Capacity Utilization	95.7%	ICU Level of Service	F
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	0.88	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.65	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1034	3433	5085	1583	1770	1863	2787	3433	1863	1556
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5085	1034	3433	5085	1583	1770	1863	2787	3433	1863	1556
Volume (vph)	491	1461	79	543	1687	775	97	350	441	1274	374	439
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	540	1605	87	597	1854	852	107	385	485	1400	411	482
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	130	0	0	204
Lane Group Flow (vph)	540	1605	87	597	1854	852	107	385	355	1400	411	278
Confl. Peds. (#/hr)	515		1700	68								5
Turn Type	Prot		Free	Prot		Free	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			6
Actuated Green, G (s)	24.0	54.0	140.0	21.0	51.0	140.0	5.0	21.0	21.0	28.0	44.0	44.0
Effective Green, g (s)	25.0	55.0	140.0	22.0	52.0	140.0	6.0	22.0	22.0	29.0	45.0	45.0
Actuated g/C Ratio	0.18	0.39	1.00	0.16	0.37	1.00	0.04	0.16	0.16	0.21	0.32	0.32
Clearance Time (s)	4.0	4.0		4.0	4.0		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	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	316	1998	1034	539	1889	1583	76	293	438	711	599	500
v/s Ratio Prot	c0.31	0.32		0.17	c0.36		0.06	c0.21		c0.41	0.22	
v/s Ratio Perm			0.08			c0.54			0.13			0.18
v/c Ratio	1.71	0.80	0.08	1.11	0.98	0.54	1.41	1.31	0.81	1.97	0.69	0.56
Uniform Delay, d1	57.5	37.7	0.0	59.0	43.5	0.0	67.0	59.0	57.0	55.5	41.4	39.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	332.2	2.4	0.2	71.7	16.4	1.3	244.8	163.5	15.0	441.2	6.3	4.4
Delay (s)	389.7	40.1	0.2	130.7	60.0	1.3	311.8	222.5	72.0	496.7	47.6	43.6
Level of Service	F	D	A	F	E	A	F	F	E	F	D	D
Approach Delay (s)		123.1			57.6			157.6			321.0	
Approach LOS		F			E			F			F	

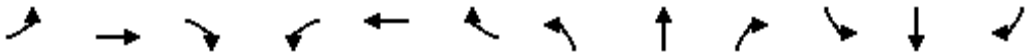
Intersection Summary			
HCM Average Control Delay	153.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.38		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	127.9%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1750	1700	1700	1800	1750	1700
Total Lost time (s)	4.0		4.0	4.0	4.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frpb, ped/bikes	0.99		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	
Frt	0.97		1.00	1.00	0.94	
Flt Protected	1.00		0.95	1.00	0.97	
Satd. Flow (prot)	1653		1583	1765	1572	
Flt Permitted	1.00		0.95	1.00	0.97	
Satd. Flow (perm)	1653		1583	1765	1572	
Volume (vph)	276	81	49	447	102	75
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	291	85	52	471	107	79
RTOR Reduction (vph)	15	0	0	0	47	0
Lane Group Flow (vph)	361	0	52	471	139	0
Confl. Peds. (#/hr)		5				
Turn Type			Prot			
Protected Phases	4		3	8	2	
Permitted Phases						
Actuated Green, G (s)	24.8		2.8	31.6	8.4	
Effective Green, g (s)	24.8		2.8	31.6	8.4	
Actuated g/C Ratio	0.52		0.06	0.66	0.18	
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	854		92	1162	275	
v/s Ratio Prot	0.22		0.03	c0.27	c0.09	
v/s Ratio Perm						
v/c Ratio	0.42		0.57	0.41	0.51	
Uniform Delay, d1	7.2		22.0	3.8	17.9	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.3		7.7	0.2	1.5	
Delay (s)	7.5		29.7	4.1	19.4	
Level of Service	A		C	A	B	
Approach Delay (s)	7.5			6.6	19.4	
Approach LOS	A			A	B	

Intersection Summary			
HCM Average Control Delay	9.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	48.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	45.7%	ICU Level of Service	A
Analysis Period (min)	15		

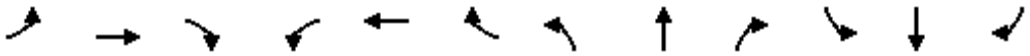
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			0.99			0.99			0.99	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.99			0.96			0.98			0.95	
Flt Protected		0.97			0.99			1.00			0.99	
Satd. Flow (prot)		1795			1745			1809			1728	
Flt Permitted		0.74			0.81			0.99			0.94	
Satd. Flow (perm)		1373			1434			1795			1637	
Volume (vph)	396	230	27	39	65	45	5	152	30	50	155	134
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	417	242	28	41	68	47	5	160	32	53	163	141
RTOR Reduction (vph)	0	2	0	0	15	0	0	9	0	0	30	0
Lane Group Flow (vph)	0	685	0	0	141	0	0	188	0	0	327	0
Confl. Peds. (#/hr)			10			10			10			10
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		38.7			38.7			18.0			18.0	
Effective Green, g (s)		39.7			39.7			19.0			19.0	
Actuated g/C Ratio		0.61			0.61			0.29			0.29	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		842			880			527			481	
v/s Ratio Prot												
v/s Ratio Perm		c0.50			0.10			0.10			c0.20	
v/c Ratio		0.81			0.16			0.36			0.68	
Uniform Delay, d1		9.7			5.4			18.0			20.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		6.1			0.1			0.4			3.8	
Delay (s)		15.7			5.4			18.4			24.0	
Level of Service		B			A			B			C	
Approach Delay (s)		15.7			5.4			18.4			24.0	
Approach LOS		B			A			B			C	

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	64.7	Sum of lost time (s)	6.0
Intersection Capacity Utilization	84.8%	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												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			0.99			1.00			0.98	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.99			0.97			0.98			0.92	
Flt Protected		0.97			0.99			0.99			1.00	
Satd. Flow (prot)		1797			1787			1818			1677	
Flt Permitted		0.68			0.95			0.93			0.99	
Satd. Flow (perm)		1264			1700			1709			1658	
Volume (vph)	91	57	7	38	196	63	21	154	23	23	196	347
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	96	60	7	40	206	66	22	162	24	24	206	365
RTOR Reduction (vph)	0	4	0	0	20	0	0	7	0	0	81	0
Lane Group Flow (vph)	0	159	0	0	292	0	0	201	0	0	514	0
Confl. Peds. (#/hr)			10			10			10			10
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		9.8			9.8			19.5			19.5	
Effective Green, g (s)		10.8			10.8			20.5			20.5	
Actuated g/C Ratio		0.29			0.29			0.55			0.55	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		366			492			939			911	
v/s Ratio Prot												
v/s Ratio Perm		0.13			c0.17			0.12			c0.31	
v/c Ratio		0.44			0.59			0.21			0.56	
Uniform Delay, d1		10.8			11.4			4.3			5.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.8			1.9			0.1			0.8	
Delay (s)		11.6			13.3			4.4			6.3	
Level of Service		B			B			A			A	
Approach Delay (s)		11.6			13.3			4.4			6.3	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	8.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	37.3	Sum of lost time (s)	6.0
Intersection Capacity Utilization	71.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1750	1700	1700	1800	1750	1700
Total Lost time (s)	4.0		4.0	4.0	4.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frpb, ped/bikes	0.99		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	
Frt	0.97		1.00	1.00	0.96	
Flt Protected	1.00		0.95	1.00	0.97	
Satd. Flow (prot)	1654		1583	1765	1589	
Flt Permitted	1.00		0.95	1.00	0.97	
Satd. Flow (perm)	1654		1583	1765	1589	
Volume (vph)	490	138	94	320	147	66
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	516	145	99	337	155	69
RTOR Reduction (vph)	11	0	0	0	18	0
Lane Group Flow (vph)	650	0	99	337	206	0
Confl. Peds. (#/hr)		5	5			
Turn Type			Prot			
Protected Phases	4		3	8	2	
Permitted Phases						
Actuated Green, G (s)	36.7		5.8	46.5	13.3	
Effective Green, g (s)	36.7		5.8	46.5	13.3	
Actuated g/C Ratio	0.54		0.09	0.69	0.20	
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	895		135	1211	312	
v/s Ratio Prot	c0.39		c0.06	0.19	c0.13	
v/s Ratio Perm						
v/c Ratio	0.73		0.73	0.28	0.66	
Uniform Delay, d1	11.8		30.2	4.1	25.2	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	3.0		18.5	0.1	5.0	
Delay (s)	14.7		48.7	4.3	30.1	
Level of Service	B		D	A	C	
Approach Delay (s)	14.7			14.4	30.1	
Approach LOS	B			B	C	

Intersection Summary			
HCM Average Control Delay	17.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	67.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Sheet No 1 of 1

Major Street	Empire Grade
Minor Street	Western Drive
Project	UCSC Marine Science Campus EIR
Scenario	Cumulative Plus Project Conditions
Peak Hour	PM

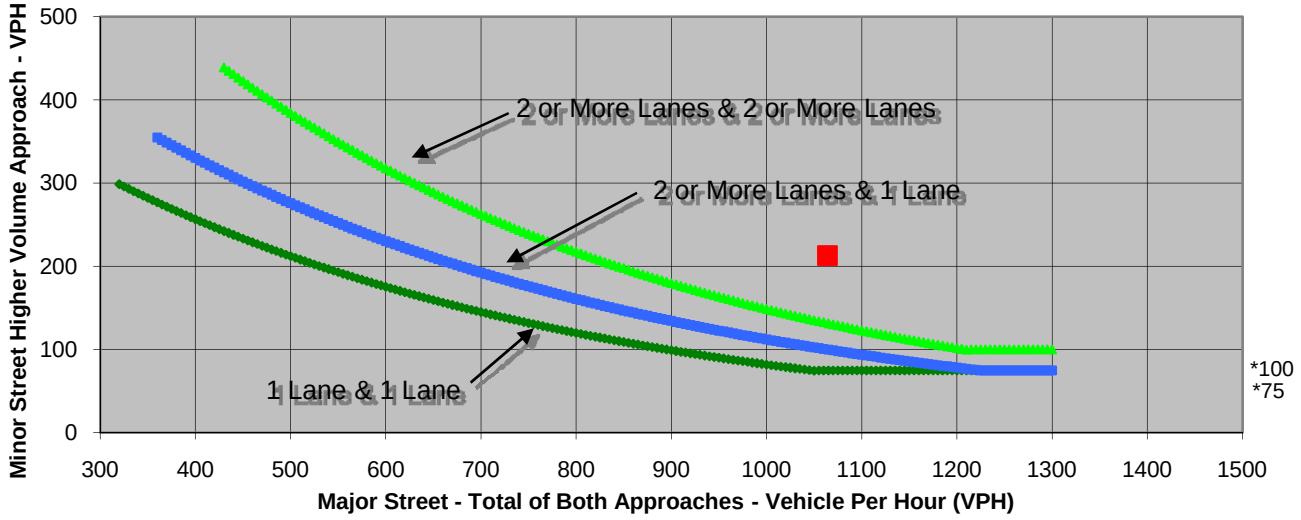
Turn Movement Volumes

	NB	SB	EB	WB
Left	147	0	0	99
Through	0	0	490	337
Right	66	0	138	0
Total	213	0	628	436

Major Street Direction

	North/South
x	East/West

Figure 4C-4
Warrant 3, Peak Hour (70% Factor)
(Rural Areas)



* Note: 100 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 75 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2006

	Major Street	Minor Street	Warrant Met
	Empire Grade	Western Drive	
Number of Approach Lanes	1	1	YES
Traffic Volume (VPH) *	1,064	213	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

FEHR & PEERS
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Sheet No 2 of 2

Major Street	Swift Avenue
Minor Street	Delaware Avenue
Project	UCSC Marine Science Campus EIR
Scenario	Cumulative Plus Project Conditions
Peak Hour	PM

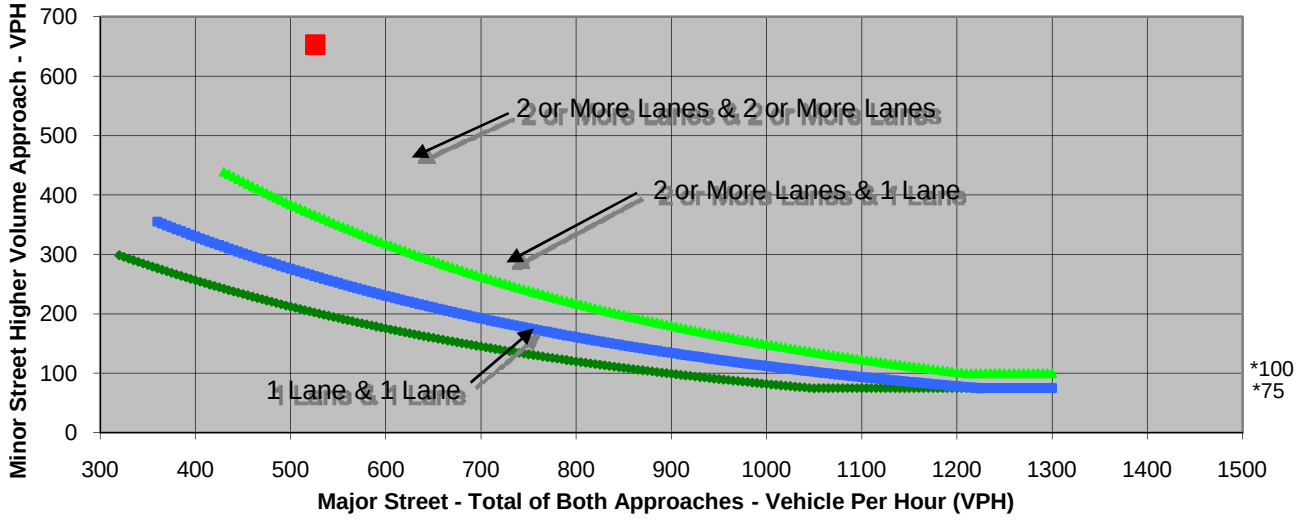
Turn Movement Volumes

	NB	SB	EB	WB
Left	5	50	396	39
Through	152	155	230	65
Right	30	134	27	45
Total	187	339	653	149

Major Street Direction

x	North/South
	East/West

Figure 4C-4
Warrant 3, Peak Hour (70% Factor)
(Rural Areas)



* Note: 100 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 75 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2006

	Major Street	Minor Street	Warrant Met
	Swift Avenue	Delaware Avenue	
Number of Approach Lanes	1	1	YES
Traffic Volume (VPH) *	526	653	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

FEHR & PEERS
TRANSPORTATION CONSULTANTS

Sheet No 1 of 2

Major Street	Swift Avenue
Minor Street	Delaware Avenue
Project	UCSC Marine Science Campus EIR
Scenario	Cumulative Plus Project Conditions
Peak Hour	AM

Turn Movement Volumes

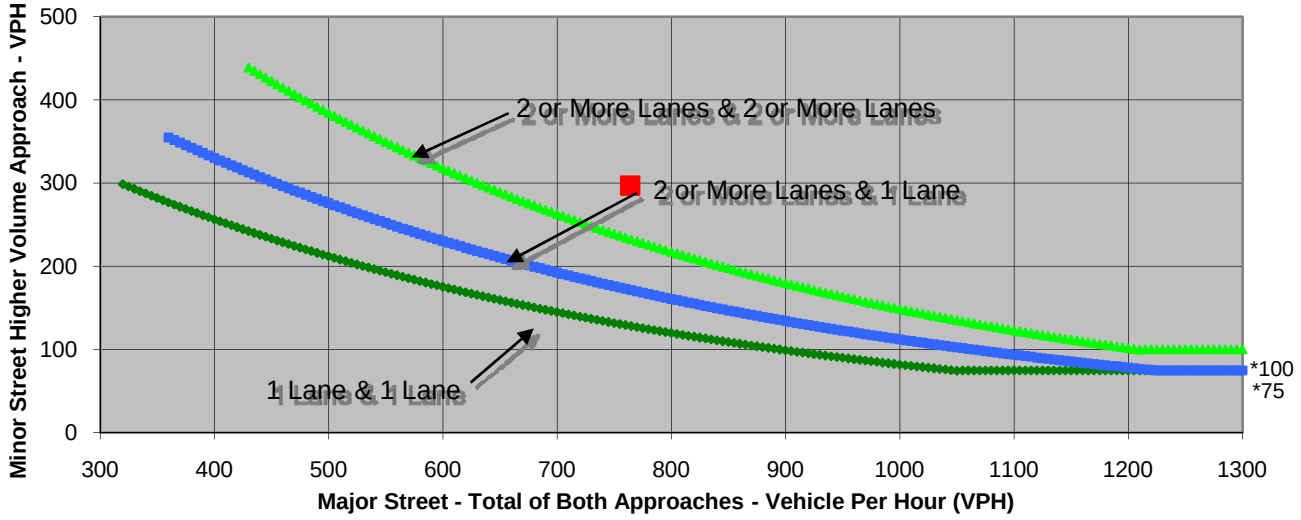
	NB	SB	EB	WB
Left	21	23	91	38
Through	154	196	57	196
Right	23	347	7	63
Total	198	566	155	297

Major Street Direction

x North/South

East/West

Figure 4C-4
Warrant 3, Peak Hour (70% Factor)
(Rural Areas)



* Note: 100 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 75 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2006

	Major Street	Minor Street	Warrant Met
	Swift Avenue	Delaware Avenue	
Number of Approach Lanes	1	1	YES
Traffic Volume (VPH) *	764	297	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

Appendix I

URBEMIS Air Emissions Modeling Results

CONSTRUCTION EMISSIONS

Off-Road Equipment , On-Road Trucks, and Fugitive Emissions

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Urbemis 2007 Version 9.2.4

Combined Summer Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Construction\Coastal Biology Building\Coastal Biology Building Construction
Project Name: Coastal Biology Building - Construction Emissions
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
2012 TOTALS (lbs/day unmitigated)	5.63	51.54	26.77	0.03	293.44	2.39	295.83	61.29	2.20	63.49
2012 TOTALS (lbs/day mitigated)	5.63	51.54	26.77	0.03	43.27	2.39	45.66	9.04	2.20	11.24
2013 TOTALS (lbs/day unmitigated)	47.38	9.40	11.06	0.01	0.04	0.51	0.54	0.01	0.46	0.48
2013 TOTALS (lbs/day mitigated)	47.38	9.40	11.06	0.01	0.04	0.51	0.54	0.01	0.46	0.48
2014 TOTALS (lbs/day unmitigated)	2.31	13.28	11.20	0.01	0.03	1.08	1.09	0.01	0.99	0.99
2014 TOTALS (lbs/day mitigated)	2.31	13.28	11.20	0.01	0.03	1.08	1.09	0.01	0.99	0.99

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-7/20/2012 Active Days: 10	5.63	**51.54**	**26.77**	**0.03**	**293.44**	**2.39**	**295.83**	**61.29**	**2.20**	**63.49**
Demolition 07/09/2012-07/20/2012	2.31	21.74	11.16	0.02	11.62	1.03	12.66	2.43	0.95	3.38
Fugitive Dust	0.00	0.00	0.00	0.00	11.56	0.00	11.56	2.41	0.00	2.41
Demo Off Road Diesel	1.46	11.14	5.77	0.00	0.00	0.64	0.64	0.00	0.59	0.59
Demo On Road Diesel	0.77	10.46	3.72	0.02	0.05	0.38	0.44	0.02	0.35	0.37
Demo Worker Trips	0.07	0.14	1.67	0.00	0.01	0.01	0.01	0.00	0.00	0.01
Fine Grading 07/09/2012-07/20/2012	3.32	29.80	15.60	0.01	281.81	1.36	283.17	58.86	1.25	60.11
Fine Grading Dust	0.00	0.00	0.00	0.00	281.77	0.00	281.77	58.84	0.00	58.84
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.57	7.74	2.75	0.01	0.04	0.28	0.32	0.01	0.26	0.27
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 7/23/2012-10/19/2012 Active Days: 65	2.66	22.56	13.13	0.00	0.01	0.98	0.99	0.00	0.90	0.91
Trenching 07/23/2012-10/19/2012	2.66	22.56	13.13	0.00	0.01	0.98	0.99	0.00	0.90	0.91
Trenching Off Road Diesel	2.57	22.40	11.13	0.00	0.00	0.98	0.98	0.00	0.90	0.90
Trenching Worker Trips	0.08	0.16	2.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01

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Time Slice 10/22/2012-12/31/2012 Active Days: 51	1.41	10.16	10.97	0.01	0.03	0.57	0.60	0.01	0.52	0.53
Building 10/22/2012-01/10/2014	1.41	10.16	10.97	0.01	0.03	0.57	0.60	0.01	0.52	0.53
Building Off Road Diesel	1.03	7.87	4.56	0.00	0.00	0.49	0.49	0.00	0.45	0.45
Building Vendor Trips	0.18	1.90	1.57	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Building Worker Trips	0.20	0.39	4.83	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 1/1/2013-11/15/2013 Active Days: 229	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 11/18/2013-12/13/2013 Active Days: 20	**47.38**	9.40	11.06	0.01	0.04	0.51	0.54	0.01	0.46	0.48
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Coating 11/18/2013-12/13/2013	46.08	0.05	0.66	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Architectural Coating	46.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coating Worker Trips	0.03	0.05	0.66	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Time Slice 12/16/2013-12/31/2013 Active Days: 12	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 1/1/2014-1/10/2014 Active Days: 8	1.20	8.54	9.85	0.01	0.03	0.44	0.47	0.01	0.40	0.41
Building 10/22/2012-01/10/2014	1.20	8.54	9.85	0.01	0.03	0.44	0.47	0.01	0.40	0.41
Building Off Road Diesel	0.88	6.70	4.39	0.00	0.00	0.37	0.37	0.00	0.34	0.34
Building Vendor Trips	0.15	1.51	1.35	0.00	0.01	0.06	0.07	0.00	0.05	0.05
Building Worker Trips	0.17	0.33	4.11	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 3/24/2014-4/18/2014 Active Days: 20	2.31	13.28	11.20	0.00	0.01	1.08	1.09	0.00	0.99	0.99
Asphalt 03/24/2014-04/18/2014	2.31	13.28	11.20	0.00	0.01	1.08	1.09	0.00	0.99	0.99
Paving Off-Gas	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.06	12.89	8.85	0.00	0.00	1.06	1.06	0.00	0.98	0.98
Paving On Road Diesel	0.02	0.21	0.08	0.00	0.00	0.01	0.01	0.00	0.01	0.01
Paving Worker Trips	0.09	0.18	2.28	0.00	0.01	0.01	0.02	0.00	0.01	0.01

Phase Assumptions

Phase: Demolition 7/9/2012 - 7/20/2012 - Type Your Description Here
Building Volume Total (cubic feet): 272525.9
Building Volume Daily (cubic feet): 27532.92
On Road Truck Travel (VMT): 382.4
Off-Road Equipment:
1 Concrete/Industrial Saws (10 hp) operating at a 0.73 load factor for 8 hours per day
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 1 hours per day
2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 6 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Fine Grading 7/9/2012 - 7/20/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 3.1
Maximum Daily Acreage Disturbed: 3.1
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 1365.6 cubic yards/day; Offsite Cut/Fill: 203.7 cubic yards/day
On Road Truck Travel (VMT): 283
Off-Road Equipment:
1 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 6 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Trenching 7/23/2012 - 10/19/2012 - Type Your Description Here
Off-Road Equipment:
1 Bore/Drill Rigs (291 hp) operating at a 0.75 load factor for 8 hours per day
1 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day
1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 0 hours per day

Phase: Paving 3/24/2014 - 4/18/2014 - Default Paving Description
Acres to be Paved: 1.1
Off-Road Equipment:
4 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 6 hours per day
1 Pavers (100 hp) operating at a 0.62 load factor for 7 hours per day
1 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day
1 Rollers (95 hp) operating at a 0.56 load factor for 7 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

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Phase: Building Construction 10/22/2012 - 1/10/2014 - Default Building Construction Description

Off-Road Equipment:

1 Cranes (399 hp) operating at a 0.43 load factor for 4 hours per day

2 Forklifts (145 hp) operating at a 0.3 load factor for 6 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

Phase: Architectural Coating 11/18/2013 - 12/13/2013 - Default Architectural Coating Description

Rule: Residential Interior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 100

Rule: Residential Exterior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250

Rule: Nonresidential Interior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250

Rule: Nonresidential Exterior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250

Construction Mitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Summer Pounds Per Day, Mitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-7/20/2012 Active Days: 10	5.63	**51.54**	**26.77**	**0.03**	43.27	**2.39**	45.66	9.04	**2.20**	11.24
Demolition 07/09/2012-07/20/2012	2.31	21.74	11.16	0.02	11.62	1.03	12.66	2.43	0.95	3.38
Fugitive Dust	0.00	0.00	0.00	0.00	11.56	0.00	11.56	2.41	0.00	2.41
Demo Off Road Diesel	1.46	11.14	5.77	0.00	0.00	0.64	0.64	0.00	0.59	0.59
Demo On Road Diesel	0.77	10.46	3.72	0.02	0.05	0.38	0.44	0.02	0.35	0.37
Demo Worker Trips	0.07	0.14	1.67	0.00	0.01	0.01	0.01	0.00	0.00	0.01
Fine Grading 07/09/2012-07/20/2012	3.32	29.80	15.60	0.01	31.64	1.36	33.00	6.61	1.25	7.86
Fine Grading Dust	0.00	0.00	0.00	0.00	31.60	0.00	31.60	6.60	0.00	6.60
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.57	7.74	2.75	0.01	0.04	0.28	0.32	0.01	0.26	0.27
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 7/23/2012-10/19/2012 Active Days: 65	2.66	22.56	13.13	0.00	0.01	0.98	0.99	0.00	0.90	0.91
Trenching 07/23/2012-10/19/2012	2.66	22.56	13.13	0.00	0.01	0.98	0.99	0.00	0.90	0.91
Trenching Off Road Diesel	2.57	22.40	11.13	0.00	0.00	0.98	0.98	0.00	0.90	0.90
Trenching Worker Trips	0.08	0.16	2.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01
Time Slice 10/22/2012-12/31/2012 Active Days: 51	1.41	10.16	10.97	0.01	0.03	0.57	0.60	0.01	0.52	0.53
Building 10/22/2012-01/10/2014	1.41	10.16	10.97	0.01	0.03	0.57	0.60	0.01	0.52	0.53
Building Off Road Diesel	1.03	7.87	4.56	0.00	0.00	0.49	0.49	0.00	0.45	0.45
Building Vendor Trips	0.18	1.90	1.57	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Building Worker Trips	0.20	0.39	4.83	0.00	0.02	0.01	0.03	0.01	0.01	0.02

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Time Slice 1/1/2013-11/15/2013 Active Days: 229	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 11/18/2013-12/13/2013 Active Days: 20	**47.38**	9.40	11.06	0.01	0.04	0.51	0.54	0.01	0.46	0.48
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Coating 11/18/2013-12/13/2013	46.08	0.05	0.66	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Architectural Coating	46.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coating Worker Trips	0.03	0.05	0.66	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Time Slice 12/16/2013-12/31/2013 Active Days: 12	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 1/1/2014-1/10/2014 Active Days: 8	1.20	8.54	9.85	0.01	0.03	0.44	0.47	0.01	0.40	0.41
Building 10/22/2012-01/10/2014	1.20	8.54	9.85	0.01	0.03	0.44	0.47	0.01	0.40	0.41
Building Off Road Diesel	0.88	6.70	4.39	0.00	0.00	0.37	0.37	0.00	0.34	0.34
Building Vendor Trips	0.15	1.51	1.35	0.00	0.01	0.06	0.07	0.00	0.05	0.05
Building Worker Trips	0.17	0.33	4.11	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 3/24/2014-4/18/2014 Active Days: 20	2.31	13.28	11.20	0.00	0.01	1.08	1.09	0.00	0.99	0.99
Asphalt 03/24/2014-04/18/2014	2.31	13.28	11.20	0.00	0.01	1.08	1.09	0.00	0.99	0.99
Paving Off-Gas	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.06	12.89	8.85	0.00	0.00	1.06	1.06	0.00	0.98	0.98
Paving On Road Diesel	0.02	0.21	0.08	0.00	0.00	0.01	0.01	0.00	0.01	0.01
Paving Worker Trips	0.09	0.18	2.28	0.00	0.01	0.01	0.02	0.00	0.01	0.01

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Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/9/2012 - 7/20/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

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Urbemis 2007 Version 9.2.4

Combined Winter Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Construction\Coastal Biology Building\Coastal Biology Building Construction
Project Name: Coastal Biology Building - Construction Emissions
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
2012 TOTALS (lbs/day unmitigated)	5.63	51.54	26.77	0.03	293.44	2.39	295.83	61.29	2.20	63.49
2012 TOTALS (lbs/day mitigated)	5.63	51.54	26.77	0.03	43.27	2.39	45.66	9.04	2.20	11.24
2013 TOTALS (lbs/day unmitigated)	47.38	9.40	11.06	0.01	0.04	0.51	0.54	0.01	0.46	0.48
2013 TOTALS (lbs/day mitigated)	47.38	9.40	11.06	0.01	0.04	0.51	0.54	0.01	0.46	0.48
2014 TOTALS (lbs/day unmitigated)	2.31	13.28	11.20	0.01	0.03	1.08	1.09	0.01	0.99	0.99
2014 TOTALS (lbs/day mitigated)	2.31	13.28	11.20	0.01	0.03	1.08	1.09	0.01	0.99	0.99

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-7/20/2012 Active Days: 10	5.63	**51.54**	**26.77**	**0.03**	**293.44**	**2.39**	**295.83**	**61.29**	**2.20**	**63.49**
Demolition 07/09/2012-07/20/2012	2.31	21.74	11.16	0.02	11.62	1.03	12.66	2.43	0.95	3.38
Fugitive Dust	0.00	0.00	0.00	0.00	11.56	0.00	11.56	2.41	0.00	2.41
Demo Off Road Diesel	1.46	11.14	5.77	0.00	0.00	0.64	0.64	0.00	0.59	0.59
Demo On Road Diesel	0.77	10.46	3.72	0.02	0.05	0.38	0.44	0.02	0.35	0.37
Demo Worker Trips	0.07	0.14	1.67	0.00	0.01	0.01	0.01	0.00	0.00	0.01
Fine Grading 07/09/2012-07/20/2012	3.32	29.80	15.60	0.01	281.81	1.36	283.17	58.86	1.25	60.11
Fine Grading Dust	0.00	0.00	0.00	0.00	281.77	0.00	281.77	58.84	0.00	58.84
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.57	7.74	2.75	0.01	0.04	0.28	0.32	0.01	0.26	0.27
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01

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Time Slice 7/23/2012-10/19/2012 Active Days: 65	2.66	22.56	13.13	0.00	0.01	0.98	0.99	0.00	0.90	0.91
Trenching 07/23/2012-10/19/2012	2.66	22.56	13.13	0.00	0.01	0.98	0.99	0.00	0.90	0.91
Trenching Off Road Diesel	2.57	22.40	11.13	0.00	0.00	0.98	0.98	0.00	0.90	0.90
Trenching Worker Trips	0.08	0.16	2.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01
Time Slice 10/22/2012-12/31/2012 Active Days: 51	1.41	10.16	10.97	0.01	0.03	0.57	0.60	0.01	0.52	0.53
Building 10/22/2012-01/10/2014	1.41	10.16	10.97	0.01	0.03	0.57	0.60	0.01	0.52	0.53
Building Off Road Diesel	1.03	7.87	4.56	0.00	0.00	0.49	0.49	0.00	0.45	0.45
Building Vendor Trips	0.18	1.90	1.57	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Building Worker Trips	0.20	0.39	4.83	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 1/1/2013-11/15/2013 Active Days: 229	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 11/18/2013-12/13/2013 Active Days: 20	**47.38**	9.40	11.06	0.01	0.04	0.51	0.54	0.01	0.46	0.48
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Coating 11/18/2013-12/13/2013	46.08	0.05	0.66	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Architectural Coating	46.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coating Worker Trips	0.03	0.05	0.66	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Time Slice 12/16/2013-12/31/2013 Active Days: 12	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 1/1/2014-1/10/2014 Active Days: 8	1.20	8.54	9.85	0.01	0.03	0.44	0.47	0.01	0.40	0.41
Building 10/22/2012-01/10/2014	1.20	8.54	9.85	0.01	0.03	0.44	0.47	0.01	0.40	0.41
Building Off Road Diesel	0.88	6.70	4.39	0.00	0.00	0.37	0.37	0.00	0.34	0.34
Building Vendor Trips	0.15	1.51	1.35	0.00	0.01	0.06	0.07	0.00	0.05	0.05
Building Worker Trips	0.17	0.33	4.11	0.00	0.02	0.01	0.03	0.01	0.01	0.02

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Time Slice 3/24/2014-4/18/2014 Active Days: 20	2.31	13.28	11.20	0.00	0.01	1.08	1.09	0.00	0.99	0.99
Asphalt 03/24/2014-04/18/2014	2.31	13.28	11.20	0.00	0.01	1.08	1.09	0.00	0.99	0.99
Paving Off-Gas	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.06	12.89	8.85	0.00	0.00	1.06	1.06	0.00	0.98	0.98
Paving On Road Diesel	0.02	0.21	0.08	0.00	0.00	0.01	0.01	0.00	0.01	0.01
Paving Worker Trips	0.09	0.18	2.28	0.00	0.01	0.01	0.02	0.00	0.01	0.01

Phase Assumptions

Phase: Demolition 7/9/2012 - 7/20/2012 - Type Your Description Here

Building Volume Total (cubic feet): 272525.9

Building Volume Daily (cubic feet): 27532.92

On Road Truck Travel (VMT): 382.4

Off-Road Equipment:

1 Concrete/Industrial Saws (10 hp) operating at a 0.73 load factor for 8 hours per day

1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 1 hours per day

2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 6 hours per day

1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Fine Grading 7/9/2012 - 7/20/2012 - Default Fine Site Grading Description

Total Acres Disturbed: 3.1

Maximum Daily Acreage Disturbed: 3.1

Fugitive Dust Level of Detail: Low

Onsite Cut/Fill: 1365.6 cubic yards/day; Offsite Cut/Fill: 203.7 cubic yards/day

On Road Truck Travel (VMT): 283

Off-Road Equipment:

1 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day

1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 6 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

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Phase: Trenching 7/23/2012 - 10/19/2012 - Type Your Description Here

Off-Road Equipment:

1 Bore/Drill Rigs (291 hp) operating at a 0.75 load factor for 8 hours per day

1 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day

2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 0 hours per day

Phase: Paving 3/24/2014 - 4/18/2014 - Default Paving Description

Acres to be Paved: 1.1

Off-Road Equipment:

4 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 6 hours per day

1 Pavers (100 hp) operating at a 0.62 load factor for 7 hours per day

1 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day

1 Rollers (95 hp) operating at a 0.56 load factor for 7 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

Phase: Building Construction 10/22/2012 - 1/10/2014 - Default Building Construction Description

Off-Road Equipment:

1 Cranes (399 hp) operating at a 0.43 load factor for 4 hours per day

2 Forklifts (145 hp) operating at a 0.3 load factor for 6 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

Phase: Architectural Coating 11/18/2013 - 12/13/2013 - Default Architectural Coating Description

Rule: Residential Interior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 100

Rule: Residential Exterior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250

Rule: Nonresidential Interior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250

Rule: Nonresidential Exterior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250

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Construction Mitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Winter Pounds Per Day, Mitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-7/20/2012 Active Days: 10	5.63	**51.54**	**26.77**	**0.03**	43.27	**2.39**	45.66	9.04	**2.20**	11.24
Demolition 07/09/2012-07/20/2012	2.31	21.74	11.16	0.02	11.62	1.03	12.66	2.43	0.95	3.38
Fugitive Dust	0.00	0.00	0.00	0.00	11.56	0.00	11.56	2.41	0.00	2.41
Demo Off Road Diesel	1.46	11.14	5.77	0.00	0.00	0.64	0.64	0.00	0.59	0.59
Demo On Road Diesel	0.77	10.46	3.72	0.02	0.05	0.38	0.44	0.02	0.35	0.37
Demo Worker Trips	0.07	0.14	1.67	0.00	0.01	0.01	0.01	0.00	0.00	0.01
Fine Grading 07/09/2012-07/20/2012	3.32	29.80	15.60	0.01	31.64	1.36	33.00	6.61	1.25	7.86
Fine Grading Dust	0.00	0.00	0.00	0.00	31.60	0.00	31.60	6.60	0.00	6.60
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.57	7.74	2.75	0.01	0.04	0.28	0.32	0.01	0.26	0.27
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 7/23/2012-10/19/2012 Active Days: 65	2.66	22.56	13.13	0.00	0.01	0.98	0.99	0.00	0.90	0.91
Trenching 07/23/2012-10/19/2012	2.66	22.56	13.13	0.00	0.01	0.98	0.99	0.00	0.90	0.91
Trenching Off Road Diesel	2.57	22.40	11.13	0.00	0.00	0.98	0.98	0.00	0.90	0.90
Trenching Worker Trips	0.08	0.16	2.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01
Time Slice 10/22/2012-12/31/2012 Active Days: 51	1.41	10.16	10.97	0.01	0.03	0.57	0.60	0.01	0.52	0.53
Building 10/22/2012-01/10/2014	1.41	10.16	10.97	0.01	0.03	0.57	0.60	0.01	0.52	0.53
Building Off Road Diesel	1.03	7.87	4.56	0.00	0.00	0.49	0.49	0.00	0.45	0.45
Building Vendor Trips	0.18	1.90	1.57	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Building Worker Trips	0.20	0.39	4.83	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 1/1/2013-11/15/2013 Active Days: 229	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02

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Time Slice 11/18/2013-12/13/2013 Active Days: 20	**47.38**	9.40	11.06	0.01	0.04	0.51	0.54	0.01	0.46	0.48
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Coating 11/18/2013-12/13/2013	46.08	0.05	0.66	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Architectural Coating	46.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coating Worker Trips	0.03	0.05	0.66	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Time Slice 12/16/2013-12/31/2013 Active Days: 12	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building 10/22/2012-01/10/2014	1.30	9.35	10.40	0.01	0.03	0.50	0.54	0.01	0.46	0.47
Building Off Road Diesel	0.95	7.29	4.48	0.00	0.00	0.43	0.43	0.00	0.39	0.39
Building Vendor Trips	0.16	1.70	1.46	0.00	0.01	0.06	0.08	0.00	0.06	0.06
Building Worker Trips	0.18	0.36	4.46	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 1/1/2014-1/10/2014 Active Days: 8	1.20	8.54	9.85	0.01	0.03	0.44	0.47	0.01	0.40	0.41
Building 10/22/2012-01/10/2014	1.20	8.54	9.85	0.01	0.03	0.44	0.47	0.01	0.40	0.41
Building Off Road Diesel	0.88	6.70	4.39	0.00	0.00	0.37	0.37	0.00	0.34	0.34
Building Vendor Trips	0.15	1.51	1.35	0.00	0.01	0.06	0.07	0.00	0.05	0.05
Building Worker Trips	0.17	0.33	4.11	0.00	0.02	0.01	0.03	0.01	0.01	0.02
Time Slice 3/24/2014-4/18/2014 Active Days: 20	2.31	13.28	11.20	0.00	0.01	1.08	1.09	0.00	0.99	0.99
Asphalt 03/24/2014-04/18/2014	2.31	13.28	11.20	0.00	0.01	1.08	1.09	0.00	0.99	0.99
Paving Off-Gas	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.06	12.89	8.85	0.00	0.00	1.06	1.06	0.00	0.98	0.98
Paving On Road Diesel	0.02	0.21	0.08	0.00	0.00	0.01	0.01	0.00	0.01	0.01
Paving Worker Trips	0.09	0.18	2.28	0.00	0.01	0.01	0.02	0.00	0.01	0.01

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Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/9/2012 - 7/20/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

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Urbemis 2007 Version 9.2.4

Combined Summer Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Construction\Infrastruction Improvements\Infrastructure Improvements
Project Name: Infrastructure - Construction Emissions
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
2012 TOTALS (lbs/day unmitigated)	5.22	42.35	25.10	0.00	58.96	2.15	60.54	12.32	1.98	14.18
2012 TOTALS (lbs/day mitigated)	5.22	42.35	25.10	0.00	7.14	2.15	8.72	1.49	1.98	3.35
2013 TOTALS (lbs/day unmitigated)	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07
2013 TOTALS (lbs/day mitigated)	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-7/20/2012 Active Days: 10	3.00	24.85	14.24	**0.00**	**58.96**	1.18	60.14	**12.32**	1.09	13.40
Demolition 07/09/2012-07/20/2012	0.12	0.96	0.74	0.00	0.58	0.04	0.62	0.12	0.03	0.15
Fugitive Dust	0.00	0.00	0.00	0.00	0.57	0.00	0.57	0.12	0.00	0.12
Demo Off Road Diesel	0.06	0.41	0.22	0.00	0.00	0.02	0.02	0.00	0.02	0.02
Demo On Road Diesel	0.04	0.52	0.18	0.00	0.00	0.02	0.02	0.00	0.02	0.02
Demo Worker Trips	0.01	0.03	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading Dust	0.00	0.00	0.00	0.00	58.37	0.00	58.37	12.19	0.00	12.19
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01

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Time Slice 7/23/2012-8/3/2012 Active Days: 10	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading Dust	0.00	0.00	0.00	0.00	58.37	0.00	58.37	12.19	0.00	12.19
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 8/6/2012-11/16/2012 Active Days: 75	**5.22**	**42.35**	**25.10**	0.00	58.39	**2.15**	**60.54**	12.20	**1.98**	**14.18**
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading Dust	0.00	0.00	0.00	0.00	58.37	0.00	58.37	12.19	0.00	12.19
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Trenching 08/06/2012-11/16/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 11/19/2012-12/7/2012 Active Days: 15	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading Dust	0.00	0.00	0.00	0.00	58.37	0.00	58.37	12.19	0.00	12.19
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 12/10/2012-12/31/2012 Active Days: 16	2.55	14.72	11.72	0.00	0.01	1.25	1.27	0.00	1.15	1.16
Asphalt 12/10/2012-02/15/2013	2.55	14.72	11.72	0.00	0.01	1.25	1.27	0.00	1.15	1.16
Paving Off-Gas	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.34	14.35	8.99	0.00	0.00	1.24	1.24	0.00	1.14	1.14
Paving On Road Diesel	0.01	0.16	0.06	0.00	0.00	0.01	0.01	0.00	0.01	0.01
Paving Worker Trips	0.11	0.22	2.67	0.00	0.01	0.01	0.02	0.00	0.01	0.01
Time Slice 1/1/2013-2/15/2013 Active Days: 34	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07
Asphalt 12/10/2012-02/15/2013	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07
Paving Off-Gas	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.19	13.60	8.91	0.00	0.00	1.15	1.15	0.00	1.05	1.05
Paving On Road Diesel	0.01	0.14	0.05	0.00	0.00	0.01	0.01	0.00	0.00	0.00
Paving Worker Trips	0.10	0.20	2.47	0.00	0.01	0.01	0.02	0.00	0.01	0.01

Phase Assumptions

Phase: Demolition 7/9/2012 - 7/20/2012 - Type Your Description Here
Building Volume Total (cubic feet): 13537.92
Building Volume Daily (cubic feet): 1367.63
On Road Truck Travel (VMT): 18.99
Off-Road Equipment:
1 Concrete/Industrial Saws (10 hp) operating at a 0.73 load factor for 8 hours per day

Phase: Fine Grading 7/9/2012 - 12/7/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 3.5
Maximum Daily Acreage Disturbed: 3.5
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 170.91 cubic yards/day; Offsite Cut/Fill: 7.27 cubic yards/day
On Road Truck Travel (VMT): 67.27
Off-Road Equipment:
1 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 6 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Trenching 8/6/2012 - 11/16/2012 - Type Your Description Here
Off-Road Equipment:
2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day
1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

Phase: Paving 12/10/2012 - 2/15/2013 - Default Paving Description
Acres to be Paved: 1.6
Off-Road Equipment:
4 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 6 hours per day
1 Pavers (100 hp) operating at a 0.62 load factor for 7 hours per day
1 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day
1 Rollers (95 hp) operating at a 0.56 load factor for 7 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

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Construction Mitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Summer Pounds Per Day, Mitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-7/20/2012 Active Days: 10	3.00	24.85	14.24	**0.00**	7.14	1.18	8.32	1.49	1.09	2.58
Demolition 07/09/2012-07/20/2012	0.12	0.96	0.74	0.00	0.58	0.04	0.62	0.12	0.03	0.15
Fugitive Dust	0.00	0.00	0.00	0.00	0.57	0.00	0.57	0.12	0.00	0.12
Demo Off Road Diesel	0.06	0.41	0.22	0.00	0.00	0.02	0.02	0.00	0.02	0.02
Demo On Road Diesel	0.04	0.52	0.18	0.00	0.00	0.02	0.02	0.00	0.02	0.02
Demo Worker Trips	0.01	0.03	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading Dust	0.00	0.00	0.00	0.00	6.54	0.00	6.54	1.37	0.00	1.37
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 7/23/2012-8/3/2012 Active Days: 10	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading Dust	0.00	0.00	0.00	0.00	6.54	0.00	6.54	1.37	0.00	1.37
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 8/6/2012-11/16/2012 Active Days: 75	**5.22**	**42.35**	**25.10**	0.00	6.57	**2.15**	8.72	1.37	**1.98**	3.35
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading Dust	0.00	0.00	0.00	0.00	6.54	0.00	6.54	1.37	0.00	1.37
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Trenching 08/06/2012-11/16/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01

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Time Slice 11/19/2012-12/7/2012 Active Days: 15	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading Dust	0.00	0.00	0.00	0.00	6.54	0.00	6.54	1.37	0.00	1.37
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 12/10/2012-12/31/2012 Active Days: 16	2.55	14.72	11.72	0.00	0.01	1.25	1.27	0.00	1.15	1.16
Asphalt 12/10/2012-02/15/2013	2.55	14.72	11.72	0.00	0.01	1.25	1.27	0.00	1.15	1.16
Paving Off-Gas	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.34	14.35	8.99	0.00	0.00	1.24	1.24	0.00	1.14	1.14
Paving On Road Diesel	0.01	0.16	0.06	0.00	0.00	0.01	0.01	0.00	0.01	0.01
Paving Worker Trips	0.11	0.22	2.67	0.00	0.01	0.01	0.02	0.00	0.01	0.01
Time Slice 1/1/2013-2/15/2013 Active Days: 34	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07
Asphalt 12/10/2012-02/15/2013	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07
Paving Off-Gas	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.19	13.60	8.91	0.00	0.00	1.15	1.15	0.00	1.05	1.05
Paving On Road Diesel	0.01	0.14	0.05	0.00	0.00	0.01	0.01	0.00	0.00	0.00
Paving Worker Trips	0.10	0.20	2.47	0.00	0.01	0.01	0.02	0.00	0.01	0.01

Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/9/2012 - 12/7/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

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Urbemis 2007 Version 9.2.4

Combined Winter Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Construction\Infrastruction Improvements\Infrastructure Improvements
Project Name: Infrastructure - Construction Emissions
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
2012 TOTALS (lbs/day unmitigated)	5.22	42.35	25.10	0.00	58.96	2.15	60.54	12.32	1.98	14.18
2012 TOTALS (lbs/day mitigated)	5.22	42.35	25.10	0.00	7.14	2.15	8.72	1.49	1.98	3.35
2013 TOTALS (lbs/day unmitigated)	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07
2013 TOTALS (lbs/day mitigated)	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-7/20/2012 Active Days: 10	3.00	24.85	14.24	**0.00**	**58.96**	1.18	60.14	**12.32**	1.09	13.40
Demolition 07/09/2012-07/20/2012	0.12	0.96	0.74	0.00	0.58	0.04	0.62	0.12	0.03	0.15
Fugitive Dust	0.00	0.00	0.00	0.00	0.57	0.00	0.57	0.12	0.00	0.12
Demo Off Road Diesel	0.06	0.41	0.22	0.00	0.00	0.02	0.02	0.00	0.02	0.02
Demo On Road Diesel	0.04	0.52	0.18	0.00	0.00	0.02	0.02	0.00	0.02	0.02
Demo Worker Trips	0.01	0.03	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading Dust	0.00	0.00	0.00	0.00	58.37	0.00	58.37	12.19	0.00	12.19
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01

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Time Slice 7/23/2012-8/3/2012 Active Days: 10	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading Dust	0.00	0.00	0.00	0.00	58.37	0.00	58.37	12.19	0.00	12.19
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 8/6/2012-11/16/2012 Active Days: 75	**5.22**	**42.35**	**25.10**	0.00	58.39	**2.15**	**60.54**	12.20	**1.98**	**14.18**
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading Dust	0.00	0.00	0.00	0.00	58.37	0.00	58.37	12.19	0.00	12.19
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Trenching 08/06/2012-11/16/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 11/19/2012-12/7/2012 Active Days: 15	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	58.38	1.14	59.52	12.19	1.05	13.25
Fine Grading Dust	0.00	0.00	0.00	0.00	58.37	0.00	58.37	12.19	0.00	12.19
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 12/10/2012-12/31/2012 Active Days: 16	2.55	14.72	11.72	0.00	0.01	1.25	1.27	0.00	1.15	1.16
Asphalt 12/10/2012-02/15/2013	2.55	14.72	11.72	0.00	0.01	1.25	1.27	0.00	1.15	1.16
Paving Off-Gas	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.34	14.35	8.99	0.00	0.00	1.24	1.24	0.00	1.14	1.14
Paving On Road Diesel	0.01	0.16	0.06	0.00	0.00	0.01	0.01	0.00	0.01	0.01
Paving Worker Trips	0.11	0.22	2.67	0.00	0.01	0.01	0.02	0.00	0.01	0.01
Time Slice 1/1/2013-2/15/2013 Active Days: 34	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07
Asphalt 12/10/2012-02/15/2013	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07
Paving Off-Gas	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.19	13.60	8.91	0.00	0.00	1.15	1.15	0.00	1.05	1.05
Paving On Road Diesel	0.01	0.14	0.05	0.00	0.00	0.01	0.01	0.00	0.00	0.00
Paving Worker Trips	0.10	0.20	2.47	0.00	0.01	0.01	0.02	0.00	0.01	0.01

Phase Assumptions

Phase: Demolition 7/9/2012 - 7/20/2012 - Type Your Description Here
Building Volume Total (cubic feet): 13537.92
Building Volume Daily (cubic feet): 1367.63
On Road Truck Travel (VMT): 18.99
Off-Road Equipment:
1 Concrete/Industrial Saws (10 hp) operating at a 0.73 load factor for 8 hours per day

Phase: Fine Grading 7/9/2012 - 12/7/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 3.5
Maximum Daily Acreage Disturbed: 3.5
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 170.91 cubic yards/day; Offsite Cut/Fill: 7.27 cubic yards/day
On Road Truck Travel (VMT): 67.27
Off-Road Equipment:
1 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 6 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Trenching 8/6/2012 - 11/16/2012 - Type Your Description Here
Off-Road Equipment:
2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day
1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

Phase: Paving 12/10/2012 - 2/15/2013 - Default Paving Description
Acres to be Paved: 1.6
Off-Road Equipment:
4 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 6 hours per day
1 Pavers (100 hp) operating at a 0.62 load factor for 7 hours per day
1 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day
1 Rollers (95 hp) operating at a 0.56 load factor for 7 hours per day
1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

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Construction Mitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Winter Pounds Per Day, Mitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-7/20/2012 Active Days: 10	3.00	24.85	14.24	**0.00**	7.14	1.18	8.32	1.49	1.09	2.58
Demolition 07/09/2012-07/20/2012	0.12	0.96	0.74	0.00	0.58	0.04	0.62	0.12	0.03	0.15
Fugitive Dust	0.00	0.00	0.00	0.00	0.57	0.00	0.57	0.12	0.00	0.12
Demo Off Road Diesel	0.06	0.41	0.22	0.00	0.00	0.02	0.02	0.00	0.02	0.02
Demo On Road Diesel	0.04	0.52	0.18	0.00	0.00	0.02	0.02	0.00	0.02	0.02
Demo Worker Trips	0.01	0.03	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading Dust	0.00	0.00	0.00	0.00	6.54	0.00	6.54	1.37	0.00	1.37
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 7/23/2012-8/3/2012 Active Days: 10	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading Dust	0.00	0.00	0.00	0.00	6.54	0.00	6.54	1.37	0.00	1.37
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 8/6/2012-11/16/2012 Active Days: 75	**5.22**	**42.35**	**25.10**	0.00	6.57	**2.15**	8.72	1.37	**1.98**	3.35
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading Dust	0.00	0.00	0.00	0.00	6.54	0.00	6.54	1.37	0.00	1.37
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Trenching 08/06/2012-11/16/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01

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Time Slice 11/19/2012-12/7/2012 Active Days: 15	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading 07/09/2012-12/07/2012	2.88	23.89	13.50	0.00	6.56	1.14	7.70	1.37	1.05	2.42
Fine Grading Dust	0.00	0.00	0.00	0.00	6.54	0.00	6.54	1.37	0.00	1.37
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.14	1.84	0.65	0.00	0.01	0.07	0.08	0.00	0.06	0.07
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 12/10/2012-12/31/2012 Active Days: 16	2.55	14.72	11.72	0.00	0.01	1.25	1.27	0.00	1.15	1.16
Asphalt 12/10/2012-02/15/2013	2.55	14.72	11.72	0.00	0.01	1.25	1.27	0.00	1.15	1.16
Paving Off-Gas	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.34	14.35	8.99	0.00	0.00	1.24	1.24	0.00	1.14	1.14
Paving On Road Diesel	0.01	0.16	0.06	0.00	0.00	0.01	0.01	0.00	0.01	0.01
Paving Worker Trips	0.11	0.22	2.67	0.00	0.01	0.01	0.02	0.00	0.01	0.01
Time Slice 1/1/2013-2/15/2013 Active Days: 34	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07
Asphalt 12/10/2012-02/15/2013	2.39	13.94	11.43	0.00	0.01	1.16	1.17	0.00	1.07	1.07
Paving Off-Gas	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.19	13.60	8.91	0.00	0.00	1.15	1.15	0.00	1.05	1.05
Paving On Road Diesel	0.01	0.14	0.05	0.00	0.00	0.01	0.01	0.00	0.00	0.00
Paving Worker Trips	0.10	0.20	2.47	0.00	0.01	0.01	0.02	0.00	0.01	0.01

Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/9/2012 - 12/7/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

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Urbemis 2007 Version 9.2.4

Combined Summer Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Construction\Specific Resource Plan\SRP Construction Emissions.urb924
Project Name: Specific Resource Plan Wetland Restoration
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
2012 TOTALS (lbs/day unmitigated)	2.12	18.64	9.35	0.00	64.06	0.73	64.79	13.38	0.67	14.05
2012 TOTALS (lbs/day mitigated)	2.12	18.64	9.35	0.00	7.19	0.73	7.92	1.50	0.67	2.18

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-10/15/2012 Active Days: 71	**2.12**	**18.64**	**9.35**	**0.00**	**64.06**	**0.73**	**64.79**	**13.38**	**0.67**	**14.05**
Fine Grading 07/09/2012-10/15/2012	2.12	18.64	9.35	0.00	64.06	0.73	64.79	13.38	0.67	14.05
Fine Grading Dust	0.00	0.00	0.00	0.00	64.05	0.00	64.05	13.38	0.00	13.38
Fine Grading Off Road Diesel	2.04	17.93	8.45	0.00	0.00	0.71	0.71	0.00	0.65	0.65
Fine Grading On Road Diesel	0.05	0.66	0.23	0.00	0.00	0.02	0.03	0.00	0.02	0.02
Fine Grading Worker Trips	0.03	0.05	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Phase Assumptions

Phase: Fine Grading 7/9/2012 - 10/15/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 5.5
Maximum Daily Acreage Disturbed: 5.5
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 66.2 cubic yards/day; Offsite Cut/Fill: 2.82 cubic yards/day
On Road Truck Travel (VMT): 23.94
Off-Road Equipment:
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 8 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

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Construction Mitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Summer Pounds Per Day, Mitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-10/15/2012 Active Days: 71	**2.12**	**18.64**	**9.35**	**0.00**	7.19	**0.73**	7.92	1.50	**0.67**	2.18
Fine Grading 07/09/2012-10/15/2012	2.12	18.64	9.35	0.00	7.19	0.73	7.92	1.50	0.67	2.18
Fine Grading Dust	0.00	0.00	0.00	0.00	7.18	0.00	7.18	1.50	0.00	1.50
Fine Grading Off Road Diesel	2.04	17.93	8.45	0.00	0.00	0.71	0.71	0.00	0.65	0.65
Fine Grading On Road Diesel	0.05	0.66	0.23	0.00	0.00	0.02	0.03	0.00	0.02	0.02
Fine Grading Worker Trips	0.03	0.05	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/9/2012 - 10/15/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

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Urbemis 2007 Version 9.2.4

Combined Winter Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Construction\Specific Resource Plan\SRP Construction Emissions.urb924
Project Name: Specific Resource Plan Wetland Restoration
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
2012 TOTALS (lbs/day unmitigated)	2.12	18.64	9.35	0.00	64.06	0.73	64.79	13.38	0.67	14.05
2012 TOTALS (lbs/day mitigated)	2.12	18.64	9.35	0.00	7.19	0.73	7.92	1.50	0.67	2.18

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-10/15/2012 Active Days: 71	**2.12**	**18.64**	**9.35**	**0.00**	**64.06**	**0.73**	**64.79**	**13.38**	**0.67**	**14.05**
Fine Grading 07/09/2012-10/15/2012	2.12	18.64	9.35	0.00	64.06	0.73	64.79	13.38	0.67	14.05
Fine Grading Dust	0.00	0.00	0.00	0.00	64.05	0.00	64.05	13.38	0.00	13.38
Fine Grading Off Road Diesel	2.04	17.93	8.45	0.00	0.00	0.71	0.71	0.00	0.65	0.65
Fine Grading On Road Diesel	0.05	0.66	0.23	0.00	0.00	0.02	0.03	0.00	0.02	0.02
Fine Grading Worker Trips	0.03	0.05	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Phase Assumptions

Phase: Fine Grading 7/9/2012 - 10/15/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 5.5
Maximum Daily Acreage Disturbed: 5.5
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 66.2 cubic yards/day; Offsite Cut/Fill: 2.82 cubic yards/day
On Road Truck Travel (VMT): 23.94
Off-Road Equipment:
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 8 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

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Construction Mitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Winter Pounds Per Day, Mitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/9/2012-10/15/2012 Active Days: 71	**2.12**	**18.64**	**9.35**	**0.00**	7.19	**0.73**	7.92	1.50	**0.67**	2.18
Fine Grading 07/09/2012-10/15/2012	2.12	18.64	9.35	0.00	7.19	0.73	7.92	1.50	0.67	2.18
Fine Grading Dust	0.00	0.00	0.00	0.00	7.18	0.00	7.18	1.50	0.00	1.50
Fine Grading Off Road Diesel	2.04	17.93	8.45	0.00	0.00	0.71	0.71	0.00	0.65	0.65
Fine Grading On Road Diesel	0.05	0.66	0.23	0.00	0.00	0.02	0.03	0.00	0.02	0.02
Fine Grading Worker Trips	0.03	0.05	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/9/2012 - 10/15/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

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Urbemis 2007 Version 9.2.4

Combined Summer Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Phase 4\Phase 4 Infrastructure Emissions.urb924
Project Name: UCSC Marine Science Campus - Phase 4 Infrastructure Construction
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
2012 TOTALS (lbs/day unmitigated)	2.87	23.80	13.47	0.00	46.03	1.14	47.17	9.62	1.05	10.66
2012 TOTALS (lbs/day mitigated)	2.87	23.80	13.47	0.00	5.17	1.14	6.31	1.08	1.05	2.13
2013 TOTALS (lbs/day unmitigated)	2.88	14.66	11.69	0.00	0.02	1.18	1.20	0.01	1.09	1.10
2013 TOTALS (lbs/day mitigated)	2.88	14.66	11.69	0.00	0.02	1.18	1.20	0.01	1.09	1.10

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/20/2012-8/20/2012 Active Days: 22	2.87	**23.80**	**13.47**	**0.00**	**46.03**	1.14	**47.17**	**9.62**	1.05	**10.66**
Fine Grading 07/20/2012-08/20/2012	2.87	23.80	13.47	0.00	46.03	1.14	47.17	9.62	1.05	10.66
Fine Grading Dust	0.00	0.00	0.00	0.00	46.02	0.00	46.02	9.61	0.00	9.61
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.13	1.74	0.62	0.00	0.01	0.06	0.07	0.00	0.06	0.06
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 10/15/2012-11/6/2012 Active Days: 17	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching 10/15/2012-11/06/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 12/17/2012-12/21/2012 Active Days: 5	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching 12/16/2012-12/23/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01

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Time Slice 2/15/2013-2/22/2013 Active Days: 6	**2.88**	14.66	11.69	0.00	0.02	**1.18**	1.20	0.01	**1.09**	1.10
Asphalt 02/15/2013-02/22/2013	2.88	14.66	11.69	0.00	0.02	1.18	1.20	0.01	1.09	1.10
Paving Off-Gas	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.19	13.60	8.91	0.00	0.00	1.15	1.15	0.00	1.05	1.05
Paving On Road Diesel	0.07	0.86	0.31	0.00	0.01	0.03	0.04	0.00	0.03	0.03
Paving Worker Trips	0.10	0.20	2.47	0.00	0.01	0.01	0.02	0.00	0.01	0.01

Phase Assumptions

Phase: Fine Grading 7/20/2012 - 8/20/2012 - Default Fine Site Grading Description

Total Acres Disturbed: 1.2

Maximum Daily Acreage Disturbed: 0.3

Fugitive Dust Level of Detail: Low

Onsite Cut/Fill: 127.27 cubic yards/day; Offsite Cut/Fill: 63.64 cubic yards/day

On Road Truck Travel (VMT): 63.64

Off-Road Equipment:

1 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day

1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 6 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Trenching 10/15/2012 - 11/6/2012 - Type Your Description Here

Off-Road Equipment:

2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

Phase: Trenching 12/16/2012 - 12/23/2012 - Type Your Description Here

Off-Road Equipment:

2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

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Phase: Paving 2/15/2013 - 2/22/2013 - Default Paving Description

Acres to be Paved: 1.2

Off-Road Equipment:

4 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 6 hours per day

1 Pavers (100 hp) operating at a 0.62 load factor for 7 hours per day

1 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day

1 Rollers (95 hp) operating at a 0.56 load factor for 7 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

Construction Mitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Summer Pounds Per Day, Mitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/20/2012-8/20/2012 Active Days: 22	2.87	**23.80**	**13.47**	**0.00**	5.17	1.14	6.31	1.08	1.05	2.13
Fine Grading 07/20/2012-08/20/2012	2.87	23.80	13.47	0.00	5.17	1.14	6.31	1.08	1.05	2.13
Fine Grading Dust	0.00	0.00	0.00	0.00	5.16	0.00	5.16	1.08	0.00	1.08
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.13	1.74	0.62	0.00	0.01	0.06	0.07	0.00	0.06	0.06
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 10/15/2012-11/6/2012 Active Days: 17	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching 10/15/2012-11/06/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 12/17/2012-12/21/2012 Active Days: 5	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching 12/16/2012-12/23/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 2/15/2013-2/22/2013 Active Days: 6	**2.88**	14.66	11.69	0.00	0.02	**1.18**	1.20	0.01	**1.09**	1.10
Asphalt 02/15/2013-02/22/2013	2.88	14.66	11.69	0.00	0.02	1.18	1.20	0.01	1.09	1.10
Paving Off-Gas	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.19	13.60	8.91	0.00	0.00	1.15	1.15	0.00	1.05	1.05
Paving On Road Diesel	0.07	0.86	0.31	0.00	0.01	0.03	0.04	0.00	0.03	0.03
Paving Worker Trips	0.10	0.20	2.47	0.00	0.01	0.01	0.02	0.00	0.01	0.01

Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/20/2012 - 8/20/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

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Combined Winter Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Phase 4\Phase 4 Infrastructure Emissions.urb924
Project Name: UCSC Marine Science Campus - Phase 4 Infrastructure Construction
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
2012 TOTALS (lbs/day unmitigated)	2.87	23.80	13.47	0.00	46.03	1.14	47.17	9.62	1.05	10.66
2012 TOTALS (lbs/day mitigated)	2.87	23.80	13.47	0.00	5.17	1.14	6.31	1.08	1.05	2.13
2013 TOTALS (lbs/day unmitigated)	2.88	14.66	11.69	0.00	0.02	1.18	1.20	0.01	1.09	1.10
2013 TOTALS (lbs/day mitigated)	2.88	14.66	11.69	0.00	0.02	1.18	1.20	0.01	1.09	1.10

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/20/2012-8/20/2012 Active Days: 22	2.87	**23.80**	**13.47**	**0.00**	**46.03**	1.14	**47.17**	**9.62**	1.05	**10.66**
Fine Grading 07/20/2012-08/20/2012	2.87	23.80	13.47	0.00	46.03	1.14	47.17	9.62	1.05	10.66
Fine Grading Dust	0.00	0.00	0.00	0.00	46.02	0.00	46.02	9.61	0.00	9.61
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.13	1.74	0.62	0.00	0.01	0.06	0.07	0.00	0.06	0.06
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 10/15/2012-11/6/2012 Active Days: 17	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching 10/15/2012-11/06/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 12/17/2012-12/21/2012 Active Days: 5	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching 12/16/2012-12/23/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01

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Time Slice 2/15/2013-2/22/2013 Active Days: 6	**2.88**	14.66	11.69	0.00	0.02	**1.18**	1.20	0.01	**1.09**	1.10
Asphalt 02/15/2013-02/22/2013	2.88	14.66	11.69	0.00	0.02	1.18	1.20	0.01	1.09	1.10
Paving Off-Gas	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.19	13.60	8.91	0.00	0.00	1.15	1.15	0.00	1.05	1.05
Paving On Road Diesel	0.07	0.86	0.31	0.00	0.01	0.03	0.04	0.00	0.03	0.03
Paving Worker Trips	0.10	0.20	2.47	0.00	0.01	0.01	0.02	0.00	0.01	0.01

Phase Assumptions

Phase: Fine Grading 7/20/2012 - 8/20/2012 - Default Fine Site Grading Description

Total Acres Disturbed: 1.2

Maximum Daily Acreage Disturbed: 0.3

Fugitive Dust Level of Detail: Low

Onsite Cut/Fill: 127.27 cubic yards/day; Offsite Cut/Fill: 63.64 cubic yards/day

On Road Truck Travel (VMT): 63.64

Off-Road Equipment:

1 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day

1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 6 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Trenching 10/15/2012 - 11/6/2012 - Type Your Description Here

Off-Road Equipment:

2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

Phase: Trenching 12/16/2012 - 12/23/2012 - Type Your Description Here

Off-Road Equipment:

2 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day

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Phase: Paving 2/15/2013 - 2/22/2013 - Default Paving Description

Acres to be Paved: 1.2

Off-Road Equipment:

4 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 6 hours per day

1 Pavers (100 hp) operating at a 0.62 load factor for 7 hours per day

1 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day

1 Rollers (95 hp) operating at a 0.56 load factor for 7 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

Construction Mitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Winter Pounds Per Day, Mitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Time Slice 7/20/2012-8/20/2012 Active Days: 22	2.87	**23.80**	**13.47**	**0.00**	5.17	1.14	6.31	1.08	1.05	2.13
Fine Grading 07/20/2012-08/20/2012	2.87	23.80	13.47	0.00	5.17	1.14	6.31	1.08	1.05	2.13
Fine Grading Dust	0.00	0.00	0.00	0.00	5.16	0.00	5.16	1.08	0.00	1.08
Fine Grading Off Road Diesel	2.69	21.95	11.51	0.00	0.00	1.07	1.07	0.00	0.99	0.99
Fine Grading On Road Diesel	0.13	1.74	0.62	0.00	0.01	0.06	0.07	0.00	0.06	0.06
Fine Grading Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 10/15/2012-11/6/2012 Active Days: 17	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching 10/15/2012-11/06/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 12/17/2012-12/21/2012 Active Days: 5	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching 12/16/2012-12/23/2012	2.34	18.46	11.60	0.00	0.01	1.01	1.01	0.00	0.93	0.93
Trenching Off Road Diesel	2.29	18.35	10.26	0.00	0.00	1.00	1.00	0.00	0.92	0.92
Trenching Worker Trips	0.06	0.11	1.34	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Time Slice 2/15/2013-2/22/2013 Active Days: 6	**2.88**	14.66	11.69	0.00	0.02	**1.18**	1.20	0.01	**1.09**	1.10
Asphalt 02/15/2013-02/22/2013	2.88	14.66	11.69	0.00	0.02	1.18	1.20	0.01	1.09	1.10
Paving Off-Gas	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	2.19	13.60	8.91	0.00	0.00	1.15	1.15	0.00	1.05	1.05
Paving On Road Diesel	0.07	0.86	0.31	0.00	0.01	0.03	0.04	0.00	0.03	0.03
Paving Worker Trips	0.10	0.20	2.47	0.00	0.01	0.01	0.02	0.00	0.01	0.01

Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Fine Grading 7/20/2012 - 8/20/2012 - Default Fine Site Grading Description

For Soil Stablizing Measures, the Apply soil stabilizers to inactive areas mitigation reduces emissions by:

PM10: 84% PM25: 84%

For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

For Soil Stablizing Measures, the Equipment loading/unloading mitigation reduces emissions by:

PM10: 69% PM25: 69%

For Unpaved Roads Measures, the Manage haul road dust 2x daily watering mitigation reduces emissions by:

PM10: 55% PM25: 55%

CONSTRUCTION EMISSIONS

Building Construction Worker Trip Emissions (100 Employees)

4/28/2011 03:55:47 PM

Urbemis 2007 Version 9.2.4

Combined Summer Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Worker Trips - 100 Employees.urb924
Project Name: Worker Trips - 100 Employees
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Worker Trips	1.11	2.18	26.74	0.02	0.11	0.08	0.19	0.04	0.07	0.11

Phase Assumptions

Phase: Fine Grading 11/30/2012 - 12/31/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 0
Maximum Daily Acreage Disturbed: 0
Fugitive Dust Level of Detail: Default
20 lbs per acre-day
On Road Truck Travel (VMT): 0
Off-Road Equipment:
80 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

4/28/2011 03:56:31 PM

Urbemis 2007 Version 9.2.4

Combined Winter Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Worker Trips - 100 Employees.urb924
Project Name: Worker Trips - 100 Employees
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Worker Trips	1.11	2.18	26.74	0.02	0.11	0.08	0.19	0.04	0.07	0.11

Phase Assumptions

Phase: Fine Grading 11/30/2012 - 12/31/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 0
Maximum Daily Acreage Disturbed: 0
Fugitive Dust Level of Detail: Default
20 lbs per acre-day
On Road Truck Travel (VMT): 0
Off-Road Equipment:
80 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

CONSTRUCTION EMISSIONS

Non-Building Construction Worker Trip Emissions (50 Employees)

4/28/2011 03:47:29 PM

Urbemis 2007 Version 9.2.4

Combined Summer Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Worker Trips - 50 Employees.urb924
Project Name: Worker Trips - 50 Employees
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Worker Trips	0.55	1.09	13.37	0.01	0.05	0.04	0.10	0.02	0.03	0.05

Phase Assumptions

Phase: Fine Grading 11/30/2012 - 12/30/2012 - Default Fine Site Grading Description
Total Acres Disturbed: 0
Maximum Daily Acreage Disturbed: 0
Fugitive Dust Level of Detail: Default
20 lbs per acre-day
On Road Truck Travel (VMT): 0
Off-Road Equipment:
40 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

4/28/2011 03:47:46 PM

Urbemis 2007 Version 9.2.4

Combined Winter Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Worker Trips - 50 Employees.urb924
Project Name: Worker Trips - 50 Employees
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5
Worker Trips	0.55	1.09	13.37	0.01	0.05	0.04	0.10	0.02	0.03	0.05

Phase Assumptions

Phase: Fine Grading 11/30/2012 - 12/30/2012 - Default Fine Site Grading Description

Total Acres Disturbed: 0

Maximum Daily Acreage Disturbed: 0

Fugitive Dust Level of Detail: Default

20 lbs per acre-day

On Road Truck Travel (VMT): 0

Off-Road Equipment:

40 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

OPERATIONAL EMISSIONS

Motor Vehicle and Area Source Emissions

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Urbemis 2007 Version 9.2.4

Combined Summer Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Operational\UCSC Marine Campus Operational Emissions.urb924
Project Name: UCSC Marine Science Campus Operational Emissions
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

AREA SOURCE EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10	PM2.5
TOTALS (lbs/day, unmitigated)	0.37	0.02	1.55	0.00	0.01	0.01

OPERATIONAL (VEHICLE) EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10	PM2.5
TOTALS (lbs/day, unmitigated)	3.84	5.29	41.64	0.03	6.52	1.30

SUM OF AREA SOURCE AND OPERATIONAL EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10	PM2.5
TOTALS (lbs/day, unmitigated)	4.21	5.31	43.19	0.03	6.53	1.31

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5
Natural Gas						
Hearth - No Summer Emissions						
Landscape	0.12	0.02	1.55	0.00	0.01	0.01
Consumer Products	0.00					
Architectural Coatings	0.25					
TOTALS (lbs/day, unmitigated)	0.37	0.02	1.55	0.00	0.01	0.01

Area Source Changes to Defaults

Percentage of residences with wood stoves changed from 35% to 0%

Percentage of residences with wood fireplaces changed from 10% to 0%

Percentage of residences with natural gas fireplaces changed from 55% to 100%

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Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25
General light industry	3.84	5.29	41.64	0.03	6.52	1.30
TOTALS (lbs/day, unmitigated)	3.84	5.29	41.64	0.03	6.52	1.30

Operational Settings:

Includes correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2014 Temperature (F): 70 Season: Summer

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
General light industry		12.67	1000 sq ft	43.00	544.81	3,751.02
					544.81	3,751.02

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	44.2	0.5	99.0	0.5
Light Truck < 3750 lbs	17.1	1.2	94.7	4.1
Light Truck 3751-5750 lbs	20.2	0.5	99.0	0.5
Med Truck 5751-8500 lbs	8.4	0.0	100.0	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.4	0.0	71.4	28.6
Lite-Heavy Truck 10,001-14,000 lbs	0.9	0.0	55.6	44.4
Med-Heavy Truck 14,001-33,000 lbs	1.2	0.0	16.7	83.3
Heavy-Heavy Truck 33,001-60,000 lbs	0.7	0.0	0.0	100.0
Other Bus	0.1	0.0	100.0	0.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	4.5	53.3	46.7	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	1.1	0.0	90.9	9.1

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Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	11.8	8.3	7.1	11.8	4.4	4.4
Rural Trip Length (miles)	11.8	8.3	7.1	11.8	4.4	4.4
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
General light industry				50.0	25.0	25.0

1/21/2011 01:01:22 PM

Urbemis 2007 Version 9.2.4

Combined Winter Emissions Reports (Pounds/Day)

File Name: Z:\Air Quality\680.12 UCSC Marine Science Campus\Emissions\Operational\UCSC Marine Campus Operational Emissions.urb924
Project Name: UCSC Marine Science Campus Operational Emissions
Project Location: Monterey Bay Air District
On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006
Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

AREA SOURCE EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10	PM2.5
TOTALS (lbs/day, unmitigated)	0.25	0.00	0.00	0.00	0.00	0.00

OPERATIONAL (VEHICLE) EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10	PM2.5
TOTALS (lbs/day, unmitigated)	4.47	6.48	46.62	0.03	6.52	1.30

SUM OF AREA SOURCE AND OPERATIONAL EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10	PM2.5
TOTALS (lbs/day, unmitigated)	4.72	6.48	46.62	0.03	6.52	1.30

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5
Natural Gas						
Hearth	0.00	0.00	0.00	0.00	0.00	0.00
Landscaping - No Winter Emissions						
Consumer Products	0.00					
Architectural Coatings	0.25					
TOTALS (lbs/day, unmitigated)	0.25	0.00	0.00	0.00	0.00	0.00

Area Source Changes to Defaults

Percentage of residences with wood stoves changed from 35% to 0%

Percentage of residences with wood fireplaces changed from 10% to 0%

Percentage of residences with natural gas fireplaces changed from 55% to 100%

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Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25
General light industry	4.47	6.48	46.62	0.03	6.52	1.30
TOTALS (lbs/day, unmitigated)	4.47	6.48	46.62	0.03	6.52	1.30

Operational Settings:

Includes correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2014 Temperature (F): 50 Season: Winter

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
General light industry		12.67	1000 sq ft	43.00	544.81	3,751.02
					544.81	3,751.02

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
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Lite-Heavy Truck 10,001-14,000 lbs	0.9	0.0	55.6	44.4
Med-Heavy Truck 14,001-33,000 lbs	1.2	0.0	16.7	83.3
Heavy-Heavy Truck 33,001-60,000 lbs	0.7	0.0	0.0	100.0
Other Bus	0.1	0.0	100.0	0.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	4.5	53.3	46.7	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	1.1	0.0	90.9	9.1

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Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	11.8	8.3	7.1	11.8	4.4	4.4
Rural Trip Length (miles)	11.8	8.3	7.1	11.8	4.4	4.4
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
General light industry				50.0	25.0	25.0

Appendix J

AMBAG Consistency Determination for CLRDP

Air Quality Footnote #11

RECEIVED
FEB 0 6 2003
ENVIRONMENTAL SCIENCE ASSOC.

AMBAG
ASSOCIATION OF MONTEREY BAY AREA GOVERNMENTS

February 5, 2003

J. Austin Kerr
Environmental Science Associates
225 Bush Street, Suite 1700
San Francisco, CA 94104

Re: *Consistency Determination for UCSC Marine Science Campus Project*

Dear Mr. Kerr:

This letter is in response to your November 26, 2002 request for a determination of consistency of the UCSC Marine Science Campus project with the *2000 Air Quality Management Plan for the Monterey Bay Region* (AQMP).

Consistency of institutional projects to the AQMP is determined by comparing the current population of the jurisdiction containing the proposed project to the jurisdiction's growth forecasted in the *AMBAG 1997 Regional Population and Employment Forecast.* If the jurisdiction's current population is less than the population forecasted, the project is determined to be consistent.

The current population of Santa Cruz is 55,085 (1/1/02 Department of Finance estimate). The forecasted population of Santa Cruz in the year 2005, the next forecasted year, is 60,299. As the current population of Santa Cruz is less than the forecasted population, the institutional portion of the UCSC Marine Science Campus project is **consistent** with the AQMP.

Consistency of residential projects to the AQMP is determined by adding population growth due to the proposed project to growth from existing permitted units and comparing the total to the applicable jurisdiction's current estimated population plus growth forecasted in the *AMBAG 1997 Regional Population and Employment Forecast.*

The UCSC Marine Science Campus project as described in your letter includes beds for 254 residents. Although the average daily occupancy is estimated to be 140 persons, this consistence determination will use the design capacity as the basis of analysis.

Cumulative impacts are determined by adding the 254 new residents expected from the proposed project to other growth approved in the jurisdiction during the 2000 - 2005 period.

The cumulative population growth in Santa Cruz is estimated from data faxed to us by Santa Cruz city staff on January 17, 2003. One hundred and six units were constructed in 2002 and 572 units are currently approved but not yet constructed. The assumption is made that these approved units will be constructed in the 2000-2005 period. To estimate population impacts, AMBAG assumes average household size in Santa Cruz to be 2.46 persons per dwelling unit (State Department of Finance *Official State Estimates* of May 2002). However, actual resident population will be less due to vacancies. The latest applicable vacancy rate of 4.94% for Santa Cruz is used for this project, from the same source. Applying this average household size and vacancy rate, 678 constructed or permitted new units could add 1,584 residents to the City of Santa Cruz.

Project consistency is determined by comparing the cumulative estimate of future residents to the growth between the current DOF population estimate and Santa Cruz's population forecasted in the applicable forecast period. The difference between Santa Cruz's estimated current population and its forecasted population for 2005 is 5,214 persons.

The cumulative population growth added to the growth associated to the UCSC Marine Science Campus project (1,838 by year 2005) is less that the difference between the current population estimate for Santa Cruz and the population growth forecasted for 2005 (5,214 by year 2005). Therefore, the residential portion of the project is **consistent** with the AQMP.

Please feel free to contact Todd Muck of our staff if you have any questions about this determination.

Sincerely,

Nicolas Papadakis
Executive Director

cc: Janet Brennan, MBUAPCD

c:\consisty\UCSC\Marine Science Campus