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MEMO

To: Santa Cruz Greenway

From: Alta Planning + Design

Date: October 18, 2018

Re: Proposed Modifications to the Unified Corridor Investment Study's Analysis Methods

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Introduction

This memorandum outlines potential modifications to the Unified Corridor Investment Study: Step 2 Analysis Results based on a review of the methods used for the analysis.

Scenario Development

The Unified Corridor Investment Study: Step 2 Analysis Results studied seven scenarios (including a no build scenario), covering the most readily available corridor combinations. While it is cost prohibitive to analyze - especially at the level of detail provided in the study - every potential scenario, analysis of additional combinations may help identify new opportunities that meld the best of multiple options. An even more refined approach could evaluate each presented option for each segment (e.g., Highway 1, Soquel Avenue/Drive and Freedom Blvd, and Rail Corridor) and show the resulting combinations in a matrix. Or, short of a full matrix, one additional combination that should be analyzed is listed below:

- **Scenario G**:
  - Highway 1
    - Bus shoulders, ramp metering, Mission Street intersection improvements
  - Soquel Avenue/Drive and Freedom Boulevard
    - BRT Lite with increased transit frequency, buffered/protected bike lanes, bike/ped intersection improvements
  - Rail Corridor
    - Bike and pedestrian trail

This proposed approach combines project components that have existing funding available, are relatively low-cost compared to the alternatives (as shown in the following section, the estimated costs for the Trail Only Option along the rail corridor may have been overstated in the UCS and revised estimated costs are presented on **Page 4** of this memorandum), and can be implemented progressively so that residents can experience the benefits of the scenario more quickly.

This lower-cost scenario can be constructed in phases, allowing for quicker implementation. As currently presented, the UCS focuses only on the life-cycle costs compared to the estimated benefits in future year 2035. However, in practice, quicker implementation will allow for additional years of immediate benefits that can accumulate over the project's full useful life. In addition, the funding available for a project depreciates in value over time due to necessary adjustments for inflation. Quicker implementation will allow for reduced loss of funding in present dollars.

Cost Estimates

Scenario and individual costs are shown in Appendix A of the Unified Corridor Investment Study: Step 2 Analysis Results. They are presented as planning-level estimates with contingencies based on standard practices. Annual operating and maintenance costs are included for each scenario. The comparison of vastly different transportation options on a large scale is a challenging undertaking, and the authors have done a good job in trying to make meaningful comparisons. There were several areas where we had questions about the methods or conclusions, as identified below.

We have attempted to reproduce Table A-13: Trail Only on page 156 below. As a first step, we broke down each segment based on width, bridge, or parallel to road, and extrapolated the length in feet and miles, and the square feet of pavement.

Trail Only Scenario (Table 1A in UCS), Total Length: 30.1 miles (28.7 miles excluding bridges)

SEGMENT	LENGTH MILES	LENGTH FEET	PAVED WIDTH (FEET)	PAVED SQUARE FEET
SEGMENT A	8.6	45,408	26	1,180,608
SEGMENT B	5.4	28,512	16	456,192
SEGMENT C	14	73,920	14	1,034,880
SUB-TOTAL PAVED	28	147,840	56	2,671,680
SEGMENT D (BRIDGE)	1.4	7,392	12	-
SEGMENT E (PARALLEL TO ROAD)	0.7	3,696	12	-
TOTAL	**30.10**	**158,928**	**-**	**2,671,680**

Breakdown of Trail Only Scenario Costs (Table A-13 in UCS)

	COSTS	PER SQUARE FOOT	PER MILE
EARTHWORK/PAVING	$35,000,000	$13.10	$1,250,000
DRAINAGE	$2,000,000	$0.75	$71,429
FENCING	$600,000		
RAIL REMOVAL	$8,300,000		
TRAIL CROSSINGS/ROAD TREATMENTS	$5,600,000		
LANDSCAPING	$1,500,000		
AMENITIES	$7,100,000		
OTHER	$18,700,000		
SUB-TOTAL HARD COSTS	**$78,800,000**	$29.49	$2,814,286
CONTINGENCY (50%)	$39,400,000		
SOFT COSTS (39%)	$30,732,000		
BRIDGE STRUCTURES (INCL CONTINGENCY)	$14,200,000		
SUB-TOTAL PROJECT COSTS	**$163,132,000**	$61.06	$5,826,143
POLICY REVERSAL	$41,000,000		
TOTAL	**$204,132,000**	$76.41	$7,290,429

We were not able to replicate the contingency and soft costs in Table A-13. Contingency and soft costs would always be applied against the construction figures, and not the $41 million policy reversal figure or the bridge figure, which already includes a contingency as noted. Our calculations based on the assumptions in Table A-13 are a total project cost of $204,132,000 versus $219,000,000 in the UCS report.

In reviewing the numbers in Table A-13 more closely, we had these questions and comments:

1. Earthwork and Pavement
   Costs per square foot for the Trail Only Option are $13.10/SF compared to $8.10/SF for the Trail Next to Rail Option, a 62% difference. In practice, the Trail Next to Rail Option will require much more extensive earthwork than the Trail Only Option, which will be located on a pre-graded corridor with existing sub-base.

a.	Trail Only	$35,000,000 /2,671,680 SF = $13.10/SF
b.	Trail Next to Rail	$16,000,000 /1,974,720 SF = $8.10/SF

2. Construction Costs
   Values included differ from those in published sources and actual recent experience building Class I bike paths in California. The PedBikeInfo Center, a FHWA-funded resource based at the University of North Carolina, publishes cost data for bike paths and multi-use trails needing little grading with median costs at $1 million per mile. Costs shown in Table A-13 come in at over $5.8 million per mile (excluding policy reversal cost), or almost 600% higher. Even assuming rising construction costs and width of some of the trail, this is a very high construction cost.

3. Updated Costs
   We created an alternative cost table based on the best available sources and research (see the table on the next page). We made the following changes:
   a. We lowered the earthwork/pavement cost to $7.00/SF. The proposed corridor is a pre-graded corridor with existing sub-base material and some existing drainage. These figures have been confirmed with licensed civil engineers and actual costs in California.
   b. We eliminated the fencing costs because these costs are already included in the amenity costs in the MBSST Master Plan cost estimates.
   c. We retained the landscaping, amenity, and trail crossing/roadway treatment figures even though we believe some of these could be further reduced.
   d. We lowered the ‘other’ costs from $18.7 million to $2 million because there is no ‘other’ category or unaccounted-for costs in the MBSST Master Plan cost estimates.
   e. We lowered the contingency to 30% and soft costs to 30%, reflecting the fact that this project contains far less unknowns than the passenger rail and other large projects—which have a 30% contingency. Typically, contingencies for trails are in the 20-25% range, and depending on whether environmental is needed, soft costs between 20-30%.
   f. We eliminated the $41 million policy reversal figure. While we understand some of the logic behind this figure, this is not a true project cost for the Trail Only Option or any other option. The $41 million is not assigned to any other option including the BRT Option of Railroad Right of Way. Losing funding won by RTC is not a project cost for other options. Any moneys or staff time spent studying options or

even implementing improvements is not a cost to any specific alternative being considered. This cost appears to be a penalty assigned to one option only for no clear reason.

g. The resulting cost of $85 million or $2.8 million per mile still makes this an expensive project, but far less than the $219 million originally identified.
h. Note that some of these changes could also be applied to the Trail Next to Rail Option.
i. For some reason the trail next to rail option and the passenger rail service option are costed separately, as if two independent projects, when in fact the Trail Next to Rail Option would only be constructed if rail service was implemented.
j. It is unclear why the cost of bridge structures is $60.2 million for the Trail Next to Rail option, and only $5 million for the Passenger Rail Option, especially considering the Trail Next to Rail Option will be routed around the Capitola trestle and the passenger rail option requires this trestle be rebuilt. The same issue is true with the BRT On Rail ROW Option, which has a structures cost of $25 million versus $5 million for the Passenger Rail option.
k. It is not clear why the operation costs of new local bus transit connection to rail isn't included in the Passenger Rail operating costs—which would increase this cost from $14 million to $26 million per year.
l. It is not clear why BRT operation costs, which normally are used primarily by re-routed existing transit services, are almost as high or as high as new passenger rail service.
m. The rail removal costs of $8.3 million for the Trail Only option has been reduced by $1.3 million to $7 million reflecting the salvage value of the scrap rail, assuming $250 per metric ton.

Revised Costs for Trail Only Option

	TOTAL COSTS	PER SQUARE FOOT	PER MILE
EARTHWORK/PAVING	$18,701,760	$7.00	$667,920
DRAINAGE	$2,671,680	$0.75	$95,417.1
FENCING	-	-	-
RAIL REMOVAL	$7,000,000	-	-
TRAIL CROSSINGS/ROAD TREATMENTS	$5,600,000	-	-
LANDSCAPING	$1,500,000	-	-
AMENITIES	$7,100,000	-	-
OTHER	$2,000,000	-	-
SUB-TOTAL	**$44,573,440**	$16.68	$1,591,908.6
CONTINGENCY (30%)	$22,286,720	-	-
SOFT COSTS (30%)	$17,383,642	-	-
BRIDGE STRUCTURES (INCL CONTINGENCY)	$14,200,000	-	-
SUB-TOTAL	**$98,443,802**	$36.85	$3,515,850.1
POLICY REVERSAL	-	-	-
TOTAL	**$98,443,802**	$36.85	$3,515,850.1

Demand Estimates

Appendix C in the Unified Corridor Investment Study: Step 2 Analysis Results documents the steps used to forecast the number of annual bicycle and pedestrian trips for the selected scenarios. Below is a list of proposed modifications to the method:

- Proposed Modification #1: Conduct separate bicycle and pedestrian trip forecasts. The current analysis forecasts the number of potential bicycle trips and then estimates the number of potential pedestrian trips by assuming a set ratio of bicycle to pedestrian trips using 2016 count data near the rail right of way. This process may oversimplify the relationship between bicycle and pedestrian usage and does not necessarily account for variations between the two modes in terms of trip length, willingness for out-of-direction travel, and likelihood of mode choice by trip purpose.

- Proposed Modification #2: Adjust buffer size around the proposed alignments. The current analysis uses 0.5, 0.5-1.0, and 1.0-1.5-mile buffers around the proposed alignments as a study catchment area. Appendix C notes that the average bicycle trip distance according to CHTS and CTSC school bicycle counts ranged from 1.4 miles for K-12 school trips and utilitarian trips to 7.0 miles for recreational trips. Use of the average trip length to define the catchment area limits the analysis to approximately only half of potential bicycle trips. An increase of the catchment area to a 3.0- or 3.5-mile buffer area for bicycling would better capture the large number of anticipated recreational trips and would be more in-line with industry standards.[1] The existing buffers of 0.5 miles to 1.5 miles is adequate for pedestrian trips.

- Proposed Modification #3: Base "likelihood" factors on comparable facility data. The current analysis assesses the likelihood that a given individual within the alignment's catchment area will bicycle based on a combination of regional mode share targets and existing regional mode share estimates by trip purpose from the CHTS, ACS, and CTSC. This approach provides a good high-level assessment of an individual's likelihood to bicycle in general but may not be sensitive to variations in the facility quality. Isolating the mode share estimates by trip purpose to identical buffer areas around existing bicycle facilities in California that are similar to those in the proposed scenarios would provide a more fine-grain analysis.

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[1] Federal Transit Administration. Final Policy on the Eligibility of Pedestrian and Bicycle Improvements Under Federal Transit Law (2011). <https://www.federalregister.gov/documents/2011/08/19/2011-21273/final-policy-statement-on-the-eligibility-of-pedestrian-and-bicycle-improvements-under-federal>

- Proposed Modification #4: Account for limitations in trail width. One potentially limiting factor associated with the selected scenarios is trail capacity based on trail width. FHWA's Shared Use Path Level of Service Calculator shows that the maximum free-flow capacity for a shared-use path varies by the facility's width, as shown below:
    - 8' shared use path – 330 max users per hour
    - 10' shared use path – 420 max users per hour
    - 12' shared use path – 650 max users per hour
    - 15' shared use path – 850 max users per hour

  Because the width of the proposed trail varies among the selected scenarios, accounting for limitations in capacity is necessary. The daily bicycle and pedestrian trip estimates should be converted into hour-by-hour estimates using 24-hour bicycle and pedestrian count data in the region. Where the hour-by-hour trip estimate exceeds the available capacity of the proposed trail segment, the demand estimates should be limited to a hard cap of the maximum capacity.

  In addition, the selection of segment end points for each of the selected scenarios should be reviewed to account for variations in facility width and facility type, if these have not already been included.

- Proposed Modification #5: Update reduction factors based on defensible data. The current analysis assumes a general reduction in the number of bicycle and pedestrian trips of 10% for a trail segment with Level of Service D or less, 5% for proximity moving transit vehicles, and 20% for segments with on-street components. The current analysis also assumes a 5% general increase in the number of bicycle and pedestrian trips for facilities near transit due to increased access to transit for longer trips. No documentation is provided on the method behind these assumptions. To identify if these assumptions are sensitive to real-world conditions, a regression analysis of existing trail and on-street bikeway facilities in the region could be conducted. The regression analysis could be used to control for variations in route connectivity/directness to activity centers, continuity/overall length, proximity to transit, and proximity to moving transit vehicles to identify more defensible reduction factors and to better account for the large variation in facility quality among off-street and on-street bikeways. For examples of this direct demand modelling approach, see NCHRP 770 - Estimating Bicycling and Walking for Planning and Project Development: A Guidebook.

- Proposed Modification #6: Show a 30-year cumulative analysis. The current analysis estimates the number of bicycle and pedestrian trips in the year 2035. To better account for variations in time needed to construct segments of each scenario, the analysis should include year-by-year estimates for the project's useful life (approximately 30 years) or another similar selected window of analysis. By including a year-by-year analysis, the cumulative number of bicycle and pedestrian trips could be assessed. This approach would help demonstrate lags in usage for scenarios that would take longer to construct.

- Proposed Modification #7: Factor in future e-bike usage. Electric bicycle (e-bikes) are a growing trend around the world. Increased sales of e-bikes in the United States suggests that it may also follow this global trend. The current analysis does account for the increased average length of commute, college, and other utilitarian bicycle trips made possible by e-bikes; however, the method used is not clearly documented in Appendix C. If a year-by-year analysis is conducted per Proposed Modification #6, the ability to account for gradual growth of projected e-bike sales (and/or low-speed electric vehicles, if permitted) and the subsequent increase in average trip distance, the study catchment area, and individual bicycle likelihood factors could better be accommodated.