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ROAD 76 OVERCROSSING FEASIBILITY STUDY MEMORANDUM

DATE: April 14, 2022

TO: Faigda Rico | City of Pasco
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FROM: Aaron Berger, PE | DKS
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SUBJECT: Road 76 Overcrossing Feasibility Study Project #22061-000

BACKGROUND

The City of Pasco has grown dramatically over the last 15 years. This growth has included both new residential developments, particularly north of the I-182 freeway, and new commercial corridors, particularly along Road 68. As the City continues to grow, the I-182 freeway has become a significant community barrier. Current I-182 crossing opportunities in the western portion of Pasco are limited to interchanges, forcing local trips to mingle with regional traffic. This increases congestion on the Road 68 and Road 100 corridors, while also creating corridor and intersection safety issues.

The Road 68 and Road 100 interchanges provide minimal pedestrian and bicycle facilities. This effectively cuts off the neighborhoods north of I-182 from residences, schools, and recreational opportunities south of the freeway, with nearly 7 miles of I-182 separating usable bicycle and pedestrian crossings. This barrier limits use of active transportation modes and encourages dependence on auto travel.

Road 76 is a collector roadway currently separated by I-182 into two segments, one extending from south from Chapel Hill Boulevard and the other extending north from Burden Boulevard. The southern segment of Road 76 terminates with a roundabout at Chapel Hill Boulevard and includes a buffered 12’ mixed use path on the west side and a buffered sidewalk on the east side from Argent Road to Chapel Hill Boulevard. The northern segment terminates with a right-angle turn at Burden Boulevard and includes buffered sidewalks on both sides.

The Road 76 Overcrossing project is intended to complete a new, multi-model collector connection across I-182 by joining together the segments of Road 76 north and south of the freeway with a

new overpass and roadway connection. This project is also intended to complete an active transportation connection across I-182, providing an alternate route to Road 68 for bicycles and pedestrians. This project has been identified as a near term priority in the City Comprehensive Plan, Transportation System Master Plan, in the Benton-Franklin Council of Governments (BFCOG) Regional Transportation Plan (RTP), and in the City of Pasco Capital Improvement Plan.

METHODOLOGY

To determine most feasible alternative that meets the project goals and objectives, Road 76 from Chapel Hill Boulevard to Burden Boulevard and Road 68 from Chapel Hill Boulevard to Burden Boulevard (See Figure 1) were selected as the primary project impact area and analyzed to quantify the project safety and traffic operations benefits.

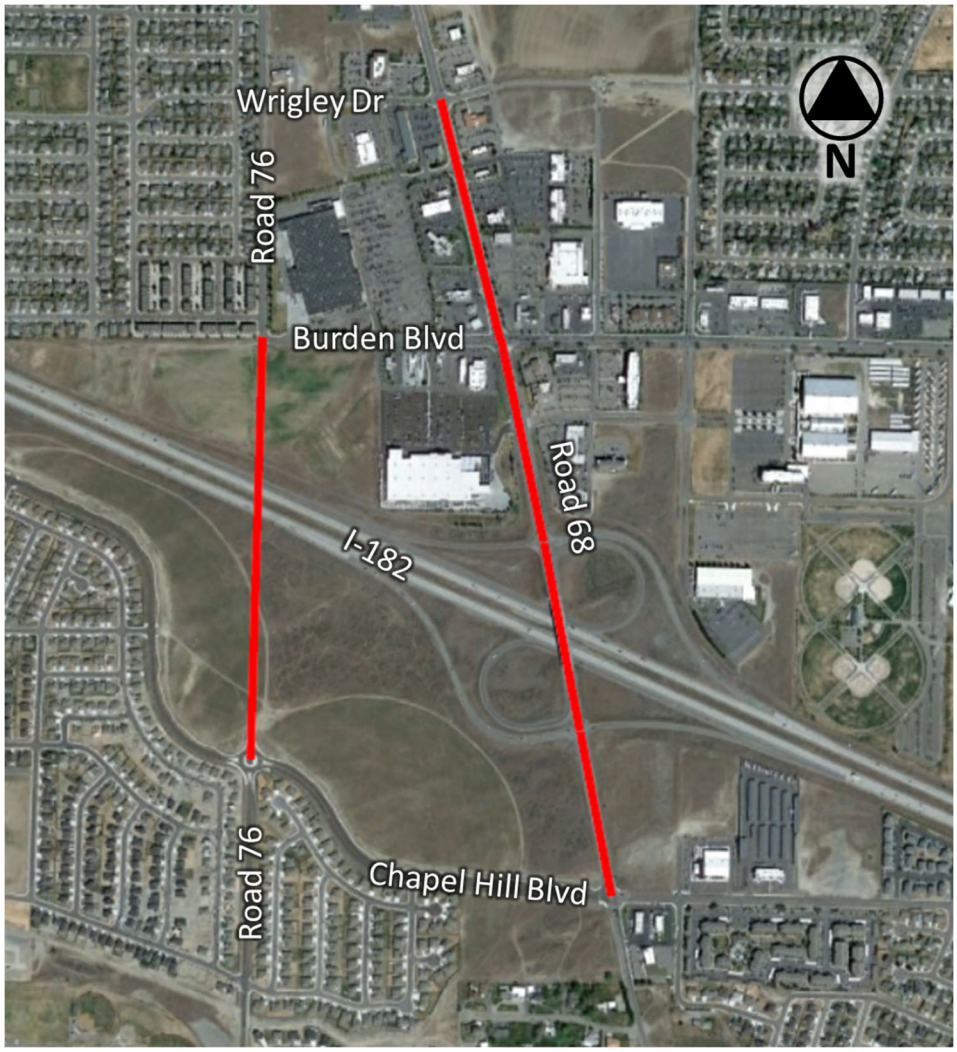

FIGURE 1: PROJECT ANALYSIS STUDY AREA

The following sections outline the analyses methods used to estimate these benefits.

TRAFFIC OPERATIONS ANALYSIS METHODOLOGY

During the Pasco TSMP project, a subarea PM peak hour travel demand model was developed for western Pasco. This model extends from Road 36 to the east, the Columbia River to the west, Argent Road to the south, and Clark Road to the north. This model was calibrated to 2019 PM peak hour turn movement counts at key intersections. The model was then validated for future 2045 conditions using data from the BFCOG model. This model was used to assess the traffic operations benefits of the TSMP projects in western Pasco.

For this study, the TSMP subarea model will be used to assess the mobility benefits of the Road 76 overcrossing. The model will be applied for a without project (No-Build) and with project (Build) condition to determine the PM peak hour delay (measured in vehicle hours of delay). Synchro (Version 11) software will be used to determine the needed traffic control and lane configuration at the Build condition Road 76 and Burden Boulevard intersection.

BFCOG collects 24-hour traffic counts every two years at several locations throughout the Tri-Cities. The last set of counts were collected in 2020. These counts were affected by the COVID-19 business and school closures. Traffic as returned to pre-pandemic levels in the Tri-Cites by 2022. Therefore, the project team used 2018 BFCOG 24-hour traffic counts, factored these to 2019 conditions using WSDOT Automatic Traffic Recorder (ATR data), and combined these counts with some additional counts collected by the City with speed warning units to develop a set of 2019 Average Annual Daily Traffic counts to support the project safety analysis.

The BFCOG 2019 and 2045 travel demand models were used to develop AADT forecasts for Road 76 and Road 68 in the project study area. The net daily trip growth from the travel demand model was combined with 2019 AADT traffic count data developed within the project study area to create year 2045 volume forecasts.

SAFETY ANALYSIS METHODOLOGY

A comprehensive safety analysis was conducted to understand the crash patterns and severities of the study corridor. The study area included the approximately one mile stretch of Road 68 from Wrigley Drive in the north to Chapel Hill Boulevard in the south. The corridor was broken up into five study intersections and four study segments of relatively equal length to better analyze the crash trends.

The Crash Predictive Method (CPM) through the Highway Safety Manual (HSM) seeks to determine an average crash rate that would be predicted according to the built infrastructure and vehicular volumes present for a roadway segment or intersection. For this feasibility study, the analysis focused on the Road 68 corridor between Wrigley Drive and Chapel Hill Boulevard and the future Road 76 corridor crossing I-182. Using HSM methodologies, the predictive method for urban and suburban arterials was used to quantify predicted crashes between Baseline and Build conditions.

EXISTING CONDITIONS

This section summarizes the Existing (2019) conditions for the project area. Note that the Road 68 corridor has already been analyzed for existing conditions in Pasco TSMP. This section focuses on reviewing and documenting the 2019 AADT in the project area and performing an existing conditions safety assessment.

TRAFFIC VOLUMES

As noted in the methodology section, the AADT for the corridor was derived primarily from 2018 counts collected by BFCOG, supplemented by 2022 data collected by the City of Pasco. The 2019 AADT volumes throughout the project study area is summarized in Table 1.

TABLE 1: 2019 AADT

INTERSECTIONS AND SEGMENTS	EAST/WEST 2019 AADT	NORTH/SOUTH 2019 AADT
ROAD 76		
ROAD 76/BURDEN - INTERSECTION	2,525	3,203
BURDEN TO CHAPEL HILL - SEGMENT	N/A	0
ROAD 76/CHAPEL HILL - INTERSECTION	4,045	2,000
ROAD 68		
ROAD 68/WRIGLEY - INTERSECTION	2,820	18,953
WRIGLEY TO BURDEN – SEGMENT	N/A	21,539
ROAD 68/BURDEN - INTERSECTION	20,437	34,938
ROAD 68 SEGMENT – SEGMENT	N/A	49,841
ROAD 68/I-182 WB - INTERSECTION	13,812	44,207
ROAD 68 SEGMENT – SEGMENT	N/A	37,068
ROAD 68 /I-182 EB - INTERSECTION	18,698	29,966
ROAD 68 SEGMENT – SEGMENT	N/A	22,970
ROAD 68/CHAPEL HILL - INTERSECTION	5,153	19,758

SAFETY ASSESSMENT

This section examines the crash history for the area and trends in crashes, as well as describes the methodology and results for predicting future crashes between future baseline and build scenarios and monetizing the added safety benefits to the project.

OVERALL CRASH FINDINGS

There were 390 crashes total in the five-year analysis period, which included three suspected serious injury crashes. No fatal crashes nor crashes involving pedestrians or bicyclists were reported. The three suspected injury crashes are summarized below.

- The first suspected serious injury crash occurred in 2016 at the intersection of Burden Boulevard and Road 68. A vehicle was traveling southbound on Road 68 when it hit a vehicle traveling westbound through the intersection, causing an angle crash. The primary contributing circumstance was disregarding the traffic signal indication due to distracted driving. No drugs or alcohol were involved.
- The second suspected serious injury crash occurred in 2016 on Road 68 just south of the Rodeo Drive intersection between Burden Boulevard and the I-182 WB-Ramps. A vehicle was traveling southbound on Road 68 when it rear-ended a vehicle. The primary contributing circumstance was exceeding a reasonably safe speed. No drugs or alcohol were involved. The primary driver was a Target Zero Young Driver User and the secondary driver was a Target Zero Older Driver.
- The third suspected serious injury crash occurred in 2017 at the intersection of Burden Boulevard and Road 68. A vehicle was traveling southbound on Road 68 when it hit a vehicle traveling westbound through the intersection, causing an angle crash. The primary contributing circumstance was disregarding the traffic signal indication due to distracted driving. No drugs or alcohol were involved.

Table 2 lists the number of crashes per year at each study intersection and segment. A few common trends can be seen below. First, the number of crashes per year for the corridor was relatively the same for each analysis year, except for 2020. This single-year decrease in number of crashes for 2020 could be attributed to the Covid-19 Pandemic's overall decrease in vehicle miles traveled. Second, the Burden Boulevard/Road 68 intersection witnessed a much higher rate of crashes than its study intersection counterparts. However, both I-182 ramp terminal intersections still had a high number of crashes. Third, the Road 68 segment from Wrigley Drive to Burden Boulevard witnessed the most crashes, which can be attributed to the multiple major commercial driveways that exist on that short quarter-mile stretch of roadway.

TABLE 2: CORRIDOR CRASHES BY INTERSECTION/SEGMENT AND YEAR

	2016	2017	2018	2019	2020	TOTAL
INTERSECTIONS						
WRIGLEY DR/ ROAD 68	4	4	8	5	8	29
BURDEN BLVD/ ROAD 68	16	18	26	19	13	92
I-182 WB RAMPS/ ROAD 68	15	11	11	7	5	49
I-182 EB RAMPS/ ROAD 68	13	16	13	16	6	64
CHAPEL HILL BLVD/ ROAD 68	4	0	2	2	3	11
SEGMENTS						
WRIGLEY DR -> BURDEN BLVD	10	12	9	13	13	57
BURDEN BLVD -> I-182 WB RAMPS	14	8	11	8	3	44
I-182 WB RAMPS -> I-182 EB RAMPS	6	9	5	8	3	31
I-182 WB RAMPS -> CHAPEL HILL BLVD	2	4	4	1	2	13
COMBINED TOTAL						
TOTAL	84	82	89	79	56	390

Figure 2 provides a heatmap visualization of crashes along the corridor. As described above, most of the corridor crashes happened at three major intersections. This is reflected in the heatmap.

FIGURE 2: STUDY CORRIDOR CRASH HEATMAP

While total crashes are an important metric for understanding the safety of a corridor, the severity of those crashes is also crucial. Across the study corridor, there were 306 Property Damage Only (PDO) crashes, which was the majority of the 390 total crashes reported (78% of crashes). There were another 70 Possible Injury crashes (18% of crashes) and 10 Suspected Minor Injury crashes (3% crashes). The final 3 crashes (1% of crashes) were the Suspected Serious Injury crashes as described in detail previously. Table 3 provides the crashes by severity per each study intersection and segment.

TABLE 3: CORRIDOR CRASHES BY LOCATION AND SEVERITY

	FATAL	SERIOUS INJURY	MINOR INJURY	POSSIBLE INJURY	PDO	TOTAL
INTERSECTIONS						
WRIGLEY DR/ ROAD 68	-	-	-	9	20	29
BURDEN BLVD/ ROAD 68	-	2	1	14	75	92
I-182 WB RAMPS/ ROAD 68	-	-	1	14	34	49
I-182 EB RAMPS/ ROAD 68	-	-	3	12	49	64
CHAPEL HILL BLVD/ ROAD 68	-	-	-	3	8	11
SEGMENTS						
WRIGLEY DR -> BURDEN BLVD	-	-	2	8	47	57
BURDEN BLVD -> I-182 WB RAMPS	-	1	2	5	35	44
I-182 WB RAMPS -> I-182 EB RAMPS	-	-	1	4	26	31
I-182 WB RAMPS -> CHAPEL HILL BLVD	-	-	-	1	12	13
COMBINED TOTAL						
TOTAL	-	3	10	70	306	390

Table 4 provides the crashes by severity and type for the whole corridor.

TABLE 4: CRASH SEVERITY BY TYPE

	FATAL	SERIOUS INJURY	MINOR INJURY	POSSIBLE INJURY	PDO	TOTAL
ANGLE	-	2	1	14	43	60
FIXED OBJECT	-	-	1	1	9	11
OPPOSITE DIRECTION	-	-	1	-	17	18
OTHER	-	-	-	1	14	15
REAR END	-	1	5	51	179	236
SIDESWIPE	-	-	2	3	45	50
TOTAL	-	3	10	70	307	390

TOP CONTRIBUTING FACTORS

The top primary contributing factors to the crashes along the corridor were Inattention/Distraction (35% of crashes), Following Too Closely (30% of crashes), Failure to Give Right-of-Way (10% of crashes), Improper Turning/Merging (6% of crashes), and Disregarding a Traffic Signal (5% of crashes).

TARGET ZERO AGE

The State of Washington tracks Fatal and Suspected Serious Injury crash rates for Young Driver (16-25 years old) and Older Driver (over 65 years old) users as part of their Target Zero plan. Over the last five years of reported data, Young Drivers were involved in approximately 30% of all Fatal and Suspected Serious Injury crashes and Older Drivers were involved in approximately 16% of all Fatal and Suspected Serious Injury crashes.

Three Suspected Injury crashes occurred on the corridor (and no Fatal crashes), one of them involved both a Young Driver and Older Driver.

While younger and older driver statistics are not tracked for other severity levels, understanding the context of the ages of these crashes can be beneficial. 209 crashes along the corridor (54%) involved young drivers and 67 crashes along the corridor (17%) involved older drivers.

ALTERNATIVES ANALYSIS

The alternatives analysis focuses on three primary components:

- Future Conditions
  - Operations
  - Safety
- Design
- Cost Estimate

Each of these project components are discussed in more detail in the subsequent sections.

FUTURE CONDITIONS

The future conditions analysis focuses on comparing future conditions between the No-Build (no Road 76 connection) and Build (with Road 76 connection) alternatives to determine the estimated project benefits. The analysis is broken into operations and safety components, summarized in the subsequent sections.

OPERATIONS

The daily traffic volumes for the No-Build and Build condition were forecasted by combining the growth increment from the BFCOG 2019 and 2045 models, with the 2045 model run with and without the Road 76 connection in place. The outputs from these models were combined with the 2019 AADT to calculate the 2045 forecasted AADT for No-Build and Build conditions. These forecasted volumes are summarized in Table 5.

TABLE 5: FORECASTED 2045 AADT

INTERSECTIONS AND SEGMENTS	EAST/WEST AADT			NORTH/ SOUTH AADT		
	2019	2045 NO-BUILD	2045 BUILD	2019	2045 NO-BUILD	2045 BUILD
ROAD 76						
ROAD 76/BURDEN - INTERSECTION	2,525	7,615	7,118	3,203	6,629	19,864
BURDEN TO CHAPEL HILL - SEGMENT	N/A	N/A	N/A	0	-	18,297
ROAD 76/CHAPEL HILL - INTERSECTION	4,045	14,823	12,711	2,000	2,890	12,760
ROAD 68						
ROAD 68/WRIGLEY - INTERSECTION	2,820	4,368	4,039	18,953	40,393	40,467
WRIGLEY TO BURDEN – SEGMENT	N/A	N/A	N/A	21,539	43,292	41,798
ROAD 68/BURDEN - INTERSECTION	20,437	27,268	21,968	34,938	55,813	46,219
ROAD 68 SEGMENT – SEGMENT	N/A	N/A	N/A	49,841	79,796	55,942
ROAD 68/I-182 WB - INTERSECTION	13,812	17,802	15,312	44,207	73,508	57,091
ROAD 68 SEGMENT – SEGMENT	N/A	N/A	N/A	37,068	56,492	39,767
ROAD 68 /I-182 EB - INTERSECTION	18,698	29,966	23,930	29,966	43,250	29,397
ROAD 68 SEGMENT – SEGMENT	N/A	N/A	N/A	22,970	36,136	23,641
ROAD 68/CHAPEL HILL - INTERSECTION	5,153	12,945	10,250	19,758	27,870	18,667

As shown in Table 5, the AADT on Road 68 decreases by as much as 35% between Burden Boulevard and Chapel Hill Boulevard. Reducing traffic volumes on the corridor that is currently the most congested in the City will provide significant delay savings for drivers by the year 2045.

To better assess the PM peak hour traffic operations benefits of the project, the subarea model developed for the TSMP was run for 2045 conditions with and without the Road 76 overpass. The model results showed significant reductions in intersection delay and improved traffic Level of Service (LOS) along Road 68. The net project benefit aggregated over western Pasco was estimated to total a savings of 125 vehicle hours of delay per day over the PM peak period by the year 2045, totaling to a system wide 12% reduction in delay. Table 6 summarizes the project year 2045 PM peak hour travel delay savings per day, calculated from TSMP subarea model.

TABLE 6: PROJECT DELAY SAVINGS

SCENARIO	2045 PM HOUR VEHICLE HOURS OF DELAY (PER DAY)
2045 NO-BUILD	1,061.7 vehicle-hours
2045 BUILD	936.4 vehicle-hours
BUILD – NO-BUILD	125.3
PERCENT REDUCTION IN DELAY	12%

The traffic operations at the Road 76 and Burden Boulevard intersection were analyzed in Synchro for 2045 PM peak hour conditions using volumes developed from the TSMP subarea model. To achieve LOS D conditions, a signal will be needed at this intersection, along with an exclusive northbound right turn lane, a southbound left turn lane, and a westbound right turn and left turn lane. The Synchro analysis results are included in Appendix A.

SAFETY ANALYSIS

The safety analysis included multiple methodologies to better understand the future crash issues in the project area, as summarized in the following sections. The with and without project year 2045 AADT volumes provided in the prior section were used to complete this analysis.

HSM Methodology

The Crash Predictive Method (CPM) through the Highway Safety Manual (HSM) seeks to determine an average crash rate that would be predicted according to the built infrastructure and vehicular volumes present for a roadway segment or intersection. This analysis focused on the Road 68 corridor between Wrigley Drive and Chapel Hill Boulevard and the future Road 76 corridor crossing I-182. Using HSM methodologies, the predictive method for urban and suburban arterials was used to quantify predicted crashes between Baseline and Build conditions.

Predicted Crash Analysis

Using the CPM, it was determined that all four study segments and three of the five study intersections had crash rates over the predicted values. Trends of particular significance are discussed below:

- The Road 68 segment between Wrigley Drive and Burden Boulevard had an observed crash rate **over seven times** its predicted rate.
- The Road 68 segment between Burden Boulevard and the I-182 WB Ramps had an observed crash rate **approximately three times** its predicted rate.
- The Burden Boulevard intersection on Road 68 had an observed crash rate **approximately three and a half times** its predicted rate.

Future predicted crash rates were calculated based on forecasted daily volumes along Road 68 and the future Road 76. For the roundabout intersection of Road 76 and Chapel Hill Boulevard, a further Crash Modification Factor (CMF) was applied to the predicted crash rates to account for the added

safety benefit of a roundabout over a standard stop-controlled intersection; the CMFs used are provided in Table 7.

TABLE 7: CRASH MODIFICATION FACTOR: CONVERSION OF STOP-CONTROLLED INTERSECTION INTO SINGLE-LANE ROUNDABOUT

CMF	CRASH TYPE	CRASH SEVERITY	AREA TYPE
0.28	All	All	Urban
0.12	All	A (serious injury), B (minor injury), C (possible injury)	Urban

Source: CMF Clearinghouse, CMF ID#s 206 & 210

Combining the forecasted daily volumes, HSM analysis output and added roundabout CMF, the overall predicted crash rates between both corridors is shown in Table 8. While the addition of a new Road 76 segment over I-182 would introduce new crashes on that corridor, the lower traffic burden placed on Road 68 would be expected to result in a net decrease in overall crash rates between both corridors.

TABLE 8: PREDICTED FUTURE CRASH RATES (HSM ANALYSIS)

SCENARIO	VEHICULAR CRASH RATES			PED CRASH RATE	BIKE CRASH RATE
	TOTAL	FATAL/ INJURY (FI)	PROPERTY DAMAGE ONLY (PDO)		
FUTURE BASELINE	67	22	45	0.45	0.85
FUTURE BUILD	59	19	40	0.51	0.74
% DIFF.	-12%	-14%	-11%	+13%	-13%

DESIGN

The conceptual design for the preferred alternative is broken down into the following sections:

- Alignment
- Profile
- Bridge Structure
- Cross Section
- Intersection Design/Future Access
- Active Transportation Connections

Each of these components of the project is discussed further in the subsequent sections.

ALIGNMENT

After assessing the alignment and profile feasibility of multiple options, including an alignment that follows the existing property lines as the Road 76 centerline from Chapel Hill Boulevard to I-182, a straight-line alignment between Chapel Hill and Burden Boulevard was selected as the preferred alternative. This alignment is shown in Appendix B.

PROFILE

The profile for the preferred alignment is designed to raise Road 76 high enough to provide a minimum of 16.5’ of clearance over I-182, meeting the AASHTO standard for freeway clearance. The proposed profile is shown in Appendix B, along with the resulting grading footprint.

The design assumes maximum grades of 5% to accommodate ADA compliant active transportation facilities. The vertical curves are designed for 40 mph to provide adequate site distance. Overall, the project will be built primarily on embankment with minimal cut due to the relatively flat grades along the alignment.

BRIDGE STRUCTURE

The recommended bridge structure is a pre-cast girder system, with a column located in the I-182 median to support the spans. The column in the freeway median would be protected by a yet to be determine type of guard rail. The longest span will be across the westbound I-182 mainline lanes, striped gore, on-ramp, and mixed-use path and will be approximately 210’ in length. This span length is feasible for a pre-cast girder. The project will include a 2:1 toe slope, which will extend down to I-182. The bridge profile view is included in Appendix B. Note that this project will require an access break approval from FHWA to extend the bridge over the interstate.

CROSS SECTION

The preferred alternative cross section was selected to prioritize active transportation facilities while still including flexibility to accommodate future development and access needs along Road 76. The typical cross section varies between the bridge and at-grade sections of Road 76, as shown in Appendix B.

The cross section is intended to allow for a center turn lane to be added in the future if needed. The I-182 overcrossing cross section only assumes two travel lanes, as this segment should not need turn lanes in the future.

INTERSECTION DESIGN/FUTURE ACCESS

The project is intended to tie into the Road 76 and Chapel Hill Boulevard roundabout as the northern leg. On the north end of the project, Burden Boulevard will be re-aligned to allow for a four-leg intersection at Burden and Road 76. This intersection is currently recommended to be signalized with northbound right turn and southbound left turn lanes. In the future, a roundabout could replace the signal to better accommodate development west of Road 76. Shifting Burden Boulevard to the south also provides more separation between the Quadra Drive and Burden Blvd

intersections on Road 76. The future west leg of this intersection would become a Burden Blvd extension and would tie to Flores Lane in the future. Once this connection is completed, the Road 76 and Quadra Drive intersection can be converted to RI/RO, allowing for increased storage for the southbound left turn at Road 76 and Burden Boulevard, as well as reducing left turn conflicts on Road 76.

Due to the grades and proximity to nearby intersections and the bridge structure, the preferred alternative intends that no additional access points will be allowed between the re-aligned Burden Boulevard and the new I-182 overcrossing. South of I-182, a single access point may be added in the future between Chapell Hill Boulevard and the I-182 overpass.

ACTIVE TRANSPORTATION CONNECTIONS

As noted previously, the new segment of Road 76 will include a 12' mixed use path on the west side and a 6' sidewalk on the east side. Both the path and the sidewalk will be buffered everywhere accept at the I-182 overcrossing structure. On the structure, the sidewalk will shift over to curb tight, and the mixed-use path will be separated from the travel lanes with a barrier.

The existing I-182 path will be re-routed to climb up and through the new bridge toe north of I-182. The I-182 path will be raised high enough above I-182 to prevent vehicles from running in to it. This alignment minimizes the out of direction travel on the I-182.

In addition, the newly extended Road 86 mixed use path will include a connection to the I-182 path. This new connection will be designed to minimize grades as much as possible.

COST ESTIMATE

The estimates project cost is $22.8 million. This total includes ROW acquisition, design and permitting, and contingency. The detailed cost estimate is included in Appendix C. The most expensive component of the project is the bridge structure.

RECOMMENDATIONS

Based on the analysis and preliminary design completed for this feasibility study, the recommended project includes the following components, and is shown in Figure X:

- Two lane bridge over I-182 with columns located in the freeway median
- Two lane road segment tying into Road 76 at Chapel Hill Boulevard and Burden Boulevard. The cross section for this segment should allow for re-striping to three lanes if need.
- 12' buffered mixed use path on the west side of the new segment of Road 76
- 6' buffered sidewalk along the east side of the new segment of Road 76
- Re-aligned Burden Boulevard to allow for a future fourth leg at the new Burden Boulevard and Road 76 intersection
- New Traffic signal at Burden Boulevard and Road 76

- Along with single northbound and southbound through lanes, include a northbound right turn lane, southbound right turn lane, and eastbound right turn and left turn lanes at Burden Boulevard and Road 76

The estimated cost for this project is **$22.8 million**.

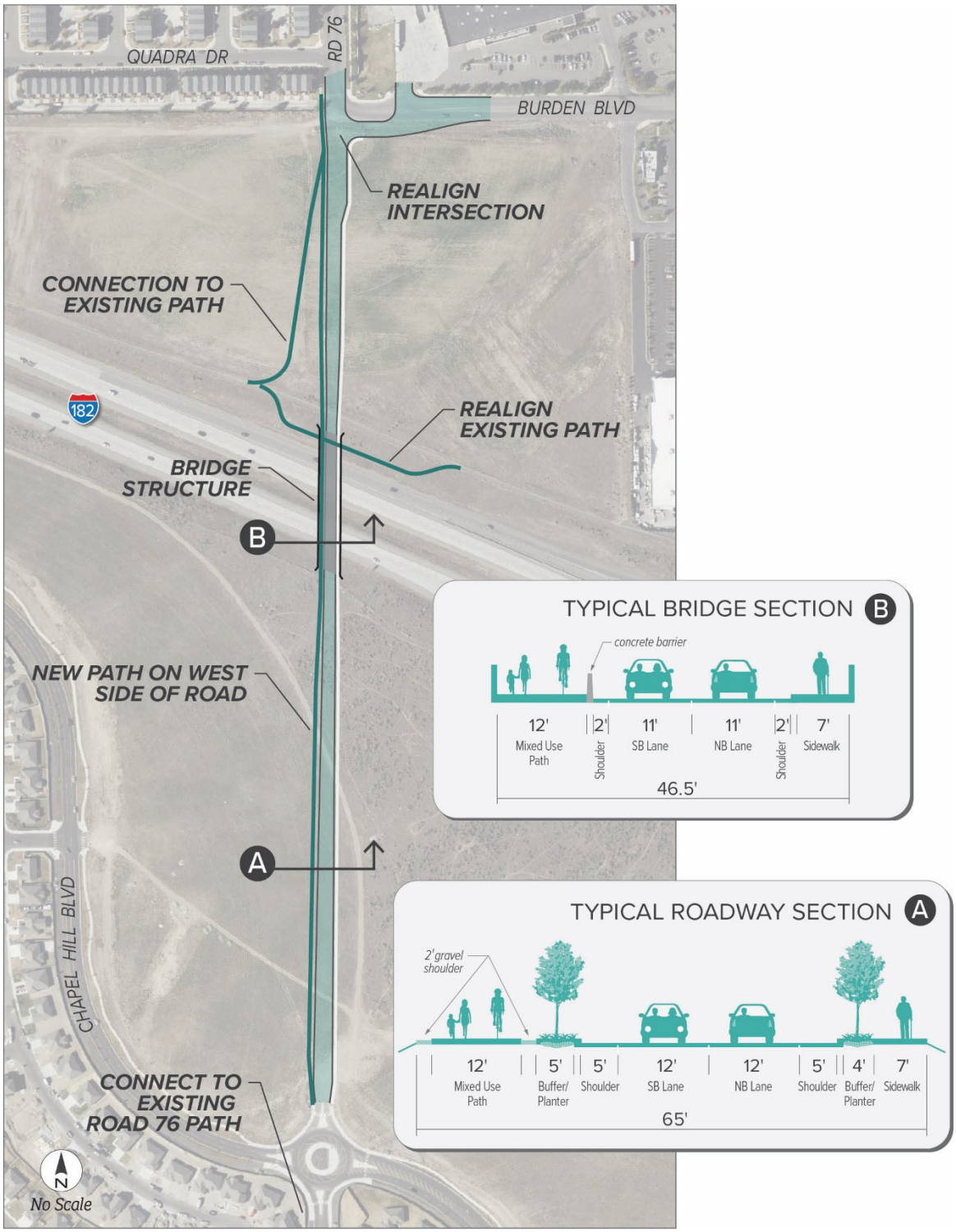

FIGURE 3: RECOMMENDED ROAD 76 OVERCROSSING DESIGN

APPENDICES

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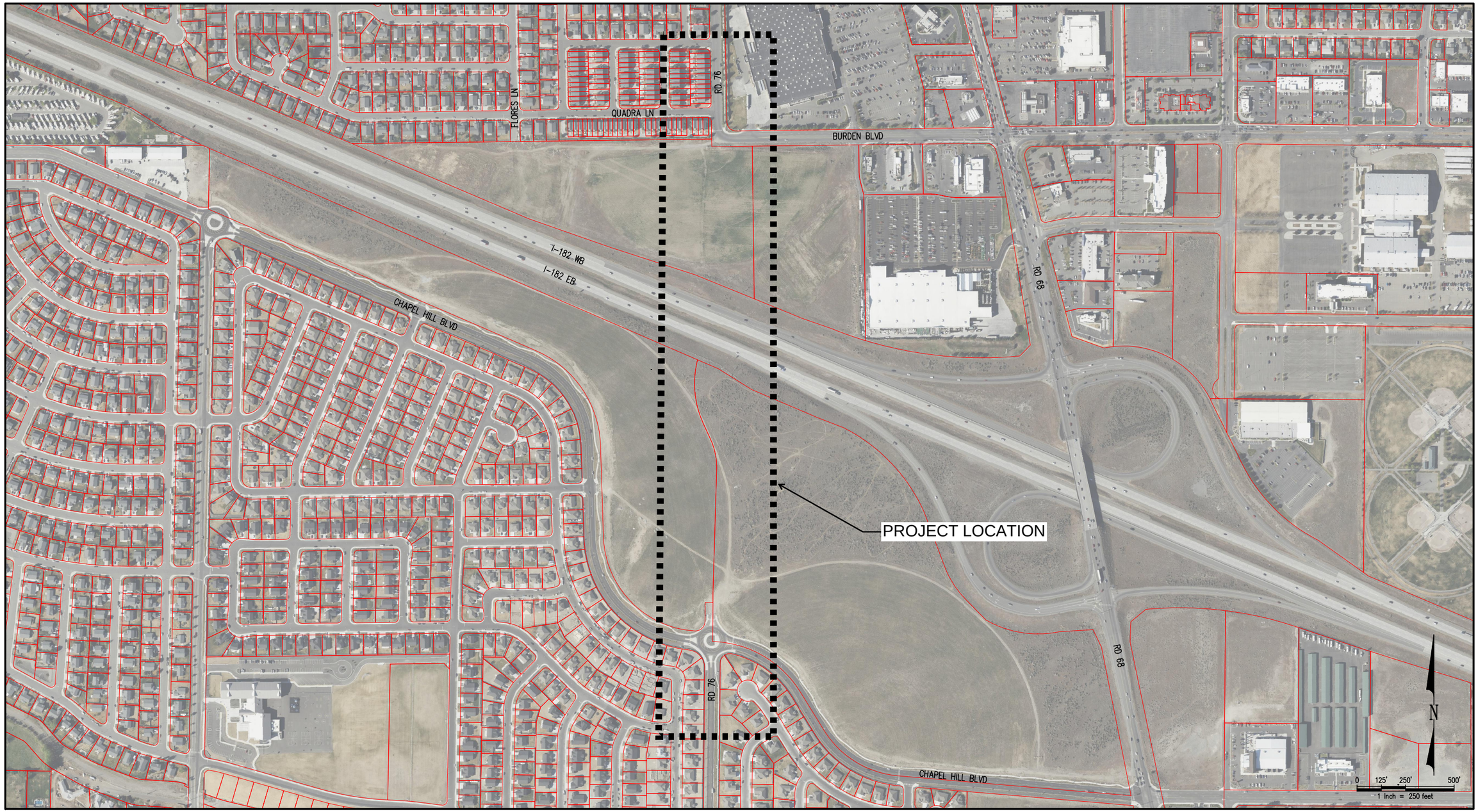
APPENDIX A. SYNCHRO OUTPUTS

Movement	WBL	WBR	NBT	NBR	SBL	SBT		
Lane Configurations								
Traffic Volume (veh/h)	130	315	695	275	530	390		
Future Volume (veh/h)	130	315	695	275	530	390		
Initial Q (Qb), veh	0	0	0	0	0	0		
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00		
Work Zone On Approach	No		No			No		
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870		
Adj Flow Rate, veh/h	141	342	755	299	576	424		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
Percent Heavy Veh, %	2	2	2	2	2	2		
Cap, veh/h	168	545	947	952	616	1507		
Arrive On Green	0.09	0.09	0.51	0.51	0.25	0.81		
Sat Flow, veh/h	1781	1585	1870	1585	1781	1870		
Grp Volume(v), veh/h	141	342	755	299	576	424		
Grp Sat Flow(s),veh/h/ln	1781	1585	1870	1585	1781	1870		
Q Serve(g_s), s	7.0	8.5	30.1	8.4	19.4	5.1		
Cycle Q Clear(g_c), s	7.0	8.5	30.1	8.4	19.4	5.1		
Prop In Lane	1.00	1.00		1.00	1.00			
Lane Grp Cap(c), veh/h	168	545	947	952	616	1507		
V/C Ratio(X)	0.84	0.63	0.80	0.31	0.93	0.28		
Avail Cap(c_a), veh/h	168	545	947	952	696	1507		
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00		
Uniform Delay (d), s/veh	40.1	24.7	18.4	8.8	22.5	2.2		
Incr Delay (d2), s/veh	29.4	2.3	7.0	0.9	18.6	0.5		
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0		
%ile BackOfQ(50%),veh/ln	4.4	6.2	13.8	3.7	14.6	1.3		
Unsig. Movement Delay, s/veh								
LnGrp Delay(d),s/veh	69.5	27.0	25.4	9.7	41.2	2.7		
LnGrp LOS	E	C	C	A	D	A		
Approach Vol, veh/h	483		1054			1000		
Approach Delay, s/veh	39.4		20.9			24.8		
Approach LOS	D		C			C		
Timer - Assigned Phs	1	2				6	8	
Phs Duration (G+Y+Rc), s	27.0	50.0				77.0	13.0	
Change Period (Y+Rc), s	4.5	4.5				4.5	4.5	
Max Green Setting (Gmax), s	26.5	41.5				72.5	8.5	
Max Q Clear Time (g_c+I1), s	21.4	32.1				7.1	10.5	
Green Ext Time (p_c), s	1.0	4.4				3.0	0.0	
Intersection Summary								
HCM 6th Ctrl Delay			26.0					
HCM 6th LOS			C					

APPENDIX B. CONCEPTUAL DESIGN



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Seattle, WA 98101
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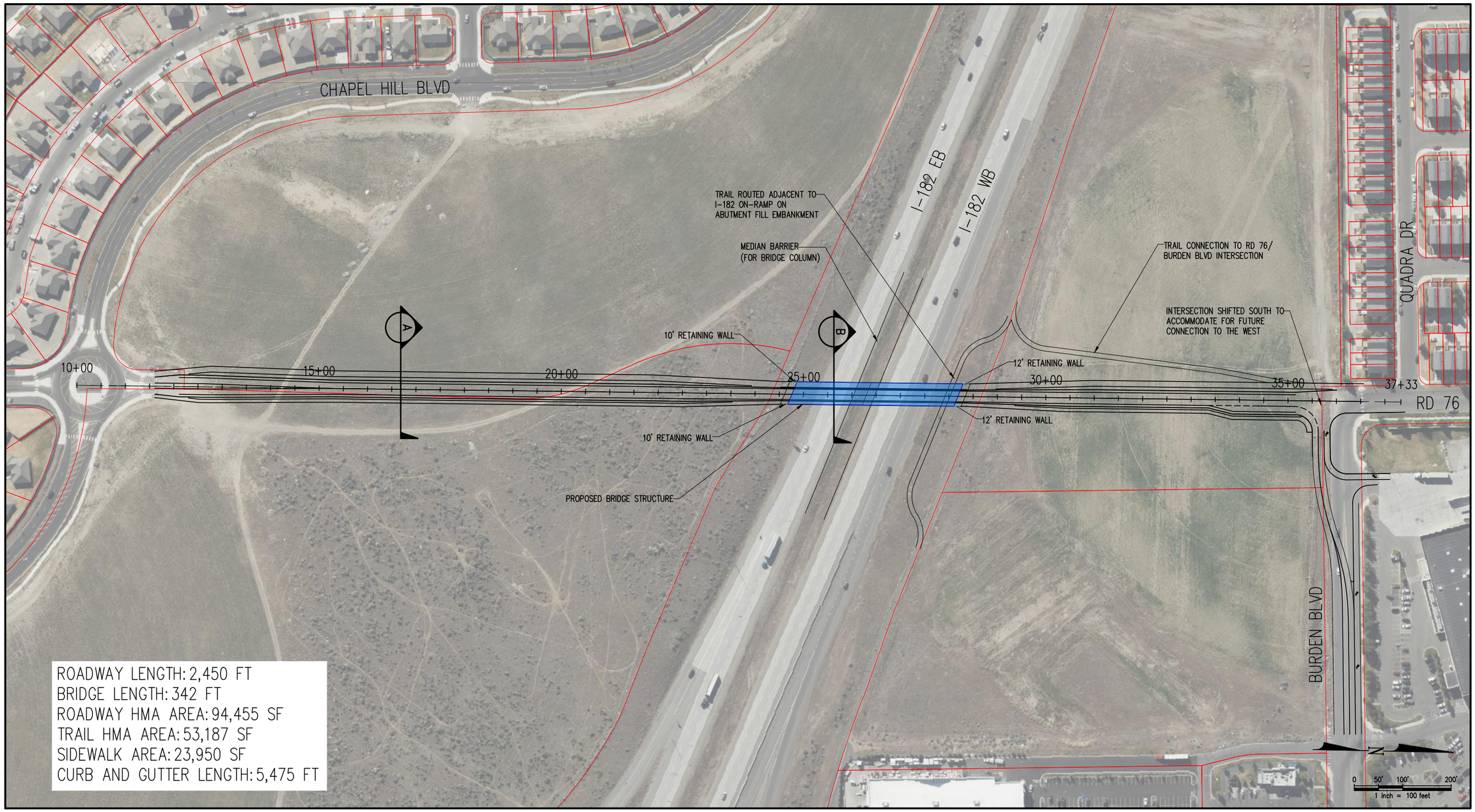
PASCO ROAD 76 GRANT STUDY

EXISTING CONDITIONS



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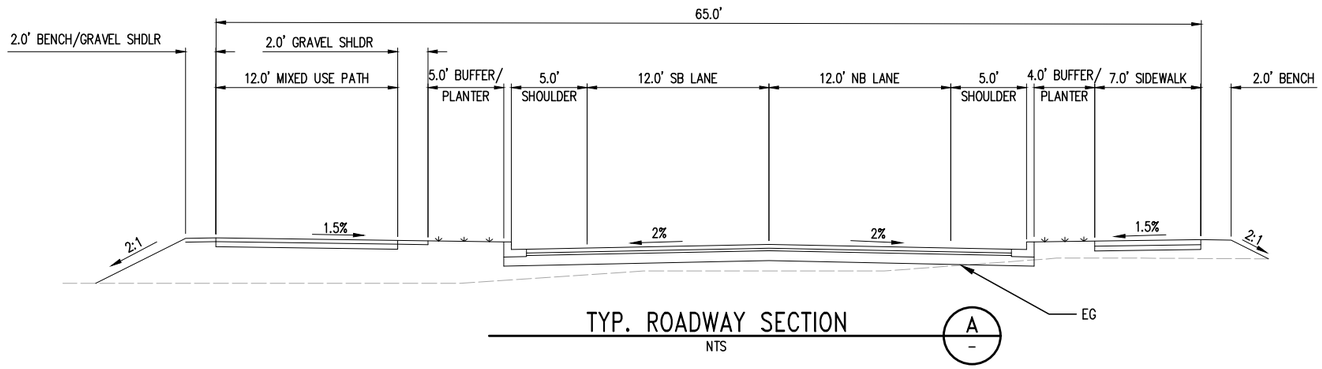
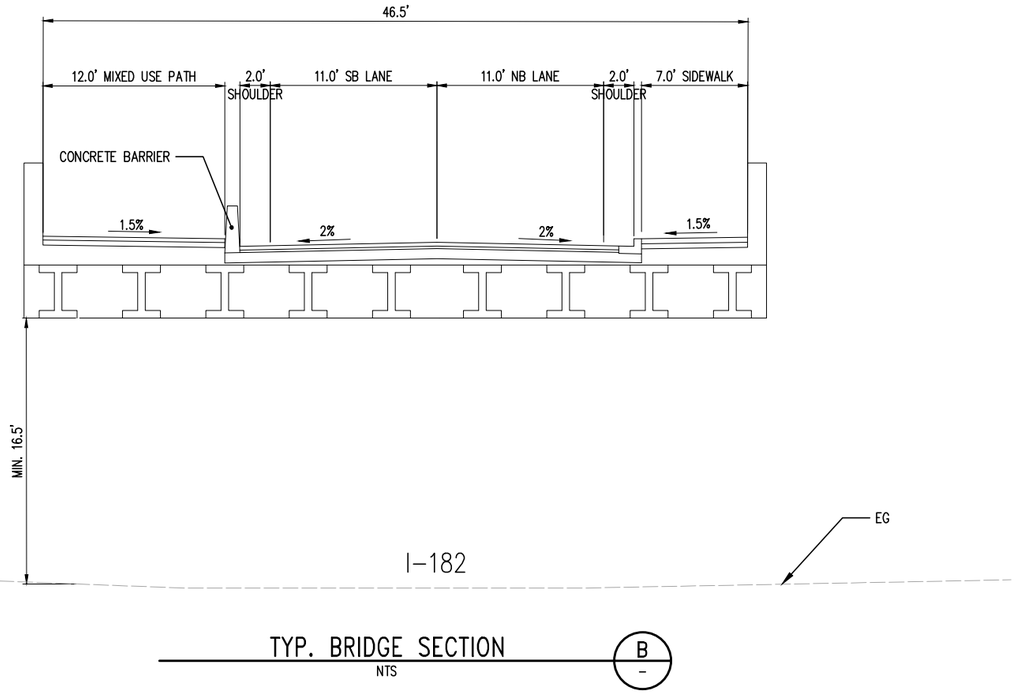
PROPOSED PLAN



TYP. ROADWAY SECTION
NTS
A
–



TYP. BRIDGE SECTION
NTS
B
–

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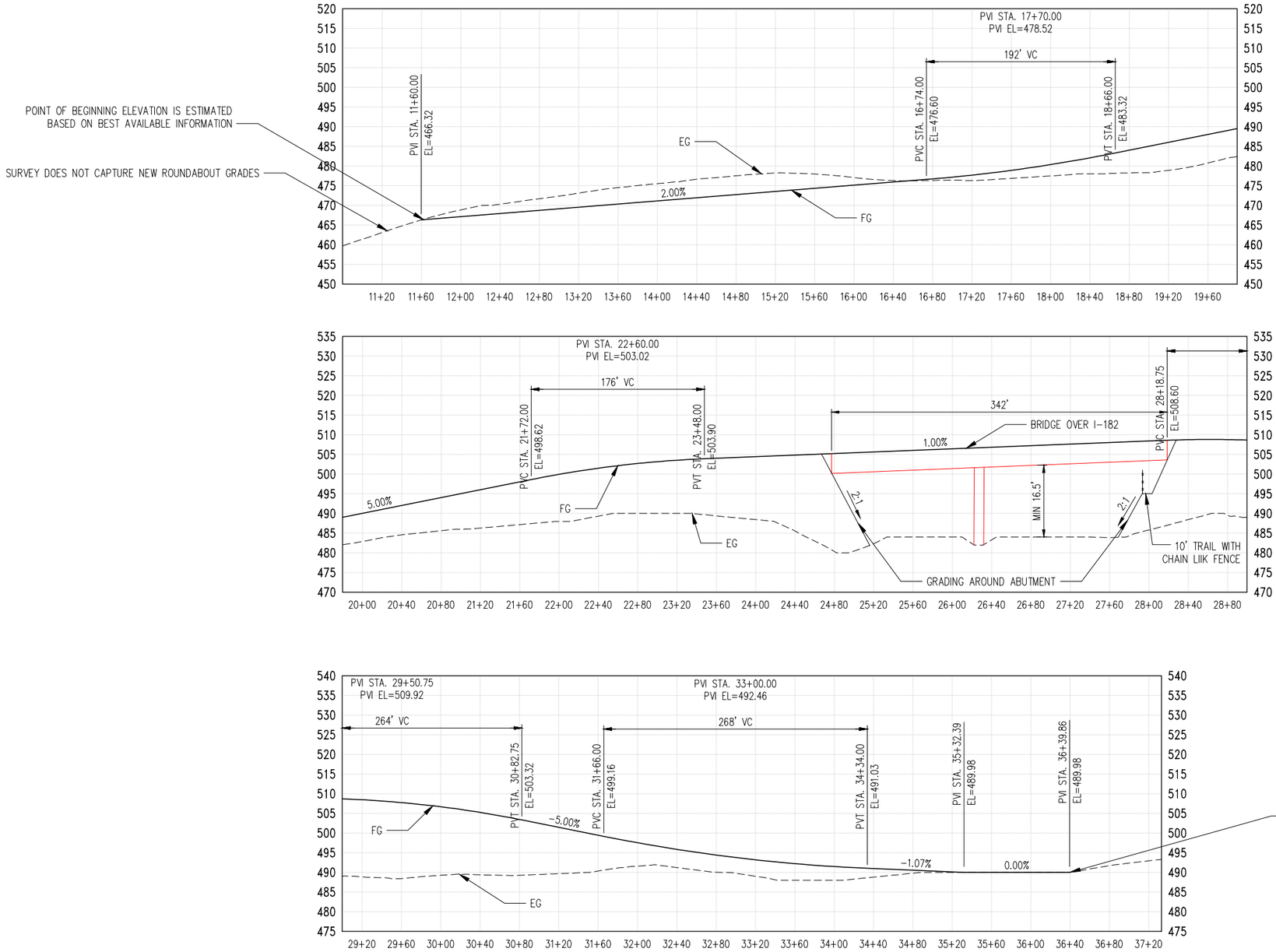
PROPOSED SECTIONS



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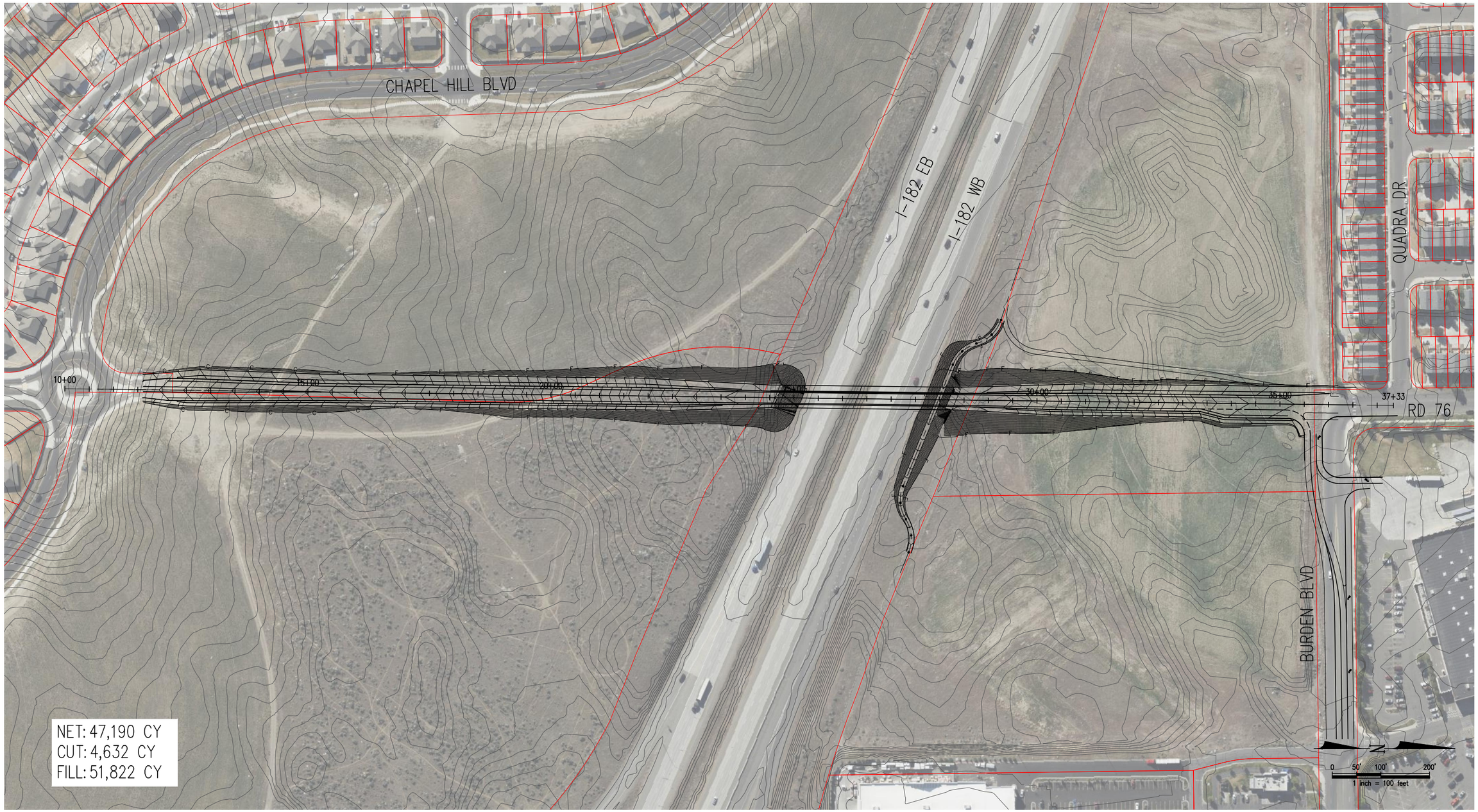
PROPOSED PROFILE



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PASCO ROAD 76 GRANT STUDY

PROPOSED GRADING

APPENDIX C. COST ESTIMATE

Road 76 Overcrossing Study

Conceptual Cost Estimate

Item	Unit	Quantity	Unit Cost	Cost	%
Preparation					
Clearing & Grubbing	AC	5.58	$ 7,200.00	$ 40,152.89	0.3%
Sawcut	LF	500	$ 25.00	$ 12,500.00	0.1%
Removing Bituminous Pavement	SY	150	$ 10.00	$ 1,500.00	0.0%
Removing Sign	EA	7	$ 250.00	$ 1,750.00	0.0%
Removing Paint Line	LF	700	$ 1.00	$ 700.00	0.0%
Light Pole Removal	EA	1	$ 5,000.00	$ 5,000.00	0.0%
Earthwork					
Excavation	CY	4632	$ 15.00	$ 69,480.00	0.6%
Gravel Borrow	TON	28012	$ 30.00	$ 840,356.76	6.9%
Shoring & Extra Excavation	CY	0	$ 30.00	$ -	0.0%
Surfacing					
CSBC	TON	4691	$ 40.00	$ 187,652.11	1.5%
CSTC	TON	1626	$ 60.00	$ 97,539.54	0.8%
Roadway HMA	TON	1793	$ 130.00	$ 233,076.46	1.9%
Commercial HMA (for trail)	TON	1010	$ 100.00	$ 100,956.81	0.8%
Structural					
Bridge Structure	SF	16185	$ 550.00	$ 8,901,750.00	73.2%
Retaining Wall at Abutments	SF	150	$ 150.00	$ 22,500.00	0.2%
Drainage					
12" Pipe	LF	5000	$ 75.00	$ 375,000.00	3.1%
Type 1 CB	EA	6	$ 2,000.00	$ 12,000.00	0.1%
Other					
ADA Ramps	EA	2	$ 3,000.00	$ 6,000.00	0.0%
Conc. Sidewalk	SY	2661	$ 100.00	$ 266,111.11	2.2%
Curb & Gutter	LF	5475	$ 50.00	$ 273,750.00	2.3%
Traffic Signal	EA	1	$ 350,000.00	$ 350,000.00	2.9%
Light Pole	EA	6	$ 10,000.00	$ 60,000.00	0.5%
Pavement Markings	LF	9090	$ 5.00	$ 45,450.00	0.4%
Permanent Signing	LS	1	$ 12,000.00	$ 12,000.00	0.1%
Maintenance of Traffic	LS	1	$ 200,000.00	$ 200,000.00	1.6%
I-182 Median Barrier	LS	1	$ 50,000.00	$ 50,000.00	0.4%
Chain Link Fence	LF	290	$ 75.00	$ 21,750.00	0.2%
			Item Sub-Total	**$ 12,165,225.67**	100.0%

Lump Sum Percentages					
Mobilization (7%)	LS	1	$ 851,565.80	$ 851,565.80	
Landscaping (5%)	LS	0	$ -	$ -	
			Lump Sum Sub-Total	**$ 851,565.80**	
			Item + Lump Sum Total	**$ 13,016,791.47**	
Design Contingency	20%			$ 2,603,358.29	
			Sub-Total	**$ 15,620,149.76**	

Design & Permitting	20%			$ 3,124,029.95	
Construction Admin	20%			$ 3,124,029.95	
			Sub-Total	**$ 21,868,209.67**	

NW Property	SF	113895			
NE Property	SF	20615			
SE Property	SF	38115			
SW Property	SF	15545			
ROW Acquisition	SF	188170	$ 5.00	$ 940,850.00	
			Sub-Total	**$ 22,809,059.67**	

Grand Total	**$ 22,809,059.67**