Task 7: Deliverable G

Benefit Cost Analysis – FINAL

November 2018

Central Oahu Transportation Study

Prepared for

Oahu Metropolitan Planning Organization

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APPENDICES

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ACRONYMS

APTA	American Public Transportation Association
BCA	Benefit Cost Analysis
COTS	Central Oahu Transportation Study
CPI-U	Consumer Price Index
DTS	Department of Transportation Services
EPA	U.S. Environmental Protection Agency
GHG	Greenhouse Gas
HDOT	Hawaii Department of Transportation
ITS	Intelligent Transportation Systems
O-D	origin and destination
OMB	Office of Management and Budget
ORTP	*Oahu Regional Transportation Plan*
PDO	property damage only
ROI	return on investment
ROW	right-of-way
STIP	State Transportation Improvement Program
TDM	Transportation Demand Management
TIGER	Transportation Investment Generating Economic Recovery
USDOT	U.S. Department of Transportation
VTTS	value of travel time savings

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OVERVIEW OF THE CENTRAL OAHU TRANSPORTATION STUDY

The Central Oahu Transportation Study (COTS) will assess the multi-modal transportation needs of the region and identify key transportation system improvements, strategies and policies that can improve regional transportation mobility and access in a sustainable way. The strategies and system improvements will be technically feasible, financially realistic, sustainable, and meet regional transportation needs.

This report comprises the deliverable for **Task 7, Deliverable G**. The full list of tasks are:

- Task 1: Coordinate and review past and on-going traffic, transit, and land use studies prepared by other agencies, establish a project management working group, and develop a stakeholder involvement process.
- Task 2: Identify Performance Measures and measures of economic sustainability to collect and establish a comprehensive baseline multi-modal transportation dataset.
- Task 3: Analyze and evaluate regional transportation, demographic, economic, and land use trends and issues.
- Task 4: Determine and assess current and future multi-modal needs and opportunities for the region through technical methodologies, user survey and stakeholder outreach. The technical forecasting of future traffic, transit, land use, and other related projections will utilize and be done in coordination with OahuMPO's current travel demand forecast model and Congestion Management Process.
- Task 5: Identify potential strategies and system improvements for key corridors in the region, including but not limited to, transit improvements with connections to the Honolulu rail transit system and H-2.
- Task 6: Assess order-of-magnitude of impacts of the potential strategies and system improvements utilizing identified Performance Measures. This order-of-magnitude assessment will include expected project and strategy implementation timing, project delivery issues including land acquisition, environmental impacts, and estimates of operations and maintenance costs.
- **Task 7: Define the benefits and costs of the potential strategies and system improvements and compare those benefits and costs to each other.**
- Task 8: Compare and prioritize those potential strategies and system improvements that meet the desired purpose mentioned above (technically feasible, financially realistic, and sustainable).
- Task 9: Develop recommendations and an implementation timeframe to set priorities for those strategies and system improvements.

Twelve deliverables document the results of the nine tasks and their subtasks. The reports include:

A. Assessment of Previous Studies and Surveys associated with the study area and recommendations for further data collection or survey work as needed. Report A provides the assessment of the studies and surveys identified in two deliverables that have been submitted: List of Previous Studies and List of Previous Surveys.

B. Identification of the Trends and Issues impacting the COTS area. This report will include the demographics, economics and land trends occurring in the study area as well as identify the impacts of those trends.

B.2 Identification and definitions of Performance Measures, Sustainability Performance Measures, Baseline and Data Elements that will be used to guide and evaluate project alternatives.

C. Data Memorandum that lists the information needed based upon Deliverables A through B.2 and documents the results of the data collection.

D. A discussion of previous Alternatives as well as strategies for improvements will be presented in this report.

E. The Preliminary Ranking of Identified Projects is detailed in this report. The Performance Measures identified in Report B will be applied to the alternatives. TransCAD model using the OahuMPO model runs will provide a means to compare alternatives (as applicable). The outcome of these tasks will be a ranking of alternatives and their impacts on the study area. A separate technical memorandum (Deliverable E-2) will be prepared summarizing the effectiveness of the TransCAD model as a planning tool for this study.

F. Documents the Feasibility Assessment of the alternatives. Documentation will include identifying criteria for feasibility and sustainability assumptions; reporting on the impacts by Performance Measure; identification of environmental impacts and identified mitigations; and, assumptions for implementation all leading to a refinement of the alternative rankings.

G. The Financial Assessment will be documented in this report. Financial assumptions and requirements including costs will be reviewed. The benefits and costs of the alternatives will be assessed and compared including any identified trade-offs.

H. The Final Report on Prioritization and Recommendations for Implementation will summarize and prioritize strategies; identify recommendations; identify impacts of no implementation; recommend an implementation timeframe; and, identify any impacts if implementation is not accomplished within the recommended timeframe.

I. This report will provide a summary of the Community Input and how that input was used to inform the study.

J. Survey Results from any new surveys will be documented in this report.

EXECUTIVE SUMMARY

Benefit Cost Analysis (BCA) is a method of analyzing potential investments. It compares monetized benefits against financial capital and operating costs to see if an investment is reasonable. BCA is expressed as either a ratio (benefits divided by costs) or as net present value which subtracts costs from benefits. The BCA ratio over 1.0 has a positive benefit. A Net Present Value with a positive sign (greater than zero) has a positive benefit. The purpose of conducting BCA is to help consider the individual merit of a project to determine if it justifies further commitment of resources and continued planning.

It is important to understand that BCA is only one method of analysis. Many times, project purposes go beyond what can be given a dollar value. An example is social equity, making the transportation investment available to those who are underserved, poor or from a minority population. For many decision-makers these non-quantified characteristics are more important than the BCA results. A previous deliverable in this study examined the project list against performance measures, and against feasibility criteria (difficulty to construct, environmental compliance, conformity with regional plans).

There are many calculations that go into the BCA formula. Because this is a very early stage of planning, there are many assumptions that go into the development of monetary values. Among these are the base year (2018 in this study), time horizon (2040 in this study), inflation rate (1% in this study), and the time value of money/discount rates. These terms, procedures, and assumptions follow the *US DOT Benefit-Cost Analysis Guidance for Discretionary Programs* (2017) and certain other specialized guidance by mode.

Benefits

Benefit calculations for roadways typically include travel time savings, auto operating cost savings, safety, and emissions reductions. The benefits for transit projects include the same variables plus congestion reduction, equity/mobility, and noise reduction. Bicycle and pedestrian benefits also include a category called “livability” which connotes economic development, mobility and equity.

Because benefits accrue over multiple years, for each project an opening date must be determined. The benefits start accruing in that year and continue through 2040. Future year benefits are discounted by 7% per guidance.

The total benefits for all COTS projects, taking into account future years, is shown in **Table ES-1**.

Costs

Costs for projects are made up of three parts. First, is the construction cost. This was initially calculated in 2018 dollars. It is inflated by 1% (per HDOT guidance) to an assumed year of construction, sometimes up to ten years ahead if the project is not already on the state STIP. Second, is the cost of land. Not all projects required additional land. For those that do, an assumption was made about the unit cost of an acre by reviewing adjacent parcels from the City & County Real Property records. Third, is the cost of operations and maintenance (O&M). This cost was calculated using national costs (for roadways and bicycle/pedestrian projects) and using Honolulu costs (for transit projects). O&M is a cost which is needed every year versus a one-time cost such as construction or land. Therefore, O&M costs were inflated up 1% from opening year to 2040.

The costs for all COTS projects, taking into account future years are shown in **Table ES-2**.

Benefit Cost Comparison

The benefit cost comparison is expressed at a ratio. Because benefits and costs are streamed over many years, a discount rate is applied. The rate of 3% is considered the most appropriate rate by the study preparers because these are public projects not requiring a return on investment other than the transportation benefits reflected in the project goals. Federal BCA guidance allows use of 3% but only if BCA is also calculated at 7% (which is a rate commonly used for private investments). **Table ES-3** in this executive summary shows the BCA using the 3% discount rate. Tables for both 3% and 7% discount rate can be found in **Section 6.1** of this report.

The highest transit project BCA at 3% discount rate is Bus Rapid Transit from Wahiawa to Pearl Highlands Station (3.58). Expansion of existing bus service and Park & Ride with flyer stop in the median of H-2 also have high BCA ratios.

The highest bicycle facility (off-street) is a new pathway on Waipahu Street between Paiwa Street and Kamehameha Highway (3.74). Four other new bicycle facilities had high BCA ratios. All seven of the on-street bicycle delineations had high BCA ratios. The highest pedestrian facility project was for Complete Street treatments on Kipapa Drive between Hookelewaa Street and Mililani Waena Elementary School.

The highest roadway access BCA ratio is the widening of the H-2 ramp at Meheula Parkway (8.13). The highway roadway project is a widening of Kamehameha Highway between Ka Uka Boulevard and Lanikuhana (3.68); having this serve as a Kamehameha HOV lane is also high (2.93).

Table ES-1. Cumulative Benefits for COTS Projects

Project Number	Project Description	Start Year	End Year	Travel Time Saving	Vehicle Operating Cost Saving	Safety	Emissions Reduction	Congestion Reduction	Mobility & Equity	Noise Reduction	Recreational	Health	Reduced Auto Use/ Parking Cost	TOTAL BENEFITS (7%)	TOTAL BENEFITS (3%)
100 TRANSIT PROJECTS															
101	**GENERAL**														
101.1	Bus Service Expansion	2021	2040	$900,864	$2,350,888	$1,066,682	$130,605	$7,500,452	$624,240	$12,146	--	$1,073,616--	$555,822	**$156,505,944**	**$221,172,689**
102	**HIGH CAPACITY TRANSIT**														
102.2	Light Rail between Wahiawa and Leeward Community College Rail Station	2028	2040	$6,190,437	$6,073,127	$2,755,595	$397,645	$19,376,167	$2,165,970	$31,378	--	$2,773,508	$1,435,874	**$353,488,228**	**$451,024,768**
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	2023	2040	$2,252,160	$2,938,610	$1,333,352	$180,748	$9,375,565	$765,000	$15,183	--	$1,342,020	$694,778	**$184,276,237**	**$246,029,028**
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	2025	2040	$2,711,225	$3,036,563	$1,377,798	$186,773	$9,688,083	$1,082,985	$15,689	--	$1,386,754	$717,937	**$197,007,950**	**$263,025,995**
102.6	HART rail technology between Mililani and Leeward Community College	2030	2040	$12,089,595	$8,619,922	$3,911,167	$598,606	$27,501,656	$3,074,280	$44,536	--	$3,936,592	$2,038,014	**$474,063,762**	**$586,086,401**
102.8	Aerial Gondola between Waipio and Leeward Community College	2028	2040	$5,574,096	$4,407,915	$2,000,029	$288,613	$14,063,347	$1,572,075	$22,774	--	$2,013,030	$1,042,166	**$265,831,659**	**$339,180,389**
200 BICYCLE PROJECTS															
201	**BICYCLE PATHS (Off-street bicycle facility)**														
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2019	2040	--	--	$875,856	--	--	$48,912	--	$826,944	$34,579	$1,739	**$7,483,789**	**$12,037,789**
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2019	2040	--	--	$278,800	--	--	$20,380	--	$258,420	$11,174	$1,579	**$ 1,428,048**	**$2,579,412**
201.4	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street	2019	2040	--	--	$868,641	--	--	$54,618	--	$814,023	$34,277	$2,858	**$4,322,956**	**$7,788,842**
201.5	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station	2029	2040	--	--	$752,814	--	--	$46,466	--	$706,348	$29,747	$1,551	**$3,769,870**	**$6,797,183**
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	2019	2040	--	--	$913,111	--	--	$60,325	--	$852,786	$35,938	$6,392	**$4,572,509**	**$8,245,027**
201.7	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2029	2040	--	--	$297,074	--	--	$17,119	--	$279,955	$11,929	$658	**$1,510,366**	**$2,727,004**
201.8	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	2029	2040	--	--	$888,546	--	--	$52,988	--	$835,558	$35,032	$1,429	**$4,416,703**	**$7,959,832**
201.10	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	2019	2040	--	--	$405,102	--	--	$26,086	--	$379,016	$16,006	$719	**$2,020,273**	**$3,641,248**
202	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**														
202.3	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	2019	2040	--	--	$934,309	--	--	$42,760	--	$891,549	$37,750	$3,032	**$11,950,315**	**$17,526,109**
202.4	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	2019	2040	--	--	$780,373	--	--	$39,569	--	$740,804	$31,106	$2,876	**$9,784,174**	**$14,302,416**
202.6	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path	2029	2040	--	--	$524,024	--	--	$28,719	--	$495,305	$20,989	$902	**$2,585,386**	**$4,654,994**

Project Number	Project Description	Start Year	End Year	Travel Time Saving	Vehicle Operating Cost Saving	Safety	Emissions Reduction	Congestion Reduction	Mobility & Equity	Noise Reduction	Recreational	Health	Reduced Auto Use/ Parking Cost	TOTAL BENEFITS (7%)	TOTAL BENEFITS (3%)
202.7	Bicycle lane on Kamehameha Highwy from Ka Uka Blvd to Lanikahuna Ave	2019	2040	--	--	$689,127	--	--	$34,463	--	$654,664	$27,633	$2,914	**$8,736,889**	**$12,793,493**
203	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**														
203.1	Bicycle route on California Ave between Plum St and Iliahi Elementary	2019	2040	--	--	$495,305	--	--	--	--	$495,305	$20,838	$1,622	**$6,170,182**	**$9,027,160**
203.3	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	--	--	$163,666	--	--	--	--	$163,666	$6,946	$113	**$1,888,430**	**$2,720,827**
203.5	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	--	--	$430,700	--	--	--	--	$430,700	$18,120	$1,410	**$5,368,303**	**$7,837,333**
203.6	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	2019	2040	--	--	$766,646	--	--	--	--	$766,646	$32,012	$3,995	**$9,657,826**	**$14,122,973**
303	**COMPLETE STREETS (BICYCLE BENEFITS)**														
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2019	2040	--	--	--	--	--	$12,334	--	$292,876	$12,231	$611	**$2,670,723**	**$4,306,444**
300 PEDESTRIAN PROEJCTS															
301	**LOCATION-SPECIFIC**														
301.1	Crosswalk across makai leg of Kamehameha Hwy and Avocado St intersection	2019	2040	--	--	$350,210	--	--	--	--	$5,930,739	$243,261	$10,998	**$ 6,407,010**	**$2,670,723**
303	**COMPLETE STREETS**														
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	2019	2040	--	--	$393,727	--	--	--	--	$277,155	$116,572	--	**$1,882,266**	**$3,391,939**
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2019	2040	--	--	$625,740	--	--	--	--	$440,463	$185,277	--	**$5,143,230**	**$8,270,340**
400 ROADWAY PROJECTS															
403	**KAMEHAMEHA HIGHWAY**														
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	2028	2040	$13,002,014	$ (138,373)	$-	$14,767	--	--	--	--	--	--	**$ 117,708,401**	**$ 149,781,500**
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	2028	2040	$9,864,505	$1,066,716	$61,032	$12,103	--	--	--	--	--	--	**$ 100,579,602**	**$ 127,985,458**
404	**H-2 INTERCHANGES**														
404.2	H-2 & Meheula Pkwy (widen on-ramp)	2023	2040	$5,437,921	$ (164,827)	$-	$(196)	--	--	--	--	--	--	**$55,194,057**	**$75,465,147**
405	**H-1 & H-2 INTERCHANGE**														
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	2028	2040	$3,503,360	$-	$-	$-	--	--	--	--	--	--	**$32,020,643**	**$40,745,604**
406	**CENTRAL MAUKA ROADS**														
406.1	New Road between Mililani Mauka and Pearl City	2028	2040	$15,434,229	$157,330	$-	$68,902	--	--	--	--	--	--	**$143,136,312**	**$ 182,137,989**
406.3	New Road between California Ave and Meheula Pkwy	2028	2040	$110,091	$270,320	$-	$ 1,342	--	--	--	--	--	--	**$3,489,215**	**$4,439,954**
408	**MILILANI ACCESS**														

Project Number	Project Description	Start Year	End Year	Travel Time Saving	Vehicle Operating Cost Saving	Safety	Emissions Reduction	Congestion Reduction	Mobility & Equity	Noise Reduction	Recreational	Health	Reduced Auto Use/ Parking Cost	TOTAL BENEFITS (7%)	TOTAL BENEFITS (3%)
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	2028	2040	$3,307,613	$455,711	$-	$13,215	--	--	--	--	--	--	**$34,517,494**	**$43,922,795**
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	2023	2040	$270,259	$-	$-	$-	--	--	--	--	--	--	**$2,828,936**	**$3,867,918**
500 TRANSPORTATION SYSTEM MANAGEMENT															
501	**TRANSPORTATION DEMAND MANAGEMENT**														
501.1 through 501.10	TDM Package	2020	2040		$642,600	$262,414	$32,130	$1,845,180	--	$ 2,988	--	--	--	**$30,422,324**	**$42,937,370**
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**														
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	2028	2040	$525,504	$-	$-	--	--	--	--	--	--	--	**$4,803,096**	**$6,111,841**
600 PRICING SOLUTIONS															
601	**PRICING**														
601.2	HOT lanes	2028	2040	$1,839,264	$-	$-	--	--	--	--	--	--	--	**$16,810,837**	**$21,391,442**

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Table ES-2. Cumulative Costs for COTS Projects

Project Number	Project Description	Start Year	End Year	Construction	Land	Operation & Maintenance	TOTAL COSTS
100TRANSIT PROJECTS							
101	**GENERAL**						
101.1	Bus Service Expansion	2021	2040	$8,710,000	--	$ 57,533,909	**$ 66,243,909**
101.3	City Operations & Maintenance, including Bus Stop/Shelter Conditions	2018	2040	--	--	$969,504,510	**$969,504,510**
102	**HIGH CAPACITY TRANSIT**						
102.2	Light Rail between Wahiawa and Leeward Community College Rail Station	2028	2040	$ 578,032,000	--	$ 70,501,172	**$648,533,172**
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	2025	2040	$30,217,600	--	$ 27,499,511	**$57,717,111**
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	2025	2040	$ 103,900,400	--	$ 21,550,941	**$125,451,341**
102.6	HART rail technology between Mililani and Leeward Community College	2030	2040	$ 894,310,350	--	$452,261,880	**$1,346,572,230**
102.8	Aerial Gondola between Waipio and Leeward Community College	2028	2040	$283,972,000	--	$141,839,518	**$425,808,518**
200 BICYCLE PROJECTS							
201	**BICYCLE PATHS (Off-street bicycle facility)**						
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2023	2040	$3,211,130	--	$ 166,748	**$ 3,377,878**
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2028	2040	$5,900,190	$211,482	$ 289,429	**$ 6,401,101**
201.4	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street	2028	2040	$4,882,468	--	$ 192,953	**$ 5,075,421**
201.5	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station	2028	2040	$3,129,245	--	$ 120,598	**$ 3,249,843**
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	2028	2040	$11,684,577	--	$ 410,027	**$ 12,094,604**
201.7	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2028	2040	$4,150,250	$27,885	$ 120,598	**$ 4,298,733**
201.8	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	2028	2040	$3,099,614	--	$ 96,477	**$ 3,196,091**
201.10	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	2028	2040	$2,009,656	--	$ 102,507	**$ 2,112,163**
202	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**						
202.3	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	2019	2040	$4,255,763	--	--	**$ 4,255,763**
202.4	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	2019	2040	$2,508,175	--	--	**$ 2,508,175**
202.6	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path	2028	2040	$4,358,552	--	--	**$ 4,358,552**
202.7	Bicycle lane on Kamehameha Highway from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$4,496,900	--	--	**$4,496,900**
203	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**						
203.1	Bicycle route on California Ave between Plum St and Iliahi Elementary	2019	2040	$ 150,844	--	--	**$150,844**
203.3	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$ 26,947	--	--	**$ 26,947**
203.5	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$ 132,977	--	--	**$132,977**
203.6	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	2019	2040	$ 144,986	--	--	**$144,986**
300 PEDESTRIAN PROEJCTS							
301	**LOCATION-SPECIFIC**						
301.1	Crosswalk across makai leg of Kamehameha Hwy and Avocado St intersection	2019	2040	$ 523,412	--	--	**$523,412**
302	**GENERAL**						

Project Number	Project Description	Start Year	End Year	Construction	Land	Operation & Maintenance	TOTAL COSTS
302.1	Safe Routes to School	2019	2040	$250,000	--	--	**$250,000**
302.2	Pedestrian Crossing Safety	2019	2040	$500,000	--	--	**$500,000**
302.3	Mobility Hubs	2019	2040	$2,400,000	--	--	**$2,400,000**
303	**COMPLETE STREETS**						
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	2028	2040	$8,067,108	--	--	**$ 8,067,108**
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$1,095,233	--	--	**$ 1,095,233**
303.3	Complete Streets modifications on priority roads	2019	2040	$600,000	--	--	**$600,000**
400 ROADWAY PROJECTS							
403	**KAMEHAMEHA HIGHWAY**						
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	2028	2040	$37,901,404	--	$2,753,445	**$40,654,849**
403.7	Kamehameha Hwy Roosevelt Bridge (rehabilitation)	2018	2040	$14,925,000	--	$333,119	**$15,258,119**
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	2028	2040	$25,627,138	$13,780,539	$4,296,159	**$43,703,836**
404	**H-2 INTERCHANGES**						
404.2	H-2 & Meheula Pkwy (widen on-ramp)	2023	2040	$8,223,342	--	$1,055,721	**$9,279,063**
405	**H-1 & H-2 INTERCHANGE**						
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	2028	2040	$13,867,121	--	$58,585	**$13,925,706**
406	**CENTRAL MAUKA ROADS**						
406.1	New Road between Mililani Mauka and Pearl City	2028	2040	$56,968,577	$1,421,413	$19,528,007	**$77,917,996**
406.3	New Road between California Ave and Meheula Pkwy	2028	2040	$21,636,001	$10,552	$3,905,595	**$25,552,148**
408	**MILILANI ACCESS**						
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	2028	2040	$51,258,000	$317,204	$3,905,595	**$55,480,799**
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	2023	2040	$6,909,732	--	$680,954	**$7,590,685**
500 TRANSPORTATION SYSTEM MANAGEMENT							
501	**TRANSPORTATION DEMAND MANAGEMENT**						
501.1 through 501.10	TDM Package	2020	2040	--	--	$ 15,105,480	**$ 15,105,480**
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**						
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	2028	2040	$8,110,684	--	$697,705	**$8,808,390**
600 PRICING SOLUTIONS							
601	**PRICING**						
601.2	HOT lanes	2028	2040	$103,052,675	--	$11,921,613	**$114,974,288**
601.3	Parking strategies	2028	2040	$713,027	--	$108,733	**$ 821,761**

Table ES-3. Benefit Cost Ratio for COTS Projects (3% Discount Rate for Benefits)

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	BCA Ratio
100 TRANSIT PROJECTS						
101	**GENERAL**					
101.1	Bus Service Expansion	2021	2040	$ 221,172,689	$ 66,243,909	**3.34**
102	**HIGH CAPACITY TRANSIT**					
102.2	Light Rail between Wahiawa and Leeward Community College Rail Station	2028	2040	$ 451,024,768	$ 648,533,172	**0.70**
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	2023	2040	$ 246,029,028	$ 57,717,111	**4.26**
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	2025	2040	$ 263,025,995	$ 125,451,341	**2.10**
102.6	HART rail technology between Mililani and Leeward Community College	2030	2040	$ 586,086,401	$1,346,572,230	**0.44**
102.8	Aerial Gondola between Waipio and Leeward Community College	2028	2040	$ 339,180,389	$ 425,808,518	**0.80**
200 BICYCLE PROJECTS						
201	**BICYCLE PATHS (Off-street bicycle facility)**					
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2023	2040	$ 12,037,789	$ 3,252,281	**3.70**
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2028	2040	$ 2,579,412	$ 5,895,690	**0.44**
201.4	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street	2028	2040	$ 7,788,842	$ 4,657,188	**1.67**
201.5	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station	2028	2040	$ 6,797,183	$ 2,981,792	**2.28**
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	2028	2040	$ 8,245,027	$ 11,093,701	**0.74**
201.7	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2028	2040	$ 2,727,004	$ 3,943,222	**0.69**
201.8	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	2028	2040	$ 7,959,832	$ 2,930,577	**2.72**
201.10	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	2028	2040	$ 3,641,248	$ 1,940,015	**1.88**
202	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**					
202.3	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	2019	2040	$ 17,526,109	$ 4,255,763	**4.12**

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	BCA Ratio
202.4	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	2019	2040	$ 14,302,416	$ 2,508,175	**5.70**
202.6	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path	2028	2040	$ 4,654,994	$ 4,358,552	**1.07**
202.7	Bicycle lane on Kamehameha Highwy from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$ 12,793,493	$ 4,496,900	**2.84**
203	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**					
203.1	Bicycle route on California Ave between Plum St and Iliahi Elementary	2019	2040	$ 9,027,160	$ 150,844	**59.84**
203.3	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$ 2,720,827	$ 26,947	**100.97**
203.5	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$ 7,837,333	$ 132,977	**58.94**
203.6	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	2019	2040	$ 14,122,973	$ 144,986	**97.41**
303	**COMPLETE STREETS (BICYCLE)**					
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$ 4,306,444	$ 7,376,078	**0.58**
300 PEDESTRIAN PROEJCTS						
301	**LOCATION-SPECIFIC**					
301.1	Crosswalk across makai leg of Kamehameha Hwy and Avocado St intersection	2019	2040	$ 2,670,723	$ 523,412	**5.10**
303	**COMPLETE STREETS**					
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	2028	2040	$ 3,391,939	$ 7,376,078	**0.46**
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$ 8,270,340	$ 1,052,498	**7.86**
400 ROADWAY PROJECTS						
403	**KAMEHAMEHA HIGHWAY**					
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	2028	2040	$ 149,781,500	$ 40,654,849	**3.68**
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	2028	2040	$ 127,985,458	$ 43,703,836	**2.93**
404	**H-2 INTERCHANGES**					
404.2	H-2 & Meheula Pkwy (widen on-ramp)	2023	2040	$ 75,465,147	$ 9,279,063	**8.13**
405	**H-1 & H-2 INTERCHANGE**					

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	BCA Ratio
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	2028	2040	$ 40,745,604	$ 13,925,706	**2.93**
406	**CENTRAL MAUKA ROADS**					
406.1	New Road between Mililani Mauka and Pearl City	2028	2040	$ 182,137,989	$ 77,917,996	**2.34**
406.3	New Road between California Ave and Meheula Pkwy	2028	2040	$ 4,439,954	$ 25,552,148	**0.17**
408	**MILILANI ACCESS**					
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	2028	2040	$ 43,922,795	$ 55,480,799	**0.79**
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	2028	2040	$ 3,867,918	$ 7,590,685	**0.51**
500 TRANSPORTATION SYSTEM MANAGEMENT						
501	**TRANSPORTATION DEMAND MANAGEMENT**					
501.1 through 501.10	TDM Package	2020	2040	$ 42,937,370	$ 15,105,480	**2.84**
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**					
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	2028	2040	$ 6,111,841	$ 8,808,390	**0.69**
600 PRICING SOLUTIONS						
601	**PRICING**					
601.2	HOT lanes	2028	2040	$ 21,391,442	$ 114,974,288	**0.19**

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1.0 INTRODUCTION

The Central Oahu Transportation Study (COTS) is preparing several analyses to assist in decision making for which of many alternatives should be selected for further study, as well as which should be considered for possible funding and implementation. There are five types of projects being reviewed, and the report presents results according to the project type. This is in part because it is not appropriate or meaningful to compare projects of different types, for example, to compare a pedestrian sidewalk to a light rail system.

- Transit Projects
- Bicycle Projects
- Pedestrian Projects
- Roadway Projects
- Programs: Including Intelligent Transportation Systems (ITS), Transportation Demand Management (TDM), and Pricing

This report (Deliverable G) calculates cost, and benefit cost comparisons is best understood along with the results of two other reports in this study. Each of the evaluation steps leads to better information about individual projects and at times, the elimination of projects, or combination of one or more projects. Collectively, the analyses and information from the evaluation series of reports leads to the final study report on recommendations and implementation.

- The report on mobility benefits documented in Deliverable E-1 examined 90 projects, including 17 that are to be performed by a private developer (Koa Ridge) in Central. Twenty projects were dropped or merged with others as a result of the mobility analyses.
- The projects were evaluated for their contributions to various performance measures and for their project feasibility in Deliverable F. During the performance and feasibility analyses, 70 projects were reviewed, due to twenty being dropped after the mobility analysis. At this stage, one bicycle project was added on Kipapa Drive.
- The cost and cost benefit review was conducted on 37 projects and is documented in this report, Deliverable G. A total of 25 projects were eliminated from the cost analysis for various reasons: All of the projects that are the responsibility of Koa Ridge would be costed by them. The nine remaining TSM projects were combined into a single project due to their relatively small cost. Four pedestrian program projects which are not site specific, the Roosevelt Bridge rehabilitation project, and parking strategies were deemed too difficult to quantify the benefits.

A tracking table showing disposition of all projects can be found in **Appendix A.**

1.1 Purpose of Benefit Cost Analysis (BCA)

The purpose of BCA is to prepare objective, fact-based information to assist in decision making. BCA assesses values in dollar terms. This is a useful piece of information using units (i.e., dollars) readily understood by most.

Before undertaking BCA, it is important to re-state the goals and intentions of the COTS study. The study goal is to “assess multi-modal needs of the Central region and to identify transportation system improvements, strategies, and policies that can improve mobility and access in a sustainable way.” For purposes of this study, “sustainable” means fiscal reasonableness. The improvements and strategies that prove to be effective in providing mobility, safety or environmental benefits will be reviewed further by

OahuMPO, city and state agencies as part of their long range planning processes. Subsequent to that, projects that meet the financially constrained cut will be further studied and/or moved into the project development process.

This study is a very early stage in planning before resource constraints are factored in. BCA helps consider the value of individual project values in order to determine if it justifies further commitment of resources and continued planning.

Given the high degree to which assumptions have to be made, BCA should not be used as an absolute method for comparing projects, except possibly among those who have the same characteristics for mode. Other limitations to consider are:

- For some of the higher cost projects, the availability (or likely non-availability) of funding may be a more important consideration than its BCA ratio.
- Benefits can be harder to quantify than Costs. For projects with a high degree of social purpose, such as providing mobility to low income, senior, or persons with disabilities, BCA is not the most appropriate tool.
- Even projects which have several benefits that can be measured, they will also have unmeasurable benefits which need to be "made visible," that is, explained in the narrative as important, but not measured in the equations.

1.2 How the Benefit Cost Analysis was Completed

The procedures and values used in this analysis were developed using USDOT guidance, professional best practices, and computing techniques, which are explained in the various sections. A full list is found in the References at the end. Where Hawai'i data and information was available, it was used; otherwise, national default values were used. Several of the study team also participated in a three day BCA Workshop in Honolulu, Hawaii, which was delivered by Graduate School USA.

Among the key resource documents are the following:

- US Department of Transportation (USDOT). 2017. *Benefit Cost Analysis Guidance for Discretionary Programs.*
- Office of Management and Budget (OMB) *Circular A-94*. 1992. And the most recent update (November 2017) of Appendix C: Additional Guidance for Discounting.
- OMB *Circular A-4*: This circular concerns regulatory impact analysis when economic impact exceeds $100 million annually. While Circular A-4 is less pertinent to this project, its discussions on time horizon, baseline, and sensitivity analysis are helpful.

The BCA was done by first, separately calculating the benefits and costs on each project and checking them for reasonableness. The sources for benefit estimation vary by project type and are explained in the paragraphs below. Benefits for roadway projects use variables that are very commonly calculated, including travel time savings, operating cost savings and safety. The bicycle and transit projects have project purposes that include a less commonly used category of benefits known as Livability, which is meant to connote economic development and access to mobility (equity); and Environmental Sustainability such as reduced auto use and emission reductions. A literature search yielded a few cases that could be followed, none from Hawai'i. Benefits considered by type of project are provided in **Table 1**. Benefit calculations are provided in **Chapter 2.0**.

Cost estimations include construction, land, and operations and maintenance (O&M). These calculations are provided in **Chapter 3.0** and **Chapter 4.0**.

Second, both benefits and costs are considered over multiple years and need to be either inflated or discounted. This is explained in **Chapter 5.0**.

Table 1. Benefits by Project Type

Type Project	Benefit 1	Benefit 2	Benefit 3	Benefit 4	Qualitative
Transit	Travel Time Saving	Vehicle Operating Cost Saving	Safety	Emission Reduction	Congestion Equity Noise
Bicycle and Pedestrian	Mobility	Recreation	Health	Auto Use	--
Roadway	Travel Time Saving	Operating Cost Saving	Safety	Emission Reduction	--
TDM, ITS, and Pricing	Travel Time Saving	--	--	--	--

Finally, for conducting the comparison of Benefits and Costs, two methods were used. The first was the Benefit Cost Ratio which is a sum of the present value of all benefits divided by the present value of all costs. Values greater than 1 indicate that the project has a favorable ratio. Those with values less than 1 indicate an unfavorable ratio. The second method of comparison was to subtract the sum total of Costs from the Sum total of Benefits to get the Net Present Value. When the result is greater than Zero, it is favorable, when it is less than Zero, it is unfavorable. The return on investment (ROI) method which measures the Net Present Value divided by Initial Investment Cost was not used. This is explained in **Chapter 6.0**.

1.3 Assumptions Made

In preparing the BCA calculations, several assumptions had to be made which are explained here.

Time Horizon. The time horizon covers the time period when the economic costs and benefits take place. It begins when the action is implemented or constructed and available to the public for use. The time horizon continues as long as the action is in effect, or until it has reached its useful life. This study looks at benefits and costs in one year increments.

One of the basic principles of BCA is that actions need to be comparable, that is using the same units of measure. Since the "start" point of many of the projects being analyzed here is uncertain, a uniform ten year projection for "start" was used for any project not already contained in the State Transportation Improvement Program (STIP). The start year used is 2028. The standard period of analysis selected was the study forecast year of 2040. Thus, for those costs that have a stream of values, at least twelve years of benefits was applied, or longer if it was to start sooner than 2028. For some projects, there is a residual value beyond that period, but that is not part of the calculation for BCA.

Baseline. The baseline year for analysis selected for this study was 2018. The baseline is necessary to allow assessment of relative benefits and costs attributable to the proposed project or action compared to not taking the action.

Time Value of Money and Discount Rate. Because a dollar today is worth more than a dollar at a future date, this difference is factored into the benefit cost analysis through discounting or compounding to compute going from present value to future value. Factors for calculating these values can be looked up in tables to simplify the task. This study used both the factor tables for Annuity (annual payments) and Single Payments to look at something over a period of years. The tables were provided in the Workshop

Participant Guide (Graduate School USA, 2018), although they can be found in many other places, including electronically.

Inflation Rate. Federal regulations (23 CFR 450.2.8(1)) require using year of expenditures when preparing financial plans. Guidance from the State of Hawaii Department of Transportation (HDOT) dated October 9, 2017 instructs the OahuMPO and others to use an inflation rate of 1% when preparing the STIP. This was based on recent Consumer Price Index (CPI-U) data.

Sensitivity Analysis. BCA analysis requires predictions about the future, but the future is rarely certain. A sensitivity analysis shows how results of the analysis change if assumptions change. A good example of this is using the recommended 7% discount rate versus the lower 3% discount rate. The 7% rate is an estimate of average before-tax rate for private investments. The 3% rate has shown to be more accurate for government debt which is pre-tax. Federal guidance allows using the lower rate if the higher rate is also shown. Sensitivity analysis for discount rates was done in this study, for example, in the transit analysis.

Value of Time. This measure recognizes that people have alternate choices (than travel) for how they use their time. Hourly wages is one such measure. The USDOT Guidance provides default values for time, and these were used in this project analysis.

Risk. Risk is a measure of uncertainty. There are three attributes to risk: Cause, Risk Probability, and Risk Severity. This study mentions risk, but does not calculate the probability (likelihood) or Severity (impact) of risks identified. Another way of looking at risk is to ask the question, what impacts the ability to succeed and achieve the desired results?

1.4 Limitations in the Use of Benefit Cost Analysis

There are many challenges when preparing a BCA. There are many unique variable associated with each set of costs, benefits, and risks. The time period for analysis must be determined and dollar values associated with each time period. This study uses best practices/tools and techniques. There are very few examples of BCA to learn from in the transportation planning field. The study team did its best to make educated guesses on input decisions, to test them when possible, and to justify them in this report. They are subject to criticisms and debate, and different assumptions would lead to different results. Therefore, more so than in many other areas of analysis, it is critical that the methodology be laid out so that it can be understood and the logic followed by the reader.

The concern for the analyst is that the reader put too much importance into these BCA numbers simply because they are out there. As stated earlier, it is important to consider many other factors, and many that are not quantifiable and cannot be neatly placed into an equation. For completeness, non-quantified benefits are revealed and described so they are not lost. For some reviewers, the non-financial information will be of greater value.

BCA Guidance for Discretionary Grant Programs has been available from the USDOT since July 2017. This study uses that guidance including national default values for travel time savings, operating cost, value of statistical life/injuries/property damage, and pollutant emissions. The US Department of Transportation, Office of Inspector General (February 2018) recently conducted a review of BCA analyses submitted under the Transportation Investment Generating Economic Recovery (TIGER) grant program. BCA is part of the application qualification process. OIG found that the way BCA were developed and reviewed was not standardized, and lacked key information and they called for more consistency. Stated another way, the practice of BCA in transportation is evolving.

2.0 BENEFIT ANALYSIS

Benefits of a transportation project are the direct, positive effects of that project. In other words, the desirable outcomes of investing in a project. For example, the project may reduce the number or severity of crashes, eliminate long delays during peak hours, or provide a shorter route. These benefits are translated into monetary values.

The following sections identify categories of benefits for the different project types: Transit, Bicycle and Pedestrian, Roadway, and Programs. Each benefit has a specific unit of measure that is calculated for each project. These units are assigned a value based on accepted transportation planning methods and literature. Therefore, each project has a monetary benefit that can be compared to other projects.

2.1 Identification and Monetization of Benefits for Transit Projects

Table 2 shows the benefits that are usually monetized in the United States Department of Transportation (USDOT) guidance for discretionary grants. These benefits include travel time savings, cost savings, safety, and environmental (e.g., emission reduction).

Qualitative based benefits are acknowledged but may be considered more difficult to quantify and monetize. Discussion on these benefits while recommended to be qualitative, have been monetized. For example, guidance states: "Currently, USDOT has not developed reliable means to estimate the public value of noise reductions for U.S. projects…" However, in 2013 the USDOT Federal Highway Administration provided a benefit valuation for noise based on vehicle miles traveled. It is acknowledged that Federal guidance does change and it is appropriate to include quantitative-based benefits. Check marks identify those benefits which are included in the following transit project discussion.

Table 2. Transit Project Benefits

Guidance Based	Included in Review	Qualitative Based
Travel Time Savings	✓	Parking Cost Savings
Vehicle Operating Cost Savings	✓	Chauffeur Driver Savings
Safety	✓	Route Shift
Emissions Reduction	✓	Real Estate
Congestion	✓	Economic Benefits
Equity/Mobility	✓	Health
Noise	✓	Parking Cost Savings

2.1.1 Travel Time Savings

Travel time savings are calculated by identifying the number of passengers and the estimated travel minutes saved by the passenger with the project (minutes saved were averaged from selected origin and destination points). They were annualized using a factor of 255 days for consistency with the application of travel time savings to roadway projects. Using a factor of 255 days recognizes that the majority of travel time savings occurs during the weekday and encompasses work and school trips. The travel time savings are monetized by using $14.72 per hour as provided by guidance.

Table 3 presents the travel time savings for the transit projects. Ridership was based on mode, service characteristics, and estimates of ridership from comparable projects.

Table 3. Transit Project Travel Time Savings

Project Number	Project Description		Travel Time		
		Weekday Passengers	Time Saved/Yr (person-hrs)	Value of Time	Total Travel Time Benefit
100TRANSIT PROJECTS					
101	**GENERAL**				
101.1	Bus Service Expansion	2,400	61,200	$ 14.72	$ 900,864
102	**HIGH CAPACITY TRANSIT**				
102.2	Light Rail between Wahiawa and Pearl Highlands Rail Station	6,200	420,546	$ 14.72	$ 6,190,437
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	3,000	153,000	$ 14.72	$ 2,252,160
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	3,100	184,187	$ 14.72	$ 2,711,233
102.6	HART rail technology between Mililani and Pearl Highlands Rail Station	8,800	821,304	$ 14.72	$ 12,089,595
102.8	Aerial Gondola between Mililani Mauka and Leeward Community College Rail Station	4,500	378,675	$ 14.72	$ 5,574,096

2.1.2 Vehicle Cost Savings

Vehicle cost savings measures savings by taking transit versus using a personal vehicle. Vehicle cost savings were calculated based on the following factors:

- Half the daily passenger estimate is assumed to be new users. The 50% estimate was based on the HART 2012 Transit Passenger Survey which found that over 55% of the current bus riders would drive or drive with someone else if the bus were not available. 50% was used as a conservative estimate.
- 53.8% will be traveling to work or college. This breakdown is based on the HART 2012 Transit Passenger Survey.
- Average miles travel saved.

Operating costs per mile are calculated on gasoline, maintenance, tires, and depreciation (assuming an average of 15,000 miles driven per year) as provided by the USDOT *Benefit Cost Analysis Guidance for Discretionary Grant Programs*. Fixed costs are not included in this calculation. The US DOT BCA Guidance document identifies per mile vehicle operating cost for a car as $0.40 per mile (in 2016 dollars) as shown in Table 8 of Appendix A. Inflation adjusted for 2018, this value is $0.42 per mile.

Table 4 shows the vehicle cost savings for each transit project.

Table 4. Transit Project Vehicle Cost Savings

Project Number	Project Description	Vehicle Cost Savings		
		Vehicle Miles/Saved Year	Operating Cost	Total Vehicle Operating CostBenefit
101.1	Bus Service Expansion	5,597,352	$ .42	$ 2,350,888
102.2	Light Rail between Wahiawa and Pearl Highlands Rail Station	14,459,826	$ .42	$ 6,073,127
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	6,996,690	$ .42	$ 2,938,610
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	7,229,913	$ .42	$ 3,036,563
102.6	HART rail technology between Mililani and Pearl Highlands Rail Station	20,523,624	$ .42	$ 8,619,922
102.8	Aerial Gondola between Mililani Mauka and Leeward Community College Rail Station	10,495,035	$ .42	$ 4,407,915

2.1.3 Safety Benefits

Safety benefits were calculated based on the vehicle miles traveled saved and national experience of the safety factors that are shown in **Table 5**. These include monetized values for the fatality reduction, serious injury avoidance, and property damage that were avoided by a switch to the transit project.

Table 5. Transit Project Safety Benefits

Project	Project Description	Safety						
		Fatalities Reduced	Fatality Value	Serious Injuries Avoided	Serious Injuries Value	Property Damage Avoided	Property Damage Value	Total Safety Benefit
101.1	Bus Service Expansion	.037	$10,021,548	2.666	$225,485	3.454	$4,439	$1,066,682
102.2	Light Rail between Wahiawa and Pearl Highlands	.095	$10,021,548	6.887	$225,485	8.923	$4,439	$2,755,595
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands	.046	$10,021,548	3.333	$225,485	4.318	$4,439	$1,333,352
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	.048	$10,021,548	3.444	$225,485	4.462	$4,439	$1,377,798
102.6	HART rail technology between Mililani and Pearl Highlands	.135	$10,021,548	9.775	$225,485	12.665	$4,439	$3,911,167
102.8	Aerial Gondola between Mililani Mauka and Leeward Community College	.069	$10,021,548	4.999	$225,485	6.476	$4,439	$2,000,029

The US DOT BCA guidance document includes the cost of various collisions from Property Damage Only (PDO) through fatalities with several levels of injury severity. At the high end, the cost of a fatal collision is the most expensive at $9,600,000 (in 2016 dollars). At the low end, the cost of a PDO collision is identified as $4,252. Inflation-adjusted to 2018 dollars these costs are as follows:

- PDO = $4,439
- Injury = $225,485
- Fatal = $10,021,548

It may seem odd to have a partial reduction for a fatality or partial numbers for injuries and property damage. However, these safety factors will be calculated over multiple years such as 12 years for bus expansion or 40 years for the high capacity transit projects.

2.1.4 Emission Reduction

Emission reductions are based on the calculated vehicle miles traveled saved by switching to the transit project and how those miles saved impact emissions. Converting vehicle miles saved was converted to Greenhouse Gas (GHG) emission reductions by using the U.S. Environmental Protection Agency (EPA) Greenhouse Gas Calculator. The tool converts standard metrics for fuel use into metric tons of carbon dioxide equivalent, $MTCO_2e$ using standard national conversion factors (EPA, 2017). Monetization on those emissions are based on guidance received from the USDOT TIGER BCA Resource Guide (USDOT, 2015). Transit project emission reduction benefits are provided in **Table 6**.

Table 6. Transit Project Emission Reduction Benefits

Project Number	Project Description	Emission Reduction	
		Vehicle Miles/Saved Year	Emission Reduction CostBenefit
101.1	Bus Service Expansion	5,597,352	$ 130,605
102.2	Light Rail between Wahiawa and Pearl Highlands Rail Station	14,459,826	$397,645
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	6,996,690	$ 180,748
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	7,229,913	$ 186,773
102.6	HART rail technology between Mililani and Pearl Highlands Rail Station	20,523,624	$ 598,606
102.8	Aerial Gondola between Mililani Mauka and Leeward Community College Rail Station	10,495,035	$ 288,613

2.1.5 Additional Benefits for Transit Projects

Additional benefits that were monetized for transit projects include congestion reduction, mobility and equity, and noise reduction.

Congestion reduction benefits includes factors such as delay, additional fuel consumption, reduced business activity, and employment opportunity losses. The Victoria Transport Policy Institute *Evaluating Public Transit Benefits and Costs* (2018) identified value ranges for congestion reduction on vehicle miles traveled (or kilometers). Their review showed a range from $1.20 per VMT saved in 2011 (which is $1.34

in 2018) to $2 per VMT ($2.24 in 2018). Congestion relief was valued at $1.34 per VMT saved to be on the conservative end of the range.

Mobility and equity represent an important benefit for transit projects. A project can provide mobility to low-income, seniors, or disabled persons providing access to jobs and services that are otherwise not available or are too costly to access. Many low-income people rely upon taxis or rides from family and friends which can be inconvenient and in the case of taxis or ride share too expensive. Mobility and equity benefits were applied based upon $1.02 (in 2018 dollars) per passenger by 255 days was used for bus projects and $1.37 for high capacity transit projects. Economic studies would need to be performed to recommend a higher factor.

Noise reduction was based on the FHWA guidance from 2013 noted previously in **Section 2.1**. Noise reduction is based on vehicle miles traveled (VMT) saved by a value of $.00217 (2018 value) per VMT. The value of the noise reduction benefit is low compared to the other benefits.

Health cost savings of transit projects has been increasingly studied as the United States obesity levels rise. A 2017 study conducted by Zhaowei She, Douglas M. King, and Sheldon H. Jacobson showed that a one percent increase in public transit use resulted in a 0.221 percent decrease in obesity rates. This correlates with studies that have found that transit users walk more and walk longer distances that non-transit users.

A 2008 study estimated the health care cost savings of implementing light rail transit in Charlotte, North Carolina. Estimates were based upon an obesity rate of 23%; Honolulu has a countywide obesity rate of 22.3%. Health care costs were identified as either direct or indirect and calculated using conservative estimates. Annual direct costs were estimated at $458 ($556.66 in 2018) and indirect costs at $429 (521.41 in 2018). A third category of "willingness to pay" was valued at $787 per year ($921.16 in 2018). This third category is based upon how much people are willing to pay each year for weight loss programs. The third category of cost savings is not included in this benefit calculation. Using the median public health costs saved resulted in an average savings per passenger boarding applied to public transit projects of:

- $230.70 (2018) for Direct cost savings
- $216.64 (2018) for Indirect cost savings

Parking cost savings is another qualitative benefit that can be applied to transit projects. Typical parking cost savings recommended by the Victoria Transport Policy Institute for mode shifts from auto to transit for a round trip are identified as:

- $9.00 for commute trips for large cities; $6.00 other trips
- $6.00 for commute trips for medium sized cities; $4.00 other trips
- $3.00 for commute trips for small sized cities; $2.00 other trips

Many of Honolulu's employers provide parking at a discounted rate. However, other costs are involved in parking supply which include operations and maintenance. The recommended parking rates listed above include passenger and employer cost savings. Benefits were calculated on 50% of transit ridership estimated to be shifted from auto. Central Oahu commuters are estimated at 53.8% of the current transit trips (per DTS/HART surveys) with 46.2% composed of other trips. Commute trips were valued at $1.50 each trip (half of the round trip amount) and non-commute trip parking cost savings were valued at $1.00. Parking cost savings were calculated for project 102.5 (Park & Ride Lot with Flyer Stop) as operations and maintenance costs are included within the cost structure of the project and benefits will be realized from other areas.

Table 7 presents the additional benefits that have been monetized for this project.

Table 7. Additional Transit Project Benefits

Project Number	Project Description	Qualitative Based Benefits				
		Congestion Reduction	Mobility & Equity	Noise Reduction	Health Cost Savings	Parking Cost Savings
101.1	Bus Service Expansion	$7,500,452	$624,2400	$12,146	$1,073,616	$555,822
102.2	Light Rail between Wahiawa and Pearl Highlands Rail Station	$19,376,167	$2,165,970	$31,378	$2,773,508	$1,435,874
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	$9,375,565	$765,000	$15,183	$1,342,020	$694,778
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	$9,688,083	$1,082,985	$15,689	$1,386,754	$717,937
102.6	HART rail technology between Mililani and Pearl Highlands Rail Station	$27,501,656	$3,074,280	$44,536	$3,936,592	$2,038,014
102.8	Aerial Gondola between Mililani Mauka and Leeward Community College Rail Station	$14,063,347	$1,552,075	$22,774	$2,013,030	$1,042,166

2.1.6 Non-Quantified Benefits for Transit Projects

Economic benefits are commonly recognized that investment in public transportation projects whether bus or higher capacity modes provides an economic benefit to the community. These costs have not been monetized however two elements within this category are briefly discussed:

The American Public Transportation Association (APTA) has a long history of researching the benefits of transit investment. APTA summarizes that for every $1 invested in public transportation $4 in economic returns are realized (APTA, 2018). Investment includes spending on operations and maintenance. Using this example, each of the listed projects would have the construction costs and operations and maintenance costs multiplied by $4.

A second common economic benefit cited by APTA is that for every $1 billion invested in public transportation, over 50,000 jobs are created or supported, both directly and indirectly. These two economic "quick facts" actually double count the benefit, but they do point to the overall economic benefit of public transit investment.

2.1.7 Sum of Quantified Benefits for Transit Projects

Table 8 provides the sum of the monetized benefits for the transit projects. This includes travel time savings (**Table 3**); vehicle operating cost savings (**Table 4**); safety (**Table 5**); emissions reduction (**Table 6**); and congestion, equity/mobility, and noise (**Table 7**).

Table 8. Sum of Annual Benefits for Transit Projects

Project Number	Project Description	Total Annual Project Benefit Value
101.1	Bus Service Expansion	$14,135,332
102.2	Light Rail between Wahiawa and Pearl Highlands Rail Station	$41,016,356
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	$18,797,439
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	$20,100,506
102.6	HART rail technology between Mililani and Pearl Highlands Rail Station	$61,504,003
102.8	Aerial Gondola between Mililani Mauka and Leeward Community College Rail Station	$27,656,284

2.2 Identification and Monetization of Benefits for Commute Bicycle and Pedestrian Projects

For this analysis, the baseline for the majority of projects is assumed to be from years 2018 through 2040. Those projects requiring more intensive construction, such as bridges, are assumed to have a baseline from years 2028 through 2040. The monetization of benefits is estimated starting in the project opening year 2019 and 2029 respectively, to account for the benefits that don't accrue immediately, and taken through the analysis year 2040. Each proposed facility is analyzed in order to determine its impact on the growth of pedestrians and bicycle volumes. Methodology from NCHRP Report 552: *Guidelines for Analysis of Investments in Bicycle Facilities* (TRB, 2006) was used to identify and forecast the bicycle demand. It notes that value for pedestrian is not appropriate in urban areas because there are already well-developed and safe pedestrian facilities. Maps from the 2010 U.S. Census Bureau identify the locations proposed for bicycle and pedestrian improvements as urbanized.

Benefits provided in NCHRP Report 552 were provided in 2006 dollars and thus needed to be extrapolated to 2018 dollars. In order to do this, inflation adjustment values were calculated between 2006 and 2012 using the gross domestic product taken from Table 1.1.9 Implicit Price Deflators for Gross Domestic Product (BEA, 2016) from the Bureau of Economic Analysis, National Income and Product Accounts webpage. An inflation rate of 1% per year from 2012 to 2018 was then applied, as per Consumer Price Index (CPI-U) data from the State of Hawaii Department of Transportation (HDOT). After accounting for the effects of inflation, to express costs and benefits in real dollars, an adjustment was made to account for the time value of money.

OMB Circular A-94 (*Guidelines and Discount Rates for Benefit Cost Analysis of Federal Programs*) provides a real discount rate of 7% per year to discount benefits and costs to their present value in their BCA. This was applied in calculation of total benefits, Benefit Cost ratio, and net present value. An undiscounted and less conservative 3% discounted rate were also used in calculation of total benefits for comparison.

All benefits reasonably expected to result from the implementation of a project needed to be monetized for inclusion in the BCA. Benefits then needed to be calculated on an annual basis from the year of opening throughout the analysis year.

Walking and cycling play unique and important roles in an efficient and equitable transport system. They provide basic mobility, affordable travel, access to motorized modes, physical fitness and recreation.

Benefits from bike and pedestrian infrastructure projects contribute to most of the benefits discussed above directly or indirectly. The direct benefits from these projects are discussed.

The various benefits monetized as a result of bicycle and pedestrian benefits are provided in **Table 9**. Calculation of these benefits is provided in **Appendix B**.

Table 9. Monetized Benefits for Bicycle and Pedestrian Projects

BENEFIT	DESCRIPTION
Mobility	Increased use as a result of user feeling of increased safety and mobility.
Recreational	User recreational time as a result of facility.
Health	Public health impact benefits resulting from increase in active transportation.
Auto Use	Reduction in vehicle operating costs as a result of modal shift away from vehicle.

In order to quantify benefits, existing users as well as future users resulting from the construction of the proposed project need to be estimated. The approaches for tabulating existing and new cyclists and pedestrians are based on separate methodology presented in NCHRP Report 552. Traffic analysis zone (TAZ) populations were taken from the 2010 U.S. Census and extrapolated to 2019 using a growth rate of 0.5% per year taken from Resident Population by County, US Census Bureau, Population Division. Populations were tabulated for areas within ¼-mile, ½-mile, and 1-mile of the proposed project.

The total number of cyclists is made up of commuting and recreational users. A factor from NCHRP Report 552 was applied to the populations in relation to their distance from the facility for calculation of bicycle trips. Bicycle commuter percentage was assumed to be 0.2%, as reported for the Central Oahu Public Use Microdata Area provided by the US Census Bureau. General assumptions used, as mentioned in NCHRP Report 552, are that 80% of area residents are adults, 50% of adults are commuters, and 0.60% of adults use bicycles. Formulas used to calculate existing and new bicycle users is as follows:

- Daily Existing Bicycle Commuters = R * 80% * 50% * C
- Daily Existing Adult Cyclists = R * 80% * 50% * C
- Daily New Bicycle Commuters = Σ (Existing Bike Commuters * (L -1))
- Daily New Adult Cyclists = Σ (Existing Adult Cyclist * (L -1))
    - R = population
    - C = Commuter%
    - L = average length of trip in miles

Pedestrian trips used TAZ populations for areas within 1-mile of the proposed facility. It was assumed that 10.5% of all trips are made by walking, as reported in National Household Travel Survey data. It is assumed that individuals make an average of 3.2 trips per day, as stated in NCHRP Report 552. Of all pedestrian trip purposes, 15% are made for recreation while 39% are made for exercise or health, as reported in the 2012 National Survey of Pedestrian and Bicyclist Attitudes and Behaviors, Highlights Report, reported on the Pedestrian and Bicycle Information Center webpage. Other trips purposes are less likely to be affected by these projects. New pedestrian trips were estimated to increase 22% as a result of complete street projects, as reported by FHWA to U.S. Congress on the Outcomes of the Non-motorized Transportation Pilot Program SAFETEA-LU Section 1807 and reported by the National Complete Streets Coalition.

2.2.1 Mobility

Pedestrian and bicycle improvement projects increase the mobility for all commuters by improving safety and mobility for pedestrians and cyclists. This can have the effect of increasing active transportation while reducing vehicle use. The increase in bike and pedestrian commuting trips can also have an indirect positive effect in reducing vehicle travel times and hence considered as an added benefit.

With the implementation of bicycle projects, the ability of cyclists to move more freely increases. According to NCHRP Report 552, cyclists are willing to spend more time on commuting depending on the type of facility and whether it is on or off street. The additional time and value tabulated as a result of these facilities is:

- Off-street bicycle facilities: additional 20.38 minutes which equates to $4.80
- On-street bicycle lanes without parking: additional 18.02 minutes which equates to $4.25
- On-street bicycle lane with parking: additional 15.83 minutes which equates to $3.74

These benefits are only applied to commuter travel as recreational riding is not constrained by time. The formula used to calculate existing and new bicycle users is as follows:

- Annual Bicycling Mobility Benefit = M*(V/60)*(Existing Bicycle Commuters + New Bicycle Commuters) * 50 * 5 * 2
    - M = extra time bicyclists are willing to spend per facility type
    - V = hourly value per type

NCHRP Report 552 states that walking is 10 times more common than bicycling as an estimated 70% of adults walk at least once per week while only 7% bike. As a result, NCHRP Report 552 provides methodology to estimate the mobility benefits resulting from increased bicycle ridership however, pedestrian facilities and benefits are considered to have an insignificant impact on total demand. NCHRP Report 552 also states that the mobility benefits are not applicable to pedestrians as it seems unlikely that new facilities will have a significant impact on pedestrians commuting to work. This is also true for bike routes, which are seen to have an insignificant impact on commuting.

Mobility benefits for bicycle and pedestrian projects are provided in **Table 10**.

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Table 10. Mobility Benefits for Bicycle and Pedestrian Projects

Project #	Project Description	Year of Opening	Year of Analysis	Total Opening Year Mobility Benefits (2018 dollars)
200 Bicycle Projects				
Bicycle Paths				
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2019	2040	$48,912
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2019	2040	$20,380
201.4	New Pathway along Kamehameha Hwy from Ka Uka Blvd to Waipahu St	2019	2040	$54,618
201.5	New Pathway connecting Kamehameha Hwy at Waipahu St to Leeward Community College	2029	2040	$46,466
201.6	New Pathway along Kamehameha Hwy between Wahiawa and Anania Dr in Mililani	2019	2040	$60,325
201.7	New Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2029	2040	$17,119
201.8	Bike Pathway through the H-2/Meheula Parkway Interchange	2029	2040	$52,988
201.10	Bike Pathway in Central Oahu Regional Park	2019	2040	$26,086
Bicycle Lanes				
202.3	Bike Lanes on Meheula Parkway between the H-2 Interchange and Kapanoe St	2019	2040	$42,760
202.4	Bicycle Lanes on Kuahelani Ave between Hokuahiahi Park and Meheula Pkwy	2019	2040	$39,569
202.6	Bicycle lanes on Kamehameha Hwy from Waihona St connecting to the Pearl Harbor Bike Path	2029	2040	$28,719
202.7	Bicycle lane on Kamehameha Highway from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$34,463
300 Complete Streets				
Complete Streets (Bicycle Benefits)				
303.2	Complete Streets project for Kipapa Dr Between Hookelewaa St and Mili	2019	2040	$12,334

2.2.2 Recreational Bicycling and Walking

In general, people bicycle and walk for recreation because they enjoy the activity and the improved sense of well-being that comes from it. While there is a monetary cost to owning and maintaining a bike, the apparent cost of any given ride is generally very low. The larger cost of riding is the value of the time that it takes. NCHRP Report 552 provides the net benefits of outdoor recreational activities by subtracting the ownership and time costs from the overall benefits realized from the user as a result of the activity. On average, cyclists ride an estimated 60 minutes per day with a time value savings of $11.80 per hour ($0.20 per minute). The formula used to calculate the recreational benefits resulting from new facilities is as follows:

- Annual Recreational Benefit (For Bicycle Projects) = D * 365 *(Daily New Adult Cyclists – Daily New Bicycle Commuters)
    - D = hourly value
    - Daily New Adult Cyclists – Daily New Bicycle Commuters = New Users who use the facility for Recreational purpose
- Annual Recreational Benefit (For Pedestrian Projects) = D * 365 * (New Pedestrians who use the facility for Recreational purpose)
    - D = hourly value

The recreational benefits of bicycle and pedestrian projects are shown in **Table 11**.

Table 11. Recreational Benefits of Bicycle and Pedestrian Projects

Project #	Project Description	Year of Opening	Year of Analysis	Total Opening Year Recreational Benefits (2018 dollars)
200 Bicycle Projects				
Bicycle Paths				
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2019	2040	$826,944
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2019	2040	$258,420
201.4	New Pathway along Kamehameha Hwy from Ka Uka Blvd to Waipahu St	2019	2040	$814,023
201.5	New Pathway connecting Kamehameha Hwy at Waipahu St to Leeward Community College	2029	2040	$706,348
201.6	New Pathway along Kamehameha Hwy between Wahiawa and Anania Dr in Mililani	2019	2040	$852,786
201.7	New Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2029	2040	$279,955
201.8	Bike Pathway through the H-2/Meheula Parkway Interchange	2029	2040	$835,558
201.10	Bike Pathway in Central Oahu Regional Park	2019	2040	$379,016
Bicycle Lanes				
202.3	Bike Lanes on Meheula Parkway between the H-2 Interchange and Kapanoe St	2019	2040	$891,549
202.4	Bicycle Lanes on Kuahelani Ave between Hokuahiahi Park and Meheula Pkwy	2019	2040	$740,804
202.6	Bicycle lanes on Kamehameha Hwy from Waihona St connecting to the Pearl Harbor Bike Path	2029	2040	$495,305
202.7	Bicycle lane on Kamehameha Highway from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$654,664
Bicycle Routes				
203.1	Bicycle Route on California Ave between Plum St and Iliahi Elementary School	2019	2040	$495,305
203.3	Bicycle Route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$163,666
203.5	Bicycle Route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$430,700

Project #	Project Description	Year of Opening	Year of Analysis	Total Opening Year Recreational Benefits (2018 dollars)
203.6	Bicycle Route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Shopping Center	2019	2040	$766,646
300 Complete Streets				
Complete Streets (Bicycle Benefits)				
303.2	Complete Streets project for Kipapa Dr Between Hookelewaa St and Mililani Waena Elementary School	2019	2040	$292,876
Complete Streets (Pedestrian Benefits)				
303.1	Complete Streets project for California Ave between Kamehameha Hwy and Wahiawa District Park	2019	2040	$277,155
303.2	Complete Streets project for Kipapa Dr Between Hookelewaa St and Mililani Waena Elementary School	2019	2040	$440,463

2.2.3 Health

The benefits of physical activity in enhancing overall health are well established however challenging to monetize. NCHRP Report 552 provides a methodology for estimating the public health impact of bicycle facilities in terms of economic impacts using a value of $151 of health savings per person per year. The formula used to calculate the health benefits resulting from new facilities is as follows:

- Annual Health Benefit (For Bicycle Projects) = Daily New Adult Cyclists * H
- Annual Health Benefit (For Pedestrian Projects) = (New Pedestrians who use the facility for Health purposes) * H
    - H = health savings per person per year

The health benefits of bicycle and pedestrian projects are provided in **Table 12**.

Table 12. Health Benefits of Bicycle and Pedestrian Projects

Project #	Project Description	Year of Opening	Year of Analysis	Total Opening Year Health Benefits (2018 dollars)
200 Bicycle Projects				
Bicycle Paths				
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2019	2040	$34,579
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2019	2040	$11,174
201.4	New Pathway along Kamehameha Hwy from Ka Uka Blvd to Waipahu St	2019	2040	$34,277
201.5	New Pathway connecting Kamehameha Hwy at Waipahu St to Leeward Community College	2029	2040	$29,747
201.6	New Pathway along Kamehameha Hwy between Wahiawa and Anania Dr in Mililani	2019	2040	$35,938
201.7	New Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2029	2040	$11,929

Project #	Project Description	Year of Opening	Year of Analysis	Total Opening Year Health Benefits (2018 dollars)
201.8	Bike Pathway through the H-2/Meheula Parkway Interchange	2029	2040	$35,032
201.10	Bike Pathway in Central Oahu Regional Park	2019	2040	$16,006
Bicycle Lanes				
202.3	Bike Lanes on Meheula Parkway between the H-2 Interchange and Kapanoe St	2019	2040	$37,750
202.4	Bicycle Lanes on Kuahelani Ave between Hokuahiahi Park and Meheula Pkwy	2019	2040	$31,106
202.6	Bicycle lanes on Kamehameha Hwy from Waihona St connecting to the Pearl Harbor Bike Path	2029	2040	$20,989
202.7	Bicycle lane on Kamehameha Highway from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$27,633
Bicycle Routes				
203.1	Bicycle Route on California Ave between Plum St and Iliahi Elementary School	2019	2040	$20,838
203.3	Bicycle Route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$6,946
203.5	Bicycle Route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$18,120
203.6	Bicycle Route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Shopping Center	2019	2040	$32,012
300 Complete Streets				
Complete Streets (Bicycle Benefits)				
303.2	Complete Streets project for Kipapa Dr Between Hookelewaa St and Mililani Waena Elementary School	2019	2040	$12,231
Complete Streets (Pedestrian Benefits)				
303.1	Complete Streets project for California Ave between Kamehameha Hwy and Wahiawa District Park	2019	2040	$116,572
303.2	Complete Streets project for Kipapa Dr Between Hookelewaa St and Mililani Waena Elementary School	2019	2040	$185,277

2.2.4 Reduced Auto Use

A common goal of transportation infrastructure improvement projects is to improve the flow of traffic by reducing congestion. This can be achieved through the increase in capacity or reduction in auto use. USDOT's Revised Departmental Guidance on Valuation of Travel Times in Economic Analysis, publishes guidance on the appropriate value of travel time savings (VTTS) for use in evaluating the benefits of transportation infrastructure investments.

Vehicle operating costs refer to changes in the costs of owning and operating a vehicle. Projects that alter vehicle miles traveled, traffic speed and delay, roadway surfaces, or roadway geometry may affect vehicle operating costs.

It was assumed that on average people work 50 weeks per year for 5 days per week. The distance of commuting trips was multiplied by 2 to account for trips to and from work.

For Bicycle projects, NCHRP Report 552 recommends using a value of $0.094 of savings per mile for suburban areas. It states that auto use benefit are not applicable to pedestrians as it seems unlikely that new facilities will have a significant impact on pedestrians commuting to work. The monetary benefits of travel time and vehicle operating cost savings are tabulated for use under auto use. The formula used to calculate the benefits of reduced auto use resulting from new facilities is as follows:

- Auto Use Benefit = Daily New Bicycle Commuters * L * S * 50 * 5 * 2
  - L = average length of trip in miles
  - S = savings per mile

The auto use benefit for bicycle and pedestrian projects is shown in **Table 13**.

Table 13. Auto Use Benefits for Bicycle and Pedestrian Projects

Project #	Project Description	Year of Opening	End Year of Analysis	Total Opening Year Auto Use Benefits (2018 dollars)
200 Bicycle Projects				
Bicycle Paths				
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2019	2040	$1,739
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2019	2040	$1,579
201.4	New Pathway along Kamehameha Hwy from Ka Uka Blvd to Waipahu St	2019	2040	$2,858
201.5	New Pathway connecting Kamehameha Hwy at Waipahu St to Leeward Community College	2029	2040	$1,551
201.6	New Pathway along Kamehameha Hwy between Wahiawa and Anania Dr in Mililani	2019	2040	$6,392
201.7	New Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2029	2040	$658
201.8	Bike Pathway through the H-2/Meheula Parkway Interchange	2029	2040	$1,429
201.10	Bike Pathway in Central Oahu Regional Park	2019	2040	$719
Bicycle Lanes				
202.3	Bike Lanes on Meheula Parkway between the H-2 Interchange and Kapanoe St	2019	2040	$3,032
202.4	Bicycle Lanes on Kuahelani Ave between Hokuahiahi Park and Meheula Pkwy	2019	2040	$2,876
202.6	Bicycle lanes on Kamehameha Hwy from Waihona St connecting to the Pearl Harbor Bike Path	2029	2040	$902
202.7	Bicycle lane on Kamehameha Highway from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$2,914
Bicycle Routes				
203.1	Bicycle Route on California Ave between Plum St and Iliahi Elementary School	2019	2040	$1,622
203.3	Bicycle Route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$113
203.5	Bicycle Route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$1,410

Project #	Project Description	Year of Opening	End Year of Analysis	Total Opening Year Auto Use Benefits (2018 dollars)
203.6	Bicycle Route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Shopping Center	2019	2040	$3,995
300 Complete Streets				
Complete Streets (Bicycle Benefits)				
303.2	Complete Streets project for Kipapa Dr Between Hookelewaa St and Mililani Waena Elementary School	2019	2040	$611

2.2.5 Safety

Transportation infrastructure improvements can reduce the likelihood of fatalities, injuries, and property damages that result from crashes on the facility, both by reducing the number of such crashes and/or their severity. Estimating the change in the number of fatalities, injuries, and amount of property damage can be done using crash modification factors (CMFs), which relate different safety improvements to crash outcomes. CMFs are estimated by analyzing crash data and types, and relating outcomes to different safety infrastructure. However, NCHRP Report 552 does not recommend including user safety benefits in a quantitative analysis because the data is inconclusive. It goes on to state that the safety of a facility is a factor of the total value included in the Mobility and Recreational benefits. The safety benefits for bicycle and pedestrian projects are shown in **Table 14**.

Table 14. Safety Benefits for Bicycle and Pedestrian Projects

Project #	Project Description	Year of Opening	End Year of Analysis	Total Opening Year Safety Benefits (2018 dollars)
200 Bicycle Projects				
Bicycle Paths				
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2019	2040	$875,856
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2019	2040	$278,800
201.4	New Pathway along Kamehameha Hwy from Ka Uka Blvd to Waipahu St	2019	2040	$868,641
201.5	New Pathway connecting Kamehameha Hwy at Waipahu St to Leeward Community College	2029	2040	$752,814
201.6	New Pathway along Kamehameha Hwy between Wahiawa and Anania Dr in Mililani	2019	2040	$913,111
201.7	New Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2029	2040	$297,074
201.8	Bike Pathway through the H-2/Meheula Parkway Interchange	2029	2040	$888,546
201.10	Bike Pathway in Central Oahu Regional Park	2019	2040	$405,102
Bicycle Lanes				
202.3	Bike Lanes on Meheula Parkway between the H-2 Interchange and Kapanoe St	2019	2040	$934,309
202.4	Bicycle Lanes on Kuahelani Ave between Hokuahiahi Park and Meheula Pkwy	2019	2040	$780,373

Project #	Project Description	Year of Opening	End Year of Analysis	Total Opening Year Safety Benefits (2018 dollars)
202.6	Bicycle lanes on Kamehameha Hwy from Waihona St connecting to the Pearl Harbor Bike Path	2029	2040	$524,024
202.7	Bicycle lane on Kamehameha Highway from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$689,127
Bicycle Routes				
203.1	Bicycle Route on California Ave between Plum St and Iliahi Elementary School	2019	2040	$495,305
203.3	Bicycle Route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$163,666
203.5	Bicycle Route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$430,700
203.6	Bicycle Route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Shopping Center	2019	2040	$766,646
300 Complete Streets				
Complete Streets (Bicycle Benefits)				
303.2	Complete Streets project for Kipapa Dr Between Hookelewaa St and Mililani Mauka	2019	2040	$305,210
Complete Streets (Pedestrian Benefits)				
303.1	Complete Streets project for California Ave between Kamehameha Hwy and Wahiawa District Park	2019	2040	$393,727
303.2	Complete Streets project for Kipapa Dr Between Hookelewaa St and Mililani Mauka	2019	2040	$625,740

2.2.6 Qualitative Based Benefits for Bicycle and Pedestrian Projects

There were six projects for which benefits could not be quantified. These projects and the reason for being unable to quantify benefits are provided in **Table 15**.

Table 15. Bicycle and Pedestrian Projects without Quantifiable Benefits

Project		Reason
303.1	Complete Streets project for California Ave between Kamehameha Hwy and Wahiawa District Park	No change in existing bicycle facilities are being proposed.
301.1	Crosswalk across makai leg of Kamehamenha Hwy intersections at Olive and Avacado Streets	Insufficient distance for calculation of benefits.
302.1	Safe Routes to School	Policy change with no identified infrastructure improvements as of yet.
302.2	Pedestrian Crossing Safety	Policy change with no identified infrastructure improvements as of yet.
302.3	Mobility Hubs	Policy change with no identified infrastructure improvements as of yet.
303.3	Complete Streets Projects on Priority Roads	Policy change with no identified infrastructure improvements as of yet.

2.2.7 Sum of Benefits for Bicycle and Pedestrian Projects

Table 16 provides a summary of the total annual benefits for bicycle and pedestrian projects. This includes benefits associated with the following: mobility (**Table 10**), recreation (**Table 11**), health (**Table 12**), reduced auto use (**Table 13**), and safety (**Table 14**).

Table 16. Sum of Annual Benefits for Bicycle and Pedestrian Projects

Project #	Project Description	Year of Opening	Year of Analysis	Total Opening Year Benefits (2018 dollars)
200 Bicycle Projects				
Bicycle Paths				
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2023	2040	$1,788,030
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2028	2040	$570,353
201.4	New Pathway along Kamehameha Hwy from Ka Uka Blvd to Waipahu St	2028	2040	$1,794,758
201.5	New Pathway connecting Kamehameha Hwy at Waipahu St to Leeward Community College	2028	2040	$1,553,645
201.6	New Pathway along Kamehameha Hwy between Wahiawa and Anania Dr in Mililani	2028	2040	$1,892,939
201.7	New Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2028	2040	$611,925
201.8	Bike Pathway through the H-2/Meheula Parkway Interchange	2028	2040	$1,831,509
201.10	Bike Pathway in Central Oahu Regional Park	2028	2040	$837,009
Bicycle Lanes				
202.3	Bike Lanes on Meheula Parkway between the H-2 Interchange and Kapanoe St	2019	2040	$1,909,400
202.4	Bicycle Lanes on Kuahelani Ave between Hokuahiahi Park and Meheula Pkwy	2019	2040	$1,594,728
202.6	Bicycle lanes on Kamehameha Hwy from Waihona St connecting to the Pearl Harbor Bike Path	20287	2040	$1,069,939
202.7	Bicycle lane on Kamehameha Highway from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$719,674
Bicycle Routes				
203.1	Bicycle Route on California Ave between Plum St and Iliahi Elementary School	2019	2040	$1,013,070
203.3	Bicycle Route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$334,391
203.5	Bicycle Route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$880,930
203.6	Bicycle Route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Shopping Center	2019	2040	$1,569,299
300 Complete Streets				
Complete Streets (Bicycle Benefits)				
303.2	Complete Streets project for Kipapa Dr Between Hookelewaa St and Mili	2023	2040	$623,262
Complete Streets (Pedestrian Benefits)				

Project #	Project Description	Year of Opening	Year of Analysis	Total Opening Year Benefits (2018 dollars)
303.1	Complete Streets project for California Ave between Kamehameha Hwy and Wahiawa District Park	2028	2040	$787,454
303.2	Complete Streets project for Kipapa Dr Between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$1,251,480

2.3 Identification and Monetization of Benefits for Roadway Projects

Monetized benefits of roadway projects include an array of elements including travel time savings, lower vehicle operating costs based on reduced travel distance, safety enhancements in the form of fewer collisions, and reduced vehicle emissions resulting in improved air quality. These benefits are described in detail in the *Benefit Cost Analysis Guidance for Discretionary Grant Programs* published by the U.S. Department of Transportation (July 2017). This document was used to develop the primary methodology for evaluating the pertinent benefits and costs associated with roadway projects in this study. Additional ancillary benefits of roadway project are described in the USDOT document (including resilience, work zone impacts, noise pollution, etc.). However, most of these require a finer-grained level of analysis than conducted for this study and are not addressed here. The roadway project benefits considered in this study are shown in **Table 17**. Calculations of these benefits are provided in **Appendix C**. Benefits were not calculated for Project 403.7, Kamehameha Highway Roosevelt Bridge (rehabilitation) since the project is not one that adds capacity or has a transportation benefit. Rather, it is a bridge rehabilitation. Any benefits to the transportation network would be due to structural integrity of the facility and are not calculated here.

Table 17. Roadway Project Benefits

Guidance Based	Included in Review	Qualitative Based	Included in Review
Travel Time Savings	✓	Congestion	
Vehicle Operating Cost Savings	✓	Equity/Mobility	
Safety	✓	Noise	
Emissions Reduction	✓	Parking Cost Savings	
		Chauffeur Driver Savings	
		Route Shift	
		Real Estate	
		Economic Benefits	

2.3.1 Travel Time Savings

The construction of new or expanded roadway facilities is intended to increase vehicle capacity for purposes of reducing travel delays, especially during peak congestion periods. Reducing delays results in travel time savings and increased reliability, which has both quality of life and discernible economic benefits in terms of increased employee productivity and the value of personal and/or business travel time. This benefit can be estimated based on the reduced travel time between select destinations within the study area between a set of defined origin and destination (O-D) pairs as listed in Performance Measure 4 described in Deliverable B-2 and subsequently applied and quantified in Deliverable E-1 for this study. The savings in travel time (or slight increase in some cases) is the combination of reduced travel time between all O-D pairs.

The USDOT BCA Guidance document includes specific monetary values of time for personal travel and business travel, as well as a blended value for personal and business travel time when the split of each is not known. That is the case in this study where the OahuMPO travel demand model (like most regional travel demand models does not readily discern between these types of trips. The blended value in 2016 dollars is $14.10 per person-hour for private vehicle use as shown in Table 6 of Appendix A to the BCA Guidance document. This value was inflation-adjusted to 2018 dollars using data from www.usinflationcalculator.com and results in a blended value of $14.72.Since the output from the model for individual street segments is in vehicle trips, an average vehicle occupancy factor of 1.4 from the model was applied to the projected vehicle volume at each project site location to convert the number of vehicle-hours saved to person-hours saved.

The summary of the monetized travel time savings benefits for the applicable projects is included in **Table 18**.

Table 18. Roadway Project Travel Time Savings

Project Number	Project Description	Travel Time		
		Travel Time Saved/Year (person-hrs)	Value of Time	Total Annual Travel Time Benefit
400 ROADWAY PROJECTS				
403	**KAMEHAMEHA HIGHWAY**			
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	883,289	$ 14.72	$13,002,014
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	670,143	$ 14.72	$9,864,505
404	**H-2 INTERCHANGES**			
404.2	H-2 & Meheula Pkwy (widen on-ramp)	369,424	$ 14.72	$5,437,921
405	**H-1 & H-2 INTERCHANGE**			
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvement	238,000	$ 14.72	$3,503,360
406	**CENTRAL MAUKA ROADS**			
406.1	New Road between Mililani Mauka and Pearl City	1,048,521	$ 14.72	$15,434,229
406.3	New Road between California Ave and Meheula Pkwy	7,479	$ 14.72	$110,091
408	**MILILANI ACCESS**			
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	224,702	$ 14.72	$3,307,613
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	18,360	$ 14.72	$270,259

2.3.2 Automobile Operating Cost Savings

Enhanced roadway capacity can also reduce the overall distance that vehicles must travel to reach their destination. This is especially true of new roads or widened roadways that reduces diversion or shortens the overall travel path. Use of the travel demand model for the more substantive roadway projects allows for the calculation of the change in vehicle miles of travel (VMT) resulting from individual project

implementation. In some cases, VMT may actually increase with a project if the longer path can be traveled a higher rate of speed, which will reduce the overall travel time for a trip.

For this study, VMT was calculated for both the COTS study area, as well as for the entire island of Oahu, which is the geographic extent of the model roadway network. This analysis uses the COTS area VMT to show the immediate area benefit of the applicable projects. Specifically, the change in VMT between conditions with each project and the 2040 baseline condition was used to identify the reduced travel distance and corresponding reduced vehicle operating cost.

The cost of operating a vehicle is directly related to the number of miles driven, and reducing overall VMT can directly translate to lower operating costs in terms of fuel, maintenance, tires, etc. The US DOT BCA Guidance document identifies per mile vehicle operating cost for a car as $0.40 per mile (in 2016 dollars) as shown in Table 8 of Appendix A. Inflation adjusted for 2018, this value is $0.42 per mile. While some of the vehicles using the study area roadways are trucks, which have a higher operating cost (and corresponding greater potential savings), the proportion of trucks is less than 5% of the total vehicle flow on all of the study roadways. As such, the resulting operating savings using only car operating cost savings are considered conservative for purposes of this analysis.

The summary of the monetized travel time savings benefits for the applicable projects is included in **Table 19**.

Table 19. Roadway Project Vehicle Operating Cost Savings

Project Number	Project Description	Vehicle Operating Costs Savings		
		Vehicle Miles Saved/Year[1]	Operating Cost	Total Annual Vehicle Operating Cost Benefit
400ROADWAY PROJECTS				
403	**KAMEHAMEHA HIGHWAY**			
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	-329,460	$0.42	-$138,373
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	2,539,800	$0.42	$1,066,716
404	**H-2 INTERCHANGES**			
404.2	H-2 & Meheula Pkwy (widen on-ramp)	-392,445	$0.42	-$164,827
405	**H-1 & H-2 INTERCHANGE**			
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvement	0	$0.42	$0
406	**CENTRAL MAUKA ROADS**			
406.1	New Road between Mililani Mauka and Pearl City	374,595	$0.42	$157,330
406.3	New Road between California Ave and Meheula Pkwy	643,620	$0.42	$270,320
408	**MILILANI ACCESS**			

Project Number	Project Description	Vehicle Operating Costs Savings		
		Vehicle Miles Saved/Year[1]	Operating Cost	Total Annual Vehicle Operating Cost Benefit
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	1,085,025	$0.42	$455,711
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	0	$0.42	$0
[1] Negative number indicates increase in vehicle miles traveled; thus, negative benefit amount indicates increased cost for drivers.				

2.3.3 Safety Benefits

Depending on the collision history of a particular location, safety benefits can amount to a substantial savings with implementation of a project, if it can be shown that an improvement will reduce the likelihood of a fatal, injury or property damage only (PDO) collision. The greatest benefits are achieved when fatal collisions are avoided given their order of magnitude higher cost.

The US DOT BCA guidance document includes the cost of various collisions from PDO through fatalities with several levels of injury severity. At the high end, the cost of a fatal collision is the most expensive at $9,600,000 (in 2016 dollars) is shown in Table 4 of Appendix A of that document. At the low end, the cost of a PDO collision is identified as $4,252 as shown in Table 5. Table 4 also lists various levels of injury severity with corresponding costs. The average of these costs in 2016 dollars is $216,000, which is the assumed value for an injury collision for this study. Inflation-adjusted to 2018 dollars these costs are as follows:

- PDO = $4,439
- Injury = $225,485
- Fatal = $10,021,548

Since this area-wide study only identified the number of collisions by mode and did not identify the severity of a collision (e.g., whether or not it included serious injuries or resulted in property damage only (PDO)), additional research was conducted to identify the proportion of each type of collision along a given roadway segment. From a research paper entitled *Transportation Research Record 1467: Analyzing the Relationship Between Crash Types and Injuries in Motor Vehicle Collisions in Hawaii* (Kim, Nitz, Richardson and Li), the relative proportions of collisions fatal collisions is as follows: 0.1% fatal, 19.0% injury, and 80.9% property damage only. It is important to note that no vehicle collision fatalities were recorded in the study area between 2014 and 2016 for roadway segments where projects were selected for BCA. Thus, the proportion of PDO collisions on a given roadway is assumed to be 81% of all collisions, and injury collisions are assumed to represent 19% of all collisions.

The challenge with determining the specific safety benefit of a project is that widening projects of existing roadways or even the construction of a new roadway does not necessarily result in fewer or less severe collisions. The most effective improvements are those that completely eliminate conflicts such as grade-separating two facilities or eliminating turning movement conflicts through median channelization or other physical means. However, it can be assumed that some safety enhancement will occur with: 1) widening of roadways to appropriate design standards and/or 2) reducing congestion or volume by

providing new roadways. For the H-1 Corridor Study conducted for HDOT, the implementation of improvement projects was assumed to result in a potential 10% reduction in the number of collisions in a given corridor or area for purposes of prioritizing projects and establishing a potential safety benefit. No reduction in collision severity was assumed with this approach.

For this study, only one of the roadway projects (Project 403.8 – Kamehameha Highway HOT Lanes) would affect a street with a substantive number of collisions where a 10% reduction would result in a calculable safety savings. The number of collisions per year between 2014 and 2016 on Kamehameha Highway between Ka Uka Boulevard and Waipahu Street varied from four (4) to 13, with the highest number of 13 occurring each year in 2014 and 2016. Applying the proportional percentages of 81% for PDO and 19% for injury collisions from above, this would correlate to a maximum of 10.5 PDO collisions and 2.5 injury collisions per year at this location. If the total number of PDO collisions could be reduced by 10%, that would result in 1.05 PDO collisions that could be avoided annually with the proposed project (for purposes of calculating the safety benefit). Reducing the 2.5 injury collisions by 10% would result in 0.25 injury collisions avoided per year. Fractional collision numbers are used in the benefit cost analysis since benefits are calculated over the life of the project (typically 20 or more years) and will have incremental benefits over this period. **Table 20** shows the safety benefits for Project 403.8.

Table 20. Safety Benefits for Roadway Projects

Project Number	Project Description	Safety						
		Fatalities Reduced	Fatality Value	Serious Injuries Avoided	Serious Injury Value	PDO Avoided	PDO Value	Total Safety Benefit
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	-	$10,021,548	0.25	$225,485	1.05	$4,439	$61,032

2.3.4 Emissions Reduction Benefits

In addition to reducing congestion, roadway improvement projects can also have the added benefit of reducing air pollutant emissions through lower VMT levels and travel speeds closer to optimal levels. Emissions are much greater under stop and go conditions and lower congested VMT can minimize vehicle output of these pollutants. While, the island of Oahu and the State of Hawaii does not have the air quality problems of numerous other states, emissions reductions can still be quantified and counted as a benefit for applicable roadway projects.

Use of the OahuMPO travel demand model allows for the direct calculation of various emissions. For this study, the pollutants used in the emissions reduction benefit calculation include the following: Volatile Organic Compounds (VOCs), nitrogen oxides (NOx), and particulate matter (PM). The model provides the output of these emissions in grams, and these weights are converted to short tons for purposes of quantifying annual emissions benefits. The corresponding damage costs per short ton in 2016 dollars are provided in Table 9 from Appendix A to the US DOT BCA guidance document for each of the pollutants items is $1,872, $7,377, and $337,459, respectively. Adjusted for 2018 dollars, these values are as follows:

- VOCs = $1,954
- NOx = $7,701
- PM = $337,459

The amount of each pollutant avoided is multiplied by the corresponding monetary value and then the savings are totaled to determine the total emissions reduction benefit, as shown in **Table 21**.

Table 21. Roadway Project Emissions Reduction Savings

Project Number	Project Description	Emissions Savings			
		VOC Value Saved/Year[1]	NOx Value Saved/Year[1]	PM Value Saved/Year[1]	Total Annual Emissions Benefit
400 ROADWAY PROJECTS					
403	**KAMEHAMEHA HIGHWAY**				
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	$299	$982	$13,486	$14,767
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	$249	$1,964	$9,890	$12,103
404	**H-2 INTERCHANGES**				
404.2	H-2 & Meheula Pkwy (widen on-ramp)	$0	-$196	$0	-$196
405	**H-1 & H-2 INTERCHANGE**				
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvement	$0	$0	$0	$0
406	**CENTRAL MAUKA ROADS**				
406.1	New Road between Mililani Mauka and Pearl City	$1,844	$4,124	$62,935	$68,902
406.3	New Road between California Ave and Meheula Pkwy	$50	$393	$899	$1,342
408	**MILILANI ACCESS**				
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	$349	$1,178	$11,688	$13,215
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	$0	$0	$0	$0

[1] Negative number indicates increase in vehicle miles traveled; thus, negative benefit amount indicates increased cost for drivers.

2.3.5 Sum of Benefits for Roadway Projects

Table 22 provides the summary of the total benefit value for all applicable roadway projects. This includes benefits associated with the following: travel time savings (**Table 18**), automobile operating cost savings (**Table 19**), safety (**Table 20**), and emissions reduction (**Table 21**).

Table 22. Sum of Benefits for Roadway Projects

Project Number	Project Description	Total Annual Roadway Project Benefit Value
400 ROADWAY PROJECTS		
403	**KAMEHAMEHA HIGHWAY**	
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	$12,878,408
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	$11,004,356
404	**H-2 INTERCHANGES**	
404.2	H-2 & Meheula Pkwy (widen on-ramp)	$5,272,898
405	**H-1 & H-2 INTERCHANGE**	
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvement	$3,503,360
406	**CENTRAL MAUKA ROADS**	
406.1	New Road between Mililani Mauka and Pearl City	$15,660,461
406.3	New Road between California Ave and Meheula Pkwy	$381,753
408	**MILILANI ACCESS**	
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	$3,776,539
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	$270,259

Appendix C provides additional calculation details for the benefit categories by project.

2.4 Identification and Monetization of TDM, ITS, and Pricing Projects

The goal of the TDM program is to help move commuters from single occupant vehicles to carpooling, transit, or other modes of travel. Encouraging those whose employment is conducive to working-at-home is part of the alternative transportation mix. In many cases, employees are able to work at home at least one day a week. The success of the program can be determined by the number of vanpools formed, employers participating in a ride home program, and number of carpools formed. The following monetizes the benefits of the TDM program by estimating VMT saved by the formation of vanpools and applying those savings to those benefits that can be measured. The benefits are estimated to begin accruing in 2021 with 20 ten-person vanpools being formed. The benefits were estimated based on each ten-person vanpool coming from single occupant vehicles.

Monetized benefits of ITS and Pricing projects include travel time savings, which are described in detail in the *Benefit Cost Analysis Guidance for Discretionary Grant Programs* published by the U.S. Department of Transportation (July 2017). The summary of monetized TDM, ITS, and Pricing benefits is shown in **Table 23**.

Table 23. Summary of TDM Benefits

Project Number	Project Description	Benefits						
		Vehicle Operating Cost Saving	Safety	Emissions Reduction	Congestion Reduction	Noise	Travel Time Savings	Total Benefits
500 TRANSPORTATION SYSTEM MANAGEMENT								
501	**TRANSPORTATION DEMAND MANAGEMENT (TDM)**							
501.1 through 501.10	TDM Package	$642,600	$262,414	$32,130	$1,845,180	$2,988		$2,785,312
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**							
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	--	--	--	---	--	$525,504	$525,504
600 PRICING PROJECTS								
601	**PRICING**							
601.2	HOT Lanes	--	--	--	---	--	$1,839,264	$1,839,264
601.3	Parking Strategies	--	--	--	---	--	--	--

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3.0 COST ANALYSIS: CONSTRUCTION AND LAND

The cost of transportation projects is a combination of the resources, such as land, labor, and materials, expended on the project by the entity (e.g., agency) providing the project. These costs are agency costs and do not include costs borne by the users of the facility once complete. Unlike Benefits, which have to be assigned a value based on the unit of measure, costs represent goods or services that already have an associated value. The following sections provide the construction costs for each project, as well as the land cost for those projects requiring right-of-way (ROW).

3.1 Transit

3.1.1 Construction Costs

Three transit projects are listed under the "General" category:

- 101.1 Bus Service Expansion,
- 101.2 Construct Transit Center at Koa Ridge, and
- 101.3 City Bus Operations & Maintenance (O&M) in Central Oahu.

Planning level construction or initiation costs listed for **Project 101.1** are for the purchase of ten buses for the expansion of service in the COTS area. On June 6, 2018 the Honolulu City Council passed on second reading Bill 8. The purpose of Bill 8 is to set pollution control requirements for certain City buses as stated in the bill. The bill's intent is to have zero-emissions buses used to service routes serving the rail stations or operating within 100 years of a rail station. The bill includes using zero-emissions buses beginning when the rail system is operational at all stations. Bill 8 has a caveat that "This requirement does not apply to routes that include at least one bus stop that is at least three miles away from the closest Honolulu High-Capacity Transit Corridor Project rail station …" (City & County of Honolulu, 2018). Bill 8 is on the August 30, 2018 Committee on Transportation agenda.

The cost estimate for **Project 101.1** is for the purchase of electric buses. While most Central Oahu bus routes have at least one bus stop at least three miles away from a rail station, it is anticipated that DTS will transition to a zero-emission fleet as new electric buses are procured. The estimated cost has been inflated by 2% per year for a purchase year of 2020 for service start in 2021 and total cost of $8,885,000. The average age that 35-foot or larger buses are retired is 12 years. Therefore, the life of the project is stated at 12 years. Retained bus services would be incorporated into DTS's annual O&M budgets and on-going bus replacement programs.

Project 101.2 will be built by Castle & Cooke as part of the Koa Ridge Development and is not included in this section. **Project 101.3** is an ongoing annual program to support transit services identified by the DTS and included in the OahuMPO *Oahu Regional Transportation Plan* (ORTP). This is an operations and maintenance project; therefore, construction costs are not provided.

The planning level initiation costs for General Transit Projects are shown in **Table 24**.

Table 24. Construction Costs for General Transit Projects

Project Number	Project Description	Timing		Construction/ Initiation Cost
		Life of Project	Year Open	
100 TRANSIT PROJECTS				
101	**GENERAL**			
101.1	Bus Service Expansion	12	2021	$8,710,000
101.2	Construct Transit Center at Koa Ridge	N/A	N/A	N/A
101.3	City Bus Operations & Maintenance in Central Oahu, including Bus Stop/Shelter Conditions	N/A	ongoing	N/A

The planning level construction costs for the five High Capacity Transit projects are summarized in **Table 25** and detailed in the following paragraphs.

Table 25. Construction Costs for High Capacity Transit Projects

Project Number	Project Description	Timing		Construction/ Initiation Cost
		Life of Project	Year Open	
102	**HIGH CAPACITY TRANSIT**			
102.2	Light Rail between Wahiawa and Leeward Community College Rail Station	40	2028	$414,460,000
	Light Rail between Kamehameha Highway & Meheula and Mililani Mauka at Lehiwa	40	2028	$163,572,000
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	40	2025	$30,217,600
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	40	2025	$100,437,000
	Pedestrian/Bicycle bridge from Koa Ridge to Flyer Stop	40	2025	$3,463,400
102.6	HART rail technology between Mililani and Pearl Highlands Rail Station	40	2030	$894,310,350
102.8	Aerial Gondola between Mililani Mauka and Leeward Community College Station	40	2028	$283,972,000

Two projects, Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station (Project 102.3), with extension to Mililani Mauka, and the Park-and-Ride in the median of H-2 (Project 102.5), with pedestrian bridge to Koa Ridge, are shown as opening in 2025. This is to coincide with the full opening of the rail system to Ala Moana Center. These two projects would provide needed capacity for accessing the rail system at Pearl Highlands, either by BRT or additional parking.

Project 102.3 Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station includes a mix of BRT treatments in the congested peak period areas in Wahiawa and Mililani, and operations in general purpose traffic on segments of Kamehameha Highway, H-2, and Koa Ridge. BRT treatments include bus only painted lanes and upgraded stops. Stops will include information signage showing bus arrival times and fare machines. BRT costs of $3.5 million per mile are based on industry experience. The costs include

ramp metering with a bus and HOV bypass lane onto town bound H-2 at Meheula Parkway and Ka Uka Boulevard. A 30% contingency is added.

Description	Unit Cost	Units	Total Cost
BRT Treatments	$3,500,000/mile	6.9 miles	$24,230,000
Ramp Metering	$100,000/ramp	2 ramps	$200,000
Contingency	30%		$7,329,000
Total			**$31,759,000**

The costs for **Project 102.5 Park and Ride with Flyer Stop in Median of H-2 Mauka of Ka Uka Boulevard**, include construction of a 2,000-space parking garage, 400 parking spaces in an open lot, two H-2 on-ramps, two H-2 off-ramps, internal circulation areas, and four bus stops with passenger waiting area amenities (shelter, seating, lighting). The two on-ramps to H-2, one in each direction should have a minimum length of .4 miles. The two off-ramps from H-2 should have a minimum length of .25 mile. A separate cost is shown in **Table 25** for a pedestrian and bicycle bridge connecting the Koa Ridge Development to the transit stops. The pedestrian/bicycle bridge is contingent on Castle & Cooke's agreement for a connection to their development. This may prove desirable to the development if future use of the median includes a HART rail station.

Description	Unit Cost	Units	Total Cost
Structure Parking	$30,000/space	2,000 spaces	$60,000,000
Ground Parking	$10,000/space	400 spaces	$ 4,000,000
Ramps & Circulation			$17,200,000
Contingency	30%		$24,360,000
Total			**$105,560,000**

Description	Unit Cost	Units	Total Cost
Bike/Ped Bridge	$450 square foot	4,000 sq. feet	$ 1,800,000
Ramps			$ 1,000,000
Contingency	30%		$840,000
Total			**$3,640,000**

The final three high capacity transit projects have a project opening of 2028 or 2030. These projects, Light Rail between Wahiawa and Leeward Community College (Project 102.2), HART rail technology between Mililani and Pearl Highlands rail station (Project 102.6), and the Aerial Gondola (Project 102.8), all require additional environmental studies, funding identification, and construction mitigation.

Planning level construction costs for **Project 102.2 Light Rail between Wahiawa and Leeward Community College Rail Station**, are shown for two project segments. The main line is between the community college and Wahiawa Park-and-Ride Lot and the Mililani Mauka segment is from Kamehameha Highway and Meheula Parkway (near the Post Office) and terminating at Lehiwa Drive. Costs for construction are differentiated by at-grade and structure costs.

At grade construction costs are estimated at $35,000,000 per mile while structure costs are estimated at $100,000,000 per mile. A 30% contingency has been added to all High Capacity Transit costs. An additional $25,000,000 is included for the pedestrian connection to Leeward Community College and unknown

mitigation costs. The structure costs include shared use paths (SUP) paralleling the tracks to serve as an emergency safety walkway. The length of elevated track serving the Mililani Mauka Park-and-Ride Lot does not include a SUP as that is provided as part of a separate pedestrian/bicycle project described in Project 408.4.

The Wahiawa alignment includes 1.44 miles of elevated structure, 5.2 miles of at-grade track, and 13 stations. Ten of the stations serve two tracks and three serve a single track. This alignment includes 11 signalized intersections including a new intersection for the Koa Ridge Development. Costs for the Wahiawa alignment are shown below:

Description	**Unit Cost**	**Units**	**Total Cost**
Elevated Structure	$100,000,000/mile	1.44 miles	$144,000,000
At Grade	$35,000,000/mile	5.20 miles	$182,000,000
Contingency	30%		$97,800,000
Ped Bridge/Mitigation			$25,000,000
Total			**$448,800,000**

The Mililani Mauka alignment includes 0.61 miles of elevated structure, 2.15 miles of at-grade track, and 5 stations. Three of the stations serve two tracks and two serve a single track. This alignment includes 11 signalized intersections. Costs for the Mililani Mauka alignment are shown below:

Description	**Unit Cost**	**Units**	**Total Cost**
Elevated Structure	$100,000,000/mile	0.61 miles	$61,000,000
At Grade	$35,000,000/mile	2.15 miles	$75,250,000
Contingency	30%		$40,875,000
Total			**$177,125,000**

The combined cost for both alignments is estimated at $625,925,000. **Table 26** details the description for at-grade and structure sections for both alignments.

Table 26. At-Grade and Structure Sections for Wahiawa and Mililani Mauka Alignments for High Capacity Rail Project

Section			TRACK		SHARED USE PATH	FEATURES
No.	Begin	End	No.	Length in feet	Length in feet	
Wahiawa Alignment						
1	Before the Leeward CC Station	After Waipahu Street Station	2	1,670	1,670	At grade on fill next to ramp. Shared use path (SUP) parallels rail line
2	After the Waipahu Street Station	After the Lumiauau Street Station	1	3,000	3,000	On elevated structure over H-1. SUP parallels single track rail line on structure and serves as emergency safety walkway for rail.
3	After the Lumiauau Street Station	After Koa Ridge Station	2	8,230	0	At grade in the middle and along the Diamond Head side of Kamehameha Highway.
4	After Koa Ridge Station	Before the Anania Drive Station	1	4,590	4,590	On elevated structure over Kipapa Gulch. SUP parallels single track rail line on structure and serves as emergency safety walkway for rail.
5	After the Anania Drive Station	Before the Meheula Station	2	5,593	0	At grade along the Diamond Head side of Kamehameha Parkway. The Anania Drive Station connects to the pedestrian bridge.
6	After the Meheula Station	Wahiawa Park and Ride Station	1	11,750		At grade operating along the Diamond Head side of Kamehameha Highway.
Mililani Mauka Alignment						
7	After Meheula Station	Before the H-2 Flyer Stop	2	6,787	0	At grade along the mauka side of Meheula Parkway which is mostly an existing greenway.
8	Before the H-2 Flyer Stop	Immediately after the H-2 Flyer stop	2	800	0	On elevated Structure with two directional rail tracks but no SUP because that is provided as part of the Flyer Stop configuration.
9	Immediately after the H-2 Flyer Stop	Before the Makaikai Street Station	1	2,400	0	On elevated Structure with one rail track and no SUP because that is provided as part of the Flyer Stop configuration.
10	Before the Makaikai Street Station	After the Lehiwa Drive station	1	4,500	0	At grade single track along the mauka side of Meheula Parkway.

The most expensive project to construct in those listed is **Project 102.6 HART Rail Technology between Mililani Mauka and Pearl Highlands Rail Station**. The project includes three stations, one serving Waipio requiring a pedestrian/bicycle bridge connection, one serving Koa Ridge via Project 102.5, and the terminus at the Mililani Mauka Park-and-Ride. Construction cost estimates are based on HART experience for guideway and stations.

The current system is estimated to cost over $400,000,000 per mile including stations and vehicles. The cost estimate for an extension to Mililani Mauka is substantially less since cost items such as the vehicles and maintenance and operations center do not need to be included. The extension is not expected to have right of way acquisition costs although there are five utility crossings along H-2 corridor that the guideway will need to avoid. Due to the utility crossings and additional structural support required for the guideway (over the gulch), two cost line items have been added in the following estimate:

Description	**Unit Cost**	**Units**	**Total Cost**
Guideway	$85 million/mile	5.75 miles	$488,750,000
Stations	$25 million/station	3	$75,000,000
Contingency	30%		$169,125,000
Supplemental Structure to Support Guideway			$170,000,000
Additional Mitigation			$85,000,000
Total			**$987,875,000**

Construction costs for **Project 102.8 Aerial Gondola between Mililani Mauka and Leeward Community College Rail Station** include 40 towers to support the system and seven stations. Stations are estimated to be half the size of HART technology stations due to the much smaller size of the vehicles. The stations are located at or near the following:

- Mililani Mauka Park-and-Ride Lot
- Mililani Transit Center
- Meheula Parkway and Kamehameha Highway
- Location near pedestrian overpass of Kamehameha (Anania Drive on Diamond Head side and Lanikuhana
- Koa Ridge Development mauka of Ka Uka Boulevard
- Waipio Uka
- Leeward Community College

The United States does not have a lot of experience with building aerial gondola systems other than point to point systems with two stations. However, these systems are gaining interest from cities looking at ways to reduce High Capacity Transit costs and have looked at systems internationally such as that built and being expanded in La Paz, Bolivia. There are systems in the United States such as in Breckenridge, Colorado which has two intermediate stations (four total) that has been in operation for fifteen years. Breckconnect operates year round, not just during the ski season. The following provides the estimated costs:

Description	**Unit Cost**	**Units**	**Total Cost**
Aerial Guideway	$25 million/mile	6.2 miles	$155,000,000
Stations	$10 million/station	7	$70,000,000
Contingency	30%		$67,500,000
Additional Mitigation			$15,000,000
Total			**$307,500,000**

3.1.2 Transit Land Costs

Table 27 provides a brief description of the ROW components for each project.

Table 27. Transit Project Right-of-Way Components

Project Number	Description	ROW Requirements
101.2	On-street transit center on both sides of the street	400-feet length 20-feet width 2-directions
102.2	Light Rail between Wahiawa and Leeward CC	27-feet wide for double track 15-feet wide for single track 52-feet wide minimum at stations for double track 30-feet wide minimum at stations for single track 250-feet length for stations
102.3	Bus Rapid Transit	10,000-feet length BRT treatment 20-feet width 2-directions
102.5	Park-and-Ride and Transit Center in H-2 median	2,000-feet length by 200-feet width for parking and circulation 1,320-feet by 12-feet for off-ramps (2) 2,112-feet by 12-feet for on-ramps (2)
102.6	HART Technology	30,360-feet by 12-feet for guideway 40-feet by 100-feet average for stations (3)
102.8	Aerial Gondola	20-feet by 20-feet for towers (40) 20-feet by 100-feet for stations (7)

General Transit **Projects 101.1** and **101.3** are transit service projects involving existing or expanded transit routes. These projects do not require any additional ROW as buses will operate in general purpose traffic lanes. **Project 101.2** is an on-street transit center being constructed by Castle & Cooke as part of the Koa Ridge Development. The ROW requirement is just under 0.4 acres, but no land costs are associated with the project.

The High Capacity Transit projects all have ROW requirements as shown in **Table 28**. However, all projects are expected to be constructed within the City or State ROW. The exception is for the pedestrian and bicycle bridge connecting to **Project 102.5**. Access will be required from the Koa Ridge Development. However, it is expected that access from one of the two General Preservation sites fronting H-2 near the project area can be used for this purpose without cost to the project (Castle & Cooke, 2018).

Table 28. Right-of-Way Requirements for Transit Projects

Project Number	Project Description	Right of Way (Land)		Land Subtotal ($)
		ROW Acres	Cost/Acre	
100 TRANSIT PROJECTS				
101	**GENERAL**			
101.1	Bus Service Expansion	0.0	0.0	0.0
101.2	Construct Transit Center at Koa Ridge	.37	0.0	0.0
101.3	City Bus Operations & Maintenance in Central Oahu, including Bus Stop/Shelter Conditions	0.0	0.0	0.0
102	**HIGH CAPACITY TRANSIT**			
102.2	Light Rail between Wahiawa and Leeward Community College Rail Station with Mililani Mauka extension	29.4	0.0	0.0
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	4.6	0.0	0.0
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd with pedestrian/bicycle bridge from Koa Ridge	10.9	0.0	0.0
102.6	HART rail technology between Mililani and Pearl Highlands Rail Station	8.4	0.0	0.0
102.8	Aerial Gondola between Mililani Mauka and Leeward Community College Station	1.8	0.0	0.0

3.2 Bicycle and Pedestrian Projects

3.2.1 Construction Costs

The estimating methodology was based on the parametric methods which are typically applied to projects in the planning, scoping, or early design stage. These methods involve techniques that use historical data to define the cost of the typical transportation facility using measurements that are easily determined, such as cost per lane mile, cost per interchange, cost per square foot and cost per intersection.

The estimates of probable construction costs have been prepared based on the overall project description to define the major parameters, including the overall length of the project, the major elements such as bike lane or multi-use path extents, traffic signal installation and intersection modifications. Detailed quantity estimates were not prepared as this would occur at a later phase.

Where available, the historical data based on prices from recent projects of similar nature and scope were used in the parametric estimating. Where historical data from analogous projects was not available, the British Columbia Ministry of Transportation and Infrastructure *Construction and Rehabilitation Cost Guide* (2013) was used for parametric estimating of project such as interchanges, bridge widening, and lane-mile costs, in which quantification of the major items was not possible. The costs were converted to current US dollars and adjusted to reflect the local construction conditions in Hawaii.

Since the estimated costs and project definition is limited to the functional approach and broad concept approach, a contingency amount of 30% was included within each project to provide for some allowance of unknown factors, and inherent project risks.

Although the actual costs may vary due to market conditions and economy of scale, or other factors, these costs are considered reasonable for Planning-Level cost estimating purposes. These costs are based on 2017 dollars and do not include taxes.

Estimated construction costs for bicycle and pedestrian projects are provided in **Table 29**. Tables showing the calculations of construction costs are provided in **Appendix D**.

Table 29. Construction Costs for Bicycle and Pedestrian Projects

Project Number	Project Description	Construction Cost (2018 $ Values)
200 BICYCLE PROJECTS		
201	**BICYCLE PATHS (Off-street bicycle facility)**	
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	$3,085,833
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	$5,394,779
201.4	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street	$4,464,235
201.5	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station	$2,861,194
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	$ 10,683,674
201.7	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	$3,794, 739
201.8	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	$2,834,100
201.10	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	$1,837,508
202	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**	
202.3	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	$4,255,763
202.4	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	$2,508,175
202.6	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path	$3,985,197
202.7	Bicycle Lane on Kamehameha Highway from Ka Uka Blvd to Lanikahuna Ave	$4,496,900
203	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**	
203.1	Bicycle route on California Ave between Plum St and Iliahi Elementary	$150,844
203.3	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	$ 26,947
203.5	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	$132,977
203.6	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	$144,896
300 PEDESTRIAN PROJECTS		
301	**LOCATION-SPECIFIC**	
301.1	Crosswalk across makai leg of Kamehameha Hwy and Avocado St intersection	$523,412
302	**GENERAL**	
302.1	Safe Routes to School	$250,000
302.2	Pedestrian Crossing Safety at 10 locations to be determined	$500,000
302.3	Mobility Hubs	$2,400,000

Project Number	Project Description	Construction Cost (2018 $ Values)
303	**COMPLETE STREETS**	
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	$7,376,078
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	$1,052,498
303.3	Complete Streets modifications on priority roads at 4 locations to be determined	$600,000

3.2.2 Bicycle and Pedestrian Project Land Costs

The COTS identifies two bicycle projects which may require additional right-of-way (ROW) ranging from 2.71 to 3.97 acres. This section describes the methodology utilized to develop preliminary ROW acquisition cost estimates for planning purposes.

Preliminary acquisition costs were developed using the City and County of Honolulu's real property tax information, collected from the Department of Budget and Fiscal Services, Real Property Assessment Division website on May 9, 2018 to calculate a unit cost per acre. Assessed land values were collected for a sampling of parcels adjacent to each project location/corridor to create a cost per acre. The collected assessed land values were grouped into two general categories; residential properties and agricultural/conservation properties. For the residential properties, an average unit cost per acre was developed using a sampling of parcels from the Waipio community, which is where COTS projects that require ROW are located. For projects adjacent to agricultural and conservation properties, the assessed values of the adjacent properties were used to determine unit cost per acre, which range from $100.46 to $88,398.62. Tables identifying the cost and cost per acre of adjacent parcels are included in **Appendix E**.

Land (right-of-way) costs were determined by applying unit (acre) costs to each project based on location and ROW needs. Where multiple residential, agricultural, and/or conservation unit costs were applied, the average of these unit costs was used. **Table 30** shows the estimated land costs.

Table 30. Land Cost for Bicycle Projects

Project No.	Land Use	Unit (Acre) Price	Project ROW (acres)	Estimated Land Cost
201.7	Agricultural	$10,290	2.71	**$27,884.93**
201.2	Agricultural	$40,399	3.97	**$211,482.15**

3.3 Roadway Projects

3.3.1 Construction Costs

The estimating methodology was based on the parametric methods which are typically applied to projects in the planning, scoping, or early design stage. These methods involve techniques that use historical data to define the cost of the typical transportation facility using measurements that are easily determined, such as cost per lane mile, cost per interchange, cost per square foot and cost per intersection.

The estimates of probable construction costs have been prepared based on the overall project description to define the major parameters, including the overall length of the project, the major elements such as bike lane or multi-use path extents, traffic signal installation and intersection modifications. Based on the nature and scope of the project planning documents, detailed quantity estimates were not completed for the various items.

Where available, the historical data based on prices from recent projects of similar nature and scope were used in the parametric estimating. Where historical data from analogous projects was not available, the British Columbia Ministry of Transportation and Infrastructure *Construction and Rehabilitation Cost Guide* (2013) was used for parametric estimating of project such as interchanges, bridge widening, and lane-mile costs, in which quantification of the major items was not possible. The costs were converted to current US dollars and adjusted to reflect the local construction conditions in Hawaii.

Since the estimated costs and project definition is limited to the functional approach and broad concept approach, a contingency amount of 30% was included within each project to provide for some allowance of unknown factors, and inherent project risks.

Although the actual costs may vary due to market conditions and economy of scale, or other factors, these costs are considered reasonable for Planning-Level cost estimating purposes. These costs are based on 2017 dollars and do not include taxes.

Estimated construction costs for roadway projects are provided in **Table 31**. Cost estimates for those projects included as part of the Koa Ridge project were not calculated. This includes all projects in categories **401** and **402**, as well as **Projects 403.1 through 403.4** and **Project 404.1**.

Table 31. Construction Costs for Roadway Projects

Project Number	Project Description	Construction Cost (2018 $ Values)
400 ROADWAY PROJECTS		
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	$35,004,100
403.7	Kamehameha Hwy Roosevelt Bridge (rehabilitation)	$4,141,700
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	$23,668,100
404	**H-2 INTERCHANGES**	
404.2	H-2 & Meheula Pkwy (widen on-ramp)	$7,982,000
405	**H-1/H-2 INTERCHANGE**	
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	$12,808,000
406	**CENTRAL MAUKA ROADS**	
406.1	New Road between Mililani Mauka and Pearl City	$52,614,000
406.3	New Road between California Ave and Meheula Pkwy	$19,982,100
408	**MILILANI ACCESS**	
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	$51,258,000
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	$6,707,000

3.3.2 Roadway Project Land Costs

The COTS identifies four (4) roadway projects which may require additional right-of-way (ROW) ranging from 3.97 to 37.88 acres. This section describes the methodology utilized to develop preliminary ROW acquisition cost estimates for planning purposes.

Preliminary acquisition costs were developed using the City and County of Honolulu's real property tax information, collected from the Department of Budget and Fiscal Services, Real Property Assessment Division website on May 9, 2018. Assessed land values were collected for a sampling of parcels adjacent to each project location/corridor. The collected assessed land values were grouped into two general categories; residential properties and agricultural/conservation properties. For the residential properties, an average unit cost per acre was developed using a sampling of parcels from the Waipio community, which is where COTS projects that require ROW are located. For projects adjacent to agricultural and conservation properties, the assessed values of the adjacent properties were used to determine unit cost per acre, which range from $100.46 to $88,398.62. Tables identifying the cost and cost per acre of adjacent parcels are included in **Appendix C**.

Land (right-of-way) costs were determined by applying unit (acre) costs to each project based on location and ROW needs. Where multiple residential, agricultural, and/or conservation unit costs were applied, the average of these unit costs was used. **Table 32** shows the estimated land cost for roadway projects.

Table 32. Land Cost for Roadway Projects

Project No.	Land Use	Unit (Acre) Cost	Project ROW (acres)	Land Cost
403.8	Urban	$3,471,568	3.97	**$13,780,538.83**
406.3	Agricultural/Conservation	$696	15.15	**$10,551.96**
408.1	Agricultural	$12,200	26	**$317,203.92**
406.1	Agricultural	$37,524	37.88	**$1,421,412.67**

3.4 Programmatic Projects: TDM, ITS, and Pricing

3.4.1 Construction Costs

The costs for ITS-related elements of **Project 502.1** include estimates for side-mounted dynamic traveler information signs, dynamic speed limit signs, and adaptive signal installations. The unit costs for the dynamic signs were obtained from the H-1 Corridor Study conducted for HDOT in 2015. This freeway corridor study included a variety of infrastructure improvements to enhance regional travel of which ITS elements were a part of the comprehensive mobility improvement strategy.

The cost of adaptive traffic signal installations were obtained from US DOT Office of the Assistant Secretary for Research and Technology: ITS Joint Program Office. Depending on the technology used, the cost can vary widely from $6,000 to $60,000 based on field studies. For this analysis, an average per intersection cost of $35,000 was used. Once all of the ITS capital costs were totaled, the following additional costs were added in: utility relocation (2%); engineering, survey, and environmental (2%); and contingencies (50%).

Similar to ITS elements, the unit costs for HOT lane construction for **Project 601.2** were also obtained from the H-1 Corridor Study. This cost assumes conversion of the existing HOV lanes to HOT lanes on the H-2

freeway from the Mililani Mauka interchange to H-1. Additional costs for utilities, environmental/design and contingencies were also included in the HOT lane cost estimate.

The cost for parking strategies primarily focused on the investment in new parking meters. The estimate assumed the installation of individual parking meters for each spaces and the unit capital costs were obtained from the *Honolulu Urban Core Parking Master Plan* prepared for DTS by Walker Parking Consultants (February 8, 2011). The cost estimate assumed that meters would be installed on approximately four (4) files of commercial streets with roughly 200 spaces per lane-mile of road. Similar additional construction costs were included for utility relocation (2%); engineering, survey, and environmental (2%); and contingencies (50%).

The ITS project includes installation of two traveler information signs each on the H-2 Freeway and Kamehameha Highway, and two overhead dynamic speed limit signs on the H-2 Freeway in the southbound direction. The following provides the estimated costs:

Description	**Unit Cost**	**Units**	**Total Cost**
Dynamic Message Sign	$500,000/sign	4 signs	$2,000,000
Dynamic Speed Limit Sign	$750,000/sign	2 signs	$1,500,000
Adaptive Travel Sign Retrofit	$35,000/intersection	30 intersections	$1,050,000
Utility Relocation	2% of Construction Cost		$91,000
Engineering, Survey, Environmental	11% of Construction Cost		$500,500
Contingency	50% of Construction Cost		$2,275,000
Total			**$7,416,500**

Installation of HOT lanes would involve the conversion of HOV lanes to HOT lanes. Estimated cost for the conversion is as follows:

Description	**Unit Cost**	**Units**	**Total Cost**
Convert H-2 HOV Lanes	$5,000,000/lane-mile	11 lane-miles	$55,000,000
Utility Relocation	2% of Construction Cost		$1,100,000
Engineering, Survey, Environmental	11% of Construction Cost		$6,050,000
Contingency	50% of Construction Cost		$27,500,000
Total			**$89,650,000**

Parking strategies would include the installation of smart parking meters on all major commercial corridors where on-street parking is allowed. Estimated cost for the installation of these meters is shown below:

Description	**Unit Cost**	**Units**	**Total Cost**
Install Smart Meters	$500/meter	800 meters	$400,000
Utility Relocation	2% of Construction Cost		$8,000
Engineering, Survey, Environmental	11% of Construction Cost		$44,000
Contingency	50% of Construction Cost		$200,000
Total			**$652,000**

A summary of the estimated construction costs for programmatic projects is provided in **Table 33**.

Table 33. Construction/Initiation Costs for Programmatic Projects

Project Number	Project Description	Construction Cost (2018 $ Values)
500 TRANSPORTATION SYSTEM MANAGEMENT		
501	**TRANSPORTATION DEMAND MANAGEMENT (TDM)**	
501.1 through 501.10	TDM Package	$0
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**	
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	$7,416,500
600 PRICING PROJECTS		
601	**PRICING**	
601.2	HOT Lanes	$89,650,000
601.3	Parking Strategies	$652,000

3.4.2 Land Costs

TDM, ITS, and Pricing projects would be implemented within existing ROW. Therefore, there would be no land costs.

4.0 COST ANALYSIS: OPERATIONS AND MAINTENANCE

Operations and maintenance (O&M) costs are those annual costs that exist throughout the life of the project. The following sections describe the development of O&M costs for the different transportation modes, as well as the annual O&M costs for each project. O&M costs are inflated by 1% each year throughout the life of the project, as per HDOT guidance.

4.1 Transit Projects O&M

The development of annual O&M costs for bus transit service is based on a cost model with three cost centers:

1. Fixed costs including facilities and administration
2. Costs assigned to bus hours includes operator wages
3. Costs assigned to bus miles includes wear items such as tires

Bus hours and miles are an output of a Service Model. The service model is based on the following inputs:

1. Route mileage by direction
2. Number of trips by time period and direction
3. Headway by time period and direction
4. Running time by time period and direction
5. Layover time by time period and direction

These inputs provide mileage, hours of service and vehicle requirements as outputs which are then applied to costs. Also calculated are miles per hour by time period and direction for reasonableness tests. Deadhead time, the time the bus takes to travel to the start of revenue service from the operating base or back to the operating base is applied as an overall factor for planning level purposes. For bus services, it was determined that cost per hour would be used as the study is adding a limited number of bus hours.

Bus service hours provided in the COTS service area is approximately 13% of the total service hours provided by DTS. This percentage was used to show the COTS area share of annual O&M costs shown for Project 101.3.

Three of the transit projects are technologies currently not operating in Honolulu. Annual O&M estimates for Projects 102.2, 102.3, and 102.8 are based on best practices and experience from cities operating those technologies.

Project 102.5 has three items listed under the cost basis. This is due to the freeway ramps, parking structure, and circulation/bridge costs requiring different estimates. Structured parking O&M is traditionally assigned per space, while freeway ramps use a per mile factor. The circulation and bridge component is shown as a line item.

Project 102.6 O&M costs are based on the HART – FTA Financial Recovery Plan for consistency. O&M costs are provided in the Recovery Plan by year which was used for a 2030 opening for the extension.

O&M costs for transit projects are shown in **Table 34**. These costs include inflation rates to the year of open for each project. For example, Project 101.1, shows a cost of $143 per hour of bus service. This number has been inflated to 2021 for this cost estimate from $136 per hour in 2018. O&M costs vary by the components of the project. Park-and-Ride lots have costs calculated by space, while light rail shows costs by hours of service.

O&M costs for the Koa Ridge Transit Center are not included in **Table 34**. It is realized that at some point the City and County of Honolulu will obtain O&M responsibilities from Castle & Cooke. However, that is not anticipated to occur until the development is built.

Table 34. Transit Project O&M Costs

Project Number	Year Open	Description	Unit of Measurement	Cost per Unit	O&M Annual Subtotal
101.1	2021	Bus Service Expansion	15,124 annual hours	$143	$2,162,732
101.2	N/A	Koa Ridge - on-street transit center	N/A		N/A
101.3	2018 and On-going	City bus & Handi-van operations in Central Oahu – based upon the COTS area receiving about 13% of total service.	13% of Annual Budget	2018 Cost Basis $136/hour bus $100/hour Handi-van	$37,700,000
102.2	2028	Light Rail between Wahiawa and Leeward CC	20,340 hours	$251	$5,105,340
102.3	2023	Bus Rapid Transit	6,000 hours	$169	$1,014,000
102.5	2025	Park-and-Ride and Transit Center in H-2 median	2,400 spaces 1.3 miles Circulation/bridge	$400 $68,275 $200,000	$960,000 $88,758 $200,000
102.6	2030	HART Technology	5.75 miles	$6,800,000	$39,100,000
102.8	2028	Aerial Gondola	6.2 miles	$1,656,662	$10,271,304

4.2 Bicycle and Pedestrian Projects O&M

As reported in NCHRP Report 552, operations costs for bicycle facilities typically includes the cost of securing or policing the facility. Maintenance of stand-alone bicycle facilities (paths and trails) includes pavement (sweeping and repair), drainage (cleaning and repair of storm drains), traffic control (pavement marking, signs, and traffic signal maintenance), and landscape maintenance. However, when bicycle facilities are elements of other, larger facilities, such as bike lanes and marked/signed routes, the maintenance costs are often included in the cost of the maintenance of the larger facility. Often the marginal or incremental cost costs of added maintenance are so modest that they are not accounted for as discrete facility costs. NCHRP Report 552 quotes $6,500 in 2002 dollars ($8,523 in 2018 dollars) per mile per year for trail maintenance which includes drainage maintenance, sweeping, trash removal, weed control, mowing, minor repairs, supplies and fuel. An inflation of 1% per year is applied as suggested by HDOT.

All pedestrian and complete streets infrastructure projects are elements of the overall roadway, expanding upon existing elements such as the sidewalk, pavement marking, landscaping, and signage. Therefore, as with bicycle projects and noted in NCHRP Report 552, operations and maintenance costs are included in the cost of the maintenance of the larger facility.

Operations and maintenance costs for bicycle path projects are shown in **Table 35**. Cost of bicycle lane, bicycle route, pedestrian, and complete street projects are assumed to be a part of the overall facility and therefore aren't separately tabulated.

Table 35. Bicycle Project O&M Costs

Project Number	Year Open	Description	Length of Facility (miles)	Cost per Mile (2018 dollars)	O&M Annual Subtotal (2018 dollars)
201.1	2023	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	1	$8,523	$8,523
201.2	2028	New Pathway between Anania Dr and Central Oahu Regional Park	2.40	$8,523	$20,455
201.4	2028	New Pathway along Kamehameha Hwy from Ka Uka Blvd to Waipahu St	1.60	$8,523	$13,637
201.5	2028	New Pathway connecting Kamehameha Hwy at Waipahu St to Leeward Community College	1	$8,523	$8,523
201.6	2028	New Pathway along Kamehameha Hwy between Wahiawa and Anania Dr in Mililani	3.40	$8,523	$28,978
201.7	2028	New Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	1	$8,523	$8,523
201.8	2028	Bike Pathway through the H-2/Meheula Parkway Interchange	0.80	$8,523	$6,818
201.10	2028	Bike Pathway in Central Oahu Regional Park	0.85	$8,523	$7,245

4.3 Roadway Projects O&M

Operating and maintaining roadways involves a variety of costs associated with paving material quality, traffic signals, drainage, safety features where applicable (e.g. guardrails), landscaping etc. In the Central Oahu study area, roadways are operated and maintained by either the City & County of Honolulu Department of Facilities & Maintenance (DFM) or by the State Hawaii Department of Transportation – Highways Division (HDOT). HDOT maintains both freeways including H-1 and H-2, as well as arterial roadways including Kamehameha Highway. DFM is responsible for arterial roadways such as Ka Uka Boulevard and other minor arterial/major collector facilities that are the subject of some of the roadway projects identified in the COTS area.

The O&M costs for roadways vary depending on the facility type, number of bridge structures, number of lanes, curb/shoulder design, etc. To account for the variation in overall facility width, a common unit of O&M costs for roadways is cost per lane-mile. For purposes of this Benefit Cost analysis, an average cost per lane-mile would be sufficient to compare roadways since no new substantive freeway segments are proposed. Ideally, the cost per-lane mile would be provided by both agencies for use in this study. However, both entities were contacted for this report but were unable to provide an average cost per lane-mile for operations and maintenance. In lieu of agency-specific information, data from a recent

national study that examined O&M costs by state was consulted as part of this effort. The *21st Annual Report on the Performance of State Highway Systems (1984–2012): State Summaries* (Policy Report 134, Reason Foundation, September 2014) identified that the State of Hawaii spent $63,482 per lane mile of highways in 2013. Adjusting this number for inflation results in an annual per lane mile cost of $68,275. This value was applied to all roadway projects to determine the annual O&M cost for purposes of determining the Benefit Cost ratio calculations. **Table 36** provides the annual O&M cost for roadway projects.

Table 36. Operation and Maintenance Costs for Roadway Projects

Project Number	Year Open	Description	Length of Facility (lane-miles)	Cost per Mile (2018 dollars)	O&M Annual Subtotal (2018 dollars)
403 KAMEHAMEHA HIGHWAY					
403.5	2028	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	2.67	$68,275	$8,523
403.7	2018	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	0	$68,275	$0
403.8	2028	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	4.17	$68,275	$284,479
404 H-2 INTERCHANGES					
404.2	2023	H-2 & Meheula Pkwy (widen on-ramp)	0.76	$68,275	$51,273
405 H-1 & H-2 INTERCHANGE					
405.1	2028	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvement	0.57	$68,275	$38,793
406 CENTRAL MAUKA ROADS					
406.1	2028	New Road between Mililani Mauka and Pearl City	18.94	$68,275	$1,293,087
406.3	2028	New Road between California Ave and Meheula Pkwy	3.79	$68,275	$258,617
408 MILILANI ACCESS					
408.1	2028	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	3.79	$68,275	$258,617
408.4	2023	New flyer stops at H-2 with pedestrian pathway to Park and Ride	0.49	$68,275	$33,612

4.4 Programmatic Projects O&M: TDM, ITS, and Pricing

The operations and maintenance costs for the TDM projects have been packaged for estimation purposes. A TDM Program with a Coordinator position is included in the O&M costs to ensure success in implementing the projects. It is anticipated that the TDM Program would be under the DTS. The project would be implemented islandwide. Funding for the islandwide program, identified in the ORTP, is $1 million per year through 2029. The ORTP increases funding to $2 million per year in 2030 through 2040. Planning level O&M costs are based on:

Description	Unit Cost	Total Cost
Program Coordinator/Staff		$250,000
20 Vanpools (COTS area)	$10,000/each	$120,000
Marketing/Promotions		$150,000
Rideshare Matching		$50,000
Ride Home Program		$50,000
Coordination with State and other Program		$30,000
Total		**$650,000**

The cost of operating and maintaining ITS elements varies by component. O&M costs for both large-scale dynamic message and speed limit signs were obtained from data provided by the US DOT Office of the Assistant Secretary for Research and Technology: ITS Joint Program Office. This knowledge resources page includes a database of costs for example projects from across the country including O&M costs for the dynamic signs noted above. In 2018, dollars the cost per sign is $7,700 in 2018 inflation-adjusted dollars.

For ITS adaptive signal technology, the O&M costs are expected to be already accounted for in the on-going signal maintenance costs currently incurred by both DFM and HDOT. While the capital costs are new, no significant difference in O&M is anticipated for these ITS elements.

The O&M cost of proposed HOT lanes is assumed to be the same $68, 275 (in 2018 dollars) as for typical roadway projects listed above in Section 4.3.4. This assumption may actually be conservative in that the O&M of existing HOV lanes as HOT lanes would not theoretically cost more for the roadway pavement section itself; however, the equipment used to collect payment, additional signage, sign lighting etc. would contribute to additional costs that are not currently incurred by HDOT. Thus, including these costs for equipment, signage, and lighting replacement and repairs is reasonable to assume.

For parking pricing strategies, the installation of up to 800 smart parking meters will incur new O&M costs for this equipment. According to data published by parking.org, the 2018 inflation adjusted cost to operate and maintain smart parking meters is $9 per unit per year. A summary of annual O&M costs for the ITS and Pricing projects is included in **Table 37**.

Table 37. ITS and Pricing Project O&M Costs

Project Number	Year Open	Description	Length of Facility (lane-miles or number of features)	Cost per Unit (2018 dollars)	O&M Annual Subtotal (2018 dollars)
502 INTELLIGENT TRANSPORTATION SYSTEMS					
502.1	2023	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	6 signs	$7,700	$46,200
601 PRICING					
601.2	2028	HOT Lanes	11	$68,275	$751,025
601.3	2023	Parking Strategies	800 parking meters	$9	$7,200

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5.0 COSTS AND BENEFITS OVER TIME

Up to now in this analysis, the benefits and costs have been provided in dollars for a single year. The next step is to stream these over multiple years using inflation and discounting factors. For purpose of analysis, all projects were taken out to the year 2040, although many would have residual value beyond that year. The purpose of this part of the analysis is to normalize all values into the same terms and years so they can be compared.

The base year being used is 2018. If any project has a different start year than 2018, that is explained. Assuming a project is constructed in 2018, then the cost is as shown in Chapter 4. But if it is constructed, say in 2028, then the construction cost needs to be inflated using the factor of 1% per year. This follows HDOT guidance.

Similarly, the dollar value of the benefits for a single year is as shown in Chapter 2 is in 2018 dollars. If the project does not start accruing benefits until some year in the future, then the benefit dollars must be discounted. Two discount factors are used. The first is 7%, which is required under the USDOT BCA Guidance (2017). The guidance also allows use of a 3% factor to account for public projects. This report does both.

This chapter presents the roll-up value of several years of benefits and future year costs. Any values that apply specifically to a particular project (for example, year of start) are explained in the text.

5.1 Project Start and End Year

The start and end year for all projects is provided in **Table 38**. The start year for projects is based on the year for which construction is assumed to be completed as per the State Transportation Improvement Program (STIP). For projects that are not included in the STIP, a start year of 2028 was assumed.

Table 38. Start and End Year for COTS Projects

Project Number	Project Description	Start Year	End Year	Number of Years
100 TRANSIT PROJECTS				
101.0	**GENERAL**			
101.1	Bus Service Expansion	2021	2040	20
101.3	City Operations & Maintenance, including Bus Stop/Shelter Conditions	2018	2040	23
102.0	**HIGH CAPACITY TRANSIT**			
102.2	Light Rail between Wahiawa and Pearl Highlands Rail Station	2028	2040	13
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	2025	2040	16
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	2025	2040	16
102.6	HART rail technology between Mililani and Leeward Community College	2030	2040	11
102.8	Aerial Gondola between Mililani Mauka and Leeward Community College	2028	2040	13
200 BICYCLE PROJECTS				
201.0	**BICYCLE PATHS (Off-street bicycle facility)**			

Project Number	Project Description	Start Year	End Year	Number of Years
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2019	2040	21
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2019	2040	21
201.4	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street	2019	2040	21
201.5	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station	2029	2040	11
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	2019	2040	21
201.7	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2029	2040	11
201.8	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	2029	2040	11
201.10	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	2019	2040	21
202.0	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**			
202.3	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	2019	2040	21
202.4	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	2019	2040	21
202.6	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path	2029	2040	11
202.7	Bicycle lane on Kamehameha Highway from Ka Uka Blvd to Lanikahuna Ave	2019	2040	21
203.0	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**			
203.1	Bicycle route on California Ave between Plum St and Iliahi Elementary	2019	2040	21
203.3	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	21
203.5	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	21
203.6	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	2019	2040	21
300 PEDESTRIAN PROEJCTS				
301.0	**LOCATION-SPECIFIC**			
301.1	Crosswalk across makai leg of Kamehameha Hwy and Avocado St intersection	2019	2040	21
302.0	**GENERAL**			
302.1	Safe Routes to School	2019	2040	21
302.2	Pedestrian Crossing Safety	2019	2040	21
302.3	Mobility Hubs	2019	2040	21
303.0	**COMPLETE STREETS**			

Project Number	Project Description	Start Year	End Year	Number of Years
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	2019	2040	21
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2019	2040	21
303.3	Complete Streets modifications on priority roads	2019	2040	21
400 ROADWAY PROJECTS				
403.0	**KAMEHAMEHA HIGHWAY**			
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	2028	2040	12
403.7	Kamehameha Hwy Roosevelt Bridge (rehabilitation)	2018	2040	22
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	2028	2040	12
404.0	**H-2 INTERCHANGES**			
404.2	H-2 & Meheula Pkwy (widen on-ramp)	2023	2040	17
405.0	**H-1 & H-2 INTERCHANGE**			
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	2028	2040	12
406.0	**CENTRAL MAUKA ROADS**			
406.1	New Road between Mililani Mauka and Pearl City	2028	2040	12
406.3	New Road between California Ave and Meheula Pkwy	2028	2040	12
408.0	**MILILANI ACCESS**			
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	2028	2040	12
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	2023	2040	17
500 TRANSPORTATION SYSTEM MANAGEMENT				
501.0	**TRANSPORTATION DEMAND MANAGEMENT**			
501.1 through 501.10	TDM Package	2020	2040	20
502.0	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**			
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	2028	2040	12
600 PRICING SOLUTIONS				
601.0	**PRICING**			
601.2	HOT lanes	2028	2040	12
601.3	Parking strategies	2028	2040	12

5.2 Cumulative Benefits

Table 39 shows the cumulative benefits over the life of the project for each of the COTS projects. Cumulative benefits were calculated using both a 7% and a 3% discount rate per year for the life of the project through 2040.

5.3 Cumulative Costs

Table 40 shows the cumulative costs over the life of the project for each of the COTS projects.

Table 39. Cumulative Benefits for COTS Projects

Project Number	Project Description	Start Year	End Year	Travel Time Saving	Vehicle Operating Cost Saving	Safety	Emissions Reduction	Congestion Reduction	Mobility & Equity	Noise Reduction	Recreational	Health	Reduced Auto Use/ Parking Cost	TOTAL BENEFITS (7%)	TOTAL BENEFITS (3%)
100 TRANSIT PROJECTS															
101	**GENERAL**														
101.1	Bus Service Expansion	2021	2040	$900,864	$2,350,888	$1,066,682	$130,605	$7,500,452	$624,240	$12,146	--	$1,073,616--	$555,822	**$156,505,944**	**$221,172,689**
102	**HIGH CAPACITY TRANSIT**														
102.2	Light Rail between Wahiawa and Leeward Community College Rail Station	2028	2040	$6,190,437	$6,073,127	$2,755,595	$397,645	$19,376,167	$2,165,970	$31,378	--	$2,773,508	$1,435,874	**$353,488,228**	**$451,024,768**
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	2023	2040	$2,252,160	$2,938,610	$1,333,352	$180,748	$9,375,565	$765,000	$15,183	--	$1,342,020	$694,778	**$184,276,237**	**$246,029,028**
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	2025	2040	$2,711,225	$3,036,563	$1,377,798	$186,773	$9,688,083	$1,082,985	$15,689	--	$1,386,754	$717,937	**$197,007,950**	**$263,025,995**
102.6	HART rail technology between Mililani and Leeward Community College	2030	2040	$12,089,595	$8,619,922	$3,911,167	$598,606	$27,501,656	$3,074,280	$44,536	--	$3,936,592	$2,038,014	**$474,063,762**	**$586,086,401**
102.8	Aerial Gondola between Waipio and Leeward Community College	2028	2040	$5,574,096	$4,407,915	$2,000,029	$288,613	$14,063,347	$1,572,075	$22,774	--	$2,013,030	$1,042,166	**$265,831,659**	**$339,180,389**
200 BICYCLE PROJECTS															
201	**BICYCLE PATHS (Off-street bicycle facility)**														
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2019	2040	--	--	$875,856	--	--	$48,912	--	$826,944	$34,579	$1,739	**$7,483,789**	**$12,037,789**
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2019	2040	--	--	$278,800	--	--	$20,380	--	$258,420	$11,174	$1,579	**$ 1,428,048**	**$2,579,412**
201.4	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street	2019	2040	--	--	$868,641	--	--	$54,618	--	$814,023	$34,277	$2,858	**$4,322,956**	**$7,788,842**
201.5	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station	2029	2040	--	--	$752,814	--	--	$46,466	--	$706,348	$29,747	$1,551	**$3,769,870**	**$6,797,183**
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	2019	2040	--	--	$913,111	--	--	$60,325	--	$852,786	$35,938	$6,392	**$4,572,509**	**$8,245,027**
201.7	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2029	2040	--	--	$297,074	--	--	$17,119	--	$279,955	$11,929	$658	**$1,510,366**	**$2,727,004**
201.8	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	2029	2040	--	--	$888,546	--	--	$52,988	--	$835,558	$35,032	$1,429	**$4,416,703**	**$7,959,832**
201.1	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	2019	2040	--	--	$405,102	--	--	$26,086	--	$379,016	$16,006	$719	**$2,020,273**	**$3,641,248**
202	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**														
202.3	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	2019	2040	--	--	$934,309	--	--	$42,760	--	$891,549	$37,750	$3,032	**$11,950,315**	**$17,526,109**
202.4	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	2019	2040	--	--	$780,373	--	--	$39,569	--	$740,804	$31,106	$2,876	**$9,784,174**	**$14,302,416**
202.6	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path	2029	2040	--	--	$524,024	--	--	$28,719	--	$495,305	$20,989	$902	**$2,585,386**	**$4,654,994**

Project Number	Project Description	Start Year	End Year	Travel Time Saving	Vehicle Operating Cost Saving	Safety	Emissions Reduction	Congestion Reduction	Mobility & Equity	Noise Reduction	Recreational	Health	Reduced Auto Use/ Parking Cost	TOTAL BENEFITS (7%)	TOTAL BENEFITS (3%)
202.7	Bicycle lane on Kamehameha Highwy from Ka Uka Blvd to Lanikahuna Ave	2019	2040	--	--	$689,127	--	--	$34,463	--	$654,664	$27,633	$2,914	**$8,736,889**	**$12,793,493**
203	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**														
203.1	Bicycle route on California Ave between Plum St and Iliahi Elementary	2019	2040	--	--	$495,305	--	--	--	--	$495,305	$20,838	$1,622	**$6,170,182**	**$9,027,160**
203.3	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	--	--	$163,666	--	--	--	--	$163,666	$6,946	$113	**$1,888,430**	**$2,720,827**
203.5	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	--	--	$430,700	--	--	--	--	$430,700	$18,120	$1,410	**$5,368,303**	**$7,837,333**
203.6	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	2019	2040	--	--	$766,646	--	--	--	--	$766,646	$32,012	$3,995	**$9,657,826**	**$14,122,973**
303	**COMPLETE STREETS (BICYCLE BENEFITS)**														
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2019	2040	--	--	--	--	--	$12,334	--	$292,876	$12,231	$611	**$2,670,723**	**$4,306,444**
300 PEDESTRIAN PROEJCTS															
301	**LOCATION-SPECIFIC**														
301.1	Crosswalk across makai leg of Kamehameha Hwy and Avocado St intersection	2019	2040	--	--	$350,210	--	--	--	--	$5,930,739	$243,261	$10,998	**$ 6,407,010**	**$2,670,723**
303	**COMPLETE STREETS**														
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	2019	2040	--	--	$393,727	--	--	--	--	$277,155	$116,572	--	**$1,882,266**	**$3,391,939**
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2019	2040	--	--	$625,740	--	--	--	--	$440,463	$185,277	--	**$5,143,230**	**$8,270,340**
400 ROADWAY PROJECTS															
403	**KAMEHAMEHA HIGHWAY**														
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	2028	2040	$13,002,014	$ (138,373)	$-	$14,767	--	--	--	--	--	--	**$117,708,401**	**$ 149,781,500**
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	2028	2040	$9,864,505	$1,066,716	$61,032	$12,103	--	--	--	--	--	--	**$100,579,602**	**$ 127,985,458**
404	**H-2 INTERCHANGES**														
404.2	H-2 & Meheula Pkwy (widen on-ramp)	2023	2040	$5,437,921	$ (164,827)	$-	$(196)	--	--	--	--	--	--	**$55,194,057**	**$75,465,147**
405	**H-1 & H-2 INTERCHANGE**														
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	2028	2040	$3,503,360	$-	$-	$-	--	--	--	--	--	--	**$32,020,643**	**$40,745,604**
406	**CENTRAL MAUKA ROADS**														
406.1	New Road between Mililani Mauka and Pearl City	2028	2040	$15,434,229	$157,330	$-	$68,902	--	--	--	--	--	--	**$143,136,312**	**$ 182,137,989**
406.3	New Road between California Ave and Meheula Pkwy	2028	2040	$110,091	$270,320	$-	$ 1,342	--	--	--	--	--	--	**$3,489,215**	**$4,439,954**
408	**MILILANI ACCESS**														
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	2028	2040	$3,307,613	$455,711	$-	$13,215	--	--	--	--	--	--	**$34,517,494**	**$43,922,795**

Project Number	Project Description	Start Year	End Year	Travel Time Saving	Vehicle Operating Cost Saving	Safety	Emissions Reduction	Congestion Reduction	Mobility & Equity	Noise Reduction	Recreational	Health	Reduced Auto Use/ Parking Cost	TOTAL BENEFITS (7%)	TOTAL BENEFITS (3%)
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	2023	2040	$270,259	$-	$-	$-	--	--	--	--	--	--	**$2,828,936**	**$3,867,918**
500 TRANSPORTATION SYSTEM MANAGEMENT															
501	**TRANSPORTATION DEMAND MANAGEMENT**														
501.1 through 501.10	TDM Package	2020	2040		$642,600	$262,414	$32,130	$1,845,180	--	$ 2,988	--	--	--	**$30,422,324**	**$42,937,370**
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**														
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	2028	2040	$525,504	$-	$-	--	--	--	--	--	--	--	**$4,803,096**	**$6,111,841**
600 PRICING SOLUTIONS															
601	**PRICING**														
601.2	HOT lanes	2028	2040	$1,839,264	$-	$-	--	--	--	--	--	--	--	**$16,810,837**	**$21,391,442**

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Table 40. Cumulative Costs for COTS Projects

Project Number	Project Description	Start Year	End Year	Construction	Land	Operation & Maintenance	TOTAL COSTS
100TRANSIT PROJECTS							
101	**GENERAL**						
101.1	Bus Service Expansion	2021	2040	$8,710,000	--	$ 57,533,909	**$ 66,243,909**
101.3	City Operations & Maintenance, including Bus Stop/Shelter Conditions	2018	2040	--	--	$969,504,510	**$969,504,510**
102	**HIGH CAPACITY TRANSIT**						
102.2	Light Rail between Wahiawa and Leeward Community College Rail Station	2028	2040	$ 578,032,000	--	$ 70,501,172	**$648,533,172**
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	2025	2040	$30,217,600	--	$ 27,499,511	**$57,717,111**
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	2025	2040	$ 103,900,400	--	$ 21,550,941	**$125,451,341**
102.6	HART rail technology between Mililani and Leeward Community College	2030	2040	$ 894,310,350	--	$452,261,880	**$1,346,572,230**
102.8	Aerial Gondola between Waipio and Leeward Community College	2028	2040	$283,972,000	--	$141,839,518	**$425,808,518**
200 BICYCLE PROJECTS							
201	**BICYCLE PATHS (Off-street bicycle facility)**						
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2023	2040	$3,211,130	--	$ 166,748	**$ 3,377,878**
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2028	2040	$5,900,190	$211,482	$ 289,429	**$ 6,401,101**
201.4	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street	2028	2040	$4,882,468	--	$ 192,953	**$ 5,075,421**
201.5	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station	2028	2040	$3,129,245	--	$ 120,598	**$ 3,249,843**
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	2028	2040	$11,684,577	--	$ 410,027	**$ 12,094,604**
201.7	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2028	2040	$4,150,250	$27,885	$ 120,598	**$ 4,298,733**
201.8	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	2028	2040	$3,099,614	--	$ 96,477	**$ 3,196,091**
201.10	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	2028	2040	$2,009,656	--	$ 102,507	**$ 2,112,163**
202	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**						
202.3	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	2019	2040	$4,255,763	--	--	**$ 4,255,763**
202.4	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	2019	2040	$2,508,175	--	--	**$ 2,508,175**
202.6	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path	2028	2040	$4,358,552	--	--	**$ 4,358,552**
202.7	Bicycle lane on Kamehameha Highwy from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$4,496,900	--	--	**$4,496,900**
203	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**						
203.1	Bicycle route on California Ave between Plum St and Iliahi Elementary	2019	2040	$ 150,844	--	--	**$150,844**
203.3	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$ 26,947	--	--	**$ 26,947**
203.5	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$ 132,977	--	--	**$132,977**
203.6	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	2019	2040	$ 144,986	--	--	**$144,986**
300 PEDESTRIAN PROEJCTS							
301	**LOCATION-SPECIFIC**						
301.1	Crosswalk across makai leg of Kamehameha Hwy and Avocado St intersection	2019	2040	$ 523,412	--	--	**$523,412**
302	**GENERAL**						
302.1	Safe Routes to School	2019	2040	$250,000	--	--	**$250,000**
302.2	Pedestrian Crossing Safety	2019	2040	$500,000	--	--	**$500,000**

Project Number	Project Description	Start Year	End Year	Construction	Land	Operation & Maintenance	TOTAL COSTS
302.3	Mobility Hubs	2019	2040	$2,400,000	--	--	**$2,400,000**
303	**COMPLETE STREETS**						
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	2028	2040	$8,067,108	--	--	**$ 8,067,108**
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$1,095,233	--	--	**$ 1,095,233**
303.3	Complete Streets modifications on priority roads	2019	2040	$600,000	--	--	**$600,000**
400 ROADWAY PROJECTS							
403	**KAMEHAMEHA HIGHWAY**						
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	2028	2040	$37,901,404	--	$2,753,445	**$40,654,849**
403.7	Kamehameha Hwy Roosevelt Bridge (rehabilitation)	2018	2040	$14,925,000	--	$333,119	**$15,258,119**
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	2028	2040	$25,627,138	$13,780,539	$4,296,159	**$43,703,836**
404	**H-2 INTERCHANGES**						
404.2	H-2 & Meheula Pkwy (widen on-ramp)	2023	2040	$8,223,342	--	$1,055,721	**$9,279,063**
405	**H-1 & H-2 INTERCHANGE**						
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	2028	2040	$13,867,121	--	$58,585	**$13,925,706**
406	**CENTRAL MAUKA ROADS**						
406.1	New Road between Mililani Mauka and Pearl City	2028	2040	$56,968,577	$1,421,413	$19,528,007	**$77,917,996**
406.3	New Road between California Ave and Meheula Pkwy	2028	2040	$21,636,001	$10,552	$3,905,595	**$25,552,148**
408	**MILILANI ACCESS**						
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	2028	2040	$51,258,000	$317,204	$3,905,595	**$55,480,799**
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	2023	2040	$6,909,732	--	$680,954	**$7,590,685**
500 TRANSPORTATION SYSTEM MANAGEMENT							
501	**TRANSPORTATION DEMAND MANAGEMENT**						
501.1 through 501.10	TDM Package	2020	2040	--	--	$ 15,105,480	**$ 15,105,480**
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**						
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	2028	2040	$8,110,684	--	$697,705	**$8,808,390**
600 PRICING SOLUTIONS							
601	**PRICING**						
601.2	HOT lanes	2028	2040	$103,052,675	--	$11,921,613	**$114,974,288**
601.3	Parking strategies	2028	2040	$713,027	--	$108,733	**$ 821,761**

6.0 COMPARE AND CONTRAST

Having calculated benefits and costs for a single year in Chapters 2 through 4, and having normalized future years in Chapter 5, it is now possible to do the benefit cost comparison.

Two methods of comparison are used.

- First, the benefit cost ratio is calculated by dividing total cost into total benefits. Any project with a ratio higher than 1.0 is said to have a positive BCA. Any project with a BCA ratio less that 1.0 is said to have a negative BCA.
- Second, the net present value is calculated by subtracting the total cost from the total benefits. Any project with a positive net present value is said to be a net benefit; any project with a negative net present value would not.

6.1 Benefit Cost

As discussed in **Section 5.0**, two discount factors are used when calculating benefits: 7% and 3%. The following tables calculate the Benefit Cost ratio using both benefit discount rates. As shown in **Table 41**, which uses a benefit discount rate of 7%, there are 23 projects with a positive Benefit Cost Ratio (over 1.0). Bicycle routes have the highest Benefit Cost Ratio, which can be attributed to the low total cost since O&M costs are not calculated separately for the bicycle facility.

Table 41. Benefit Cost Ratio for COTS Projects (7% Discount Rate for Benefits)

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	BCA Ratio
100 TRANSIT PROJECTS						
101	**GENERAL**					
101.1	Bus Service Expansion	2021	2040	$156,505,944	$66,243,909	**2.36**
102	**HIGH CAPACITY TRANSIT**					
102.2	Light Rail between Wahiawa and Leeward Community College Rail Station	2028	2040	$353,488,228	$648,533,172	**0.55**
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	2025	2040	$184,276,237	$57,717,111	**3.19**
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	2025	2040	$197,007,950	$125,451,341	**1.57**
102.6	HART rail technology between Mililani and Leeward Community College	2030	2040	$474,063,762	$1,346,572,230	**0.35**
102.8	Aerial Gondola between Waipio and Leeward Community College	2028	2040	$265,831,659	$425,808,518	**0.62**
200 BICYCLE PROJECTS						
201	**BICYCLE PATHS (Off-street bicycle facility)**					
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2023	2040	$7,483,789	$3,252,281	**2.30**
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2028	2040	$1,428,048	$5,895,690	**0.24**
201.4	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street	2028	2040	$4,322,956	$4,657,188	**0.93**

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	BCA Ratio
201.5	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station	2028	2040	$3,769,870	$2,981,792	**1.26**
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	2028	2040	$4,572,509	$11,093,701	**0.41**
201.7	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2028	2040	$1,510,366	$3,943,222	**0.38**
201.8	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	2028	2040	$4,416,703	$2,930,577	**1.51**
201.10	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	2028	2040	$2,020,273	$1,940,015	**1.04**
202	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**					
202.3	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	2019	2040	$11,950,315	$4,255,763	**2.81**
202.4	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	2019	2040	$9,784,174	$2,508,175	**3.90**
202.6	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path	2028	2040	$2,585,386	$4,358,552	**0.59**
202.7	Bicycle lane on Kamehameha Highwy from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$8,736,889	$4,496,900	**1.94**
203	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**					
203.1	Bicycle route on California Ave between Plum St and Iliahi Elementary	2019	2040	$6,170,182	$150,844	**40.90**
203.3	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$1,888,430	$26,947	**70.08**
203.5	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$5,368,303	$132,977	**40.37**
203.6	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	2019	2040	$9,657,826	$144,986	**66.61**
303	**COMPLETE STREETS (BICYCLE)**					
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$2,670,723	$1,052,498	**2.54**
300 PEDESTRIAN PROEJCTS						
301	**LOCATION-SPECIFIC**					
301.1	Crosswalk across makai leg of Kamehameha Hwy and Avocado St intersection	2019	2040	$6,407,010	$523,412	**12.24**
303	**COMPLETE STREETS**					
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	2028	2040	$1,882,266	$7,376,078	**0.26**

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	BCA Ratio
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$5,143,230	$1,052,498	**4.89**
400 ROADWAY PROJECTS						
403	**KAMEHAMEHA HIGHWAY**					
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	2028	2040	$117,708,401	$40,654,849	**2.90**
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	2028	2040	$100,579,602	$43,703,836	**2.30**
404	**H-2 INTERCHANGES**					
404.2	H-2 & Meheula Pkwy (widen on-ramp)	2023	2040	$55,194,057	$9,279,063	**5.95**
405	**H-1 & H-2 INTERCHANGE**					
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	2028	2040	$32,020,643	$13,925,706	**2.30**
406	**CENTRAL MAUKA ROADS**					
406.1	New Road between Mililani Mauka and Pearl City	2028	2040	$143,136,312	$77,917,996	**1.84**
406.3	New Road between California Ave and Meheula Pkwy	2028	2040	$3,489,215	$25,552,148	**0.14**
408	**MILILANI ACCESS**					
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	2028	2040	$34,517,494	$55,480,799	**0.62**
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	2028	2040	$2,828,936	$7,590,685	**0.37**
500 TRANSPORTATION SYSTEM MANAGEMENT						
501	**TRANSPORTATION DEMAND MANAGEMENT**					
501.1 through 501.10	TDM Package	2020	2040	$30,422,324	$15,105,480	**2.01**
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**					
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	2028	2040	$4,803,096	$8,808,390	**0.55**
600 PRICING SOLUTIONS						
601	**PRICING**					
601.2	HOT lanes	2028	2040	$16,810,837	$114,974,288	**0.15**

Table 42 provides the BCA ratio for all COTS projects using a 3% discount rate for benefits. There are 24 projects with a positive BCA.

Table 42. Benefit Cost Ratio for COTS Projects (3% Discount Rate for Benefits)

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	BCA Ratio
100 TRANSIT PROJECTS						
101	**GENERAL**					
101.1	Bus Service Expansion	2021	2040	$ 221,172,689	$ 66,243,909	**3.34**
102	**HIGH CAPACITY TRANSIT**					
102.2	Light Rail between Wahiawa and Leeward Community College Rail Station	2028	2040	$ 451,024,768	$ 648,533,172	**0.70**
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	2023	2040	$ 246,029,028	$ 57,717,111	**4.26**
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	2025	2040	$ 263,025,995	$ 125,451,341	**2.10**
102.6	HART rail technology between Mililani and Leeward Community College	2030	2040	$ 586,086,401	$1,346,572,230	**0.44**
102.8	Aerial Gondola between Waipio and Leeward Community College	2028	2040	$ 339,180,389	$ 425,808,518	**0.80**
200 BICYCLE PROJECTS						
201	**BICYCLE PATHS (Off-street bicycle facility)**					
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2023	2040	$ 12,037,789	$3,252,281	**3.70**
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2028	2040	$ 2,579,412	$ 5,895,690	**0.44**
201.4	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street	2028	2040	$ 7,788,842	$ 4,657,188	**1.67**
201.5	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station	2028	2040	$ 6,797,183	$ 2,981,792	**2.28**
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	2028	2040	$ 8,245,027	$ 11,093,701	**0.74**
201.7	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2028	2040	$ 2,727,004	$ 3,943,222	**0.69**
201.8	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	2028	2040	$ 7,959,832	$ 2,930,577	**2.72**
201.10	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	2028	2040	$ 3,641,248	$ 1,940,015	**1.88**
202	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**					
202.3	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	2019	2040	$ 17,526,109	$ 4,255,763	**4.12**

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	BCA Ratio
202.4	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	2019	2040	$ 14,302,416	$ 2,508,175	**5.70**
202.6	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path	2028	2040	$ 4,654,994	$ 4,358,552	**1.07**
202.7	Bicycle lane on Kamehameha Highwy from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$ 12,793,493	$ 4,496,900	**2.84**
203	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**					
203.1	Bicycle route on California Ave between Plum St and Iliahi Elementary	2019	2040	$ 9,027,160	$ 150,844	**59.84**
203.3	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$ 2,720,827	$ 26,947	**100.97**
203.5	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$ 7,837,333	$ 132,977	**58.94**
203.6	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	2019	2040	$ 14,122,973	$ 144,986	**97.41**
303	**COMPLETE STREETS (BICYCLE)**					
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$ 4,306,444	$ 7,376,078	**0.58**
300 PEDESTRIAN PROEJCTS						
301	**LOCATION-SPECIFIC**					
301.1	Crosswalk across makai leg of Kamehameha Hwy and Avocado St intersection	2019	2040	$ 2,670,723	$ 523,412	**5.10**
303	**COMPLETE STREETS**					
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	2028	2040	$ 3,391,939	$ 7,376,078	**0.46**
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$ 8,270,340	$ 1,052,498	**7.86**
400 ROADWAY PROJECTS						
403	**KAMEHAMEHA HIGHWAY**					
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	2028	2040	$ 149,781,500	$ 40,654,849	**3.68**
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	2028	2040	$ 127,985,458	$ 43,703,836	**2.93**
404	**H-2 INTERCHANGES**					
404.2	H-2 & Meheula Pkwy (widen on-ramp)	2023	2040	$ 75,465,147	$ 9,279,063	**8.13**
405	**H-1 & H-2 INTERCHANGE**					

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	BCA Ratio
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	2028	2040	$ 40,745,604	$ 13,925,706	**2.93**
406	**CENTRAL MAUKA ROADS**					
406.1	New Road between Mililani Mauka and Pearl City	2028	2040	$ 182,137,989	$ 77,917,996	**2.34**
406.3	New Road between California Ave and Meheula Pkwy	2028	2040	$ 4,439,954	$ 25,552,148	**0.17**
408	**MILILANI ACCESS**					
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	2028	2040	$ 43,922,795	$ 55,480,799	**0.79**
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	2028	2040	$ 3,867,918	$ 7,590,685	**0.51**
500 TRANSPORTATION SYSTEM MANAGEMENT						
501	**TRANSPORTATION DEMAND MANAGEMENT**					
501.1 through 501.10	TDM Package	2020	2040	$ 42,937,370	$ 15,105,480	**2.84**
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**					
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	2028	2040	$ 6,111,841	$ 8,808,390	**0.69**
600 PRICING SOLUTIONS						
601	**PRICING**					
601.2	HOT lanes	2028	2040	$ 21,391,442	$ 114,974,288	**0.19**

6.2 Net Present Value

Net Present Value was calculated using both benefit discount rates. As shown in **Table 43**, there are 23 projects with a positive Net Present Value when using a 7% discount rate for benefits. As shown in **Table 44**, there are 24 projects with a positive Net Present Value when using a 3% discount rate for benefits.

Table 43. Net Present Value for COTS Projects (7% Discount Rate for Benefits)

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	Net Present Value
100 TRANSIT PROJECTS						
101	**GENERAL**					
101.1	Bus Service Expansion	2021	2040	$156,505,944	$ 66,243,909	**$90,262,035**
102	**HIGH CAPACITY TRANSIT**					
102.2	Light Rail between Wahiawa and Leeward Community College Rail Station	2028	2040	$353,488,228	$ 648,533,172	**$(295,044,944)**
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	2023	2040	$184,276,237	$ 57,717,111	**$126,559,126**
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	2025	2040	$197,007,950	$ 125,451,341	**$71,556,609**
102.6	HART rail technology between Mililani and Leeward Community College	2030	2040	$474,063,762	$ 1,346,572,230	**$(872,508,468)**
102.8	Aerial Gondola between Waipio and Leeward Community College	2028	2040	$265,831,659	$ 425,808,518	**$(159,976,859)**
200 BICYCLE PROJECTS						
201	**BICYCLE PATHS (Off-street bicycle facility)**					
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2023	2040	$7,483,789	$ 3,252,281	**$ 4,231,508**
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2028	2040	$1,428,048	$ 5,895,690	**$ (4,467,642)**
201.4	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street	2028	2040	$4,322,956	$ 4,657,188	**$(334,232)**
201.5	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station	2028	2040	$3,769,870	$ 2,981,792	**$788,078**
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	2028	2040	$4,572,509	$ 11,093,701	**$ (6,521,192)**
201.7	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2028	2040	$1,510,366	$ 3,943,222	**$ (2,432,856)**
201.8	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	2028	2040	$4,416,703	$ 2,930,577	**$ 1,486,126**
201.10	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	2028	2040	$2,020,273	$ 1,940,015	**$80,258**
202	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**					
202.3	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	2019	2040	$11,950,315	$ 4,255,763	**$ 7,694,552**
202.4	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	2019	2040	$9,784,174	$ 2,508,175	**$ 7,275,999**
202.6	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path	2028	2040	$2,585,386	$ 4,358,552	**$ (1,773,166)**
202.7	Bicycle lane on Kamehameha Highwy from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$8,736,889	$ 4,496,900	**$ 4,239,989**
203	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**					
203.1	Bicycle route on California Ave between Plum St and Iliahi Elementary	2019	2040	$6,170,182	$ 150,844	**$6,019,338**
203.3	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$1,888,430	$ 26,947	**$1,861,483**
203.5	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$5,368,303	$ 132,977	**$5,235,326**
203.6	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	2019	2040	$9,657,826	$ 144,986	**$9,512,840**
303	**COMPLETE STREETS (BICYCLE)**					
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$2,670,723	$ 1,052,498	**$ 1,618,225**
300 PEDESTRIAN PROEJCTS						
301	**LOCATION-SPECIFIC**					
301.1	Crosswalk across makai leg of Kamehameha Hwy and Avocado St intersection	2019	2040	$6,407,010	$ 523,412	**$ 5,883,598**
303	**COMPLETE STREETS**					

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	Net Present Value
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	2028	2040	$1,882,266	$ 7,376,078	**$ (5,493,812)**
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$5,143,230	$ 1,052,498	**$ 4,090,732**
400 ROADWAY PROJECTS						
403	**KAMEHAMEHA HIGHWAY**					
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	2028	2040	$117,708,401	$ 40,654,849	**$77,053,552**
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	2028	2040	$100,579,602	$ 43,703,836	**$56,875,766**
404	**H-2 INTERCHANGES**					
404.2	H-2 & Meheula Pkwy (widen on-ramp)	2023	2040	$55,194,057	$ 9,279,063	**$45,914,994**
405	**H-1 & H-2 INTERCHANGE**					
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	2028	2040	$32,020,643	$ 13,925,706	**$18,094,937**
406	**CENTRAL MAUKA ROADS**					
406.1	New Road between Mililani Mauka and Pearl City	2028	2040	$143,136,312	$ 77,917,996	**$65,218,316**
406.3	New Road between California Ave and Meheula Pkwy	2028	2040	$3,489,215	$ 25,552,148	**$ (22,062,933)**
408	**MILILANI ACCESS**					
408.1	New H-2 Interchange at Mililani Mauka	2028	2040	$34,517,494	$ 55,480,799	**$ (20,963,305)**
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	2028	2040	$2,828,936	$ 7,590,685	**$ (4,761,749)**
500 TRANSPORTATION SYSTEM MANAGEMENT						
501	**TRANSPORTATION DEMAND MANAGEMENT**					
501.1 through 501.10	TDM Package	2020	2040	$30,422,324	$ 15,105,480	**$15,316,844**
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**					
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	2028	2040	$4,803,096	$ 8,808,390	**$ (4,005,294)**
600 PRICING SOLUTIONS						
601	**PRICING**					
601.2	HOT lanes	2028	2040	$16,810,837	$ 114,974,288	**$ (98,163,451)**

Table 44. Net Present Value for COTS Projects (3% Discount Rate for Benefits)

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	Net Present Value
100 TRANSIT PROJECTS						
101	**GENERAL**					
101.1	Bus Service Expansion	2021	2040	$ 220,982,603	$ 66,243,909	$ 154,738,694
102	**HIGH CAPACITY TRANSIT**					
102.2	Light Rail between Wahiawa and Leeward Community College Rail Station	2028	2040	$ 451,024,768	$ 648,533,172	$ (197,508,404)
102.3	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station	2023	2040	$ 246,029,028	$ 57,717,111	$ 188,311,917
102.5	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd	2025	2040	$ 263,025,995	$ 125,451,341	$ 137,574,654
102.6	HART rail technology between Mililani and Leeward Community College	2030	2040	$ 586,086,401	$ 1,346,572,230	$ (760,485,829)
102.8	Aerial Gondola between Waipio and Leeward Community College	2028	2040	$ 339,180,389	$ 425,808,518	$ (86,628,129)
200 BICYCLE PROJECTS						
201	**BICYCLE PATHS (Off-street bicycle facility)**					
201.1	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	2023	2040	$ 12,037,789	$ 3,252,281	$ 8,785,508
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	2028	2040	$ 2,579,412	$ 5,895,690	$(3,316,278)
201.4	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street	2028	2040	$ 7,788,842	$ 4,657,188	$ 3,131,654
201.5	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station	2028	2040	$ 6,797,183	$ 2,981,792	$ 3,815,391
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	2028	2040	$ 8,245,027	$ 11,093,701	$(2,848,674)
201.7	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station	2028	2040	$ 2,727,004	$ 3,943,222	$(1,216,218)
201.8	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	2028	2040	$ 7,959,832	$ 2,930,577	$ 5,029,255
201.10	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	2028	2040	$ 3,641,248	$ 1,940,015	$ 1,701,233
202	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**					
202.3	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	2019	2040	$ 17,526,109	$ 4,255,763	$ 13,270,346
202.4	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	2019	2040	$ 14,302,416	$ 2,508,175	$ 11,794,241
202.6	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path	2028	2040	$ 4,654,994	$ 4,358,552	$ 296,442
202.7	Bicycle lane on Kamehameha Highwy from Ka Uka Blvd to Lanikahuna Ave	2019	2040	$ 12,793,493	$ 4,496,900	$ 8,296,593
203	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**					
203.1	Bicycle route on California Ave between Plum St and Iliahi Elementary	2019	2040	$ 9,027,160	$ 150,844	$ 8,876,316
203.3	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	2019	2040	$ 2,720,827	$ 26,947	$ 2,693,880
203.5	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	2019	2040	$ 7,837,333	$ 132,977	$ 7,704,356
203.6	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	2019	2040	$ 14,122,973	$ 144,986	$ 13,977,987
303	**COMPLETE STREETS (BICYCLE)**					
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$ 4,306,444	$ 7,376,078	$(3,069,634)
300 PEDESTRIAN PROEJCTS						
301	**LOCATION-SPECIFIC**					
301.1	Crosswalk across makai leg of Kamehameha Hwy and Avocado St intersection	2019	2040	$ 2,670,723	$ 523,412	$ 2,147,311
303	**COMPLETE STREETS**					
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	2028	2040	$ 3,391,939	$ 7,376,078	$(3,984,139)
303.2	Kipapa Dr between Hookelewaa St and Mililani Waena Elementary School	2023	2040	$ 8,270,340	$ 1,052,498	$ 7,217,842

Project Number	Project Description	Start Year	End Year	Total Benefits	Total Costs	Net Present Value
400 ROADWAY PROJECTS						
403	**KAMEHAMEHA HIGHWAY**					
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	2028	2040	$ 149,781,500	$ 40,654,849	$ 109,126,651
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	2028	2040	$ 127,985,458	$ 43,703,836	$ 84,281,622
404	**H-2 INTERCHANGES**					
404.2	H-2 & Meheula Pkwy (widen on-ramp)	2023	2040	$ 75,465,147	$ 9,279,063	$ 66,186,084
405	**H-1 & H-2 INTERCHANGE**					
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	2028	2040	$ 40,745,604	$ 13,925,706	$ 26,819,898
406	**CENTRAL MAUKA ROADS**					
406.1	New Road between Mililani Mauka and Pearl City	2028	2040	$ 182,137,989	$ 77,917,996	$ 104,219,993
406.3	New Road between California Ave and Meheula Pkwy	2028	2040	$ 4,439,954	$ 25,552,148	$ (21,112,194)
408	**MILILANI ACCESS**					
408.1	New H-2 Interchange at Mililani Mauka	2028	2040	$ 43,922,795	$ 55,480,799	$ (11,558,004)
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	2028	2040	$ 3,867,918	$ 7,590,685	$(3,722,767)
500 TRANSPORTATION SYSTEM MANAGEMENT						
501	**TRANSPORTATION DEMAND MANAGEMENT**					
501.1 through 501.10	TDM Package	2020	2040	$ 42,937,370	$ 15,105,480	$ 27,831,890
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**					
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	2028	2040	$ 6,111,841	$ 8,808,390	$(2,696,549)
600 PRICING SOLUTIONS						
601	**PRICING**					
601.2	HOT lanes	2028	2040	$ 21,391,442	$ 114,974,288	$ (93,582,846)

7.0 NEXT STEPS

Following the completion of project analysis for Feasibility (Deliverable F) and for Benefit Cost (Deliverable G), the next step in this project is to compare potential strategies and system improvements to improve mobility for Central Oahu. This will result in packages of improvements to best achieve the desired results. The work involves taking the results of the technical analysis and performance, as well as public input on different scenarios.

Public input will be sought through another public meeting, which will be the third for this project.

Following the public meeting, recommendations will be presented in a final report addressing priorities for further study, funding, and implementation. Timeframe for implementation will be considered at this point. These recommendations are meant to help guide the cooperating agencies for this study as well as OahuMPO leadership.

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APPENDIX A

Project Tracking Matrix

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Project Number	Deliverable D and Deliverable E-1 Project Description	Deliverable F Project Description	Deliverable G Project Description
TRANSIT PROJECTS			
101.0	**GENERAL**		
101.1	Bus Service Expansion	Bus Service Expansion	Bus Service Expansion
101.2	Construct Transit Centers	Build Transit Center at Koa Ridge	*No quantifiable benefits*
101.3	City Operations & Maintenance	City Operations and Maintenance, including Bus Stop/ Shelter Conditions	*No quantifiable benefits*
101.4	Human Services Transportation Coordination Program	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
102.0	**HIGH CAPACITY TRANSIT**		
102.1	HART rail technology between Wahiawa and H-1	HART Rail Technology between Wahiawa and Pearl Highlands Station	*Screened out in Deliverable F, Application of Performance Measures and Feasibility Assessment*
102.2	Light Rail between Wahiawa and H-1	Light Rail between Wahiawa and Leeward Community College Rail Station	Light Rail between Wahiawa and Leeward Community College Rail Station
102.3	Bus Rapid Transit between Wahiawa and H-1	Bus Rapid Transit between Wahiawa and Pearl Highlands Station	Bus Rapid Transit between Wahiawa and Pearl Highlands Rail Station
102.4	Flyer Stops between Wahiawa and H-1	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
102.5	P & R with Flyer Stop in median mauka of Ka Uka Blvd	Park & Ride with Flyer stop in H-2 median mauka of Ka Uka Boulevard	Park and Ride with Flyer Stop in median mauka of Ka Uka Blvd
102.6	HART rail technology between Mililani & H-1	HART Rail Technology between Mililani Mauka and Pearl Highlands Station	HART rail technology between Mililani and Leeward Community College
102.7	Aerial Gondola between Waipio & Wahiawa	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*

Project Number	Deliverable D and Deliverable E-1 Project Description	Deliverable F Project Description	Deliverable G Project Description
102.8	Aerial Gondola between Waipio & Pearl Highlands station	Aerial Gondola between Waipio and Mililani Leeward Community College Rail Station	Aerial Gondola between Waipio and Leeward Community College
BICYCLE PROJECTS			
201.0	**BICYCLE PATHS (Off-street bicycle facility)**		
201.1	New Pathway between Paiwa St and Kamehameha Hwy	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy	New Pathway on Waipahu St between Paiwa St and Kamehameha Hwy
201.2	New Pathway between Anania Dr and Central Oahu Regional Park	New Pathway between Anania Dr and Central Oahu Regional Park	New Pathway between Anania Dr and Central Oahu Regional Park
201.3	New Direct Kipapa Gulch Bike Bridge and Pathway	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
201.4	New Bike Pathway along Kamehameha Hwy.	New Bike Pathway along Kamehameha Hwy from Ka Uka Boulevard to Waipahu Street	New Bike Pathway along Kamehameha Hwy. from Ka Uka Boulevard to Waipahu Street
201.5	New Ped/Bike Path connecting Kam. Hwy at Waipahu Street to PH station via LCC	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to LCC Station	New Ped/Bike Path connecting Kamehameha Hwy at Waipahu Street to Leeward Community College Rail Station
201.6	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr	New Bike Pathway along Kamehameha Hwy. between Wahiawa and Anania Dr
201.7	Bike Pathway on Cane Haul Road between H-2 & Pearl Highlands station	Bike Pathway on Cane Haul Road between H-2 & Pearl Highlands station	Bike Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station
201.8	Bicycle infrastructure around H-2 & Meheula	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange	Bicycle pathway infrastructure through the H-2/Meheula Parkway Interchange
201.9	Bike pathway along California Ave. between. Kilea Pl. and Nonohe St	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*

Project Number	Deliverable D and Deliverable E-1 Project Description	Deliverable F Project Description	Deliverable G Project Description
201.10	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St	Bike Pathway in Central Oahu Regional Park between Kamehameha Hwy and Paiwa St
202.0	**BICYCLE LANES (On-street bicycle facility delineated from vehicle traffic)**		
202.1	Ainamakua Dr between Mililani Park & Ride and Kualapa St	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
202.2	Meheula Parkway between Mililani H-2 Interchange and Mililani H-2 Interchange	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
202.3	Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St	Bicycle lanes on Meheula Parkway between Mililani H-2 Interchange and Kapanoe St
202.4	Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway	Bicycle lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway
202.5	Kamehameha Highway between H-1 and H-2	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
202.6	Waihona Street and Kamehameha Highway between Cane Haul Road bike path and Arizona Memorial	Bicycle lanes on Kamehameha Highway from Waihona St connecting to Pearl Harbor Bike Path	Bicycle lanes on Kamehameha Highway from Waihona St. connecting to Pearl Harbor Bike Path
202.7	*Project Added in Deliverable F, Application of Performance Measures and Feasibility Assessment*	Bicycle lane on Kamehameha Highway between Ka Uka Blvd and Lanikahuna Ave	Bicycle lane on Kamehameha Highwy from Ka Uka Blvd to Lanikahuna Ave
203.0	**BICYCLE ROUTES (On-street bicycle facility with street signs and/or sharrows)**		
203.1	California Ave between Plum St and Iliahi Elementary	Bicycle route on California Ave between Plum St and Iliahi Elementary	Bicycle route on California Ave between Plum St and Iliahi Elementary

Project Number	Deliverable D and Deliverable E-1 Project Description	Deliverable F Project Description	Deliverable G Project Description
203.2	Kunia Rd btwen Anonui St and Wilikina Dr	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
203.3	Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St	Bicycle route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St
203.4	Kamehameha Highway between Haleiwa Bypass and Kuahelani Ave	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
203.5	Anania Dr between Meheula Pkwy and Kipapa Gulch Path	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path	Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path
203.6	Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Shopping Center	Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center
203.7	Kamehameha Hwy between Waipio Uka St and Waipahu St	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
303.0	**COMPLETE STREETS (BICYCLE)**		
303.2	*Project Added in Deliverable G, Benefit Cost Analysis*	*Project Added in Deliverable G, Benefit Cost Analysis*	Kipapa Dr between Hookelawaa St and Mililani Waena Elementary School
PEDESTRIAN PROEJCTS			
301.0	**LOCATION-SPECIFIC**		
301.1	Crosswalk across Kamehameha Hwy between Avocado St and Kilani St	Crosswalk across makai leg of Kamehameha Hwy and Avocado Street intersection	Crosswalk across makai leg of Kamehameha Hwy and Avocado Street intersection
301.2	Shared use path on Kamehameha Hwy between Lanikuhana Ave and Meheula Pkwy	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*

Project Number	Deliverable D and Deliverable E-1 Project Description	Deliverable F Project Description	Deliverable G Project Description
302.0	**GENERAL**		
302.1	Safe Routes to School	Safe Routes to School	*No quantifiable benefits*
302.2	Pedestrian Crossing Safety	Pedestrian Crossing Safety	*No quantifiable benefits*
302.3	Mobility Hubs	Mobility Hubs	*No quantifiable benefits*
303.0	**COMPLETE STREETS**		
303.1	California Ave between Kamehameha Hwy and Wahiawa District Park	California Ave between Kamehameha Hwy and Wahiawa District Park	California Ave between Kamehameha Hwy and Wahiawa District Park
303.2	Kipapa Dr between Hookelawaa St and Mililani Waena Elementary School	Kipapa Dr between Hookelawaa St and Mililani Waena Elementary School	Kipapa Dr between Hookelawaa St and Mililani Waena Elementary School
303.3	Complete Streets modifications on priority roads	Complete Streets modifications on priority roads	*No quantifiable benefits*
ROADWAY PROJECTS			
401.0	**KA UKA BLVD. & H-2 INTERCHANGE**		
401.1	Ka Uka Blvd & H-2 Northbound On-Ramp to H-2 (freeway ramp widening & signal modification)	Ka Uka Blvd & H-2 Northbound On-Ramp to H-2 (freeway ramp widening & signal modification)	*Koa Ridge project*
401.2	Ka Uka Blvd & H-2 Southbound On-Ramp to H-2 (freeway ramp approach widening)	Ka Uka Blvd & H-2 Southbound On-Ramp to H-2 (freeway ramp approach widening)	*Koa Ridge project*
401.3	Ka Uka Blvd & H-2 Southbound Off-Ramp to Ka Uka Blvd / Moaniani St. (freeway ramp approach widening)	Ka Uka Blvd & H-2 Southbound Off-Ramp to Ka Uka Blvd / Moaniani St. (freeway ramp approach widening)	*Koa Ridge project*
401.4	Ka Uka Blvd & H-2 Northbound Off-Ramp to Limuana St (freeway ramp signal modification)	Ka Uka Blvd & H-2 Northbound Off-Ramp to Limuana St (freeway ramp signal modification)	*Koa Ridge project*
401.5	Ka Uka Blvd & H-2 Southbound Off-Ramp to Ka Uka Blvd / Moaniani St (freeway ramp widening & signal modification)	Ka Uka Blvd & H-2 Southbound Off-Ramp to Ka Uka Blvd / Moaniani St (freeway ramp widening & signal modification)	*Koa Ridge project*

Project Number	Deliverable D and Deliverable E-1 Project Description	Deliverable F Project Description	Deliverable G Project Description
401.6	Ka Uka Blvd & H-2 Northbound Off-Ramp to Ka Uka Blvd (freeway ramp relocation & widening)	Ka Uka Blvd & H-2 Northbound Off-Ramp to Ka Uka Blvd (freeway ramp relocation & widening)	*Koa Ridge project*
401.7	Ka Uka Blvd & H-2 Northbound On-Ramp to H-2 (new freeway ramp & overpass widening)	Ka Uka Blvd & H-2 Northbound On-Ramp to H-2 (new freeway ramp & overpass widening)	*Koa Ridge project*
401.8	Ka Uka Blvd & H-2 Southbound On-Ramp to H-2 (new freeway ramp & overpass widening)	Ka Uka Blvd & H-2 Southbound On-Ramp to H-2 (new freeway ramp & overpass widening)	*Koa Ridge project*
401.9	Ka Uka Blvd & H-2 Flyover Ramp	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
402.0	**KA UKA BOULEVARD**		
402.1	Ka Uka Blvd between Moaniani St and Commercial Driveway/ Spine Rd (lane addition)	Ka Uka Blvd between Moaniani St and Commercial Driveway/ Spine Rd (lane addition)	*Koa Ridge project*
402.2	Ka Uka Blvd Intersection with Commercial Driveway/ Spine Rd (intersection lane & signal modification)	Ka Uka Blvd Intersection with Commercial Driveway/ Spine Rd (intersection lane & signal modification)	*Koa Ridge project*
402.3	Ka Uka Blvd Intersection with Commercial Driveway/Spine Rd (intersection widening & modification)	Ka Uka Blvd Intersection with Commercial Driveway/Spine Rd (intersection widening & modification)	*Koa Ridge project*
402.4	Ka Uka Blvd between H-2 and new development (new road)	Ka Uka Blvd between H-2 and new development (new road)	*Koa Ridge project*
403.0	**KAMEHAMEHA HIGHWAY**		
403.1	Kamehameha Hwy & Lumiaina St Intersection (intersection widening & signal modification)	Kamehameha Hwy & Lumiaina St Intersection (intersection widening & signal modification)	*Koa Ridge project*

Project Number	Deliverable D and Deliverable E-1 Project Description	Deliverable F Project Description	Deliverable G Project Description
403.2	Kamehameha Hwy & Waipahu St Intersection (intersection restriping & signal modification)	Kamehameha Hwy & Waipahu St Intersection (intersection restriping & signal modification)	*Koa Ridge project*
403.3	Kamehameha Hwy & Ka Uka Blvd Intersection (intersection widening)	Kamehameha Hwy & Ka Uka Blvd Intersection (intersection widening)	*Koa Ridge project*
403.4	Kamehameha Hwy between Ka Uka Blvd and North of Ka Uka Blvd. (add NB lane)	Kamehameha Hwy between Ka Uka Blvd and North of Ka Uka Blvd. (add NB lane)	*Koa Ridge project*
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)
403.6	Kamehameha Hwy between H-2 and Kilani Ave (unknown)	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
403.7	Kamehameha Hwy Roosevelt Bridge (rehabilitation)	Kamehameha Hwy Roosevelt Bridge (rehabilitation)	*Unable to assess benefits for structural improvement project*
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy
404.0	**H-2 INTERCHANGES**		
404.1	H-2 & Pineapple Road Interchange	H-2 & Pineapple Road Interchange	*Koa Ridge project*
404.2	H-2 & Meheula Pkwy (widen on-ramp)	H-2 & Meheula Pkwy (widen on-ramp)	H-2 & Meheula Pkwy (widen on-ramp)
404.3	H-2 & Kamehameha Hwy (widen on-ramp)	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
405.0	**H-1 & H-2 INTERCHANGE**		
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements

Project Number	Deliverable D and Deliverable E-1 Project Description	Deliverable F Project Description	Deliverable G Project Description
406.0	**CENTRAL MAUKA ROADS**		
406.1	New Road between Mililani Mauka and Pearl City	New Road between Mililani Mauka and Pearl City	New Road between Mililani Mauka and Pearl City
406.2	New Road between Whitmore Ave (SR 804) and California Ave	*Deleted because outside of Study Area*	*N/A*
406.3	New Road between California Ave and Meheula Pkwy	New Road between California Ave and Meheula Pkwy	New Road between California Ave and Meheula Pkwy
407.0	**PAIWA EXTENSION**		
407.1	Extend Paiwa St from north of Lumiauau St to Kamehameha Hwy/Ka Uka Blvd intersection	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
408.0	**MILILANI ACCESS**		
408.1	New H-2 Interchange at Mililani Mauka	New road connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	New road connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka
408.2	New road from Wikao St to P & R	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
408.3	New road between H-2 and P & R	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
408.4	New flyer stops at H-2 with pedestrian pathway to P & R	New flyer stops at H-2 with pedestrian pathway to Park & Ride	New flyer stops at H-2 with pedestrian pathway to Park & Ride
TRANSPORTATION SYSTEM MANAGEMENT			
501.0	**TRANSPORTATION DEMAND MANAGEMENT**		
501.1	Free real-time online carpool matching	Free real-time online carpool matching	*TDM Projects packaged into one project for inclusion in Deliverable G, Benefit Cost Analysis*

Project Number	Deliverable D and Deliverable E-1 Project Description	Deliverable F Project Description	Deliverable G Project Description
501.2	Outreach promotion and marketing of alternative transportation	Outreach promotion and marketing of alternative transportation	*TDM Projects packaged into one project for inclusion in Deliverable G, Benefit Cost Analysis*
501.3	Emergency ride home program	Emergency ride home program	*TDM Projects packaged into one project for inclusion in Deliverable G, Benefit Cost Analysis*
501.4	Major special events (e.g., Mililani Holiday Parade)	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
501.5	Employer based commuter/parking programs	Employer based commuter/parking programs	*TDM Projects packaged into one project for inclusion in Deliverable G, Benefit Cost Analysis*
501.6	Carsharing	Emerging and innovative strategies – Carsharing	*TDM Projects packaged into one project for inclusion in Deliverable G, Benefit Cost Analysis*
501.7	Bikesharing	Emerging and innovative strategies – Bikesharing	*TDM Projects packaged into one project for inclusion in Deliverable G, Benefit Cost Analysis*
501.8	Vanpool program	Vanpool program	*TDM Projects packaged into one project for inclusion in Deliverable G, Benefit Cost Analysis*
501.9	Work from home	Support of working from home	*TDM Projects packaged into one project for inclusion in Deliverable G, Benefit Cost Analysis*
501.10	Alternate/shifted work hours	Support of alternate/shifted work hours	*TDM Projects packaged into one project for inclusion in Deliverable G, Benefit Cost Analysis*

Project Number	Deliverable D and Deliverable E-1 Project Description	Deliverable F Project Description	Deliverable G Project Description
501.1 through 501.10	*TDM Projects packaged into one project for inclusion in Deliverable G, Benefit Cost Analysis*	*TDM Projects packaged into one project for inclusion in Deliverable G, Benefit Cost Analysis*	TDM Package
502.0	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**		
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)
PRICING SOLUTIONS			
601.0	**PRICING**		
601.1	Congestion pricing on H-1 or H-2	*Screened out in Deliverable E-1, Project Evaluation and Preliminary Ranking Memorandum*	*N/A*
601.2	HOT lanes	HOT lanes	HOT lanes
601.3	Parking strategies	Parking strategies	*No quantifiable benefits*

PROJECT SUMMARY

- Deliverable D and Deliverable E-1: **90 Projects**
  - Transit: 12 projects
  - Bicycle: 23 projects
  - Pedestrian: 8 projects
  - Roadway: 33 projects
  - Transportation System Management: 11 projects
  - Pricing: 3 projects

- Deliverable F: **70 Projects**
  - Transit: 9 projects
  - Bicycle: 15 projects plus 1 new project = 16 projects
  - Pedestrian: 7 projects
  - Roadway: 26 projects
  - Transportation System Management: 10 projects
  - Pricing: 2 projects

- Deliverable G: **37 Projects**
  - Transit: 6 projects
  - Bicycle: 16 projects plus 1 new project = 17 projects
  - Pedestrian: 3 projects
  - Roadway: 8 projects
  - Transportation System Management: 2 projects
  - Pricing: 1 projects

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APPENDIX B

Bicycle and Pedestrian Benefit Calculations

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Project Description: **201.1 New Bicycle Pathway on Waipahu St between Paiwa St and Kamehameha Hwy**
Type: **Off Street facility**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	440, 441, 447, 448, 449, 450, 451, 462	464	442, 446, 445, 444
Population in 2010	20431	2668	4801
Growth Factor	1.05		
Population (R)	21453	2801	5041
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2, (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	17	2	4

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	103	13	24

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	33	2	2

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	199	14	9

Demand Totals

Existing Bike Commuters	23
Existing Adult Cyclists	140
New Commuters	37
New Adult Cyclists	222

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	20.38 min for off street facility
	Value of Time per trip	$ 4.8 for off-street facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.80
Auto Use	Length of Trip	1 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	48,912.00
Opening Year Health Benefit	$	33,522.00
Opening Year Recreational Benfit	$	796,795.00
Opening Year Auto Use Benefit	$	1,739.00
Total Opening Year Benefits	**$**	**880,968.00**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **201.2 New Pathway between Anania Dr and Central Oahu Regional Park**
Type: **Off Street facility**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
TAZ	463, 468, 472, 487, 489	488	483, 486, 490, 491
Population in 2010	5179	2102	4867
Growth Factor	1.05		
Population (R)	5438	2207	5110
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	4	2	4

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	26	11	25

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	8	2	2

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	50	12	10

Demand Totals

Existing Bike Commuters	10
Existing Adult Cyclists	62
New Commuters	12
New Adult Cyclists	72

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	20.38 min for off street facility
	Value of Time per trip	$ 4.8 for off-street facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Auto Use	Length of Trip	2.4 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	17,934.40
Opening Year Health Benefit	$	10,872.00
Opening Year Recreational Benfit	$	258,420.00
Opening Year Auto Use Benefit	$	1,353.60
Total Opening Year Benefits	**$**	**288,580.00**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **201.4 New Pathway along Kamehameha Highway from Ka Uka Blvd to Waipahu St**
Type: **Off Street facility**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	440, 449, 462, 463, 464, 465, 467, 468	441, 461, 466, 469, 472	448, 450, 470, 481, 487
Population in 2010	14745	11131	7045
Growth Factor	1.05		
Population (R)	15482	11688	7397
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	12	9	6

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	74	56	36

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	23	10	2

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	143	62	14

Demand Totals

Existing Bike Commuters	27
Existing Adult Cyclists	166
New Commuters	35
New Adult Cyclists	219

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	20.38 min for off street facility
	Value of Time per trip	$ 4.8 for off-street facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Auto Use	Length of Trip	1.6 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	50,542.40
Opening Year Health Benefit	$	33,069.00
Opening Year Recreational Benfit	$	792,488.00
Opening Year Auto Use Benefit	$	2,632.00
Total Opening Year Benefits	**$**	**878,731.40**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **201.5 New Pathway connecting Kamehameha Highway at Waipahu St to Leeward Community College**
Type: **Off Street facility**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2029
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2029 is 1.1

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	440, 441, 442, 449, 462, 464	431, 448, 461	447, 450, 451
Population in 2010	15656	3753	8453
Growth Factor	1.1		
Population (R)	17222	4128	9298
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	14	3	7

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	83	20	45

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	27	3	3

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	160	22	18

Demand Totals

Existing Bike Commuters	24
Existing Adult Cyclists	148
New Commuters	33
New Adult Cyclists	200

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	20.38 min for off street facility
	Value of Time per trip	$ 4.8 for off-street facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	1 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	46,466.40
Opening Year Health Benefit	$	30,200.00
Opening Year Recreational Benfit	$	719,269.00
Opening Year Auto Use Benefit	$	1,551.00
Total Opening Year Benefits	**$**	**797,486.40**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **201.6 New Pathway on Kamehameha Highway between Wahaiwa and Anania Dr in Mililani**
Type: **Off Street facility**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	488, 490, 496, 499, 501, 503, 504, 505, 506, 507, 510, 511, 518, 522, 523, 540	491, 497, 500, 502, 508, 509, 512, 517, 521	484, 485, 486, 487, 489, 492, 495, 524
Population in 2010	16328	7519	15245
Growth Factor	1.05		
Population (R)	17144	7895	16007
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	14	6	13

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	82	38	77

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	27	7	5

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	158	42	30

Demand Totals

Existing Bike Commuters	33
Existing Adult Cyclists	197
New Commuters	39
New Adult Cyclists	230

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	20.38 min for off street facility
	Value of Time per trip	$ 4.8 for off-street facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	3.4 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	58,694.40
Opening Year Health Benefit	$	34,730.00
Opening Year Recreational Benfit	$	822,637.00
Opening Year Auto Use Benefit	$	6,232.20
Total Opening Year Benefits	**$**	**922,293.60**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **201.7 New Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station**
Type: **Off Street facility**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2029
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2029 is 1.1

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
TAZ	431, 433, 438, 440, 464, 474	-	-
Population in 2010	7860		
Growth Factor	1.1		
Population (R)	8646	-	-
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

within 0.25 mile of project

Existing Bike Commuters 7

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists 42

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters 14

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists 81

Demand Totals

Existing Bike Commuters	7
Existing Adult Cyclists	42
New Commuters	14
New Adult Cyclists	81

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	20.38 min for off street facility
	Value of Time per trip	$ 4.8 for off-street facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	1 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	17,119.20
Opening Year Health Benefit	$	12,231.00
Opening Year Recreational Benfit	$	288,569.00
Opening Year Auto Use Benefit	$	658.00
Total Opening Year Benefits	**$**	**318,577.20**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **201.8 Bike Pathway through the H-2/Meheula Parkway Interchange**
Type: **Off Street facility**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2029 is 1.1

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	492, 493, 498, 500	494, 497, 502	496, 499, 501, 503
Population in 2010	15335	11389	5087
Growth Factor	1.1		
Population (R)	16869	12528	5596
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	13	10	4

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	81	60	27

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	25	11	2

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	156	67	11

Demand Totals

Existing Bike Commuters	27
Existing Adult Cyclists	168
New Commuters	38
New Adult Cyclists	234

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	20.38 min for off street facility
	Value of Time per trip	$ 4.8 for off-street facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	0.8 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	52,988.00
Opening Year Health Benefit	$	35,334.00
Opening Year Recreational Benfit	$	844,172.00
Opening Year Auto Use Benefit	$	1,428.80
Total Opening Year Benefits	**$**	**933,922.80**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **201.10 Bike Pathway in Central Oahu Regional Park**
Type: **Off Street facility**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	463, 467, 468	460, 461, 465, 469, 481	462, 466
Population in 2010	5758	6888	3866
Growth Factor	1.05		
Population (R)	6046	7232	4059
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	5	6	3

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	29	35	19

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	10	7	1

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	56	39	7

Demand Totals

Existing Bike Commuters	14
Existing Adult Cyclists	83
New Commuters	18
New Adult Cyclists	102

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	20.38 min for off street facility
	Value of Time per trip	$ 4.8 for off-street facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	1.6 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	26,086.40
Opening Year Health Benefit	$	15,402.00
Opening Year Recreational Benfit	$	361,788.00
Opening Year Auto Use Benefit	$	719.10
Total Opening Year Benefits	**$**	**403,995.50**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **202.3 Bike Lanes on Meheula Parkway between the H-2 Interchange and Kapanoe Street**
Type: **On Street facility without parking**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	492, 493, 494, 498, 500	502	497, 503
Population in 2010	24,739	709	2,454
Growth Factor	1.05		
Population (R)	25976	744	2577
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	21	1	2

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	125	4	12

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	41	1	1

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	241	4	5

Demand Totals

Existing Bike Commuters	24
Existing Adult Cyclists	141
New Commuters	43
New Adult Cyclists	250

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	18.02 min for on street facility without parking
	Value of Time per trip	$ 4.25 for on-street without parking facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	1.5 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	42,759.96
Opening Year Health Benefit	$	37,750.00
Opening Year Recreational Benfit	$	891,549.00
Opening Year Auto Use Benefit	$	3,031.50
Total Opening Year Benefits	**$**	**975,090.46**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **202.4 Bicycle Lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway**
Type: **On Street facility without parking**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	484, 485, 492, 500, 501, 502, 503, 504, 505, 506	486, 488, 490	491, 493, 497, 498
Population in 2010	16,258	3,982	13,189
Growth Factor	1.05		
Population (R)	17071	4181	13848
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	14	3	11

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	82	20	66

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	27	3	4

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	158	22	26

Demand Totals

Existing Bike Commuters	28
Existing Adult Cyclists	168
New Commuters	34
New Adult Cyclists	206

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	18.02 min for on street facility without parking
	Value of Time per trip	$ 4.25 for on-street without parking facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	1.8 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	39,568.92
Opening Year Health Benefit	$	31,106.00
Opening Year Recreational Benfit	$	740,804.00
Opening Year Auto Use Benefit	$	2,876.40
Total Opening Year Benefits	**$**	**814,355.32**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **202.6 Bicycle Lanes on Kamehameha Hwy from Waihona St connecting to the Pearl Harbor Path**
Type: **On Street facility without parking**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2029 is 1.1

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	424, 430, 431, 433, 438, 440	423, 434, 437, 464	439, 474
Population in 2010	6602	9786	7140
Growth Factor	1.1		
Population (R)	7262	10765	7854
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	6	9	6

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	35	52	38

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	12	10	2

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	68	58	15

Demand Totals

Existing Bike Commuters	21
Existing Adult Cyclists	125
New Commuters	24
New Adult Cyclists	141

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	18.02 min for on street facility without parking
	Value of Time per trip	$ 4.25 for on-street without parking facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	0.8 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	28,719.38
Opening Year Health Benefit	$	21,291.00
Opening Year Recreational Benfit	$	503,919.00
Opening Year Auto Use Benefit	$	902.40
Total Opening Year Benefits	**$**	**554,831.78**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **202.7 Bicycle Lanes on Kamehamea Highway from Ka Uka Blvd to Lanikahuna Ave**
Type: **On Street facility without parking**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assuming 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	463, 467, 468, 483, 486, 487, 488, 504	469, 485, 489	466, 482, 490, 503
Population in 2010	14,252	5,546	6,566
Growth Factor	1.05		
Population (R)	14965	5823	6894
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	12	5	6

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	72	28	33

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	23	6	2

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	139	31	13

Demand Totals

Existing Bike Commuters	23
Existing Adult Cyclists	133
New Commuters	31
New Adult Cyclists	183

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	18.02 min for on street facility without parking
	Value of Time per trip	$ 4.25 for on-street without parking facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	2 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for suburban type

Opening Year Mobility Benefit	$	34,463.00
Opening Year Health Benefit	$	27,633.00
Opening Year Recreational Benfit	$	654,664.00
Opening Year Auto Use Benefit	$	2,914.00
Total Opening Year Benefits	**$**	**719,674.00**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Benefits Undiscounted	**$**	**719,674.00**
Benefits Discounted @ 7%	**$**	**672,593.00**
Benefits Discounted @ 3%	**$**	**698,713.00**

7% is the real discount rate is recommended for all infrastructure projects according to OMB Circular a-94
3% is the discount rate derived for public investments.

Project Description: **203.1 Bicycle Route on California Avenue between Plum Street and Iliahi Elementary School**
Type: **In-traffic facility**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
TAZ	513, 514, 515, 516, 517, 518, 519, 520	521, 522	-
Population in 2010	12667	2626	-
Growth Factor	1.05		
Population (R)	13300	2757	-
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project
Existing Bike Commuters	11	2

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	64	13

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	21	2

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	124	14

Demand Totals

Existing Bike Commuters	13
Existing Adult Cyclists	77
New Commuters	23
New Adult Cyclists	138

Benefit	Variables	Values Used
Mobility	Number of Trips	No Mobility Benefit for In-traffic facilities
	Time Spent	
	Value of Time per trip	
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	1.5 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit		-
Opening Year Health Benefit	$	20,838.00
Opening Year Recreational Benfit	$	495,305.00
Opening Year Auto Use Benefit	$	1,621.50
Total Opening Year Benefits	**$**	**517,764.50**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **203.5 Bicycle route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path**
Type: **In-traffic facility**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	487, 488, 489, 490, 503	486, 492, 501, 502, 504, 505	491
Population in 2010	7368	8286	943
Growth Factor	1.05		
Population (R)	7736	8700	990
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	
Existing Bike Commuters	6	7	1

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	37	42	5

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	12	8	0

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	71	47	2

Demand Totals

Existing Bike Commuters	14
Existing Adult Cyclists	84
New Commuters	20
New Adult Cyclists	120

Benefit	Variables	Values Used
Mobility	Number of Trips	No Mobility Benefit for In-traffic facilities
	Time Spent	
	Value of Time per trip	
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	1.5 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit		-
Opening Year Health Benefit	$	18,120.00
Opening Year Recreational Benfit	$	430,700.00
Opening Year Auto Use Benefit	$	1,410.00
Total Opening Year Benefits	**$**	**450,230.00**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **203.6 Bicycle route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Town Center**
Type: **In-traffic facility**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	482, 483, 485, 486, 487, 488, 489, 490, 491, 492, 504	484, 503	481, 505, 506
Population in 2010	18318	3947	6257
Growth Factor	1.05		
Population (R)	19234	4144	6570
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	**within 0.5 mile of project**	
Existing Bike Commuters	15	3	5

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	92	20	32

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	29	3	2

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	178	22	12

Demand Totals

Existing Bike Commuters	23
Existing Adult Cyclists	144
New Commuters	34
New Adult Cyclists	212

Benefit	Variables	Values Used
Mobility	Number of Trips	No Mobility Benefit for In-traffic facilities
	Time Spent	
	Value of Time per trip	
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	2.5 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit		-
Opening Year Health Benefit	$	32,012.00
Opening Year Recreational Benfit	$	766,646.00
Opening Year Auto Use Benefit	$	3,995.00
Total Opening Year Benefits	**$**	**802,653.00**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: **303.2 Complete Streets project for Kipapa Dr Between Hookelewaa St and Mili**
Type: **On Street facility with parking**

The estimation of benefits from the improved projects is driven by the demand.
It includes the number and preferences of facility users and others who experience welfare gains.
The analysis approach is based on the methodology in the TRB's NCHRP Report 552

Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Bicycle Commuter % (C) is 0.2 % which is taken from Central Oahu Public Use Microdata Area (PUMA), US Census Bureau
Population (R) is population for 2019
Assumptions:
National average of 80% residents are Adults
50% of adults are commuters
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 0.25 mile of project	**within 0.5 mile of project**	**within 1 mile of project**
TAZ	490, 502, 503	492, 500, 501, 505, 506	488, 491, 499, 504
Population in 2010	2648	7505	5199
Growth Factor	1.05		
Population (R)	2780	7880	5459
Bike Commuter % (C)	0.20%		
Adult %	80.00%		
% of Adult Commuters	50.00%		
% Adult Cyclists (T) *	0.60%		
Distance Factors (L)**	2.93	2.11	1.39

* For Adult Cyclist calculations refer to NCHRP 552. Pg. A - 5 eq. 2 (0.3 % + 1.5 * C)
** For Distance Factors refer to NCHRP Pg. 39

Existing Bike Commuter Calculations

Formula: Daily Existing Bike Commuters = Population (R) * 80% * 50% * Commuter % (C) (NCHRP 552. Pg. 38)

	within 0.25 mile of project	within 0.5 mile of project	within 1 mile of project
Existing Bike Commuters	2	6	4

Existing Adult Cyclists Calculations

Formula: Daily Existing Adult Cyclists = Population (R) * 80% * 50% * % Adult Cyclists (T) (NCHRP 552. Pg. 38)

Existing Adult Cyclists	13	38	26

New Bike Commuter Calculations

Formula: New Bike Commuters = $\sum$ (Existing Bike Commuters*(L -1)) (Ref. NCHRP Pg. 39)

New Commuters	4	7	2

New Adult Cyclist Calculations

Formula: New Adult Cyclists = $\sum$ (Existing Adult Cyclist*(L -1)) (Ref. NCHRP Pg. 39)

New Adult Cyclists	25	42	10

Demand Totals

Existing Bike Commuters	12
Existing Adult Cyclists	77
New Commuters	13
New Adult Cyclists	77

Benefit	Variables	Values Used
Mobility	Number of Trips	50 weeks per year and 5 days per week
	Time Spent	15.83 min for on street facility with parking
	Value of Time per trip	$ 3.74 for on-street with parking facility type
Health	Value of savings per capita	$151
Recreation	# of hours spent	A typical day involves 1 hr of cycling
	Value of Savings per hour	$11.8
Reduced Auto Use	Length of Trip	1 mile
	Number of Trips	50 weeks per year and 5 days per week
	Savings per mile	9.4 cents for sub urban type

Opening Year Mobility Benefit	$	12,334.21
Opening Year Health Benefit	$	11,627.00
Opening Year Recreational Benfit	$	275,648.00
Opening Year Auto Use Benefit	$	611.00
Total Opening Year Benefits	**$**	**300,220.21**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: 303.1 Complete Streets project for California Ave between Kamehameha Hwy and Wahiawa District Park

The analysis approach is based on the methodology in the TRB's NCHRP Report 552
Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Population (R) is population for 2019
Assumptions:
10.5 % of all person trips are made by walking (Source: NHTS, 2017 https://nhts.ornl.gov/person-trips)
3.79 per person trips per day (Source: https://nhts.ornl.gov/2009/pub/stt.pdf)
Average number of trips per traveler is 3.2 (Source: NCHRP, 770, Pg. 13)
22% increae in walking overall due to complete street projects (Source: National Complete Steerts Coalition)
Growth factor assumning 0.7% growth from 2005 to 2018 is 1.09
15% of trips are recreational and 39% are for health. (http://www.pedbikeinfo.org/data/factsheet_general.cfm)
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 1 mile of project
TAZ	515, 516, 517, 518, 519, 520, 521, 522
Population in 2010	9486
Growth Factor	1.05
Population (R)	9960
No.of trips per person per day	3.79
% of trips by walk	10.50%
Trips by walk per day	3964
Trips per week	27748
# of Recreational trips per week	4162
# of Health trips per week	10822
% increase in trips with project	22%
Increased Recreational trips per week	916
Increased Health trips per week	2381
No. of Trips per traveller per week	3.2
New Pedestrians for Recreation	286
New Pedestrians for Health	744

Benefit	Variables	Values Used
Health	Value of savings per capita	$151
Recreation	Value of Savings per hour	$12
	Average time spent walking per day	13 min
	Value of time spent walking (D)	$2.56

Opening Year Health Benefit	$	112,344.00
Opening Year Recreational Benfit	$	266,890.43
Total Opening Year Benefits	**$**	**379,234.43**

***For all Formulae please refer to NCHRP 552 Pg. 39**

Project Description: 303.2 Complete Streets project for Kipapa Dr Between Hookelewaa St and Mili

The analysis approach is based on the methodology in the TRB's NCHRP Report 552
Base Year: 2018
Population from the TAZ's is taken from US Census 2010
Population (R) is population for 2019
Assumptions:
10.5 % of all person trips are made by walking (Source: NHTS, 2017 https://nhts.ornl.gov/person-trips)
3.79 per person trips per day (Source: https://nhts.ornl.gov/2009/pub/stt.pdf)
Average number of trips per traveler is 3.2 (Source: NCHRP, 770, Pg. 13)
22% increae in walking overall due to complete street projects (Source: National Complete Steerts Coalition)
Growth factor assumning 0.7% growth from 2005 to 2018 is 1.09
15% of trips are recreational and 39% are for health. (http://www.pedbikeinfo.org/data/factsheet_general.cfm)
Growth factor assumning 0.5% growth from 2010 to 2019 is 1.05

	within 1 mile of project
TAZ	488, 490, 491, 492, 499, 500, 501, 502, 503, 504, 505, 506
Population in 2010	15352
Growth Factor	1.05
Population (R)	16120
No.of trips per person per day	3.79
% of trips by walk	10.50%
Trips by walk per day	6415
Trips per week	44905
# of Recreational trips per week	6736
# of Health trips per week	17513
% increase in trips with project	22%
Increased Recreational trips per week	1482
Increased Health trips per week	3853
No. of Trips per traveller per week	3.2
New Pedestrians for Recreation	463
New Pedestrians for Health	1204

Benefit	Variables	Values Used
Health	Value of savings per capita	$151
Recreation	Value of Savings per hour	$12
	Average time spent walking per day	13 min
	Value of time spent walking (D)	$2.56

Opening Year Health Benefit	$	181,804.00
Opening Year Recreational Benfit	$	432,063.88
Total Opening Year Benefits	**$**	**613,867.88**

***For all Formulae please refer to NCHRP 552 Pg. 39**

APPENDIX C

Roadway Benefit Calculations

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Project Number	Project Description	Travel Time			Vehicle Operating Costs					Safety					
		Time Saved/Yr (person-hrs)	Value of Time	Total Travel Time Benefit	Baseline VMT	Project VMT	Vehicle Miles Saved/Yr	Operating Cost	Total Vehicle Operating Cost Benefit	Fatalities Reduced	Fatality Value	Serious Injuries Avoided	Serious Injury Value	PDO Avoided	PDO Value
400	**ROADWAY PROJECTS**														
403	**KAMEHAMEHA HIGHWAY**														
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	883,289	$ 14.72	$ 13,002,014	904,680	905,972	(329,460)	$ 0.42	$ (138,373)	-	$ 10,021,548	-	$ 225,485	-	$ 4,439
403.7	Kamehameha Hwy Roosevelt Bridge (rehabilitation)	-	$ 14.72	$ -	904,680	904,680	-	$ 0.42	$ -	-	$ 10,021,548	-	$ 225,485	-	$ 4,439
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy)	670,143	$ 14.72	$ 9,864,505	904,680	894,720	2,539,800	$ 0.42	$ 1,066,716	-	$ 10,021,548	0.25	$ 225,485	1.05	$ 4,439
404	**H-2 INTERCHANGES**														
404.2	H-2 & Meheula Pkwy (widen on-ramp)	369,424	$ 14.72	$ 5,437,921	904,680	906,219	(392,445)	$ 0.42	$ (164,827)	-	$ 10,021,548	-	$ 225,485	-	$ 4,439
405	**H-1 & H-2 INTERCHANGE**														
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	238,000	$ 14.72	$ 3,503,360	904,680	904,680	-	$ 0.42	$ -	-	$ 10,021,548	-	$ 225,485	-	$ 4,439
406	**CENTRAL MAUKA ROADS**														
406.1	New Road between Mililani Mauka and Pearl City	1,048,521	$ 14.72	$ 15,434,229	904,680	903,211	374,595	$ 0.42	$ 157,330	-	$ 10,021,548	-	$ 225,485	-	$ 4,439
406.3	New Road between California Ave and Meheula Pkwy	7,479	$ 14.72	$ 110,091	904,680	902,156	643,620	$ 0.42	$ 270,320	-	$ 10,021,548	-	$ 225,485	-	$ 4,439
408	**MILILANI ACCESS**														
408.1	New Road Connection to H-2 Interchange at Pineapple Road for access to Mililani Mauka	224,702	$ 14.72	$ 3,307,613	904,680	900,425	1,085,025	$ 0.42	$ 455,711	-	$ 10,021,548	-	$ 225,485	-	$ 4,439
408.4	New flyer stops at H-2 with pedestrian pathway to Park and Ride	18,360	$ 14.72	$ 270,259	904,680	904,680	-	$ 0.42	$ -	-	$ 10,021,548	-	$ 225,485	-	$ 4,439
502	**INTELLIGENT TRANSPORTATION SYSTEMS (ITS)**														
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	35,700	$ 14.72	$ 525,504	904,680	904,680	-	$ 0.42	$ -	-	$ 10,021,548	-	$ 225,485	-	$ 4,439
600	**PRICING SOLUTIONS**														
601	**PRICING**														
601.2	HOT lanes	124,950	$ 14.72	$ 1,839,264			-	$ 0.42	$ -	-	$ 10,021,548	-	$ 225,485	-	$ 4,439
601.3	Parking strategies	-	$ 14.72	$ -				$ 0.42	$ -		$ -		0	-	$ -

	Emissions Reduction																			
Total Safety Benefit	VOC Base	VOC Project	VOC Reduced	VOC Value/short ton	VOC Savings Benefit	NOx Base	NOx Project	NOx Reduced	NOx Value/short ton	NOx Savings Benefit	PM Base	PM Project	PM Reduced	PM Value/short ton	PM Savings Benefit	SO2 Base	SO2 Project	SO2 Reduced	SO2 Value/short ton	Total Annual Emissions Benefit	Total Annual Benefit Value
$ -	0.0348	0.0342	0.0006	$ 1,954	$ 299	0.0690	0.0685	0.0005	$ 7,701	$ 982	0.0051	0.0049	0.0002	$ 352,577	$ 13,486				$ 45,514	$ 14,767	$ 12,878,408
$ -	0.0348	0.0348	-	$ 1,954	$ -	0.0690	0.0690	-	$ 7,701	$ -	0.0051	0.0051	-	$ 352,577	$ -				$ 45,514	$ -	$ -
$ 61,032.20	0.0348	0.0343	0.0005	$ 1,954	$ 249	0.0690	0.0680	0.0010	$ 7,701	$ 1,964	0.0051	0.0049	0.0001	$ 352,577	$ 9,890				$ 45,514	$ 12,103	$ 11,004,356
$ -	0.0348	0.0348	-	$ 1,954	$ -	0.0690	0.0691	(0.0001)	$ 7,701	$ (196)	0.0051	$ 0	-	$ 352,577	$ -				$ 45,514	$ (196)	$ 5,272,898
$ -	0.0348	0.0348	-	$ 1,954	$ -	0.0690	0.0690	-	$ 7,701	$ -	0.0051	0.0051	-	$ 352,577	$ -				$ 45,514	$ -	$ 3,503,360
$ -	0.0348	0.0311	0.0037	$ 1,954	$ 1,844	0.0690	0.0669	0.0021	$ 7,701	$ 4,124	0.0051	0.0044	0.0007	$ 352,577	$ 62,935				$ 45,514	$ 68,902	$ 15,660,461
$ -	0.0348	0.0347	0.0001	$ 1,954	$ 50	0.0690	0.0688	0.0002	$ 7,701	$ 393	0.0051	0.0050	0.0000	$ 352,577	$ 899				$ 45,514	$ 1,342	$ 381,753
$ -	0.0348	0.0341	0.0007	$ 1,954	$ 349	0.0690	0.0684	0.0006	$ 7,701	$ 1,178	0.0051	0.0049	0.0001	$ 352,577	$ 11,688				$ 45,514	$ 13,215	$ 3,776,539
$ -	0.0348	0.0348	-	$ 1,954	$ -	0.0690	0.069	-	$ 7,701	$ -	0.0051	0.0051	-	$ 352,577	$ -				$ 45,514	$ -	$ 270,259
$ -	0.0348	0.0348	-		$ -	0.0690	0.0690	-	$ 7,701	$ -	0.0051	0.0051	-	$ 352,577	$ -				$ 45,514	$ -	$ 525,504
$ -	0.0348	0.0348	-		$ -	0.0690	0.0690	-	$ 7,701	$ -	0.0051	0.0051	-	$ 352,577	$ -				$ 45,514	$ -	$ 1,839,264
$ -	0.0348	0.0348			$ -	0.0690	0.0690			$ -	0.0051	0.0051			$ -						$ -

Table T

Travel Time Savings Calculations

Proj. #	Project Description	AM Peak Period				PM Peak Period				Total Veh Hrs/Yr	Total Person Hrs/Yr
		Time Saved (mins)	2040 Vol	Veh Hrs	Veh Hrs/Yr	Time Saved (mins)	2040 Vol	Veh Hrs	Veh Hrs/Yr		
403.5	Kamehameha Hwy between Ka Uka Blvd and Lanikuhana (widen from 3 to 4 lanes)	12	7,070	1,414	360,570	6	10,602	1,060	270,351	630,921	883,289
403.8	Kamehameha Hwy HOV lanes (Ka Uka Boulevard to Farrington Hwy	6	10,774	1,077	274,737	3	15,995	800	203,936	478,673	670,143
404.2	H-2 & Meheula Pkwy (widen on-ramp)	8	6,947	926	236,198	2	3,256	109	27,676	263,874	369,424
405.1	Waiawa H-1/H-2 Interchange Eastbound/Southbound Merge Improvements	2	20,000	667	170,000	1	-	-	-	170,000	238,000
406.1	New Road between Mililani Mauka and Pearl City	39	3,265	2,122	541,174	19	2,573	815	207,770	748,944	1,048,521
406.3	New Road between California Ave and Meheula Pkwy	1	308	5	1,309	1	949	16	4,033	5,342	7,479
408.1	New Connection to Pineapple Road/H-2 Interchange from Mililani Mauka	11	1,930	354	90,228	5	3,307	276	70,274	160,501	224,702
408.4	New flyer stops at H-2 with pedestrian pathway to P & R	7	9	1.05	268	5	9	0.75	191	459	18,360
502.1	ITS (Real-time traffic info, dynamic signage, adaptive signals, etc.)	0.5	6,000	50	12,750	0.5	6,000	50	12,750	25,500	35,700
601.2	HOT lanes	5	2,100	175	44,625	5	2,100	175	44,625	89,250	124,950
601.3	Parking Strategies	-	-	-	-	-	-	-	-	-	-

Notes: AM data from model per performance measure evaluation. PM savings assumed to be 50% or less of AM savings from model given multiple distribution corridors.
Person-hrs calculated from veh-hrs using average vehicle occupancy of 1.4 persons per vehicle from OahuMPO model for cars and 40 pax per bus (for project 408.4)
Travel time savings estimated to be only 1 minute given significant downstream congestion. No significant time savings estimated for Project 405.1 during PM peak period.
Travel time savings for flyer stop project calculated from Google Maps and assumes 9 total through buses (at 20 min headways per hour) with 40 pax each do not have to exit freeway.
Travel time savings for ITS and HOT lanes assumed to be an average of 5 minutes for AM and PM peak periods
Travel time savings for ITS will primarily be experienced by vehicles at adaptive signal installations and assumed tobe 6 seconds (or 10% per FHWA. Assuming volume affected is 2,000 veh/hr traveling through 5 modified intersections, total savings will be 30 seconds per vehicle. FHWA reference: (https://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/asct.cfm) of assumed average 60 sec delay)
Volumes experiencing travel time savings in the HOT lanes assumed to be 700 SOV vehicles per hour (assuming the remaining 900 or so per hour in the lane are HOV vehicles)

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APPENDIX D

Construction Cost Estimate Tables

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Project 201.1: New Bicycle Pathway on Waipahu Street between Paiwa St and Kamehameha Hwy

Purpose: To provide a dedicated shared use path from central Waipahu to the southern edge of the COTS area that will enhance active mode connectivity and safety.

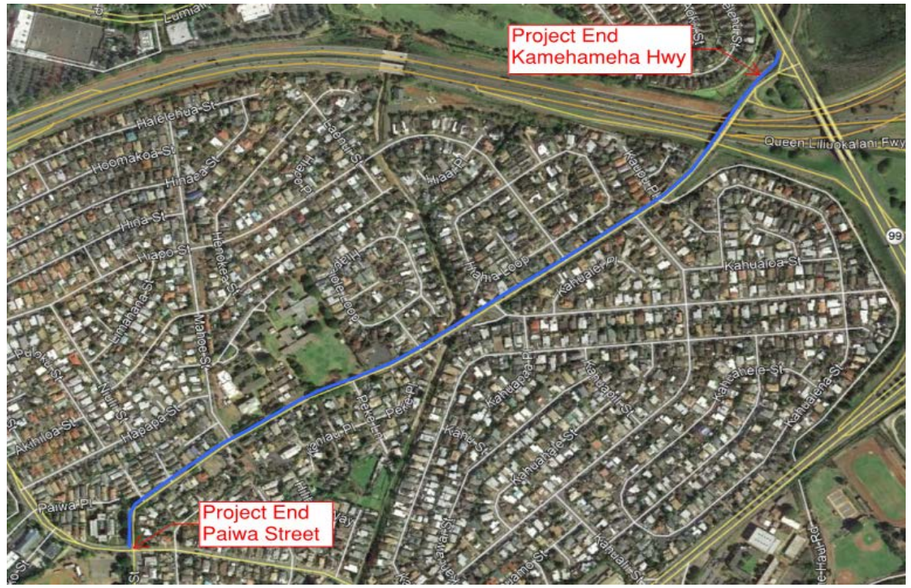
Project Description: This project would include construction of a shared use path on Waipahu Street in Waipahu. The path would be approximately 1.0 mile long.

Evaluation: Separate bicycle facilities are limited in the southern portion of the COTS area, especially in terms of active mode connections to the adjacent Waipahu community via Kamehameha Highway. Adequate right-of-way appears to be available to provide a shared use path for most of the length of the proposed improvement. This would help to contribute to expanding the bicycle and pedestrian network by roughly 1 mile.

Assumptions:

- Length = 5300'
- Width = 13'
- Material = Asphalt
- 6 intersections

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Clear and grub	Sq. Ft.	37100	$ 3.00	$ 111,300.00	7' x 5300'
	Demolish existing sidewalk	Sq. Ft.	31800	$ 5.00	$ 159,000.00	6' x 5300'
	Erosion Control	L.S.	5	$ 10,000.00	$ 50,000.00	
Site improvements						
Roadway						
	13' wide shared use path	Lin. Ft.	5300	$ 130.00	$ 689,000.00	$10/sq.ft.
	Curb Gutter	Sq. Ft.	13250	$ 20.00	$ 265,000.00	2.5 x 5300
	Drainage works	each	18	$ 14,000.00	$ 252,000.00	$14,000 / 300' catch basin spacing
	Grading Works	Cu. Yd.	2750	$ 35.00	$ 96,250.00	
	New Curb Ramp	each	12	$ 3,500.00	$ 42,000.00	2 @ each of 6 intersections
	Striping Symbols	each	22	$ 300.00	$ 6,600.00	includes bike arrows, pavement arrows @250' spacing
	4" Stripe (white/Yellow)	Lin. Ft.	5300	$ 6.00	$ 31,800.00	Lane Striping
	12"stripe (white)	Lin. Ft.	60	$ 9.00	$ 540.00	
	Cross walk striping	each	6	$ 600.00	$ 3,600.00	
	Hydrant/water meter relocates	L.S.	1	$ 50,000.00	$ 50,000.00	
Intersection						
	Traffic Signal Modification	each	1	$ 350,000.00	$ 350,000.00	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 105,354.50	
	Mobilization	L.S.	1	10%	$ 210,709.00	
	Contingency - 30%			30%	$ 632,127.00	
	TOTAL				**$ 3,055,280.50**	2017
					$ 3,085,800.00	2018

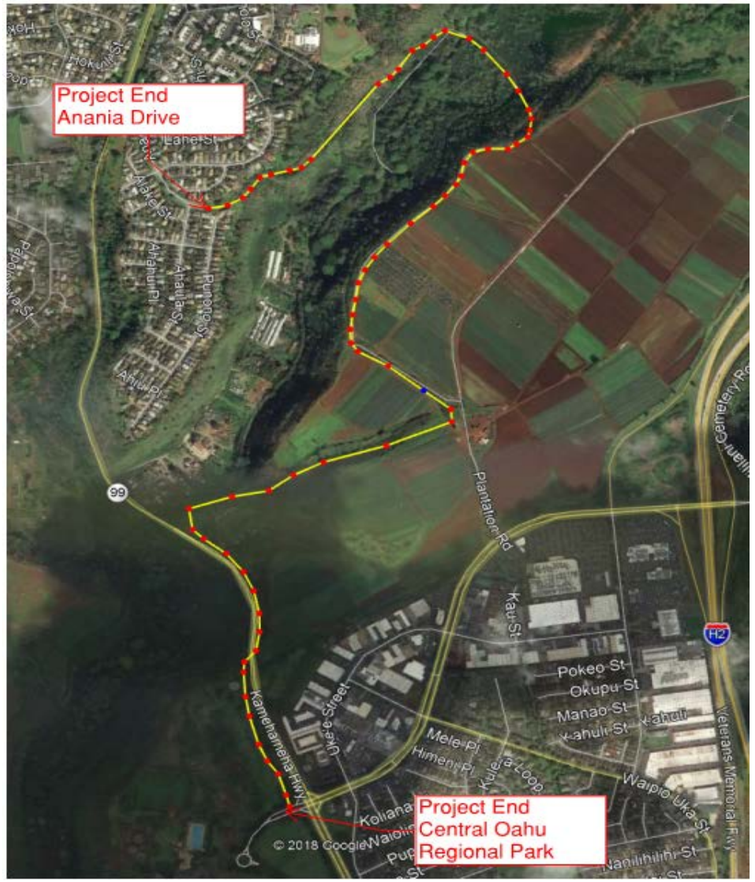


Project 201.2: New Pathway between Anania Dr and Central Oahu Regional Park

Purpose: To provide a dedicated shared use path from central Mililani to a major regional destination where a connection does not currently exist.

Project Description: This new path could initially follow the existing Plantation Road alignment until it was integrated into the new Koa Ridge community and would connect link Central Oahu Regional Park to Mililani without requiring visitors to use a private automobile.

Evaluation: Separate bicycle facilities are limited throughout the COTS area, and no dedicated bicycle and pedestrian connections connecting the Mililani and Waipio communities. This would help to contribute to expanding the bicycle and pedestrian network by roughly 2.4 miles depending on the final route.



Assumptions:

Length = 14,400'
Width = 12'
Material = Asphalt

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Clear and grub	Sq. Ft.	172800	$ 3.00	$ 518,400.00	12' x 14,400'
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	14	$ 10,000.00	$ 140,000.00	
Site improvements						
Roadway						
	12' wide shared use path	Lin. Ft.	14400	$ 120.00	$ 1,728,000.00	$10/sq.ft.
	Drainage works	each	48	$ 14,000.00	$ 672,000.00	$14,000 / 300' catch basin spacing
	Grading Works	Cu. Yd.	14900	$ 35.00	$ 521,500.00	
	New Curb Ramp	each		$ 3,500.00	$ -	2 @ each of 6 intersections
	Striping Symbols	each	58	$ 300.00	$ 17,400.00	includes bike arrows, pavement arrows @250' spacing
	4" Stripe (white/Yellow)	Lin. Ft.	14400	$ 6.00	$ 86,400.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Cross walk striping	each		$ 600.00	$ -	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 184,185.00	
	Mobilization	L.S.	1	10%	$ 368,370.00	
	Contingency - 30%			30%	$ 1,105,110.00	
	TOTAL				**$ 5,341,365.00**	2017
					$ 5,394,800.00	2018

Project 201.4: New Pathway along Kamehameha Highway from Ka Uka Blvd to Waipahu St

Purpose: To provide a dedicated shared use path from the Waipio community to the adjacent community of Waipahu that will enhance active mode connectivity and safety and allow for an alternative to commuting by private automobile.

Project Description: This new path could be incorporated into the Central Oahu Regional Park and would likely be best suited along the Ewa side of the highway.

Evaluation: Separate bicycle facilities are limited throughout the COTS area, and no dedicated bicycle and pedestrian connections currently connect the Waipahu and Waipio communities near Kamehameha Highway. This new path could be incorporated into the Central Oahu Regional Park and would likely be best suited along the Ewa side of the highway. This would help to contribute to expanding the bicycle and pedestrian network by roughly 1.6 miles depending on the final routing. This project should be combined with Project 201.1 to complete the regional bike network in this area.

Recommended for Further Evaluation: **Yes**

Assumptions:

Length = 9,800'
Width = 12'
Material = Asphalt

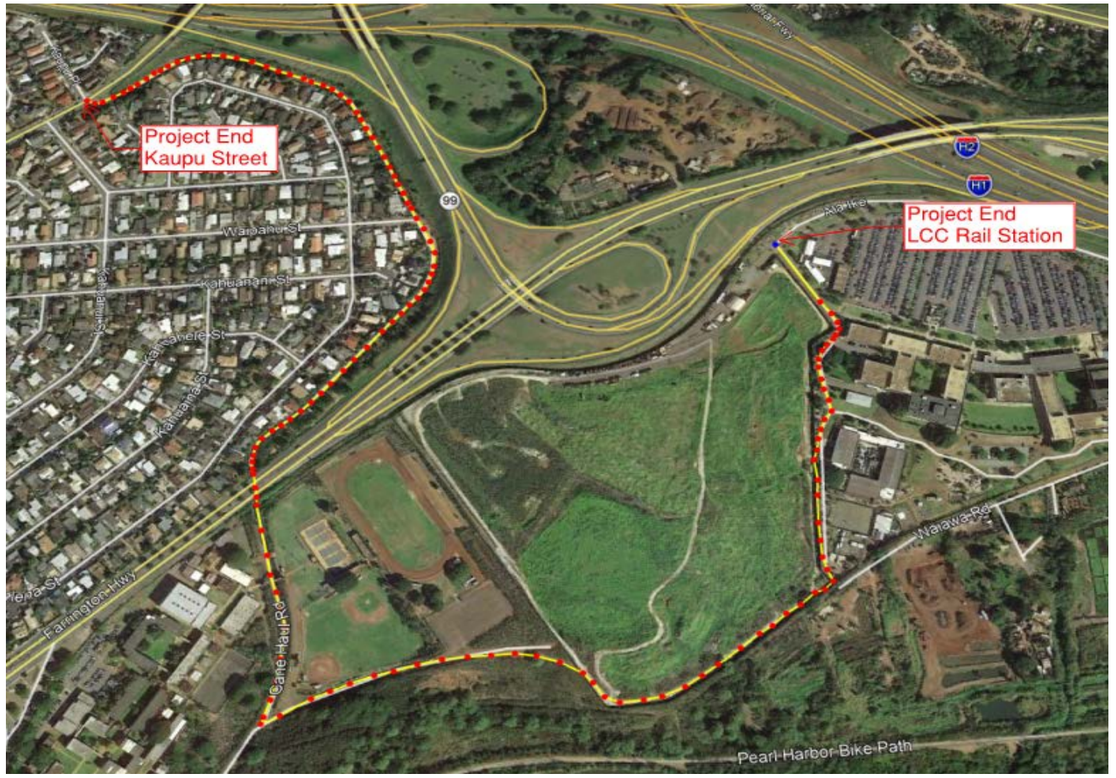
	ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST	NOTES
Removals/Demo						
	Clear and grub	Sq. Ft.	117600	$ 3.00	$ 352,800.00	10' x 9,800'
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	10	$ 10,000.00	$ 100,000.00	
Site improvements						
Roadway						
	10' wide shared use path	Lin. Ft.	9800	$ 120.00	$ 1,176,000.00	$10/sq.ft.
	New Curb Ramp	each	6	$ 3,500.00	$ 21,000.00	2 @ each of 3 intersections
	Drainage works	each	33	$ 14,000.00	$ 462,000.00	$14,000 / 300' catch basin spacing
	Grading Works	Cu. Yd.	4700	$ 35.00	$ 164,500.00	
	Striping Symbols	each	40	$ 300.00	$ 12,000.00	includes bike arrows, pavement arrows @250' spacing
	4" Stripe (white/Yellow)	Lin. Ft.	9800	$ 6.00	$ 58,800.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Cross walk striping	each	2	$ 600.00	$ 1,200.00	
Intersection						
	Traffic Signal Modification	each	2	$ 350,000.00	$ 700,000.00	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 152,415.00	
	Mobilization	L.S.	1	10%	$ 304,830.00	
	Contingency - 30%			30%	$ 914,490.00	
	TOTAL				**$ 4,420,035.00**	2017
					$ 4,464,200.00	2018

Project 201.5: New Pathway connecting Kamehameha Highway at Waipahu Street to Leeward Community College

Purpose: To provide a dedicated shared use path from the Waipio and Waikele communities to LCC and the future rail system.

Project Description: The alignment for this path could include the Cane Haul Road alignment that begins opposite Kaupu Place and wraps around the Diamond Head end of Waipahu. In any case, a bridge over Farrington Highway would be needed to connect to the LCC rail station and the adjacent college campus.

Evaluation: No safe and convenient active mode connection is currently available between communities on the mauka side of the H-1 freeway to Leeward Community College. This project would help to contribute to expanding the bicycle and pedestrian network by roughly 1 mile depending on the final routing. This project should be combined with Project 201.1 and 201.4 to complete the regional bike network in this area.



Assumptions:

Length = 8,400'
Width = 12'
Material = Asphalt

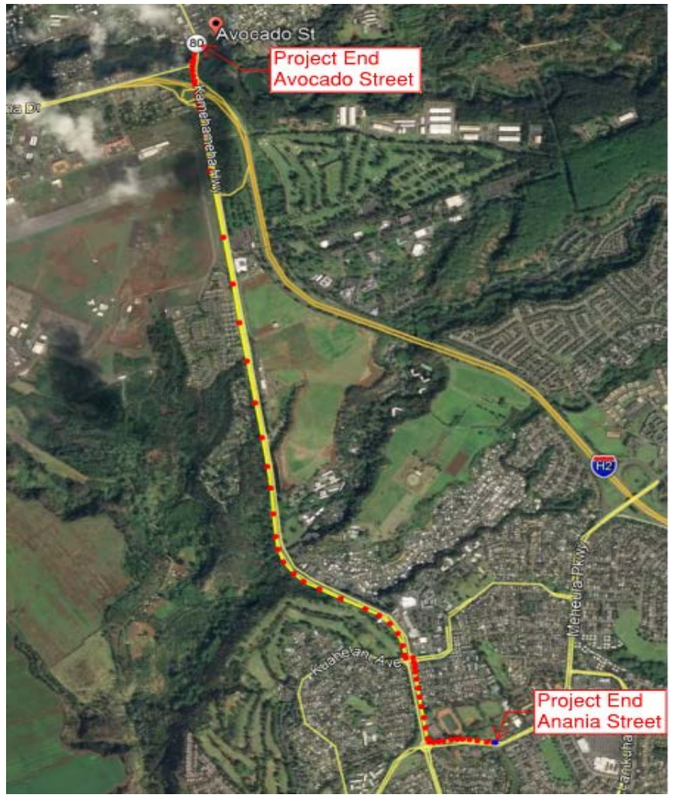
	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Clear and grub	Sq. Ft.	100800	$ 3.00	$ 302,400.00	12' x 8,400'
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	8	$ 10,000.00	$ 80,000.00	
Site improvements						
Roadway						
	12' wide shared use path	Lin. Ft.	8400	$ 120.00	$ 1,008,000.00	$10/sq.ft.
	New Curb Ramp	each		$ 3,500.00	$ -	
	Drainage works	each	28	$ 14,000.00	$ 392,000.00	$14,000 / 300' catch basin spacing
	Grading Works	Cu. Yd.	2300	$ 35.00	$ 80,500.00	
	Striping Symbols	each	68	$ 300.00	$ 20,400.00	includes bike arrows, pavement arrows @250' spacing
	4" Stripe (white/Yellow)	Lin. Ft.	8400	$ 6.00	$ 50,400.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Cross walk striping	each		$ 600.00	$ -	
Landscaping						
	Lighting Cane Haul Road Underpass	L.S.	1	$ 20,000.00	$ 20,000.00	
Misc.						
	Traffic Control	L.S.	1	5%	$ 97,685.00	
	Mobilization	L.S.	1	10%	$ 195,370.00	
	Contingency - 30%			30%	$ 586,110.00	
	TOTAL				**$ 2,832,865.00**	2017
					$ 2,861,200.00	2018

Project 201.6: New Pathway on Kamehameha Highway between Wahiawa and Anania Dr in Mililani

Purpose: To provide a dedicated shared use path between the communities of Wahiawa and Mililani where one does not currently exist.

Project Description: The path should ideally begin at the Kamehameha Highway/Avocado Street intersection and extend Makai to Meheula Parkway and Anania Drive. The alignment for this path may have to alternate sides of the highway depending on terrain and available right-of-way.

Evaluation: No safe and convenient active mode connection is currently available between Wahiawa and Mililani. This project would help to contribute to expanding the bicycle and pedestrian network by roughly 3.4 miles. A new facility along this alignment would provide a recreational and commute opportunity for residents in both communities, as well as those residents and employees on Wheeler Air Force Base and along Kahelu Avenue and Wikao Street on the east side of the H-2 freeway. This project should be combined with Projects 201.2, 201.4, and 201.5 to provide a continuous connection between Wahiawa and Leeward Community College (similar to the Pearl Harbor Historic Path that provides regional active mode connectivity).



Assumptions:

Length = 18,000'
Width = 10'
Material = Asphalt
Bridge = 300'

	ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST	NOTES
Removals/Demo						
	Clear and grub	Sq. Ft.	180000	$ 3.00	$ 540,000.00	10' x 18,000'
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	18	$ 10,000.00	$ 180,000.00	
Site improvements						
Roadway						
	10' wide shared use path	Lin. Ft.	18000	$ 100.00	$ 1,800,000.00	$10/sq.ft.
	New Curb Ramp	each		$ 3,500.00	$ -	2 @ each of 3 intersections
	Drainage works	each	60	$ 14,000.00	$ 840,000.00	$14,000 / 300' catch basin spacing
	Grading Works	Cu. Yd.	7300	$ 35.00	$ 255,500.00	
	Striping Symbols	each	72	$ 300.00	$ 21,600.00	includes bike arrows, pavement arrows @250' spacing
	4" Stripe (white/Yellow)	Lin. Ft.	18000	$ 6.00	$ 108,000.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Cross walk striping	each		$ 600.00	$ -	
	Cantilever at bridge for multi-use path	Sq. Ft.	3000	$ 250.00	$ 750,000.00	10' x 300'
Intersection						
	Traffic Signal Modification	each	8	$ 350,000.00	$ 2,800,000.00	
Landscaping						
		L.S.	1		$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 364,755.00	
	Mobilization	L.S.	1	10%	$ 729,510.00	
	Contingency - 30%			30%	$ 2,188,530.00	
	TOTAL				**$ 10,577,895.00**	2017
					$ 10,683,700.00	2018

Project 201.7: New Pathway on Cane Haul Road between H-2 and Pearl Highlands Rail Station

Purpose: To provide a dedicated shared use path between the Waipio community and the new rail station.

Project Description: This project would include approximately 1.0 mile of shared use path between H-2 and the Pearl Highlands Rail Station.

Evaluation: No safe and convenient active mode connection is currently available between Waipio and Pearl City. While this project would not complete a link to Pearl City, it would provide a commute and recreational opportunity for residents in Waipio to access the new rail station. The alignment would need to be refined based on topographic constraints (including creek crossings) and it may require use of a portion of Waihona Street to complete the path. The advantage of this project over Project 201.6 is that it will not likely require a bridge over a roadway like the H-1 freeway, but could include other structures to cross small gulches or creeks. This project would help to contribute to expanding the bicycle and pedestrian network by nearly 2.5 miles of facilities. This project should be combined with Projects 201.4 and 202.6 to extend the connection to all of the Waipio community and link it to the Pearl Harbor Historic Trail.

Assumptions:

Length = 11,800'
Width = 10'
Material = Asphalt

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Clear and grub	Sq. Ft.	118000	$ 3.00	$ 354,000.00	10' x 11,800'
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	12	$ 10,000.00	$ 120,000.00	
Site improvements						
Roadway						
	10' wide shared use path	Lin. Ft.	11800	$ 100.00	$ 1,180,000.00	$10/sq.ft.
	New Curb Ramp	each		$ 3,500.00	$ -	2 @ each of 3 intersections
	Drainage works	each	39	$ 14,000.00	$ 546,000.00	$14,000 / 300' catch basin spacing
	Grading Works	Cu. Yd.	8750	$ 35.00	$ 306,250.00	
	Striping Symbols	each	47	$ 300.00	$ 14,100.00	includes bike arrows, pavement arrows @250' spacing
	4" Stripe (white/Yellow)	Lin. Ft.	11800	$ 6.00	$ 70,800.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Cross walk striping	each		$ 600.00	$ -	
Landscaping						
		L.S.	1		$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 129,557.50	
	Mobilization	L.S.	1	10%	$ 259,115.00	
	Contingency - 30%			30%	$ 777,345.00	
	TOTAL				**$ 3,757,167.50**	2017
					$ 3,794,700.00	2018

Project 201.8: Bike Pathway through the H-2/Meheula Parkway Interchange

Purpose: To provide a separate bike facility on Meheula Parkway across the H-2 interchange to minimize potential vehicle-bicycle conflicts and better connect Mililani Mauka with central Mililani.

Project Description: The proposed path could be installed on the mauka or makai side of the Parkway and would require additional improvements including: possibly cantilevering a structure from the existing parkway overcrossing, modifying the ramp crossings to include additional traffic control devices (e.g., rectangular rapid flashing beacons), and modifying the ramp design to create nearly right-angle turns to slow vehicle speeds and improve visibility of cyclists. Ultimately, this would be a shared use path to minimize right-of-way requirements.

Evaluation: Currently, bicyclists must share the roadway with vehicles or ride on the sidewalk on Meheula Parkway between Ainamakua Drive and Kuahelani Avenue. The sidewalk is relatively narrow at 4 feet and results in conflicts with pedestrians already using this facility. However, implementation of such a facility would enhance safety and encourage bicycling in lieu of automobile travel. This facility would add up to 0.8 miles of new bicycle and pedestrian facilities.

Assumptions:

Length = 4,100'
Width = 10'
Material = Asphalt

	ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST	NOTES
Removals/Demo						
	Clear and grub	Sq. Ft.	24600	$ 3.00	$ 73,800.00	6' x 4,100'
	Demolish existing sidewalk	Sq. Ft.	16400	$ 5.00	$ 82,000.00	4' x 4,100'
	Erosion Control	L.S.	4	$ 10,000.00	$ 40,000.00	
Site improvements						
Roadway						
	10' wide shared use path	Lin. Ft.	4100	$ 100.00	$ 410,000.00	$10/sq.ft.
	New Curb Ramp	each		$ 3,500.00	$ -	2 @ each of 3 intersections
	Drainage works	each	14	$ 14,000.00	$ 196,000.00	$14,000 / 300' catch basin spacing
	Grading Works	Cu. Yd.	1500	$ 35.00	$ 52,500.00	
	Striping Symbols	each	17	$ 300.00	$ 5,100.00	includes bike arrows, pavement arrows @250' spacing
	4" Stripe (white/Yellow)	Lin. Ft.	4100	$ 6.00	$ 24,600.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Cross walk striping	each	2	$ 600.00	$ 1,200.00	
	Cantilever at bridge for multi-use path	Sq.Ft.	3000	$ 250.00	$ 750,000.00	300' x 10'
Landscaping						
	Traffic control device at ramps	L.S.	2	$ 150,000.00	$ 300,000.00	
Misc.						
	Traffic Control	L.S.	1	5%	$ 96,760.00	
	Mobilization	L.S.	1	10%	$ 193,520.00	
	Contingency - 30%			30%	$ 580,560.00	
	TOTAL				**$ 2,806,040.00**	2017
					$ 2,834,100.00	2018

Project 201.10: Bike Pathway in Central Oahu Regional Park

Purpose: To provide a dedicated bike facility through the regional park connecting the existing northern terminus of Paiwa Street (north of Lumiauau Street) to Kamehameha Highway at the park entrance (opposite Ka Uka Boulevard).

Project Description: This project includes an off-street shared use path that could be installed by widening the existing meandering sidewalk through Central Oahu Regional Park to its current terminus. A new improved path would also have to be installed between the softball fields and Paiwa Street.

Evaluation: Currently, bicyclists must share the internal park roadways and parking lots with vehicles between the park entrance at Ka Uka Boulevard and the eastern side of the softball field complex. The remaining connection to Paiwa Street is unimproved and is essentially a dirt path that is now blocked by a tall gate and fence. This would allow a more direct and safer connection for bicyclists traveling between the Waipio and Waikele communities, and would provide another travel option for Waikele residents to access the park via walking and biking. This improvement would add 0.85 mile of pedestrian and bicycle infrastructure to the COTS area.

Assumptions:

Length =5,300'
Width = 12'
Material = Asphalt

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Clear and grub	Sq. Ft.	63600	$ 3.00	$ 190,800.00	12' x 5,300'
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	5	$ 10,000.00	$ 50,000.00	
Site improvements						
Roadway						
	10' wide shared use path	Lin. Ft.	5300	$ 120.00	$ 636,000.00	$10/sq.ft.
	New Curb Ramp	each		$ 3,500.00	$ -	2 @ each of 3 intersections
	Drainage works	each	18	$ 14,000.00	$ 252,000.00	$14,000 / 300' catch basin spacing
	Grading Works	Cu. Yd.	2500	$ 35.00	$ 87,500.00	
	Striping Symbols	each	22	$ 300.00	$ 6,600.00	includes bike arrows, pavement arrows @250' spacing
	4" Stripe (white/Yellow)	Lin. Ft.	5300	$ 6.00	$ 31,800.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Cross walk striping	each		$ 600.00	$ -	
Landscaping						
		L.S.	1		$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 62,735.00	
	Mobilization	L.S.	1	10%	$ 125,470.00	
	Contingency - 30%			30%	$ 376,410.00	
	TOTAL				**$ 1,819,315.00**	2017
					$ 1,837,500.00	2018

Project 202.3: Bike Lanes on Meheula Parkway between the H-2 Interchange and Kapanoe Street

Purpose: To provide a dedicated bike facility on Meheula Parkway through most of Mililani Mauka to separate vehicles and bicyclists and enhance bicycle travel and safety.

Project Description: This project would install bicycle lanes on Meheula Parkway in Mililani Mauka.

Evaluation: Meheula Parkway is the primary roadway extending through Mililani Mauka and connects most of the neighborhoods and area schools. Bicycle lanes of approximately 5 feet in width could be striped in both directions between Lehiwa Street and Kapanoe Street without modifying the vehicle capacity in this corridor. Ten-foot lanes could be maintained adjacent to the bike lane in each direction. In the eastbound direction, a bicycle lane could also be extended from Ainamakua Drive to Lehiwa Street. However, west of Lehiwa Drive, Meheula Parkway includes three westbound vehicle lanes and an on-street bicycle lane could not be installed without removing one of those vehicle lanes. Given, the importance of encouraging bicycle travel and enhancing safety for cyclists, this project should be further evaluated from a design and capacity perspective to determine feasibility of including bicycle lanes along the entire segment and not just the sections with two travel lanes. Depending on the final design, this project would add up to 1.5 miles to the bicycle network in the COTS area.

Assumptions:

Length = 9,600'
Width = 5' minimum
Material = Existing Asphalt

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Clear and grub	Sq. Ft.		$ 3.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	9	$ 10,000.00	$ 90,000.00	
Site improvements						
Roadway						
	Repo Post - Surface mount delineator	each	730	$ 100.00	$ 73,000.00	spacing @ 20' 9600' EB & 5000' WB
	Raised Asphalt Conrete Berm (protected bike lane)	Lin. Ft.	4600	$ 15.00	$ 69,000.00	Buffer between Roadway and Bike lane 4600' WB
	Bike Boxes and Jughandles	each	15	$ 6,000.00	$ 90,000.00	660 sq. ft. for 2 lane and approach
	4" Stripe (white/Yellow)	Lin. Ft.	13600	$ 6.00	$ 81,600.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Bike lane (Green)	each	3	$ 6,750.00	$ 20,250.00	Green Paint 150' length x 5'
	Striping Symbols	each	77	$ 300.00	$ 23,100.00	includes bike arrows, sharrows, pavement arrows @ 250' spacing
	Cross walk striping	each	15	$ 600.00	$ 9,000.00	
Intersection						
	Traffic Signal Modification	each	7	$ 350,000.00	$ 2,450,000.00	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 145,297.50	
	Mobilization	L.S.	1	10%	$ 290,595.00	
	Contingency - 30%			30%	$ 871,785.00	
	TOTAL				**$ 4,213,627.50**	2017
					$ 4,255,800.00	2018

Project 202.4: Bicycle Lanes on Kuahelani Avenue between Hokuahiahi Park and Meheula Parkway

Purpose: To provide a dedicated bike facility on Kuahelani Avenue that will separate vehicles and bicyclists, and enhance bicycle travel and safety.

Project Description: This project includes the installation of bicycle lanes on Kuahelani Avenue between Meheula Parkway in Mililani and Hokuahiahi Park.

Evaluation: Kuahelani Avenue connects two neighborhoods in Mililani across Kamehameha Highway and provides access to multiple schools and parks. The section of Kuahelani Avenue that does not include front-on single family housing and/or where parking is currently prohibited extends between Hokuiwa Street and the eastern intersection with Meheula Parkway, and between the western intersection with Meheula Parkway and Lanikuhana Avenue. Bicycle lanes could be striped along this section without affecting the adjacent travel lane, but parking would have to be prohibited along this length and would affect the on-street supply adjacent to several parks and in front of some multi-family housing developments. At locations with adjacent parks or schools, it may be possible to ramp the bike lane up to the adjacent curb and create a path to allow on-street parking to be maintained. For the section of Kuahelani Avenue between Hokuiwa Street and the western Meheula Parkway intersection, front-on single family housing is prevalent and may preclude the installation of bicycle lanes. If the front-on housing section is excluded from the project to provide more conservative estimates, this project would add up to 1.8 miles to the bicycle network in the COTS area.

Assumptions:

Length =10,400' (2,600' NO Bikelane, 7,800' Bikelane)
Width = 10'
Material = Asphalt

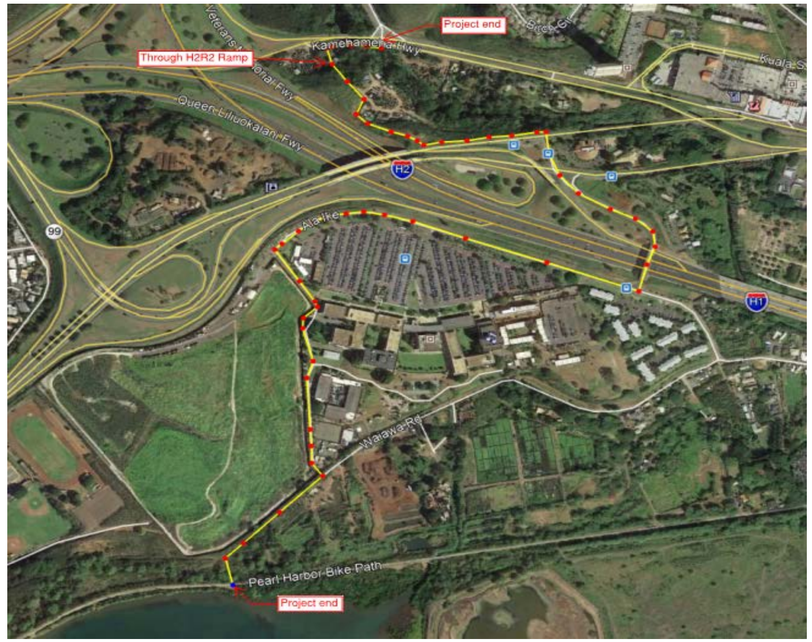
	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Clear and grub	Sq. Ft.		$ 3.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	8	$ 10,000.00	$ 80,000.00	
Site improvements						
Roadway						
	Repo Post - Surface mount delineator	each		$ 100.00	$ -	spacing @ 20'
	Raised Asphalt Conrete Berm (protected bike lane)	Lin. Ft.		$ 15.00	$ -	Buffer between Roadway and Bike lane
	Bike Boxes and Jughandles	each		$ 6,000.00	$ -	660 sq. ft. for 2 lane and approach
	4" Stripe (white/Yellow)	Lin. Ft.	15600	$ 6.00	$ 93,600.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Bike lane (Green)	each	15	$ 6,750.00	$ 101,250.00	Green Paint 150' length x 5'
	Striping Symbols	each	126	$ 300.00	$ 37,800.00	includes bike arrows, sharrows, pavement arrows @ 250' spacing
	Cross walk striping	each		$ 600.00	$ -	
Intersection						
	Traffic Signal Modification	each	4	$ 350,000.00	$ 1,400,000.00	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 85,632.50	
	Mobilization	L.S.	1	10%	$ 171,265.00	
	Contingency - 30%			30%	$ 513,795.00	
	TOTAL				**$ 2,483,342.50**	2017
					$ 2,508,200.00	2018

Project 202.6: Bicycle Lanes on Kamehameha Highway from Waihona Street connecting to the Pearl Harbor Bike Path

Purpose: To provide a separate bike facility that will link the Pearl Highlands rail station at the Waihona Street/Kamehameha Highway intersection with the Pearl Harbor Bike Path that will separate vehicles and bicyclists, and enhance bicycle travel and safety.

Project Description: Two potential options were identified for this potential improvement. The first is to provide lanes or a path along Waiawa Road adjacent to Leeward Community College including Ala Ike. A second alignment would extend along Kamehameha Highway to Lehua Street, where bicycle lanes are planned to be added as part of a resurfacing and road diet project.

Evaluation: To connect to the Pearl Harbor path, acquisition of right-of-way would have to occur to link Ala Ike to the historic path. The challenging part of this second option is the multiple conflict points with relatively high speed ramp connections between Kamehameha Highway and Farrington Highway. Multiple new bridges would be needed to establish the desired connection for bicyclists with this alternative. Assuming that the Waiawa Road/Ala Ike alignment is preferred, this project would add up to roughly 0.8 mile to the bicycle network in the COTS area.

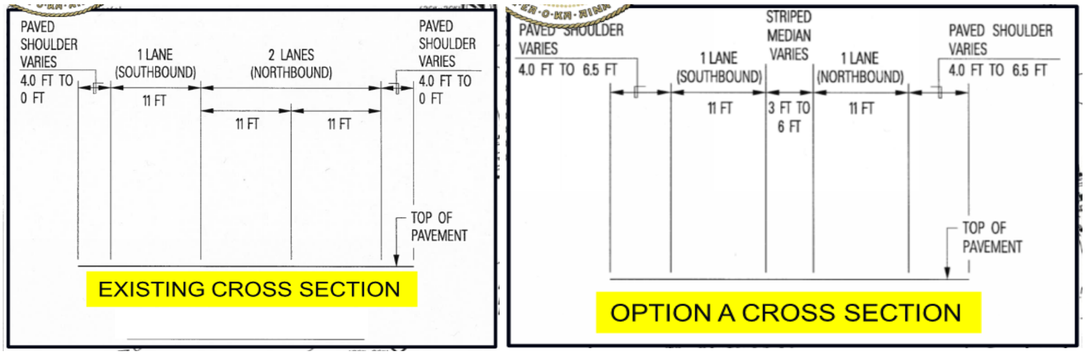


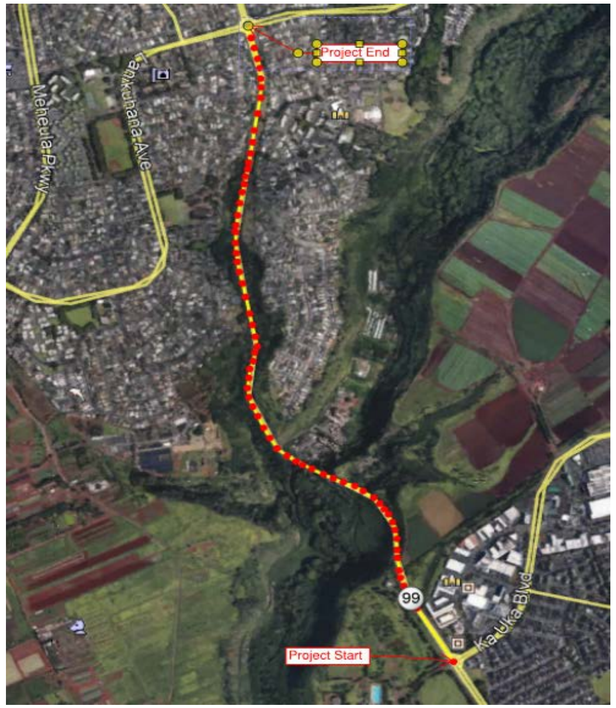
Assumptions:

Length =8,500' (3,000' Bikepath, 5,500' Bikelane)
Width = 10'
Material = Asphalt

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Clear and grub	Sq. Ft.	30000	$ 3.00	$ 90,000.00	10' x 3,000'
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	3	$ 10,000.00	$ 30,000.00	
Site improvements						
Roadway						
	10' wide shared use path	Lin. Ft.	3000	$ 100.00	$ 300,000.00	$10/sq.ft.
	New Curb Ramp	each		$ 3,500.00	$ -	2 @ each of 3 intersections
	Drainage works	each	10	$ 14,000.00	$ 140,000.00	$14,000 / 300' catch basin spacing
	4" Stripe (white/Yellow)	Lin. Ft.	8500	$ 6.00	$ 51,000.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Bike lane (Green)	each		$ 6,750.00	$ -	Green Paint 150' length x 5'
	Striping Symbols	each	34	$ 300.00	$ 10,200.00	includes bike arrows, sharrows, pavement arrows @ 250' spacing
	Cross walk striping	each		$ 600.00	$ -	
	Cantilever at bridge for multi-use path	Sq.Ft.	2800	$ 250.00	$ 700,000.00	280' x 10'
Intersection						
	Traffic Signal Modification	each	4	$ 350,000.00	$ 1,400,000.00	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 136,060.00	
	Mobilization	L.S.	1	10%	$ 272,120.00	
	Contingency - 30%			30%	$ 816,360.00	
	TOTAL				**$ 3,945,740.00**	2017
					$ 3,985,200.00	2018

202.7 Bicycle lane on Kamehameha Hwy from Ka Uka Blvd. to Lanikahuna Ave.





Assumptions: Re-striping to be done as part of re-paving project
Length =10,100'
Width = average 37'
Material = Asphalt

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Clear and grub	Sq. Ft.		$ 3.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	10	$ 10,000.00	$ 100,000.00	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.	373700	$ 6.00	$ 2,242,200.00	
	New Curb Ramp	each		$ 3,500.00	$ -	2 @ each of 3 intersections
	Drainage works	each	33	$ 14,000.00	$ 462,000.00	$14,000 / 300' catch basin spacing
	4" Stripe (white/Yellow)	Lin. Ft.	40400	$ 6.00	$ 242,400.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Bike lane (Green)	each		$ 6,750.00	$ -	Green Paint 150' length x 5'
	Striping Symbols	each	80	$ 300.00	$ 24,000.00	includes bike arrows, sharrows, pavement arrows @ 250' spacing
	Cross walk striping	each		$ 600.00	$ -	
	Cantilever at bridge for multi-use path	Sq.Ft.		$ 250.00	$ -	
Intersection						
	Traffic Signal Modification	each		$ 350,000.00	$ -	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 153,530.00	
	Mobilization	L.S.	1	10%	$ 307,060.00	
	Contingency - 30%			30%	$ 921,180.00	
	TOTAL				**$ 4,452,370.00**	2017
					$ 4,496,900.00	2018

Project 203.1: Bicycle Route on California Avenue between Plum Street and Iliahi Elementary School

Purpose: To designate a bicycle route that will highlight the presence of cyclists to drivers and enhance overall bicycle travel and safety along California Avenue.

Project Description: California Avenue could be designated a bicycle route with signage, as well as traffic calming devices and enhanced crossings to maintain slower travel speeds consistent with its 25 mph posted speed limit. This street includes multiple school and park destinations that generate elevated bicycle and pedestrian volumes.

Evaluation: Bicycle routes include signage and pavement markings to increase driver awareness of the potential presence of cyclists and the need to share the roadway because a separate traveled way for cyclists cannot be provided. Route designations are appropriate where physical constraints preclude lanes or off-street paths, and where vehicle travel speeds and volumes are appropriate for cyclists to share vehicle lanes. The traffic volume of approximately 11,000 vehicles per day is higher than typically desired for a bicycle route.

Assumptions:

Length = 5,000'
Width = Varies
Material = Asphalt

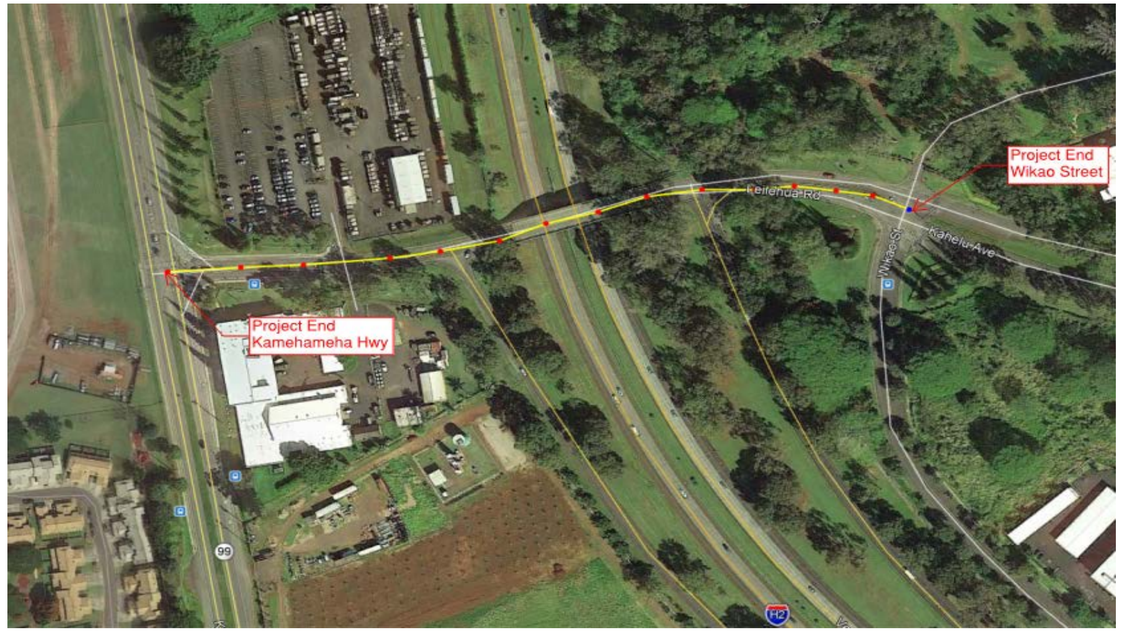
	ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST	NOTES
Removals/Demo						
	Clear and grub	Sq. Ft.		$ 3.00	$ -	4' x 5300'
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	6' x 5300'
	Erosion Control	L.S.	2	$ 10,000.00	$ 20,000.00	
Site improvements						
Roadway						
	New Sign with RRFBs	each	4	$ 1,500.00	$ 6,000.00	Cycle route sign with flashing beacon
	Traffic calming devices	each		$ 2,500.00	$ -	Speed tables, speed cushions, intersection bulbouts
	Bike Boxes and Jughandles	each		$ 6,000.00	$ -	660 sq. ft. for 2 lane and approach
	4" Stripe (white/Yellow)	Lin. Ft.	10000	$ 6.00	$ 60,000.00	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Bike lane (Green)	each		$ 6,750.00	$ -	Green Paint 150' length x 5'
	Striping Symbols	each	40	$ 300.00	$ 12,000.00	includes bike arrows, sharrows, pavement arrows @ 250' spacing
	Signage	each	10	$ 500.00	$ 5,000.00	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 5,150.00	
	Mobilization	L.S.	1	10%	$ 10,300.00	
	Contingency - 30%			30%	$ 30,900.00	
	TOTAL				**$ 149,350.00**	2017
					$ 150,800.00	2018

Project 203.3: Bicycle Route on Leilehua Golf Course Rd between Kamehameha Hwy and Wikao St

Purpose: To designate a bicycle route that will highlight the presence of cyclists to drivers and enhance overall bicycle travel and safety along Leilehua Golf Course Road.

Project Description: This project would include adding signage and pavement markings on Leilehua Golf Course Road. Additional striping and minor curb modifications could be implemented to moderate speeds of vehicles using the H-2 ramps.

Evaluation: Bicycle routes include signage and pavement markings to increase driver awareness of the potential presence of cyclists and the need to share the roadway because a separate traveled way for cyclists cannot be provided. Route designations are appropriate where physical constraints preclude lanes or off-street paths, and where vehicle travel speeds and volumes are appropriate for cyclists to share vehicle lanes. This street could be designated a route with signage and enhanced crossings to maintain slower travel speeds consistent with its 25 mph posted speed limit.



Assumptions:

Length =1,400'
Width =varies
Material = Existing Asphalt

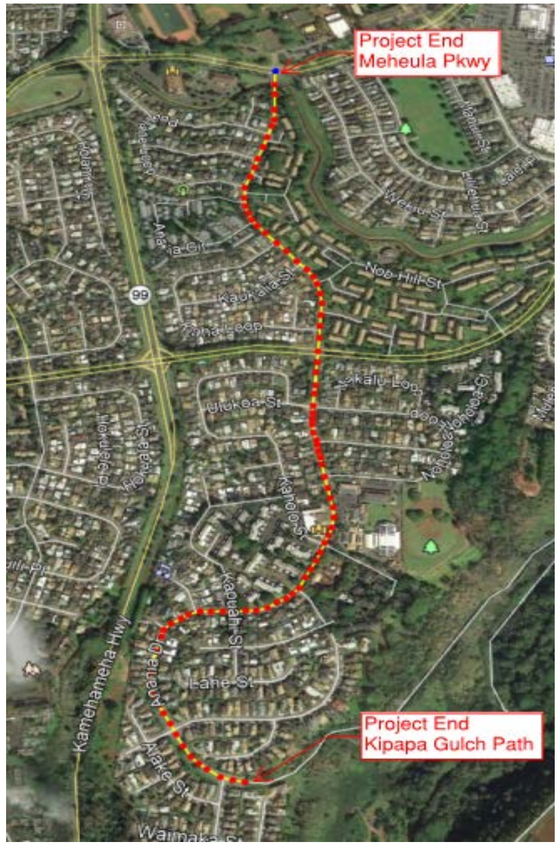
	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Clear and grub	Sq. Ft.		$ 3.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	1	$ 10,000.00	$ 10,000.00	
Site improvements						
Roadway						
	New Sign with RRFBs	each	2	$ 1,500.00	$ 3,000.00	Cycle route sign with flashing beacon
	Traffic calming devices	each		$ 2,500.00	$ -	Speed tables, speed cushions, intersection bulbouts
	Bike Boxes and Jughandles	each		$ 6,000.00	$ -	660 sq. ft. for 2 lane and approach
	4" Stripe (white/Yellow)	Lin. Ft.		$ 6.00	$ -	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Bike lane (Green)	each		$ 6,750.00	$ -	Green Paint 150' length x 5'
	Striping Symbols	each	8	$ 300.00	$ 2,400.00	includes bike arrows, sharrows, pavement arrows @ 250' spacing
	Signage	each	6	$ 500.00	$ 3,000.00	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 920.00	
	Mobilization	L.S.	1	10%	$ 1,840.00	
	Contingency - 30%			30%	$ 5,520.00	
	TOTAL				**$ 26,680.00**	
					$ 26,900.00	2018

Project 203.5: Bicycle Route on Anania Dr between Meheula Pkwy and Kipapa Gulch Path

Purpose: To designate a bicycle route that will highlight the presence of cyclists to drivers and enhance overall bicycle travel and safety along Anania Drive and provide a designated link to the proposed path crossing Kipapa Gulch.

Project Description: This project would include adding signage and pavement markings on Anania Drive between Meheula Parkway and Kipapa Gulch.

Evaluation: Bicycle routes include signage and pavement markings to increase driver awareness of the potential presence of cyclists and the need to share the roadway because a separate traveled way for cyclists cannot be provided. Route designations are appropriate where physical constraints preclude lanes or off-street paths, and where vehicle travel speeds and volumes are appropriate for cyclists to share vehicle lanes. In the case of Anania Drive, this street could be designated a route with signage, as well as traffic calming devices and enhanced crossings to maintain slower travel speeds consistent with its 25 mph posted speed limit. The link to the proposed Kipapa Gulch path will increase the need for a designated connection and the path is expected to increase demand on this street. Without Project 201.2, the need for the Anania Drive route is lessened, but would still exist.



Assumptions:

Length =6,900'
Width = 10'
Material = Asphalt

	ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST	NOTES
Removals/Demo						
	Clear and grub	Sq. Ft.		$ 3.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	3	$ 10,000.00	$ 30,000.00	
Site improvements						
Roadway						
	New Sign with RRFBs	each	4	$ 1,500.00	$ 6,000.00	Cycle route sign with flashing beacon
	Traffic calming devices	each	6	$ 5,000.00	$ 30,000.00	Speed tables, speed cushions, intersection bulbouts
	Bike Boxes and Jughandles	each		$ 6,000.00	$ -	660 sq. ft. for 2 lane and approach
	4" Stripe (white/Yellow)	Lin. Ft.		$ 6.00	$ -	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Bike lane (Green)	each		$ 6,750.00	$ -	Green Paint 150' length x 5'
	Striping Symbols	each	56	$ 300.00	$ 16,800.00	includes bike arrows, sharrows, pavement arrows @ 250' spacing
	Signage	each	16	$ 500.00	$ 8,000.00	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 4,540.00	
	Mobilization	L.S.	1	10%	$ 9,080.00	
	Contingency - 30%			30%	$ 27,240.00	
	TOTAL				**$ 131,660.00**	2017
					$ 133,000.00	2018

Project 203.6: Bicycle Route on Lanikuhana Ave from South end of Meheula Pkwy to Mililani Shopping Center

Purpose: To designate a bicycle route that will highlight the presence of cyclists to drivers and enhance overall bicycle travel and safety along Lanikuhana Avenue and provide a designated link to the Mililani Shopping Center.

Project Description: This project would include adding signage and pavement markings on Lanikuhana Avenue from Meheula Parkway in south Mililani to the Mililani Shopping Center in northern Mililani.
Evaluation: Bicycle routes include signage and pavement markings to increase driver awareness of the potential presence of cyclists and the need to share the roadway because a separate traveled way for cyclists cannot be provided. Route designations are appropriate where physical constraints preclude lanes or off-street paths, and where vehicle travel speeds and volumes are appropriate for cyclists to share vehicle lanes. In the case of Lanikuhana Avenue west of Kamehameha Highway, the street section includes two lanes in each direction, but the daily volume near Kealohi Street is less than 3,000 vehicles per day. Buffered bike lanes could be installed on the section west of the highway by repurposing the curb lane without substantially impacting vehicle operations. East of Kamehameha Highway, the volume is higher (nearly 12,000 vpd near Anania Drive) but the peak hour volumes of less than 700 vehicles per hour could still be accommodated with one travel lane in each direction, allowing for the continuation of buffered bike lanes. Bike lanes would have a more positive effect on safety and convenience for cyclists than just a route designation with signage. This project should be modified to study bike lane installation in lieu of a route.

Assumptions:

Length =12,400'
Width = varies
Material = Asphalt

ITEM		UNIT	QUANTITY	UNIT COST	TOTAL COST	NOTES
Removals/Demo						
	Clear and grub	Sq. Ft.		$ 3.00	$ -	10' x 9,800'
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Erosion Control	L.S.	5	$ 10,000.00	$ 50,000.00	
Site improvements						
Roadway						
	New Sign with RRFBs	each	6	$ 1,500.00	$ 9,000.00	Cycle route sign with flashing beacon
	Traffic calming devices	each		$ 2,500.00	$ -	Speed tables, speed cushions, intersection bulbouts
	Bike Boxes and Jughandles	each		$ 6,000.00	$ -	660 sq. ft. for 2 lane and approach
	4" Stripe (white/Yellow)	Lin. Ft.		$ 6.00	$ -	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Bike lane (Green)	each		$ 6,750.00	$ -	Green Paint 150' length x 5'
	Striping Symbols	each	100	$ 300.00	$ 30,000.00	includes bike arrows, sharrows, pavement arrows @ 250' spacing
	Signage	each	20	$ 500.00	$ 10,000.00	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 4,950.00	
	Mobilization	L.S.	1	10%	$ 9,900.00	
	Contingency - 30%			30%	$ 29,700.00	
	TOTAL				**$ 143,550.00**	2017
					$ 145,000.00	2018

Project 301.1: Crosswalk across makai leg of Kamehameha Hwy intersections at Olive and Avocado Streets

Purpose: To provide an enhanced crossing of all legs of the intersections that will facilitate direct pedestrian paths and further encourage walking as a desired mobility mode in Wahiawa Town.

Project Description: This project would add a crosswalk on the makai leg of Kamehameha Highway intersections with Olive Street and Avocado Street.

Evaluation: Most signalized intersections include marked crosswalks across all approaches of a four-legged intersection. In those cases where crosswalks and pedestrian signal phasing/heads are not provided, it is usually done to maximize vehicle signal phasing and capacity. In other cases, it is done where multiple threat collisions are a possibility, where the view of pedestrians or cyclists are blocked by adjacent turning vehicles (e.g., at a dual right-turn movement). At Avocado Street, no obvious operational constraint is evident that would preclude a crosswalk across the highway.

Assumptions:

Length = 54'
Width = 10'

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Clear and grub	Sq. Ft.		$ 3.00	$ -	4' x 5300'
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	6' x 5300'
	Erosion Control	L.S.	0.5	$ 10,000.00	$ 5,000.00	
Site improvements						
Roadway						
	New Sign with RRFBs	each		$ 750.00	$ -	Cycle route sign with flashing beacon
	Traffic calming devices	each		$ 2,500.00	$ -	Speed tables, speed cushions, intersection bulbouts
	Cross walk striping	each	1	$ 2,400.00	$ 2,400.00	
	4" Stripe (white/Yellow)	Lin. Ft.		$ 6.00	$ -	Lane Striping
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	Bike lane (Green)	each		$ 6,750.00	$ -	Green Paint 150' length x 5'
	Striping Symbols	each		$ 300.00	$ -	includes bike arrows, sharrows, pavement arrows @ 250' spacing
	Signage	each		$ 500.00	$ -	
Intersection						
	Traffic Signal Modification	each	1	$ 350,000.00	$ 350,000.00	
Landscaping						
		L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 17,870.00	
	Mobilization	L.S.	1	10%	$ 35,740.00	
	Contingency - 30%			30%	$ 107,220.00	
	TOTAL				**$ 518,230.00**	2017
					$ 523,500.00	2018

Project 302.1: Safe Routes to School

Purpose: To identify and implement circulation improvements to all travel modes but with a focus on enhancing safety of active transportation modes to encourage walking and biking. Safe Routes to School (SR2S) plans include suggested routes for walking and biking that include controlled intersection and roadway crossings or areas with the least number and severity of potential vehicle conflicts.

Project Description: The purpose of this program is to help guide and educate students and guardians on recommended travel paths, raise awareness of appropriate walking and biking behavior, and identify potential infrastructure improvements to enhance safety. This program should be employed by all schools within the COTS area.

Evaluation: Preparation of a comprehensive SR2S plan can aid in obtaining funding for improvements and ultimately lead to increased use of walking and biking modes. In addition to the inherent safety benefits, ancillary benefits include improved health, community awareness, and expanded social interaction.

Assumptions:

Length =
Width =

ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST	NOTES
Removals/Demo					
Clear and grub	Sq. Ft.		$ 3.00	$ -	4' x 5300'
Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	6' x 5300'
Erosion Control	L.S.		$ 10,000.00	$ -	
Site improvements					
Roadway					
New Sign with RRFBs	each		$ 1,500.00	$ -	Cycle route sign with flashing beacon
Traffic calming devices	each		$ 5,000.00	$ -	Speed tables, speed cushions, intersection bulbouts
Cross walk striping	each		$ 2,400.00	$ -	
4" Stripe (white/Yellow)	Lin. Ft.		$ 6.00	$ -	Lane Striping
12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
Bike lane (Green)	each		$ 6,750.00	$ -	Green Paint 150' length x 5'
Striping Symbols	each		$ 300.00	$ -	includes bike arrows, sharrows, pavement arrows @ 250' spacing
Signage	each		$ 500.00	$ -	
Landscaping					
	L.S.			$ -	
Misc.					
Traffic Control	L.S.	1	5%	$ -	
Mobilization	L.S.	1	10%	$ -	
Contingency - 30%			30%	$ -	
TOTAL				**$ -**	

Project 302.2: Pedestrian Crossing Safety

Purpose: To identify and implement improvements that will enhance safety of pedestrians when crossing streets and controlled and uncontrolled intersections.

Project Description: This project includes installation of devices to increase pedestrian safety. Potential improvements can range from education campaigns, minor infrastructure improvements (e.g., signing and striping), and more complex installations of traffic signals, rectangular rapid flashing beacons, etc.

Evaluation: The COTS area includes a wide range of streets and highways, some with characteristics that are not as conducive to pedestrian travel, especially at the intersection where crossing of a major or higher speed roadway is required. However, conditions can be hazardous on lower speed, low-volume roadways when a pedestrian or driver is not paying attention and making safety of paramount importance. Pedestrian safety is best addressed when agencies take a proactive approach to addressing locations with a high number of or increased severity collisions, or based on public notification.

Assumptions:

Length =
Width =

ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo					
Clear and grub	Sq. Ft.		$ 3.00	$ -	4' x 5300'
Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	6' x 5300'
Erosion Control	L.S.		$ 10,000.00	$ -	
Site improvements					
Roadway					
New Sign with RRFBs	each		$ 1,500.00	$ -	Cycle route sign with flashing beacon
Traffic calming devices	each		$ 5,000.00	$ -	Speed tables, speed cushions, intersection bulbouts
Cross walk striping	each		$ 2,400.00	$ -	
4" Stripe (white/Yellow)	Lin. Ft.		$ 6.00	$ -	Lane Striping
12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
Bike lane (Green)	each		$ 6,750.00	$ -	Green Paint 150' length x 5'
Striping Symbols	each		$ 300.00	$ -	includes bike arrows, sharrows, pavement arrows @ 250' spacing
Signage	each		$ 500.00	$ -	
Landscaping					
	L.S.			$ -	
Misc.					
Traffic Control	L.S.	1	5%	$ -	
Mobilization	L.S.	1	10%	$ -	
Contingency - 30%			30%	$ -	
TOTAL				**$ -**	

Project 303.1: Complete Streets project for California Ave between Kamehameha Hwy and Wahiawa District Park

Purpose: To better balance the mobility options amongst all modes and enhance safety for all road users on California Avenue in Wahiawa.

Project Description: The project includes implementing complete streets policies on California Avenue with the intent of moderating vehicle speeds, providing dedicated bicycle facilities, widening sidewalks and waiting areas at intersections, shortening pedestrian crossing distances, and expanding the on-street parking supply.

Evaluation: The City & County of Honolulu Department of Transportation Services (DTS) has developed several plans for implementing projects that are driven by complete streets policies established in 2012. Improvements are often implemented during regularly schedules repaving projects, but can sometimes include additional and more substantive improvements that may include curb extensions, road diets, provision of on-street parking, bike lanes, enhanced transit stops, etc. The end result of these types of projects is increased pedestrian and bicycle activity, increased transit patronage (where applicable), often increased economic activity for adjacent businesses, and most importantly, improved safety and convenience for all travelers.

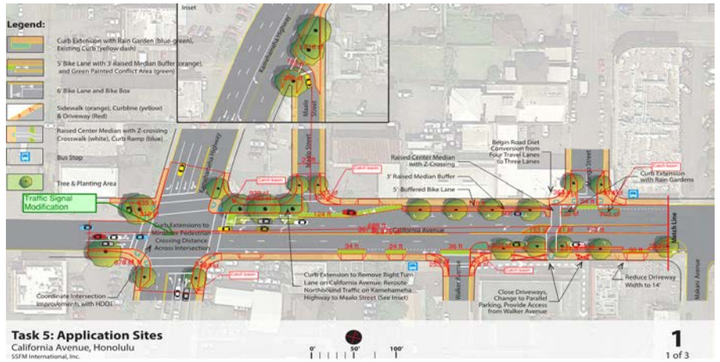
Assumptions:

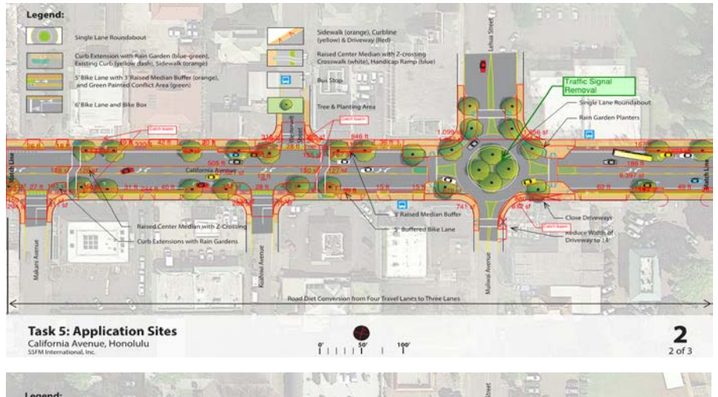
Length = 2,500'
Width = Varies
Material = Asphalt

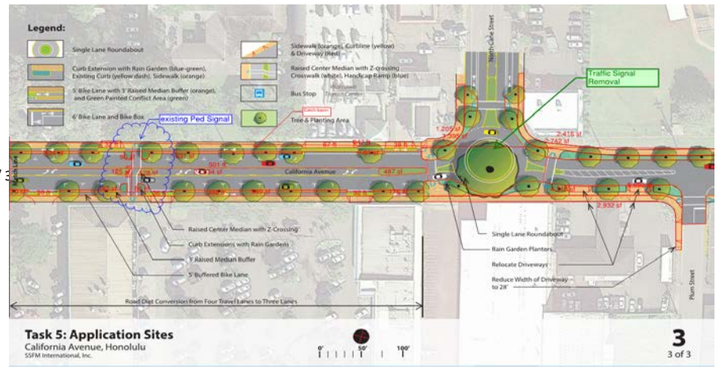
From 2013_156.000 DTS Complete Streets Implementation Study

Complete Street Demonstration - California Ave.
Concept Phase Cost Estimate

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Remove existing traffic signal	each	2	$ 100,000.00	$ 200,000.00	
	Remove existing pavement striping	Lin. Ft.		$ 3.00	$ -	
	Remove existing pavement symbol	each		$ 300.00	$ -	
	Demolish existing sidewalk	Sq. Ft.	16675	$ 5.00	$ 83,375.00	
	Demolish existing Pavement	Sq. Ft.	28867	$ 8.00	$ 230,936.00	
	Erosion Control	L.S.	1	$ 10,000.00	$ 10,000.00	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.	135428	$ 6.00	$ 812,568.00	
	Full depth roadway construction	Sq. Ft.		$ 30.00	$ -	
	Curb Gutter and Sidewalk	Sq. Ft.	14181	$ 20.00	$ 283,620.00	
	Drainage works, $14,000 / 300' catch basin spacing		9	$ 14,000.00	$ 126,000.00	$14,000 / 3
	Raised Median	Sq. Ft.	5815	$ 20.00	$ 116,300.00	
	Rectangular Rapid Flashing Beacon	each			$ -	
	Ducting and power supply	Lin. Ft.			$ -	
	4" Stripe (white/Yellow)	Lin. Ft.	10231	$ 6.00	$ 61,386.00	
	12"stripe (white)	Lin. Ft.	1350	$ 9.00	$ 12,150.00	
	5' Bike lane (Green)	Sq. Ft.	5050	$ 9.00	$ 45,450.00	
	Striping Symbols	each	56	$ 300.00	$ 16,800.00	
Intersection						
	Full Single Lane Roundabout	each	2	$ 1,300,000.00	$ 2,600,000.00	
	includes sidewalk, roadway, striping and lighting				$ -	
	Raised Intersection with Barnes Dance Ped Crossing	each			$ -	
	Traffic Signal Modification	each	1	$ 350,000.00	$ 350,000.00	
Landscaping						
	Trees	each	88	$ 1,000.00	$ 88,000.00	
	Irrigation	L.S.	1		$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 251,829.25	
	Mobilization	L.S.	1	10%	$ 503,658.50	
	Contingency			30%	$ 1,510,975.50	
	TOTAL				**$ 7,303,048.25**	2017
					$ 7,376,100.00	2018





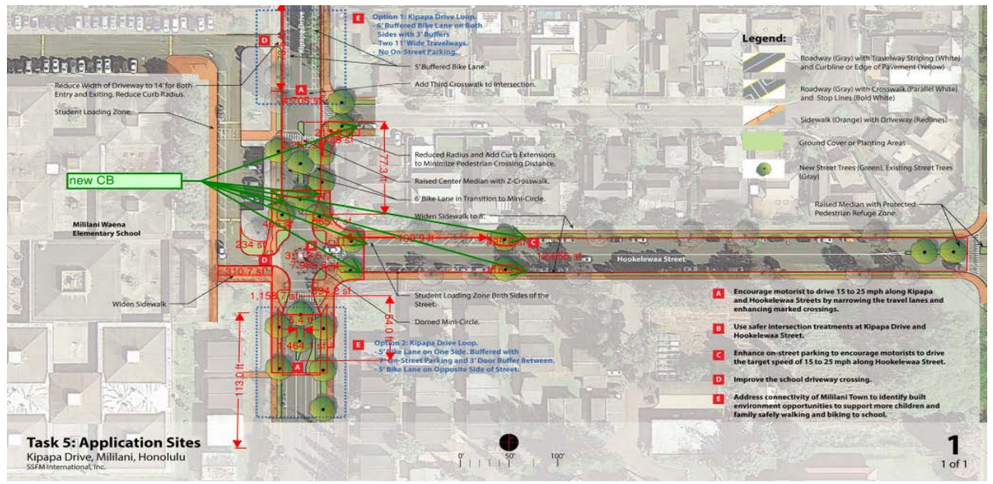


Project 303.2: Complete Streets project for Kipapa Drive between Hookelewaa St and Mililani Waena Elementary School

Purpose: To create a safer environment for students walking to and from Mililani Waena Elementary School and Mililani High School and to improve commuting for all users balance.

Project Description: The reconfiguration of Kipapa Drive in front of Mililani Waena Elementary School a project includes implementing complete streets policies, as well as a neighborhood traffic circle to moderate vehicle speeds in the area. The project includes dedicated bicycle facilities, widening sidewalks and waiting areas at intersections, shortening pedestrian crossing distances, and providing dedicated passenger loading zones.

Evaluation: The City & County of Honolulu Department of Transportation Services (DTS) has developed several plans for implementing projects that are driven by complete streets policies established in 2012. Improvements are often implemented during regularly schedules repaving projects, but can sometimes include additional and more substantive improvements that may include curb extensions, road diets, provision of on-street parking, bike lanes, enhanced transit stops, etc. The end result of this projects is expected to be increased pedestrian and bicycle activity, reduced travel speeds, more predictable traffic flows, and most importantly, improved safety and convenience for all travelers.



Assumptions: Length =1,000'
Width =varies

From 2013_156.000 DTS Complete Streets Implementation Study

Complete Street Demonstration - Kipapa Drive

Concept Phase Cost Estimate

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Remove existing traffic signal	each		$ 100,000.00	$ -	
	Remove existing pavement striping	Lin. Ft.		$ 3.00	$ -	
	Remove existing pavement symbol	each		$ 300.00	$ -	
	Demolish existing sidewalk	Sq. Ft.	4534	$ 5.00	$ 22,670.00	
	Demolish existing Pavement	Sq. Ft.	7966	$ 8.00	$ 63,728.00	
	Erosion Control	L.S.	5	$ 10,000.00	$ 50,000.00	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.	17361	$ 6.00	$ 104,166.00	
	Full depth roadway construction	Sq. Ft.	6865	$ 30.00	$ 205,950.00	
	Curb Gutter and Sidewalk	Lin. Ft.	3938	$ 20.00	$ 78,760.00	
	Drainage works	each	7	$ 7,000.00	$ 49,000.00	
	Raised Median	Sq. Ft.	650	$ 20.00	$ 13,000.00	
	Rectangular Rapid Flashing Beacon	each			$ -	
	Ducting and power supply	Lin. Ft.			$ -	
	4" Stripe (white/Yellow)	Lin. Ft.	1000	$ 6.00	$ 6,000.00	
	12"stripe (white)	Lin. Ft.	600	$ 9.00	$ 5,400.00	
	5' Bike lane (Green)	Lin. Ft.		$ 9.00	$ -	
	Striping Symbols	each		$ 300.00	$ -	
Intersection						
	Mini-Circle with Mountable Domed Center	each	1	$ 100,000.00	$ 100,000.00	
	Raised Intersection with Barnes Dance Ped Crossing	each			$ -	
	Traffic Signal Modification	each			$ -	
Landscaping						
	Trees	each	20	$ 1,000.00	$ 20,000.00	
	Irrigation	L.S.	1		$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 35,933.70	
	Mobilization	L.S.	1	10%	$ 71,867.40	
	Contingency			30%	$ 215,602.20	
	TOTAL				**$ 1,042,077.30**	2017
					$ 1,052,500.00	2018

Project 303.3: Complete Streets Projects on Priority Roads

Purpose: To better balance the mobility options amongst all travel modes and enhance safety for all road users.

Project Description: Complete streets policies would be implemented on priority roads within the COTS area.

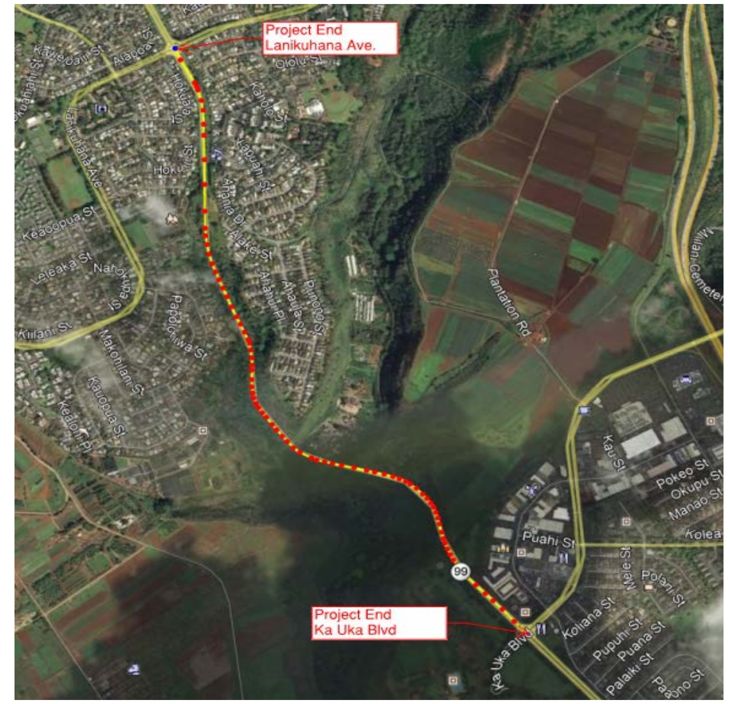
Evaluation: The City & County of Honolulu Department of Transportation Services (DTS) has developed several plans for implementing projects that are driven by complete streets policies established in 2012. Improvements are often implemented during regularly schedules repaving projects, but can sometimes include additional and more substantive improvements that may include curb extensions, road diets, provision of on-street parking, bike lanes, enhanced transit stops, etc. Overall, these projects typically provide dedicated bicycle facilities, widen sidewalks and waiting areas at intersections, shorten pedestrian crossing distances, add on-street parking where feasible and appropriate and reduce conflicts between vehicles and other users. Safety is enhanced and traffic speeds are moderated for the adjacent context.

Review 2013_156.000 DTS Complete Streets Implementation Study for list of projects completed

SSFM INTERNATIONAL , INC					9/2/2015		
Complete Street Demonstration							
Concept Phase Cost Estimate - Sumary							
#	***Application Site***	***Toltal Cost Less Contingency***	***Contingency (25%)***	***Total Construction Cost***	***Estimated Design Cost***		Design Cost Percentage Assumptions
1	Kamehameha IV Road	$ 576,961.90	$ 125,426.50	$ 702,388.40	$ 70,238.84		10% for under $1 mil
2	University Ave	$ 1,381,796.30	$ 300,390.50	$ 1,682,186.80	$ 134,574.94		8% for $1-3 mil
3	Kipapa Drive	$ 580,093.35	$ 126,107.25	$ 706,200.60	$ 70,620.06		6% for over $3 mil
4	Papipi Road	$ 3,975,577.60	$ 864,256.00	$ 4,839,833.60	$ 290,390.02		
5	North King Street	$ 2,556,597.20	$ 555,782.00	$ 3,112,379.20	$ 186,742.75		
6	Kapahulu Avenue	$ 3,950,256.90	$ 858,751.50	$ 4,809,008.40	$ 288,540.50		
7	Kalakaua Avenue	$ 2,828,613.60	$ 614,916.00	$ 3,443,529.60	$ 206,611.78		
8	Ward Avenue - Full Build	$ 5,294,634.50	$ 1,151,007.50	$ 6,445,642.00	$ 386,738.52		
8a	Ward Avenue Re-Stripe Option	$ 444,864.50	$ 97,132.50	$ 541,997.00	$ 54,199.70		
9	Liliha Street	$ 2,086,653.15	$ 453,620.25	$ 2,540,273.40	$ 203,221.87		
10	Kailua Road	$ 4,600,793.50	$ 1,000,172.50	$ 5,600,966.00	$ 336,057.96		
11	Nuuanu Avenue with Roundabout	$ 3,195,600.00	$ 798,900.00	$ 3,994,500.00	$ 239,670.00		
11a	Nuuanu Avenue without Roundabout	$ 2,643,600.00	$ 660,900.00	$ 3,304,500.00	$ 198,270.00		
12	Aumoe Road and Awakea Road	$ 688,403.80	$ 157,135.65	$ 845,539.45	$ 84,553.95		
13	Ala Wai Boulevard and McCully Street	$ 1,199,979.00	$ 260,865.00	$ 1,460,844.00	$ 116,867.52		

14	California Avenue	$	5,792,072.75	$	1,259,146.25	$	7,051,219.00	$	423,073.14
15	Kapahulu Herbert	$	5,243,019.05	$	1,196,776.09	$	6,439,795.14	$	386,387.71
16	Mahoe Street	$	2,373,517.20	$	515,982.00	$	2,889,499.20	$	231,159.94

Project 403.5: Widen Kamehameha Highway from 3 to 4 Lanes between Ka Uka Blvd and Lanikuhana Avenue



Purpose: To reduce congestion on one of the primary arterial roadways through the COTS area and increase the overall vehicle capacity near one of the major growth areas on Oahu.

Project Description: This project has been identified in multiple long-range planning documents as a way to add new vehicle and bus transit capacity within the central portion of Oahu, and to specifically enhance the carrying capacity of one of the two key mauka-makai facilities in the COTS area. The majority of the section of the highway mauka of Ka Uka Boulevard includes an imbalanced section of two lanes mauka-bound and one lane makai bound. This project would add a second makai-bound lane to provide additional capacity to reduce delays prior to and through the Ka Uka Boulevard intersection and to eliminate merging operations, especially during the morning peak hour when the primary travel directional is makai-bound. It is important to note that this improvement would require construction of a new bridge adjacent to the Roosevelt Bridge over Kipapa Gulch to accommodate the two new travel lanes.

Evaluation: To determine the potential effect of making this improvement, the project was coded into the roadway and transit network of the OahuMPO travel demand model. This is currently the best planning tool available to for testing the effects of substantial land use, transportation network, and socio-economic changes on Oahu. The results of the model run showed that this improvement would reduce the number of congested lane-miles in the COTS area by 9, or by 16% in the AM peak period and increase the number of congested lane-miles by 2 or 3% in the PM peak period. A congested lane mile is the number of miles of through lanes on a given roadway segment where the volume to capacity ratio is greater than 90%. In addition, the benefit to local travel times between select zone pairs under Performance Measure 4 would be a combined total of 12 minutes during the AM peak period.

Assumptions:

Length = 4100' 2 lanes
= 5900' 1 lane
Width = 12' lane, 10' shoulder
Bridge = 500' long and 44' wide

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Remove existing traffic signal	each		$ 100,000.00	$ -	
	Remove existing pavement striping	Lin. Ft.		$ 3.00	$ -	
	Remove existing pavement symbol	each		$ 300.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Demolish existing Pavement	Sq. Ft.	56400	$ 8.00	$ 451,200.00	4100' x 8' shoulder, 5900' x 4' shoulder
	Clearing and grubbing, stripping	Sq. Ft.	761400	$ 5.00	$ 3,807,000.00	full depth roadway + demolish existing pavement x 3
	Erosion Control	L.S.	14	$ 10,000.00	$ 140,000.00	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.	310800	$ 6.00	$ 1,864,800.00	4100' x 24, 5900' x 36
	Full depth roadway construction	Sq. Ft.	310200	$ 30.00	$ 9,306,000.00	4100' x 44', 5900' x 22'
	Curb Gutter and Sidewalk	Sq. Ft.		$ 20.00	$ -	
	Drainage works	each	68	$ 14,000.00	$ 952,000.00	$14,000 / 300' catch basin spacing = 10,000' / 300' x 2
	Raised Median	Sq. Ft.		$ 20.00	$ -	
	Raised Traffic Island	Sq. Ft.		$ 20.00	$ -	
	Raised Channel (ped crossing)	Sq. Ft.		$ 20.00	$ -	
	4" Stripe (white/Yellow)	Lin. Ft.	60000	$ 6.00	$ 360,000.00	10,000' x 3 lines x 2 directions
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	5' Bike lane (Green)	Sq. Ft.		$ 9.00	$ -	
	Striping Symbols	each	69	$ 300.00	$ 20,700.00	
	New bridge	Sq. Ft.	22000	$ 250.00	$ 5,500,000.00	
Intersection						
	Full Single Lane Roundabout includes sidewalk, roadway, striping and lighting	each		$ 1,300,000.00	$ -	
	Ped Activated Traffic Signal	each		$ 400,000.00	$ -	
	Traffic Signal Modification	each		$ 350,000.00	$ -	
	Street Light	each	100	$ 15,000.00	$ 1,500,000.00	street light spacing 200' each side
Landscaping						
	Trees	each		$ 1,000.00	$ -	
	Irrigation	L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 1,195,085.00	
	Mobilization	L.S.	1	10%	$ 2,390,170.00	
	Contingency			30%	$ 7,170,510.00	
	TOTAL				**$ 34,657,465.00**	2017
					$ 35,004,100.00	2018

Project 403.7: Rehabilitate the Kamehameha Highway Roosevelt Bridge

Purpose: To rehabilitate the Roosevelt Bridge section of Kamehameha Highway to enhance safety and extend the life of this structure providing an important circulation link within the COTS area.

Project Description: This project would rehabilitate the Roosevelt Bridge. The bridge crosses Kipapa Gulch and is located on the highway mauka of Ka Uka Boulevard.

Evaluation: The State of Hawaii conducted a detailed inspection of this bridge and documented its findings in a report dated October 6, 2015. The detailed information from this inspection is included in Appendix X and contains photographs, an accompanying log with explanations of each picture, a plan/profile sheet depicting structural issues, and a final inspection report. In the final inspection report, defects for various structural elements are listed and rated Good, Fair, Poor or Severe. For each defect the affected area is assigned to one or more of these rating categories. Most elements are rated as Good to Fair with an area of the concrete deck and short length of the concrete bridge railing rated as Poor. However, none of the elements appear to have a substantial effect on the "strength and /or serviceability of either the element or the bridge." The NBI item condition ratings for the superstructure, substructure, and channel/channel protection are 7 and the deck rating is 6. The final repairs, improvements and recommendations includes the repair of expansion joints, resurfacing the pavement overlay, repair of the large crack in south abutment ledge, repair the railing, and repair the broken support for a sagging water line.

Assumptions:

Length = 500'
Width = 36'

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Remove existing traffic signal	each		$ 100,000.00	$ -	
	Remove existing pavement striping	Lin. Ft.		$ 3.00	$ -	
	Remove existing pavement symbol	each		$ 300.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Demolish existing Pavement	Sq. Ft.		$ 8.00	$ -	
	Erosion Control	L.S.	1	$ 10,000.00	$ 10,000.00	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.	18000	$ 6.00	$ 108,000.00	36' x 500'
	Full depth roadway construction	Sq. Ft.		$ 30.00	$ -	
	Curb Gutter and Sidewalk	Sq. Ft.		$ 20.00	$ -	
	Drainage works	each	4	$ 14,000.00	$ 56,000.00	$14,000 / 300' catch basin spacing
	Raised Median	Sq. Ft.		$ 20.00	$ -	
	Raised Traffic Island	Sq. Ft.		$ 20.00	$ -	
	Raised Channel (ped crossing)	Sq. Ft.		$ 20.00	$ -	
	4" Stripe (white/Yellow)	Lin. Ft.	1500	$ 6.00	$ 9,000.00	500' x 3 lines
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	5' Bike lane (Green)	Sq. Ft.		$ 9.00	$ -	
	Striping Symbols	each		$ 300.00	$ -	
	Re-hab existing bridge	Sq. Ft.	18000	$ 125.00	$ 2,250,000.00	36' x 500'
Intersection						
	Full Single Lane Roundabout	each			$ -	
	includes sidewalk, roadway, striping and lighting				$ -	
	Ped Activated Traffic Signal	each		$ 400,000.00	$ -	
	Temporary Signal/Traffic Control	each	1	$ 350,000.00	$ 350,000.00	
	Street Light	each	3	$ 15,000.00	$ 45,000.00	@ 200' spacing
Landscaping						
	Trees	each		$ 1,000.00	$ -	
	Irrigation	L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 141,400.00	
	Mobilization	L.S.	1	10%	$ 282,800.00	
	Contingency			30%	$ 848,400.00	
	TOTAL				**$ 4,100,600.00**	2017
					$ 4,141,700.00	2018

Project 403.8: Kamehameha Highway High Occupancy Vehicle Lanes from Ka Uka Boulevard to Farrington Highway

Purpose: To provide additional capacity within the highway corridor along the segment with the highest vehicle demand, but also to incentivize ridesharing and minimizing additional single occupant vehicle travel.

Project Description: Options for adding vehicle capacity within the highway corridor are limited and simply adding new mixed-flow lanes will further degrade merging operations onto the H-1 freeway unless more substantive downstream capacity is added. By providing HOV lanes on the subject segment, multi-occupant vehicles already traveling along the highway would have a dedicated right-of-way that would help bypass existing queues. The designation of these lanes as HOV-only facilities would encourage the practice of ridesharing and would decrease reliance on single occupant vehicle travel. To accomplish this project, the roadway would have to be widened and/or the median would need to be narrowed, and merging/diverging lanes would need to be provided at the ramp junctions to and from H-1.

Evaluation: This project was coded into the model assuming one HOV lane in each direction on the subject segment, and the results of the model run showed that the number of congested lane miles in the COTS area would be reduced by 3 and 2 lane-miles in the AM and PM peak periods, respectively. It would also reduce travel time between local origins and destinations by a total of 6 minutes.

Assumptions:

Length = 11,000'
Width = 8' + 8'
New lanes for overpasses = 500'+200' = 700'

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Remove existing traffic signal	each		$ 100,000.00	$ -	
	Remove existing pavement striping	Lin. Ft.		$ 3.00	$ -	
	Remove existing pavement symbol	each		$ 300.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Demolish existing Pavement	Sq. Ft.	176000	$ 8.00	$ 1,408,000.00	11000' x 8' x 2
	Erosion Control	L.S.	11	$ 10,000.00	$ 110,000.00	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.		$ 6.00	$ -	
	Full depth roadway construction	Sq. Ft.	176000	$ 30.00	$ 5,280,000.00	11000' x 8' lane x 2
	Curb Gutter and Sidewalk	Sq. Ft.		$ 20.00	$ -	
	Drainage works	each	74	$ 14,000.00	$ 1,036,000.00	$14,000 / 300' catch basin spacing = 11,000' / 300' x 2
	Raised Median	Sq. Ft.		$ 20.00	$ -	
	Raised Traffic Island	Sq. Ft.		$ 20.00	$ -	
	Raised Channel (ped crossing)	Sq. Ft.		$ 20.00	$ -	
	4" Stripe (white/Yellow)	Lin. Ft.	44000	$ 6.00	$ 264,000.00	11000' x 2 lines/lane x 2
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	5' Bike lane (Green)	Sq. Ft.		$ 9.00	$ -	
	Striping Symbols	each	44	$ 300.00	$ 13,200.00	11000' / 500' spacing x 2
	New bridge	Sq. Ft.	28000	$ 250.00	$ 7,000,000.00	700' x 20' x 2
Intersection						
	Full Single Lane Roundabout	each			$ -	
	includes sidewalk, roadway, striping and lighting				$ -	
	Ped Activated Traffic Signal	each		$ 400,000.00	$ -	
	Traffic Signal Modification	each	3	$ 350,000.00	$ 1,050,000.00	
	Street Light	each		$ 15,000.00	$ -	
Landscaping						
	Trees	each		$ 1,000.00	$ -	
	Irrigation	L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 808,060.00	
	Mobilization	L.S.	1	10%	$ 1,616,120.00	
	Contingency			30%	$ 4,848,360.00	
	TOTAL				**$ 23,433,740.00**	2017
					$ 23,668,100.00	2018

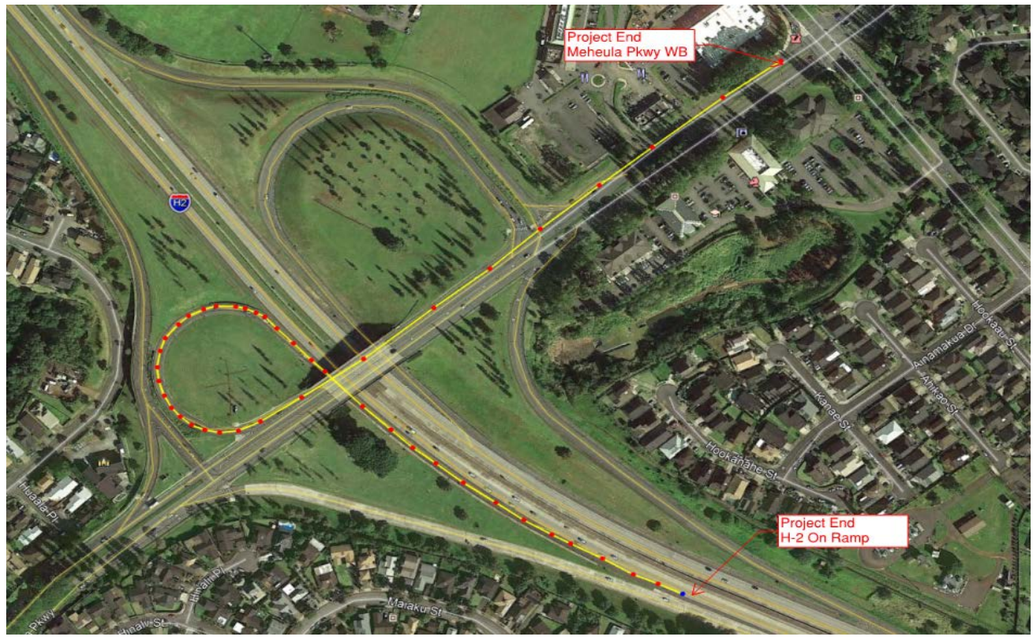
Project 404.2: Widen WB Meheula Pkwy On-Ramp to Southbound H-2

Purpose: To reduce delays for traffic traveling from Mililani Mauka to southbound H-2, the on-ramp would be widened to include two lanes from Meheula Parkway. The merge area on the freeway would also have to be widened to minimize delays to freeway flow.

Project Description: This project would provide two lanes on the westbound Meheula Parkway on-ramp to southbound H-2 to improve local congestion.

Evaluation: During the AM peak period, this on-ramp experiences its highest traffic volumes and demand. On some days, the queues from this ramp extend back onto Meheula Parkway as traffic approaches the ramp junction. This hinders traffic flow on the arterial roadway and causes driver frustration, potentially leading to more aggressive driver behavior and can reduce safety for other users along the roadway includes pedestrians and cyclists. Stop and go traffic can also result in more rear-end collisions as drivers are traveling close together and may not anticipate sudden stops or starts in traffic.

By providing two lanes on the on-ramp, the local congestion is improved, but the additional flow of traffic onto the freeway mainline does not show any appreciable change (less than 2%) in the number of congested lane miles in the AM peak period, and regional travel times under Performance Measure 1 are actually projected to increase slightly (by 1 minute). The local benefit is a total reduction in travel between local destination pairs of 8 minutes. As noted above, implementing this improvement would require special consideration for designing bicycle and pedestrian facilities that avoid the multiple threat condition of crossing two on-ramp lanes.



Assumptions:

Length = 4000'
Width = 12' Lane
bridge = 220'

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Remove existing traffic signal	each		$ 100,000.00	$ -	
	Remove existing pavement striping	Lin. Ft.		$ 3.00	$ -	
	Remove existing pavement symbol	each		$ 300.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Demolish existing Pavement	Sq. Ft.	32000	$ 8.00	$ 256,000.00	4000' x 8' shld
	Erosion Control	L.S.	4	$ 10,000.00	$ 40,000.00	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.		$ 6.00	$ -	
	Full depth roadway construction	Sq. Ft.	80000	$ 30.00	$ 2,400,000.00	4000' x 12' lane + 8' shld
	Curb Gutter and Sidewalk	Sq. Ft.	18000	$ 20.00	$ 360,000.00	2000' x 9'
	Drainage works	each	14	$ 14,000.00	$ 196,000.00	$14,000 / 300' catch basin spacing
	Raised Median	Sq. Ft.		$ 20.00	$ -	
	Raised Traffic Island	Sq. Ft.		$ 20.00	$ -	
	Raised Channel (ped crossing)	Sq. Ft.		$ 20.00	$ -	
	4" Stripe (white/Yellow)	Lin. Ft.	8000	$ 6.00	$ 48,000.00	4000 x 2 lines
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	5' Bike lane (Green)	Sq. Ft.		$ 9.00	$ -	
	Striping Symbols	each		$ 300.00	$ -	
	Bridge widening	Sq. Ft.	4400	$ 250.00	$ 1,100,000.00	220' x 20' widening
Intersection						
	Full Single Lane Roundabout	each			$ -	
	includes sidewalk, roadway, striping and lighting				$ -	
	Ped Activated Traffic Signal	each	1	$ 400,000.00	$ 400,000.00	
	Traffic Signal Modification	each	1	$ 350,000.00	$ 350,000.00	
	Street Light	each	20	$ 15,000.00	$ 300,000.00	200' spacing
Landscaping						
	Trees	each		$ 1,000.00	$ -	
	Irrigation	L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 272,500.00	
	Mobilization	L.S.	1	10%	$ 545,000.00	
	Contingency			30%	$ 1,635,000.00	
	TOTAL				**$ 7,902,500.00**	2017
					$ 7,982,000.00	2018

Project 405.1: Waiawa H-1/H-2 Interchange – Eastbound to Southbound Merge Improvements

Purpose: To reduce delays and improve merge operations for traffic traveling from southbound H-2 to eastbound H-1.

Project Description: This project was originally studied as part of the H-1 Corridor Study conducted by the Hawaii Department of Transportation. The H-1/H-2 merge includes several lanes that align next to each other within the Waiawa interchange. This project would widen the freeway to install a more traditional lane drop on the right-hand side of the merge.

Evaluation: One lane from each of the freeways merges into the other as the lanes become parallel and the segments join together. This merge, especially at higher speeds is not a standard design and contributes to slowing of traffic primarily during the morning peak period when the predominant flows are eastbound and southbound on the H-1 and H-2, respectively. Widening the freeway to install a more traditional lane drop on the right-hand side of the merge would help to expedite flow, improve safety, and be more in line with driver expectation (especially by tourists who are less familiar with the roadway system). This project was originally studied as part of the H-1 Corridor Study conducted by the Hawaii Department of Transportation and showed a potential decrease of 14% in freeway density (i.e., vehicles per mile per lane) during the AM peak period, when southbound and eastbound traffic volumes are at their highest. However, by itself this project would not significantly reduce travel time during the AM peak period without additional downstream improvements that would provide additional capacity and ultimately reduce congestion. During off-peak times, this improvement would improve safety but would not be needed from a capacity perspective. This project was originally included in one of the major packages of improvements (Package D2) that extended east towards Moanalua Road.

Assumptions:

Length =2,500 to 3000' per AASHTO page 10-120
Width = 24' Lane

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Remove existing traffic signal	each		$ 100,000.00	$ -	
	Remove existing pavement striping	Lin. Ft.		$ 3.00	$ -	
	Remove existing pavement symbol	each		$ 300.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Demolish existing Pavement	Sq. Ft.	32000	$ 8.00	$ 256,000.00	4000' x 8' shld
	Erosion Control	L.S.	3	$ 10,000.00	$ 30,000.00	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.		$ 6.00	$ -	
	Full depth roadway construction	Sq. Ft.	128000	$ 30.00	$ 3,840,000.00	3000' x 24' lane + 8' shld
	Curb Gutter and Sidewalk	Sq. Ft.		$ 20.00	$ -	2000' x 9'
	Drainage works	each	10	$ 14,000.00	$ 140,000.00	$14,000 / 300' catch basin spacing
	Retaining Wall	Sq. Ft.	28000	$ 150.00	$ 4,200,000.00	2800' x 10' high
	Raised Traffic Island	Sq. Ft.		$ 20.00	$ -	
	Raised Channel (ped crossing)	Sq. Ft.		$ 20.00	$ -	
	4" Stripe (white/Yellow)	Lin. Ft.	9000	$ 6.00	$ 54,000.00	3000 x 3lines
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	5' Bike lane (Green)	Sq. Ft.		$ 9.00	$ -	
	Striping Symbols	each		$ 300.00	$ -	
	Bridge widening	Sq. Ft.		$ 250.00	$ -	
Intersection						
	Full Single Lane Roundabout	each			$ -	
	includes sidewalk, roadway, striping and lighting				$ -	
	Ped Activated Traffic Signal	each		$ 400,000.00	$ -	
	Traffic Signal Modification	each		$ 350,000.00	$ -	
	Street Light	each	15	$ 15,000.00	$ 225,000.00	200' spacing
Landscaping						
	Trees	each		$ 1,000.00	$ -	
	Irrigation	L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 437,250.00	
	Mobilization	L.S.	1	10%	$ 874,500.00	
	Contingency			30%	$ 2,623,500.00	
	TOTAL				**$ 12,680,250.00**	2017
					$ 12,808,000.00	2018

Project 406.1: New Road between Mililani Mauka and Pearl City

Purpose: To provide additional mauka-makai vehicle capacity to and through the COTS area by constructing a new road between Mililani Mauka and the Waiawa/Pearl City area.

Evaluation: The need for an additional access point serving the COTS area was discussed for many years and was last included in the regional transportation plan in 2006 as part of the ORTP 2030 document. In a subsequent report to the legislature in 2007, the Central Mauka Road project (as it was known then) ranked 7th out of 10 second access projects across the island of Oahu. To test the potential demand for this roadway, a two-lane roadway was coded into the OahuMPO travel demand model, which is the best available planning tool for projecting long-range traffic volumes. The roadway essentially connected the east side of Mililani Mauka with the Pearl City area via Waihona Street or possibly Waimano Home Road. A connection was assumed at the east end of Ka Uka Boulevard (east of H-2) and would provide access to new development occurring as part of the Koa Ridge and Waiawa area projects. The precise alignment and connection options would have to be determined through a detailed alternatives evaluation process.

The results of this preliminary evaluation showed that the new roadway could carry peak direction volumes ranging from 1,200 to 1,900 vehicles on the section makai of Ka Uka Boulevard. This would initially indicate the need for a four-lane roadway (two lanes in each direction). Mauka of Ka Uka Boulevard and the new development, the new road would serve between 800 and 1,200 vehicles in the peak direction and could be designed as a two-lane roadway. Purely from a demand perspective, this project would provide some circulation benefit to the COTS area but would only contribute to mode shift away from the automobile if some capacity was reserved exclusively for transit, such as dedicated bus lanes. This assumes that no other high quality transit service through the COTS area to the Pearl Highland rail station was provided.

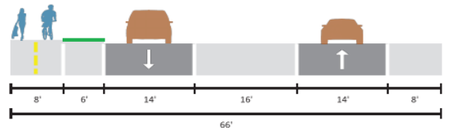
From an operational perspective, this new roadway would reduce the number of congested lane miles by 4 miles, or 7% in the AM peak period, and no appreciable change in the PM peak period. The benefit to regional destinations per Performance Measure 1 would range from 3 to 6 minutes, and the benefit to local travel times (Performance Measure 4) is projected to a combined reduction of nearly 40 minutes in travel time. From an operational perspective, this new facility would substantially benefit the COTS area, but the constructability, environmental, and community issues will have be addressed in the next phase of study.

406.1 New Road between Mililani Mauka and Pearl City

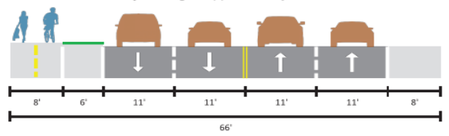
Two lane proposed roadway north of of Ka Uka Blvd

No existing roadway

Proposed North Section
Two lane proposed roadway (north of Ka Uka Blvd)
Project Length: Approximately 17,000 feet



Proposed South Section
Two lane proposed roadway (south of Ka Uka Blvd)
Project Length: Approximately 8,000 feet



Assumptions:

Length = 25000'
Width = 66'

	ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST	NOTES
Removals/Demo						
	Clearing and Grubbing	Sq. Ft.	1650000	$ 3.00	$ 4,950,000.00	25000 x 66'
	Remove existing traffic signal	each		$ 100,000.00	$ -	
	Remove existing pavement striping	Lin. Ft.		$ 3.00	$ -	
	Remove existing pavement symbol	each		$ 300.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Demolish existing Pavement	Sq. Ft.		$ 8.00	$ -	
	Erosion Control	L.S.	25	$ 10,000.00	$ 250,000.00	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.		$ 6.00	$ -	
	Roadway construction	Lin. Ft.	25000	$ 1,320.00	$ 33,000,000.00	$4.3mil/km = $1320/ft
	Curb Gutter and Sidewalk	Sq. Ft.		$ 20.00	$ -	
	Drainage works	each	84	$ 14,000.00	$ 1,176,000.00	$14,000 / 300' catch basin spacing
	Raised Median	Sq. Ft.		$ 20.00	$ -	
	Raised Traffic Island	Sq. Ft.		$ 20.00	$ -	
	Raised Channel (ped crossing)	Sq. Ft.		$ 20.00	$ -	
	4" Stripe (white/Yellow)	Lin. Ft.		$ 6.00	$ -	
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	5' Bike lane (Green)	Sq. Ft.		$ 9.00	$ -	
	Striping Symbols	each		$ 300.00	$ -	
Intersection						
	Full Single Lane Roundabout	each			$ -	
	includes sidewalk, roadway, striping and lighting				$ -	
	Ped Activated Traffic Signal	each		$ 400,000.00	$ -	
	Traffic Signal Modification	each		$ 350,000.00	$ -	
	Street Light	each		$ 15,000.00	$ -	
Landscaping						
	Landscaping	Sq. Ft.	150000	$ 10.00	$ 1,500,000.00	25000 x 6
	Irrigation	L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 1,796,300.00	
	Mobilization	L.S.	1	10%	$ 3,592,600.00	
	Contingency			30%	$ 10,777,800.00	
	TOTAL				**$ 52,092,700.00**	2017
					$ 52,614,000.00	2018

GRADING CONSTRUCTION COSTS

Costs are shown in 2013 $'s

2 - Lane Low Volume Road Construction:

Easy Conditions..... $542,000 - $867,000/km
Moderate Conditions.....$867,000 - $1,032,000/km
Difficult Conditions.....$1,032,000 - $2,166,000/km
Very Difficult Conditions..$2,166,000 - $3,250,000/km

2 - Lane High Volume Road Construction:

Easy Conditions.....$867,000 - $1,516,000/km
Moderate Conditions.....$1,516,000 - $2,703,000/km
Difficult Conditions.....$2,703,000 - $3,250,000/km
Very Difficult Conditions..$3,250,000 - $5,158,000/km

4 - Lane High Volume Road Construction:

Easy Conditions.....$1,547,000 - $2,837,000/km
Moderate Conditions.....$2,837,000 - $3,611,000/km
Difficult Conditions.....$3,611,000 - $5,158,000/km
Very Difficult Conditions..$5,158,000 - $10,832,000/km

Note: The above range of costs for highway construction include construction, engineering, materials supplied by MOT, miscellaneous and utility relocation but does not include engineering design or property acquisition

Project 406.3: New Road between California Avenue and Meheula Parkway

Purpose: To provide additional connectivity between the adjacent communities of Wahiawa and Mililani Mauka that have limited access points.

Project Description: Similar to Project 406.2, expanding connections between adjacent communities includes multiple benefits such as:

- Providing added convenience and a more direct route to complementary land uses (retail and employment opportunities) for all residents,
- Providing secondary routes in the case of an emergency,
- Reducing local/community travel on a more regional facility (i.e., the H-2 freeway), and
- Providing new multimodal connections for active transportation and transit.

Evaluation: Evaluation of this project was completed using the OahuMPO model and a connection between the mauka terminus of Lehiwa Drive and California Avenue makai of Karsten Drive was coded into the roadway network. This analysis showed no change in the number of congested lane miles in the AM peak period and an increase of 1 lane-mile in the PM peak period. Also, limited benefit to local travel times between key origins and destinations was projected with a travel time savings of only 1 minute. While this project is still recommended, it is considered a lower priority from a circulation and regional benefit perspective.

Assumptions:

Length = 10,000
Width = 66'

	ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST	NOTES
Removals/Demo						
	Clearing and Grubbing	Sq. Ft.	660000	$ 3.00	$ 1,980,000.00	10000 x 66'
	Remove existing pavement striping	Lin. Ft.		$ 3.00	$ -	
	Remove existing pavement symbol	each		$ 300.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Demolish existing Pavement	Sq. Ft.		$ 8.00	$ -	
	Erosion Control	L.S.	10	$ 10,000.00	$ 100,000.00	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.		$ 6.00	$ -	
	Roadway construction	Lin. Ft.	10000	$ 1,100.00	$ 11,000,000.00	$3.6mil/km = $1100/ft
	Curb Gutter and Sidewalk	Sq. Ft.		$ 20.00	$ -	
	Drainage works	each	34	$ 14,000.00	$ 476,000.00	$14,000 / 300' catch basin spacing
	Raised Median	Sq. Ft.		$ 20.00	$ -	
	Raised Traffic Island	Sq. Ft.		$ 20.00	$ -	
	Raised Channel (ped crossing)	Sq. Ft.		$ 20.00	$ -	
	4" Stripe (white/Yellow)	Lin. Ft.		$ 6.00	$ -	
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	5' Bike lane (Green)	Sq. Ft.		$ 9.00	$ -	
	Striping Symbols	each		$ 300.00	$ -	
Intersection						
	Full Single Lane Roundabout	each			$ -	
	includes sidewalk, roadway, striping and lighting				$ -	
	Ped Activated Traffic Signal	each		$ 400,000.00	$ -	
	Traffic Signal Modification	each		$ 350,000.00	$ -	
	Street Light	each		$ 15,000.00	$ -	
Landscaping						
	Landscaping	Sq. Ft.	200000	$ 10.00	$ 2,000,000.00	10000 x 20
	Irrigation	L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 777,800.00	
	Mobilization	L.S.	1	10%	$ 1,357,600.00	
	Contingency			30%	$ 4,072,800.00	
	TOTAL				**$ 19,784,200.00**	2017
					$ 19,982,100.00	2018

GRADING CONSTRUCTION COSTS

Costs are shown in 2013 $'s

2 - Lane Low Volume Road Construction:
Easy Conditions..... $542,000 - $867,000/km
Moderate Conditions.....$867,000 - $1,032,000/km
Difficult Conditions.....$1,032,000 - $2,166,000/km
Very Difficult Conditions..$2,166,000 - $3,250,000/km
2 - Lane High Volume Road Construction:
Easy Conditions.....$867,000 - $1,516,000/km
Moderate Conditions.....$1,516,000 - $2,703,000/km
Difficult Conditions.....$2,703,000 - $3,250,000/km
Very Difficult Conditions..$3,250,000 - $5,158,000/km
4 - Lane High Volume Road Construction:
Easy Conditions.....$1,547,000 - $2,837,000/km
Moderate Conditions.....$2,837,000 - $3,611,000/km
Difficult Conditions.....$3,611,000 - $5,158,000/km
Very Difficult Conditions..$5,158,000 - $10,832,000/km

Note: The above range of costs for highway construction include construction, engineering, materials supplied by MOT, miscellaneous and utility relocation but does not include engineering design or property acquisition

Project 408.1: New H-2 Interchange at Mililani Mauka

Purpose: To provide an alternate access from Mililani Mauka to H-2 to distribute traffic at more than one interchange and to provide an alternate access in case of emergency

Project Description: The sole vehicular, transit, bicycle and pedestrian access for the Mililani Mauka community is provided via Meheula Parkway where it intersects with the H-2 freeway. This limits circulation options for the community and focuses all of the demand at one location. To better distribute traffic and provide an alternate connection for emergency access or evacuation purposes, a connection to another interchange or freeway crossing is desirable. Two connections are possible: 1) a mauka connection to Wikao Street, which would provide access to the existing Mililani Tech Park interchange (via Leilehua Golf Course Road) or 2) a makai connection to the future Pineapple Road interchange that will serve the mauka portion of the planned Koa Ridge development. In both cases, alignments for these connections would have to be identified and studied from a feasibility and impact perspective.

Evaluation: Given the higher traffic demand to and from H-2 towards H-1, the makai connection to the future interchange was coded in the OahuMPO travel demand network. This scenario would provide the higher traffic volume estimates of the two connections. The connection for analysis purposes was made from Lehiwa Street without identifying a specific alignment or connection location.

The results of this evaluation showed that this new roadway would increase the number of congested lane miles slightly by 2 and 1 miles in the AM and PM peak periods, respectively. The effect of the project on travel to regional destinations from Mililani Town Center to regional destinations would vary a negligible amount (from -2 to +1 minutes) per Performance Measure 1. The benefit to local travel times (Performance Measure 4) is projected to be more noticeable with a combined 11 minute reduction. While the operational measures do not illustrate a clear overall benefit, this connection would enhance community connectivity and provide a means for Mililani Mauka residents to travel to and from complementary uses in Koa Ridge without ever having to use the H-2 freeway. This is in addition to the previously identified benefit of an alternate emergency access for the community.

Assumptions:

Length =
Width =

	ITEM	*UNIT*	*QUANTITY*	*UNIT COST*	*TOTAL COST*	*NOTES*
Removals/Demo						
	Remove existing traffic signal	each		$ 100,000.00	$ -	
	Remove existing pavement striping	Lin. Ft.		$ 3.00	$ -	
	Remove existing pavement symbol	each		$ 300.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Demolish existing Pavement	Sq. Ft.		$ 8.00	$ -	
	Erosion Control	L.S.		$ 10,000.00	$ -	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.		$ 6.00	$ -	
	Full depth roadway construction	Sq. Ft.		$ 17.00	$ -	
	Curb Gutter and Sidewalk	Sq. Ft.		$ 20.00	$ -	
	Drainage works	each		$ 14,000.00	$ -	$14,000 / 300' catch basin spacing
	Raised Median	Sq. Ft.		$ 20.00	$ -	
	Raised Traffic Island	Sq. Ft.		$ 20.00	$ -	
	Raised Channel (ped crossing)	Sq. Ft.		$ 20.00	$ -	
	4" Stripe (white/Yellow)	Lin. Ft.		$ 6.00	$ -	
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	5' Bike lane (Green)	Sq. Ft.		$ 9.00	$ -	
	Interchange	each	1	$ 35,000,000.00	$ 35,000,000.00	Higher than average cost
Intersection						
	Full Single Lane Roundabout	each			$ -	
	includes sidewalk, roadway, striping and lighting				$ -	
	Ped Activated Traffic Signal	each		$ 400,000.00	$ -	
	Traffic Signal Modification	each		$ 350,000.00	$ -	
	Street Light	each		$ 15,000.00	$ -	
Landscaping						
	Trees	each		$ 1,000.00	$ -	
	Irrigation	L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 1,750,000.00	
	Mobilization	L.S.	1	10%	$ 3,500,000.00	
	Contingency			30%	$ 10,500,000.00	
	TOTAL				**$ 50,750,000.00**	2017
					$ 51,258,000.00	2018

INTERCHANGES

Costs are shown in 2013 $'s

Rural Interchange

A diamond, multi-plate underpass, minimum design standards

Cost range ..... $4,400,000 - $8,800,000

Urban Interchange

A diamond, partial cloverleaf, trumpet, or directional interchange, concrete structures, high pipe underpass.

Cost range ..... $22,750,000 - $36,500,000

Project 408.4: New Flyer Stops at H-2 with Pedestrian Pathway to Mililani Mauka Park and Ride Lot

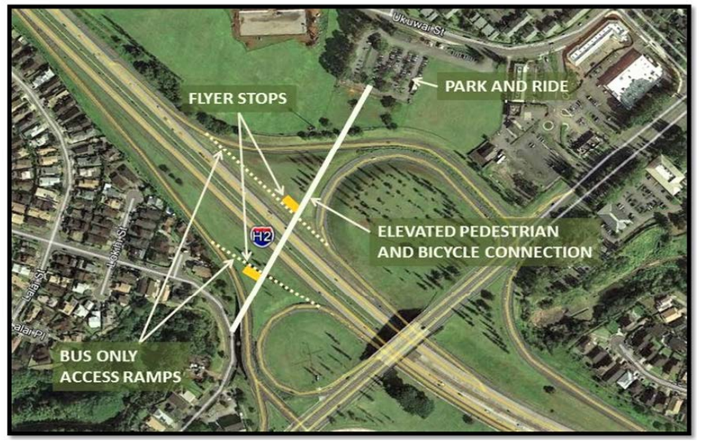
Purpose: This project allows buses traveling on H-2 to serve passengers without leaving the H-2 right-of-way, saving travel time for both bus operations and passengers.

Project Description: The project would provide two bus-only ramps (mauka and makai bound) connecting to an elevated pedestrian and bicycle path and bridge (see **Figure 6**). The pedestrian and bicycle connection is between the Mililani Mauka park and ride lot and the green space on the Ewa side of H-2.

Evaluation: This project serves as a highly desirable alternative mode link between the two Mililani communities that can also be used for those not accessing bus services. It provides pedestrians and bicyclists an alternative safe pathway across the Meheula Parkway interchange with H-2 which is designed well for vehicle flow but is not friendly to other modes.

Express buses would avoid exiting the freeway and would save the 8 to 10 minutes traversing through the congested intersections to access the park and ride during peak periods. This project gives access to express services that already exist but bypass Mililani without negatively impacting riders that are onboard. Currently North Shore and Wahiawa express buses bypass Mililani. This project would add approximately 1,100 feet of separated pedestrian and bicycle facility to the Mililani/Mililani Mauka network. This link provides a protected crossing of H-2 avoiding on/off ramps and multiple vehicle movements.

Figure 6. Conceptual Flyer Stops at H-2 and Mililani Mauka Park and Ride Lot



Assumptions:

Length = mauka 770', makai 520'
Width = 12' lane and 8' shoulder
Ped overpass = 1120' x 12' wide

	ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST	NOTES
Removals/Demo						
	Clear and grub	Sq. Ft.	25800	$ 5.00	$ 129,000.00	1290' x 20'
	Remove existing pavement striping	Lin. Ft.		$ 3.00	$ -	
	Remove existing pavement symbol	each		$ 300.00	$ -	
	Demolish existing sidewalk	Sq. Ft.		$ 5.00	$ -	
	Demolish existing Pavement	Sq. Ft.		$ 8.00	$ -	
	Erosion Control	L.S.		$ 10,000.00	$ -	
Site improvements						
Roadway						
	Mill and Overlay existing AC pavement	Sq. Ft.		$ 6.00	$ -	
	Full depth roadway construction	Sq. Ft.	25800	$ 30.00	$ 774,000.00	1290 x 20'
	Curb Gutter and Sidewalk	Sq. Ft.		$ 20.00	$ -	
	Drainage works	each	5	$ 14,000.00	$ 70,000.00	$14,000 / 300' catch basin spacing
	Raised Median	Sq. Ft.		$ 20.00	$ -	
	Raised Traffic Island	Sq. Ft.		$ 20.00	$ -	
	Raised Channel (ped crossing)	Sq. Ft.		$ 20.00	$ -	
	4" Stripe (white/Yellow)	Lin. Ft.	5160	$ 6.00	$ 30,960.00	1290 x 4
	12"stripe (white)	Lin. Ft.		$ 9.00	$ -	
	5' Bike lane (Green)	Sq. Ft.		$ 9.00	$ -	
	Striping Symbols	each		$ 300.00	$ -	
	Pedestrian Overpass	Sq. Ft.	13440	$ 250.00	$ 3,360,000.00	
	Flyer Bus Stop	each	2	$ 80,000.00	$ 160,000.00	
Intersection						
	Full Single Lane Roundabout	each			$ -	
	includes sidewalk, roadway, striping and lighting				$ -	
	Ped Activated Traffic Signal	each		$ 400,000.00	$ -	
	Traffic Signal Modification	each		$ 350,000.00	$ -	
	Street Light	each	12	$ 15,000.00	$ 180,000.00	200' spacing each side
Landscaping						
	Trees	each		$ 1,000.00	$ -	
	Irrigation	L.S.			$ -	
Misc.						
	Traffic Control	L.S.	1	5%	$ 235,198.00	
	Mobilization	L.S.	1	10%	$ 457,496.00	
	Contingency			30%	$ 1,372,488.00	
	TOTAL				**$ 6,640,142.00**	2017
					$ 6,707,000.00	2018

APPENDIX E

Land Cost Estimate Tables

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This appendix provides the information used to develop unit (acre) cost for urban, agricultural, and conservation lands.

Urban				
TMK	**Acres**	**Assessed Land Value**	**Cost Per Acre**	**Project No.**
9-4-056:114	0.2754	$720,300.00	$2,615,468.41	102.6, 102.8, 403.8
9-4-056:115	0.2498	$723,200.00	$2,895,116.09	
9-4-056:118	0.3412	$857,000.00	$2,511,723.33	
9-4-056:076	0.1752	$581,100.00	$3,316,780.82	
9-4-056:079	0.1791	$582,900.00	$3,254,606.37	
9-4-056:080	0.1791	$582,900.00	$3,254,606.37	
9-4-044:001	0.1727	$604,800.00	$3,502,026.64	
9-4-044:002	0.1791	$588,800.00	$3,287,548.86	
9-4-044:003	0.1791	$588,800.00	$3,287,548.86	
9-4-044:004	0.1791	$586,900.00	$3,276,940.26	
9-4-044:005	0.1791	$588,800.00	$3,287,548.86	
9-4-044:006	0.1791	$618,200.00	$3,451,702.96	
9-4-044:009	0.1791	$588,800.00	$3,287,548.86	
9-4-044:010	0.1791	$586,900.00	$3,276,940.26	
9-4-044:011	0.1791	$588,800.00	$3,287,548.86	
9-4-042:011	0.1534	$537,400.00	$3,503,259.45	
9-4-042:014	0.1653	$561,200.00	$3,395,039.32	
9-4-042:015	0.1655	$561,700.00	$3,393,957.70	
9-4-042:020	0.2045	$607,800.00	$2,972,127.14	
9-4-042:021	0.4666	$1,001,900.00	$2,147,235.32	
9-4-097:094	0.1002	$427,600.00	$4,267,465.07	
9-4-097:093	0.1927	$473,900.00	$2,459,263.10	
9-4-115:015	5.72	$8,105,700.00	$1,417,080.42	
9-4-118:025	0.122	$483,000.00	$3,959,016.39	
9-4-118:024	0.1096	$474,600.00	$4,330,291.97	
9-4-118:013	0.1389	$490,100.00	$3,528,437.72	
9-4-118:012	0.1055	$470,300.00	$4,457,819.91	
9-4-115:030	3.8247	$13,202,900.00	$3,452,009.31	
9-4-121:026	0.0989	$463,400.00	$4,685,540.95	
9-4-121:027	0.106	$470,900.00	$4,442,452.83	
9-4-121:081	0.1151	$480,100.00	$4,171,155.52	
9-4-121:082	0.0973	$461,700.00	$4,745,118.19	
9-4-121:137	0.1069	$471,800.00	$4,413,470.53	
9-4-121:138	0.1048	$469,600.00	$4,480,916.03	
9-4-121:188	0.1413	$491,100.00	$3,475,583.86	
	Average	**$1,145,568.57**	**$3,471,168.47**	

Agricultural				
TMK	**Acres**	**Assessed Land Value**	**Cost Per Acre**	**Project No.**
9-4-007:004	23.27	$1,419,900.00	$61,018.48	102.6, 403.8
9-4-005:074	267.354	$16,233,000.00	$60,717.25	201.2
9-4-005:079	122.79	$6,741,200.00	$54,900.24	102.6
9-4-005:095	23.768	$332,600.00	$13,993.60	102.6
9-4-005:016	31	$1,891,000.00	$61,000.00	201.2
9-4-005:007	19.377	$1,712,900.00	$88,398.62	201.2
9-4-005:010	32.543	$1,389,600.00	$42,700.43	201.2
9-4-005:052	50.152	$2,753,300.00	$54,899.11	201.2
9-4-006:002	96.669	$3,489,300.00	$36,095.34	101.2, 201.2
9-4-006:038	78.874	$3,525,900.00	$44,702.94	
9-4-006:001	344.053	$12,952,500.00	$37,646.82	101.2, 102.5, 201.2
9-6-004:024	653.152	$6,720,700.00	$10,289.64	102.3, 201.7
9-4-006:011	100.137	$150,200.00	$1,499.95	102.3, 401.6, 401.7, 401.8
9-4-006:031	25.107	$ 91,900.00	$3,660.33	102.3, 401.6, 401.7, 401.8
9-4-006:045	155.203	$1,893,500.00	$12,200.15	102.3
9-5-003:017	343.644	$16,605,100.00	$48,320.65	102.3, 408.1
9-5-003:018	401.119	$8,737,300.00	$21,782.31	102.3
9-5-003:011	438.112	$3,105,700.00	$7,088.83	
9-5-049:031	38.586	$ 57,900.00	$1,500.54	
9-5-003:010	128.664	$4,828,000.00	$37,524.09	102.3, 406.1
9-5-002:039	93.565	$ 9,400.00	$100.46	406.3

Conservation				
TMK	**Acres**	**Assessed Land Value**	**Cost Per Acre**	**Project No.**
7-6-001:001	5112.44	$6,646,200.00	$1,300.01	406.3
7-6-001:006	65.96	$2,172,600.00	$32,938.14	
9-5-004:001	995.606	$686,000.00	$689.03	

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