METROPOLITAN TRANSPORTATION COMMISSION
ASSOCIATION OF BAY AREA GOVERNMENTS

MEMORANDUM

HORIZON

Agenda Item 4

TO: Regional Advisory Working Group DATE: November 28, 2018

FR: Anup Tapase

RE: Horizon / Plan Bay Area 2050: Revisions to Project Performance Assessment Methodology

Background

At the August 2018 RAWG meeting, staff provided a detailed memorandum and presentation on the draft technical methodology for the Horizon/Plan Bay Area 2050 Project Performance Assessment. Staff appreciates all the feedback that was provided at this meeting and during the weeks after. The methodology has since been updated to reflect feedback received as well as enhancements to align with benefit-cost best practices. At the December 2018 RAWG meeting, staff will briefly present the key revisions to the methodology and answer any questions.

Key Revisions to Methodology Since August 2018 *(refer to attached methodology memo)*

- Additional clarity on how benefits from **physical activity** has been added. *(page 5)*
- A simplified approach to incorporating specific **safety** features has been incorporated, given feedback from sponsors that design details may not be available for long-range projects. *(pages 4, 7)*
- Based on feedback received, the **analysis period** of projects has been extended to 35 years, and **discount rate** has been lowered to 4 percent. *(page 16)*
- Treatment of fare revenues, tolls and parking fees has been updated to reflect economic best practices for both benefits and costs; as these are **transfers**, gross costs rather than net costs will now be used on the cost side of the benefit-cost ratio. *(pages 13-15)*
- Greater clarity on **AV and EV market shares** in intermediate years has been provided for all futures, along with safety benefit assumptions. *(page 7)*
- A proposed **equity assessment** methodology has been added to measure distributive impacts of accessibility benefits across income groups, pending feasibility. *(page 21)*
- Responses have been provided for **feedback** received during the comment period. *(page 23)*

Next Steps

Staff has released the full list of 94 projects to be evaluated since the culmination of the Transformative Projects process, including the 12 public finalists. Please refer to draft list attached (also available at bayareametro.gov/horizon). Key steps in the months ahead include:

- **Nov/Dec 2018**: code existing and committed projects in Travel Model 1.5; finalize modeling details of projects to be evaluated; conduct cost review of projects
- **January 2019:** test Travel Model 1.5 and conduct runs for no-project scenario (i.e., year 2050 baseline)
- **Winter 2019:** begin project runs using Travel Model 1.5

Attachments:

- **Attachment A:** Revised Project Performance Assessment Methodology (November 2018)
- **Attachment B:** Draft List of Major Transportation Projects for Project Performance Assessment

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METROPOLITAN TRANSPORTATION COMMISSION
ASSOCIATION OF BAY AREA GOVERNMENTS

MEMORANDUM

TO: Regional Advisory Working Group DATE: Nov 6, 2018

FR: Anup Tapase

RE: Horizon / Plan Bay Area 2050: Draft Project Performance Assessment Methodology

Background
This memorandum presents the revised methodology for evaluating transportation project performance for Horizon and Plan Bay Area 2050. The methodology leverages the framework used in Plan Bay Area and Plan Bay Area 2040 and builds on feedback received during the last planning cycle. Staff sincerely appreciates the detailed feedback on the first draft provided by stakeholders since the August 2018 RAWG meeting. The methodology has been updated to reflect this feedback, and responses to specific comments are included in the last attachment of this packet.

Project Performance Methodology Overview
The project performance assessment for Horizon and Plan Bay Area 2050 will evaluate three primary types of transportation projects: capacity-increasing investments, operational strategies, and resilience projects to address sea level rise and seismic hazards. Committed projects – those that have full funding plans and environmental clearance – are exempt from project performance and will be included in the baseline no-project scenario ("existing + committed") network. Uncommitted projects previously evaluated during Plan Bay Area 2040 – with total costs greater than $250 million[1] – and new project submissions from CMAs, public agencies, NGOs and the public with total costs greater than $1 billion[1], will be evaluated during Horizon. Other new project submissions with total costs greater than $250 million are proposed to be evaluated during Plan Bay Area 2050, following the Call for Projects, using the same evaluation methodology.

Projects will be evaluated through the following assessments:

1. **Benefit-Cost Assessment** – primary assessment
   - Compares societal benefits against anticipated project costs
   - Explores project performance against all three futures ("what if" scenarios)
   - Includes supplemental analyses of confidence & sensitivity (similar to Plan Bay Area 2040)
2. **Guiding Principles Assessment** – secondary assessment
   - Evaluates alignment with the five Guiding Principles using specific project-focused criteria
3. **Equity Assessment** – secondary assessment
   - Determines if transportation investments have the potential to benefit residents in Communities of Concern (geographic assessment)
   - Examines distributive impacts of project-level accessibility benefits across income groups

All three assessments seek to evaluate impacts of projects on the Bay Area and bring to light information that will used to develop the investment strategy of Plan Bay Area 2050. The framework to prioritize projects based on the assessments will be decided by the Planning Committee in 2019.

1. Benefit-Cost Assessment Methodology
The Benefit-Cost Assessment will leverage Travel Model 1.5[1] to quantify benefits of transportation projects. Travel Model 1.5 is an activity-based model that simulates travel decisions over a typical workday for the entire Bay Area in the horizon year of 2050. Benefits (or disbenefits) of the project relative to a baseline no-project scenario will be determined for each of the three futures, reflecting different external forces, control totals, and land use patterns. The 'cost' of each project will represent lifecycle costs. Staff has made several enhancements to the methodology this cycle given its primary role in the assessment.

*Proposed Major Enhancements (refer to **Attachment A**)*

- **Safety:** Incremental to the Plan Bay Area 2040 approach, benefits of specific operational improvements that were not previously captured, such as interchange or street design improvements, will be estimated using crash reduction factors compiled by FHWA.
- **Natural Lands:** Conversion of natural lands (e.g. wetlands, agricultural land) to infrastructure will be estimated as an annual loss of goods, such as farm products and wood, and services, such as climate regulation and habitat provision, based on a per-acre value.
- **Transit Crowding:** The effect of transit crowding will be incorporated in Travel Model 1.5 and its impact would be reflected within the project benefits. This methodology is still under development within the Travel Model 1.5.

*Benefit Valuation Updates (refer to **Attachment B**)*

- **Accessibility:** Similar to Plan Bay Area 2040, the project performance assessment will utilize the travel model's logsum outputs. Logsum is a metric that measures utility or consumer surplus, and captures mobility benefits (i.e., travel time savings, in-vehicle or out-of-vehicle), travel costs (i.e., tolls, fares, parking, vehicle operating) and the ease of consumers to reach destinations of their choice. These benefits collectively will be termed as "accessibility benefits" this cycle, consistent with the estimation methodology. Logsums can be directly converted to hours and monetized using a consistent value of time for all income classes, acknowledging the implicit judgment that the accessibility is valued the same for all people.
- **Updates to Reflect Future-Specific Income Distributions:** Valuation of time is proposed to continue following USDOT guidance at 50% of median wage rate. However, wages differ in the three futures. Percentage changes in the median wage rate for each future is estimated based on the output of different income distributions from the regional economic model. As a result, the three Futures have different values of time, ranging from $12.10 to $17.90 per hour (2018$). Similarly, auto operating costs also vary by future, ranging from $0.10 to $0.40 per mile.
- **Travel Time Reliability:** The proposed valuation this cycle incorporates the latest research which indicates a slightly lower ratio against value of time is appropriate for motorists and a higher ratio is appropriate for freight, when compared to Plan Bay Area 2040 valuations.
- **All Other Benefits:** Minor updates are proposed to valuations for all other benefits from Plan Bay Area 2040; no benefits are proposed for removal.

*Cost Estimation Updates (refer to **Attachment C**)*

- **Lifecycle Costs:** Costs will be divided into four categories: upfront capital investment costs (including planning, design and environmental), annual O&M costs, asset replacement costs over the analysis period and a residual asset value added back at the end of the period. While project sponsors submit cost estimates, all projects will undergo a cost review by an independent cost audit consultant using a uniform methodology.
- **Transfers:** Transit revenues, tolls and parking fees are considered transfers that are neither a net economic benefit nor cost to society, and hence they are not included within the benefit-cost framework as per best practice. In Plan Bay Area 2040, these transfers were eliminated from the benefits. This approach will be standardized across the costs as well.

*Benefit-Cost Ratio Calculation Methodology Updates (refer to **Attachment D**)*

- **Present Value Approach:** Present values of a stream of benefits and costs will be used to calculate a benefit-cost ratio, rather than using benefits and costs in the horizon year as in Plan Bay Area 2040. This approach can capture advantages of quicker construction and implementation timelines, and long-term benefits of large investments. Forecasting streams of benefits and costs requires various assertions and assumptions that have been detailed in the attachment.

*Supplemental Assessments (refer to **Attachment E)***

- **Minor Updates:** Confidence and sensitivity analyses will be conducted, as in Plan Bay Area 2040, with updates to the criteria that are used. The present value approach will eliminate the need for confidence assessment of timeframe inclusiveness, but calls for new criteria in the sensitivity analysis based on construction timelines, analysis period, discount rate and safety benefits from AVs.

2. **Guiding Principles Assessment** *(refer to **Attachment F)***

The Guiding Principles Assessment relies solely on qualitative criteria and seeks to ensure that projects align with five Guiding Principles that reflect core aspirations for the Bay Area – to create a region that is **Affordable**, **Connected**, **Diverse**, **Healthy**, and **Vibrant**. Specific questions were defined to evaluate projects against each principle, focusing on significant negative impacts associated with the project itself, rather than the performance of the jurisdiction(s) where the project may be located. Staff integrated feedback that was received during June RAWG and August RAWG, including additional clarity on evaluation questions. For example, an exception would be made for projects increasing travel times if they have significant safety benefits.

3. **Equity Assessment** *(refer to **Attachment G)***

While the geographical assessment of the Plan Bay Area 2040 equity assessment will be maintained, a quantitative assessment that quantifies the equity effects at a project level is being evaluated for feasibility. Combined with the geographical assessment, this would examine distributive impacts of accessibility benefits across income groups, using Travel Model outputs. An equity score can be calculated from the outputs, lending insight into which income groups benefit most from a project in terms of accessibility.

Next Steps

Next steps for the evaluation process include:

- **Nov/Dec 2018**: code existing and committed projects in Travel Model 1.5; finalize modeling details of projects to be evaluated; conduct cost review of projects
- **January 2019:** test Travel Model 1.5 and conduct runs for no-project scenario
- **Late Winter 2019:** begin project runs using Travel Model 1.5

Attachments

- **Attachment A: Benefits Estimation Methodology**
- **Attachment B: Benefit Valuations**
- **Attachment C: Costs Estimation Methodology**
- **Attachment D: Benefit-Cost Ratio Calculation Methodology**
- **Attachment E: Supplemental Assessments to Benefit-Cost Assessment**
- **Attachment F: Guiding Principles Assessment**
- **Attachment G: Equity Assessment**
- **Attachment H: Responses to Feedback Received since August 2018 RAWG**

1. Travel Model documentation is available here and it is continuously updated with model enhancements: https://github.com/BayAreaMetro/modeling-website/wiki/TravelModel
2. Cost figures refer to capital as well as O&M costs, in year of expenditure dollars, up to the horizon year 2050.

Attachment A – Benefit and Cost Estimation Methodology

Benefits Estimation

Benefit estimation will leverage Travel Model 1.5, an activity-based model that simulates travel decisions over a typical workday for the entire Bay Area in the horizon year of 2050. Travel Model 1.5 attempts to capture effects of transit crowding, TNCs, autonomous vehicles (AVs) and sea level rise, which are all new enhancements since its previous version Travel Model One that was used in PBA2040. Benefits (or disbenefits) of the project relative to a baseline no-project scenario will be determined using outputs from this model for each of the three futures, reflecting different external forces, control totals, and land use patterns. Table A.1 captures all the benefits/disbenefits that are estimated and the methodology for doing so.

Table A.1 Methodology for Estimating Project Benefits

Benefits / Disbenefits	Includes	Methodology	Accrual	Data sources

Accessibility[1,2]
 	
(logsums, expressed in hours/dollars)
	• Travel time savings
	  ○ Across all modes (auto, TNC, truck, transit, bike, ped)
	  ○ Free-flow time and recurring delay
	  ○ Includes in-vehicle and out-of-vehicle time (waiting, transfer)
	• Travel costs
	  ○ Tolls, fares, parking fees[3]
	  ○ Vehicle operating costs (fuel, maintenance, repair)
	• Transit crowding[4]
		[Same methodology as PBA2040, change in nomenclature]
		
		Change in accessibility at the individual level is measured using the logsum methodology in Travel Model 1.5. Logsum represents the consumer surplus that results from a given set of choices available to an individual. The aggregate of logsum measures across individuals measures the total change in the consumer surplus due to the project, representing accessibility benefits of the project.
			Increase in logsums, which can be converted to a dollar value, is accrued as a positive benefit	Travel Model 1.5

Travel Time Reliability (hours)	• Auto travel time reliability • Freight travel time reliability	**[Same methodology as PBA2040]** Number of hours lost due to unreliable travel time is measured as the sum of incident delay across all roadways. Incident delay is calculated as a function of volume-to-capacity ratio and number of lanes on a roadway. Assumptions on safety benefits that may result from AVs in the fleet are detailed in the endnotes[6]. The decrease in rate of collisions will be	Increase in hours is a negative benefit	Travel Model 1.5
Collisions	• Fatalities due to collisions • Injuries due to collisions • Property damage only (PDO) collisions	**[Same methodology as PBA2040 + new methodology to capture benefits from specific safety improvements and AVs]** Change in the number of collisions due to a project is calculated by multiplying the change in VMT (by area type (urban/rural),	Increase in number of victims / collisions is a negative benefit	Travel Model 1.5, SWITRS, CMF Clearinghouse (FHWA)

Benefits / Disbenefits	Includes	Methodology	Accrual	Data sources
(number of victims for fatality/ injury, number of collisions for PDO)		facility type, and number of lanes) with an estimate of number of collisions by type per VMT. These include transit and bike/ped related collisions. Incremental to the above change, the reduction in number of collisions due to specific safety improvements is estimated separately, since the VMT method does not capture such benefits. This is based on a crash reduction factors (CRF), sourced from research compiled by FHWA. Methodology and CRFs for specific safety improvements are detailed in the endnotes[5]. Further, assumptions on safety benefits that may result from AVs in the fleet are detailed in the endnotes[6].		
GHG Emissions and Air Quality (metric tons)	• CO_2 (global social effects) • Air pollutants (negative health effects) ○ $PM_{2.5}$ ○ Other volatile organic compounds (e.g. NO_x, SO_2, Acetaldehyde, Benzene)	**[Same methodology as PBA2040]** Change in emissions is measured as the sum of VMT, multiplied by an estimate of future emission levels per VMT forecasted by EMFAC. These estimates depend on time period of the day, vehicle class (including electric vehicles) and speed. The emission level would be zero in the case of electric vehicles (EVs), and hence futures with higher levels of EV adoption will have significantly lower levels of emissions benefits. Assumptions on EV penetration are detailed in the endnotes[7].	Increase in metric tons is a negative benefit	Travel Model 1.5, EMFAC
Benefits from Physical Activity (active individuals and premature deaths)	• Morbidity benefits from increased walking/cycling • Mortality benefits from increased walking/cycling	**[Same methodology as PBA2040; new ITHIM tool that is under development is being considered and will be tested for feasibility]** Morbidity benefits: Health care cost savings for every new 'active' individual. An active individual is considered to be one that walked (including to/from transit) and/or biked for 30 minutes a day[8]. Mortality benefits: Risk reduction of mortality of 11% for walking and 10% for bicycling for 'active' individuals, applied to Bay Area mortality rates. New ITHIM R-based tool[9] under development may be used depending on feasibility. The tool, which was used to estimate scenario level impacts during PBA2040, derives inputs from the Travel	Increase in active individuals and decrease in premature deaths is a positive benefit	Travel Model 1.5, ITHIM

Benefits / Disbenefits	Includes	Methodology	Accrual	Data sources
		Model on walking, bicycling and access to transit. The output is a percentage change in Disability-Adjusted-Life-Years (DALYs), which measures the sum of years of life lost due to premature mortality and/or disability.		
Noise (VMT)	• Impact of change in noise levels due to change in auto/truck VMT	**[Same methodology as PBA2040]** Change in VMT due to the project, by auto and truck	Increase in VMT is a negative benefit	Travel Model 1.5
Auto Ownership (vehicles)	• Change in number of vehicles induced by project	**[Same methodology as PBA2040]** Predicted change in the number of vehicles owned by households, based on VMT and household demographics	Increase in vehicles represents higher ownership costs and is a negative benefit	Travel Model 1.5
Loss of Natural Land (acres)	• Loss of natural land that is converted to transportation infrastructure, by land type: ○ Wetland ○ Forestland ○ Pastureland ○ Farmland	**[New disbenefit that was not considered in PBA2040]** Estimation of the area of land converted is based on the methodology used in EIR project footprint analyses – 100ft buffer around linear projects (e.g. road/rail extensions) and 150ft - 500ft buffer from center of point projects (e.g. interchanges, transit centers), depending on the size of the project. Type of land converted is determined using the Bay Area Greenprint tool. (www.bayareagreenprint.org) This disbenefit would primarily apply to projects in non-urbanized areas.	Increase in acres is a negative benefit	Bay Area Greenprint Tool

Endnotes:

1. A small number of trips are not captured by accessibility logsums – interregional trips (i.e. trips between the Bay Area and other surrounding regions), trips to/from the airports, and freight trips. Impacts of projects on these trips are measured using value of time saved and operating cost savings per VMT.

2. Accessibility is a measure of the ease with which transportation users are able to reach destinations. Improving accessibility is generally accepted as the core objective of transportation investments, since users do not use transportation for the sake of the transportation itself (except in rare cases), but to reach destinations. It represents more than just mobility improvements in terms of travel time. Users, in making travel decisions, take into account not only travel time, but also mode choices available, land use patterns (i.e., destination locations), travel costs, congestion and crowding when making travel decisions. Their decisions are also dependent on their personal characteristics such as age, household income, number of workers/dependents in the household, etc.

3. Tolls, fares and parking fees are an economic transfer between users and operators. They represent neither an economic benefit nor an economic cost of projects, and are hence omitted from benefit-cost framework. Since user travel costs factor into travel decisions, they are part of the accessibility logsums. However, they are added back again for a net zero benefit to society in the calculation of the benefit-cost ratio.

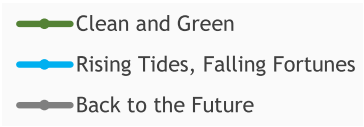
4. The disbenefit experienced due to transit crowding is taken into account within the logsum measure. The methodology is based on framework described in the paper "Incorporating crowding into the San Francisco activity-based travel model", 2012

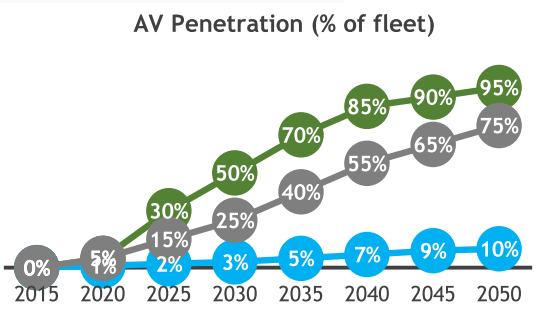
5. A finite list of safety improvements, as shown in Table A.2, will be considered for the estimation of reduction in collisions. This list is meant to capture major safety improvements within all projects that are to be evaluated, given that design details of the projects are not readily available. For each of those improvements, the following method is applied. First, the average annual number of collisions within the physical limits of the project site is obtained from SWITRS for the five year period 2012-2016. This number is then multiplied by a crash reduction factor (CRF) for the specific safety improvement (obtained from CMF Clearinghouse, FHWA) to determine the annual decrease in number of collisions as a result of the project. CRF denotes the percentage reduction in crashes that may be expected as a result of the countermeasure. For more information, please refer to http://www.cmfclearinghouse.org/faqs.cfm#q2. CRF averages listed in Table A.2 are averaged over multiple data points that are related to the safety improvement and have a rating of 3 stars or higher. The averages are meant to be indicative and are not authoritative estimates.

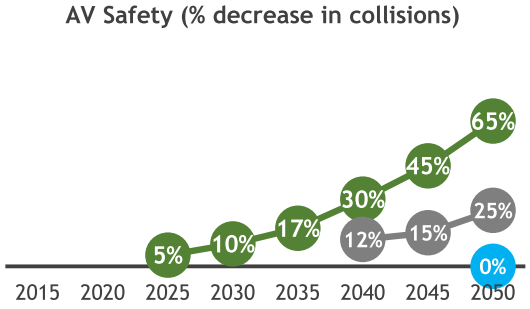
Table A.2 Crash Reduction Factors (CRF) by Safety Improvement
(Source: CMF Clearinghouse)

Safety Improvement	CRF average
Freeways: New auxiliary lane addition	20%
Freeways: New lane addition (GP/HOV/Express)	0% (data points indicate both positive and negative effects)
Freeways: Existing HOV to express lane conversion	5%
Freeways: Interchange reconfiguration	40%
Local street design improvements (e.g. transit lanes, bike/ped)	20%
Grade separation of transit	100% (for transit-related crashes only; not based on CMF research)
Change in collisions due to impacts such as - increase/decrease in auto miles - mode shift to auto/transit/other modes - decrease in vehicle ownership - speed limit changes (e.g. conversion of arterial to freeway)	Covered by VMT-based methodology

6. Assumptions on AV penetration for each future are shown in the charts below. The assumptions for AV penetration in the horizon year were determined when the three diverging futures were ascertained. This process involved peer exchange, gathering feedback from partners, and developing what-if scenarios. Safety benefits of AVs will be considered in the 'Clean and Green' and 'Back to the Future' futures, where the AV fleet penetration is 95% and 75% by the horizon year, respectively. Safety assumptions are sourced from MTC's Future Mobility Research Program work, including a Delphi survey conducted with subject area experts (40% to 90% reduction in collisions in fully-automated future based on survey results). The trend towards this reduction in collisions is shown below, and is not be assumed to be linear to reflect research on the potential disbenefits of mixing of human/AV fleets.



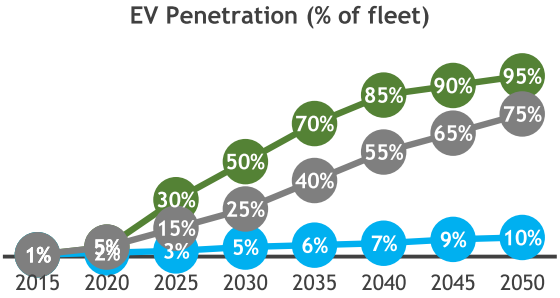




The methodology recognizes the uncertainty in the safety assumptions and the potential for greater safety with AVs, as anticipated by various agencies. The assumptions will be tested for sensitivity (by increasing the 2050 percent decrease in collisions to 90% in Clean and Green, and 40% in Back to the Future, and adjusting preceding years concomitantly).

These safety impacts also affect the estimation of travel time reliability benefits. Travel time reliability is measured by non-recurring delay, whose estimates are based on a function of traffic volumes and the level of congestion (volume-over-capacity ratio) for links containing a specified number of lanes. Given the decrease in the collision rate with AVs, the non-recurring delay will be adjusted using the same factor.

7. Assumptions on EV fleet penetration are shown below. The assumptions for EV penetration in the horizon year were determined when the three diverging futures were ascertained. This process involved peer exchange, gathering feedback from partners, and developing what-if scenarios.



8. Source: World Health Organization's Health Economic Assessment Tool, available online: http://www.heatwalkingcycling.org/

9. The R-based ITHIM tool is in development by Neil Maizlish, Visiting Research Scientist, UC Davis. The tool is expected to be ready in time for Project Performance evaluations, and it will be tested for feasibility.

Attachment B – Benefit Valuations

This attachment summarizes valuations that will be used to monetize the various benefits described in Attachment A, for the benefit-cost assessment in Horizon and Plan Bay Area 2050. The valuations are based on a review of recent research and best practices for monetizing benefits from transportation projects. Table B.1 presents the recommended valuations for each benefit category, including a comparison to the Plan Bay Area 2040 valuation and a description of the basis of the valuation. Benefit valuations that would differ by Future are indicated using CG for Clean and Green, RT for Rising Tides, Falling Fortunes, and BF for Back to the Future.

Table B.1 – Valuations of Benefits in Horizon Year – PBA2040 vs. Horizon/PBA 2050

Category	Benefit	PBA2040 Valuation (2017$)	Horizon & PBA 2050 Valuation (2018$)	Type of Update	What Does The Valuation Include?
Accessibility	***For trips captured in logsums (majority of trips)***				
	Accessibility benefits (per hour)	$12.66	No major external forces $12.71 CG $17.90 RT $12.10 BF $17.50	Update to reflect multiple futures	Accessibility benefits are interpreted using Value of Time, after converting logsums to hours. This is set at 50% of the median regional wage rate ($25.43), based on USDOT guidance. This wage rate would vary by future, due to external forces. Based on a preliminary household income distribution forecasted by the REMI model, ratios were calculated for multiplying with the wage rate in the case of no major external forces, to obtain the wage rate in the three Futures. *Sources: US Department of Transportation; Bureau of Labor Statistics Occupational Employment and Wage, 2017*
	For trips not captured in logsums (only interregional and airport auto trips, freight)				
	Auto In-Vehicle Travel Time (per hour)	$12.66	(same as above row)	Updated to reflect multiple futures	Same as above row *Sources: US Department of Transportation; Bureau of Labor Statistics Occupational Employment and Wage, 2017*
	Truck In-Vehicle Travel Time (per vehicle hour of travel)	$33.69	No major external forces $31.18 CG $43.80 RT $29.60 BF $43.00		The valuation is the total hourly compensation paid to truck drivers. This valuation represents the labor cost of transporting goods on the roadway network, including benefits. The calculation method for the three Futures is identical to that for Accessibility Benefits. *Source: FHWA Highway Economic Requirements System; Bureau of Labor Statistics Occupational Employment and Wage, 2017*

Category	Benefit	PBA2040 Valuation (2017$)	Horizon & PBA 2050 Valuation (2018$)	Type of Update	What Does The Valuation Include?
Travel Time Reliability	**Auto operating costs** (per mile)	$0.3072	No major external forces $0.20 CG $0.40 RT $0.20 BF $0.10	Updated to reflect multiple futures	The operating cost in 2015/2020 is $0.20 per mile (in 2018$), which represents the cost users experience in making daily travel decisions, following USDOT guidance. It includes cost of fuel, maintenance and repair, based on forecasted fuel costs and efficiencies in 2050. This cost varies by future based on external forces: CG: cost rises to $0.40 in 2025 and then stays constant until 2050 RT: cost stays constant at $0.20 until 2050 BF: cost declines linearly to $0.10 in 2050 *Source: USDOT, EIA Energy Outlook 2018, AAA Your Driving Costs 2017 Edition*
	Truck operating costs (per mile)	$0.8795	No major external forces $1.00 CG $1.55 RT $1.00 BF $0.70		The baseline operating cost is $1.00 per mile, which represents the cost carriers experience in making daily travel decisions, following USDOT guidance. It includes cost of fuel, maintenance and repair, and depreciation, based on forecasted fuel costs and efficiencies in 2050. This cost varies by future based on external forces, similar to auto operating costs (depreciation component is held constant). *Source: USDOT, EIA Energy Outlook 2018, AAA Your Driving Costs 2017 Edition*
	Auto (per person hour of non-recurring delay)	$12.66	No major external forces $10.17 CG $14.30 RT $9.70 BF $14.00	Major Update	This represents the value placed by an auto driver on the consistency of travel times, and measured as a Reliability Ratio * Value of Time. Recent SHRP research has indicated values of 0.3-0.8. The upper limit of 0.8 is used as a conservative estimate, and this is in line with agencies abroad. This is multiplied by the Value of Time calculated above ($12.71). *Source: SHRP 2 L35 Projects A and B - Value of Travel Time Reliability in Transportation Decision Making*
	Freight/ Truck (per vehicle hour of non-recurring delay)	$33.69	No major external forces $46.77 CG $65.70 RT $44.50 BF $64.50	Major Update	This value represents the value placed by carriers and shippers on unreliable travel times, due to increased costs from driver compensation, handling costs at origin and destination, inventory management, depreciation of commodity value. The Reliability Ratio was found to be in the range of 1.5. This is multiplied by the Value of Time calculated above ($31.18). *Source: Examining the Value of Travel Time Reliability for Freight Transportation to Support Freight Planning and Decision-Making", FDOT, 2016*

Category	Benefit	PBA2040 Valuation (2017$)	Horizon & PBA 2050 Valuation (2018$)	Type of Update	What Does The Valuation Include?
Collisions	**Fatality Collisions** (per fatality)	$10.8 million	$10.1 million	Data source version update	The valuation includes the internal costs to a fatality collision victim (and their family) resulting from the loss of life, as well as the external societal costs. It represents: • Loss of life for the victims • Medical costs incurred in attempts to revive victims • Loss of enjoyment of family member to other members of the family • Loss of productivity to the family unit (e.g., loss of earnings) • Loss of productivity to society • Loss of societal investment in the victim (e.g., educational costs) *Source: USDOT, 2017, SWITRS database*
	Injury Collisions (per injury)	$124,000	$109,200	Data source version update	The valuation includes the internal costs to an individual (and their family) resulting from the injury, as well as the external societal costs. It represents: • Pain and inconvenience for the individuals. • Pain and inconvenience for the other family members • Medical costs for injury treatment • Loss of productivity to the family unit (e.g., loss of earnings) • Loss of productivity to society *Source: USDOT, 2017, SWITRS database*
	Property Damage Only Collision (per incident)	$4,590	$3,360	Data source version update	The valuation includes the internal costs to a property damage collision victim (and their family) resulting from the time required to deal with the collision, as well as the external societal costs from this loss of time. It represents: • Inconvenience to the individual and to other members of the family • Loss of productivity to the family unit • Loss of productivity to society *Source: USDOT, 2017, SWITRS database*
Physical Inactivity	**Morbidity and productivity** (per active adult)	**$1,341**	**$1,368**	Inflation only	The current valuation from PBA2040 represents the savings achieved by influencing an insufficiently active adult to engage in moderate physical activity five or more days per week for at least 30 minutes. It reflects annual Bay Area health care cost savings of $326 (2006 dollars), as well as productivity savings of $717 (2006 dollars). *Source: California Center for Public Health Advocacy/Chenoweth & Associates 2006, "The Economic Costs of Overweight, Obesity, and Physical Inactivity Among California Adults"*
	Mortality (per life saved)	**$10.8 million**	**$10.1 million**		

Category	Benefit	PBA2040 Valuation (2017$)	Horizon & PBA 2050 Valuation (2018$)	Type of Update	What Does The Valuation Include?
Greenhouse Gas Emissions (per metric ton)	**CO_2 emissions**	**$100**	2015 **$68** 2020 **$76** 2025 **$83** 2030 **$89** 2035 **$65** 2040 **$102** 2045 **$109** 2050 **$118**	Value Update	This valuation represents the full global social cost of an incremental unit (metric ton) of CO_2 emission from the time of production to the damage it imposes over the whole of its time in the atmosphere. Valuations are available for different years in the future up to 2050, all calculated with a 2.5% discount rate. *Source: Federal Interagency Working Group on the Social Cost of Carbon, Revised 2016*
Other Pollutant Emissions (per metric ton)	**Diesel $PM_{2.5}$**	$665,400	**$657,370**	Value Updates	These valuations represent the negative health effects of increased emissions including: • Loss of productive time (work & school) • Direct medical costs from avoiding or responding to adverse health effects (illness or death) • Pain, inconvenience, and anxiety that results from adverse effects (illness or death), or efforts to avoid or treat these effects • Loss of enjoyment and leisure time • Adverse effects on others resulting from their own adverse health effects *Source: BAAQMD, 2017*
	Direct $PM_{2.5}$	$658,800	**$652,460**		
	NO_x	$6,000	**$7,010**		
	Acetaldehyde	$5,100	**$4,670**		
	Benzene	$15,200	**$14,720**		
	1,3-Butadiene	$42,600	**$41,710**		
	Formaldehyde	$5,900	**$5,490**		
	All Other ROG	$4,300	**$3,970**		
	SO_2	$22,200	**$21,850**		
Noise (per mile traveled)	**Auto**	$0.0013	$0.0014	Inflation only	This valuation represents the property value decreases and societal cost of noise abatement. *Source: FHWA Federal Cost Allocation Report*
	Truck	$0.0170	$0.0170		
Auto Ownership	**Costs per Vehicle**	$3,920	$5,124	Change in data source	This valuation represents the annual ownership costs of vehicles, beyond the per mile operating costs. It includes insurance, depreciation (15K miles annually) and financing charges. *Source: AAA, as recommended by USDOT*
Natural Land (per acre, per year)	**Wetland**	-	**$33,500**	New benefit	Represents the benefits of ecosystem goods (e.g. farm products, fish, minerals, water, wood) and services (e.g. disturbance regulation, climate regulation, habitat, nutrient cycling, pollination, recreation), based on comprehensive database of published, peer-reviewed primary valuation studies. *Source: Nature's Value in Santa Clara and Sonoma Counties, Earth Economics (2014/16)*
	Forestland	-	**$5,230**		
	Pasture	-	**$4,680**		
	Agricultural land	-	**$1,440**		

Attachment C – Costs Estimation Methodology

This attachment describes the methodology that will be used to develop lifecycle cost estimates for projects. While sponsors submit project costs, all projects will undergo a cost review by an independent cost audit consultant. Costs will be represented in four categories, as shown in Table C.1. Calculation of asset replacement costs will be based on the useful life of major asset classes that form the upfront capital costs. These are detailed in Table C.2.

Table C.1 – Methodology for Estimating Project Costs

Costs	Includes	Methodology
Upfront Capital Costs	Planning, design, environmental, right of way and rolling stock acquisition, and construction/installation	Project sponsors will submit cost estimates to MTC. Before conducting the assessment, MTC will review costs for accuracy and inclusiveness.
Operating and Maintenance Cost	Ongoing costs of operations and maintenance	Project sponsors will submit O&M estimates to MTC. MTC will review these estimates for accuracy and inclusiveness. MTC might also add O&M costs to roadway or transit projects that do not submit O&M costs. As mentioned earlier, according to best practices in cost-benefit analyses, project revenues such as tolls or fares only represent economic transfers and hence they will not be netted out of the costs. The impact of this change is discussed at the end of this attachment.
Asset Replacement Costs	Rehabilitation and replacement cost of assets above and beyond regular O&M costs	Costs of asset replacement are calculated based on the useful lifetime of assets. For example, bus assets have lifetimes of 14 years, and hence we assume there would be a same level of initial capital investment at the 14 year mark. The upfront capital investment costs will be split into major asset classes as shown in Table C.1. The purpose is to distinguish between the major asset classes that have different lifetimes.
Residual Value	Value of assets in horizon year	Since the analysis year ends in 2060, any remaining value of assets is essentially a negative cost. This is calculated based on straight-line depreciation of major asset components based on lifetime of assets. Real estate assets do not depreciate.

Table C.2: Useful Lives for Major Asset Classes
(Asset classes may be added/revised during the cost review process, and useful life definitions may be further refined to better reflect true asset replacement costs)
(Source: MTC data on Bay Area Assets Useful Life Benchmarks, FTA Standard Cost Categories)

Category	Asset Class	Expected Useful Life (in years)
Vehicle	Local / BRT Bus	14
	Express Bus	14
	Light Rail Vehicle	25
	Diesel Multiple Unit (DMU) Rail Vehicle	25
	Heavy Rail Vehicle	40
	Ferry	25
Transit Infrastructure	BRT ROW Assets	20
	Track Assets (at-grade, aerial)	80
	Track Assets (underground)	125
	Stations (at-grade, aerial)	70
	Stations (underground)	125
Real Estate	Land Acquisition	No limit
Technology / Operations	Tolling Equipment ITS Other Technology Assets	20
Roadway	Pavement (highway, bicycle lanes)	No limit; preventive/restorative maintenance, as % of upfront capital cost (real values): 5th year: 10% 10th year: 20% 20th year: 30% Costs repeat every 5th, 10th and 20th year.
	Structures (bridges, tunnels, elevated ramps)	No limit; preventive/restorative maintenance, as % of upfront capital cost (real values): 5th year: 20% 15th year: 20% 35th year: 30% Costs repeat every 5th, 15th and 35th year.

Impact of Eliminating Transfers from Project Costs

Monetary exchanges that are transfer payments, that is, transactions where money moves around without anything of economic value being created or consumed, should neither be included as benefits or costs in a social benefit-cost assessment. Examples of such transactions are tolls, parking fees and transit fares. These charges are financial tools used to transfer some or all of a project's cost to its direct beneficiaries and away from society as a whole. While they may be useful for identifying winners and losers, they do not correspond to net impacts on society as a whole.

In Plan Bay Area 2040, transfers did not appear in the benefits numerator of the benefit-cost ratio calculation. Specifically, changes in accessibility benefits (logsums) included the travel costs experienced by users in making travel decisions (i.e. tolls, fares etc.), but these charges were added back in as a benefit, thus cancelling each other out. However, the project costs denominator

represented net operating costs to the project sponsor. In the case of transit projects, the net operating cost was calculated using the average farebox recovery ratio by operator. In the case of tolling and cordon pricing projects, the O&M costs (and in some cases a portion of the capital costs) were assumed to be covered by expected revenues. In Horizon, to be consistent with social benefit-cost analysis practices, transfers will be removed from the costs denominator as well. This means that the cost denominator would represent the full cost of the project to society.

Benefit-cost assessments (BCA) seek to calculate the societal benefits of transportation, and not benefits to any particular section of the population. When projects involve large transfer payments, such as cordon pricing projects, or other projects that may be studied in Horizon, such as free transit, the BCA is limited in its ability to measure the effects of the project. The magnitude of transfer payments is irrelevant in a BCA, but it is certainly not irrelevant to the economic impacts of the project/policy. Staff will consider the revenue generation and impacts of such projects in the investment strategy.

Attachment D – Benefit-Cost Ratio Calculation Methodology

The methodology to calculate the benefit-cost ratio (BCR) in Horizon reflects a significant update from the last plan cycle. In Horizon, BCR will be calculated as the ratio of the present value of the stream of benefits of the project, to the present value (PV) of the stream of lifecycle costs, including capital costs, O&M costs, asset replacement/rehabilitation costs, and a reduction in costs based on residual value. The following formula illustrates this calculation:

$$BCR = \frac{PV(Benefits)}{PV(Capital\ Costs) + PV(O\&M\ costs) + PV(Asset\ Replacement\ Costs) - PV(Residual\ Value)}$$

In this methodology, various assertions and assumptions are made with respect to discounting, the period of analysis, and forecasting cost and benefit streams until the end of the analysis period.

Discount Rate

The real discount rate (discount rate net of the inflation rate) used to calculate the present values of forecasted benefits and costs is 4% per year, based on Caltrans guidance for benefit-cost analysis applications. The exception to this is for natural resources – emissions, air quality and natural land value (dis)benefits. A lowered discount rate of 2.5% is used to reflect the renewable nature of natural capital, consistent with other Bay Area agencies. The sensitivity analysis will test using discount rates of 0% for natural resources, and 7% for all other.

Analysis Period

Since the assessment is primarily concerned in comparing the BCR of projects, similar timelines should be considered to appropriately compare the present values. BCRs will be calculated for a 35-year period for all projects, including construction time, discounting all benefits and costs to the first year of construction of the project. This analysis period should account for 20-25 years of operation post construction at a minimum, if not more. For convenience of analysis, and since the horizon year is fixed at 2050, the analysis period starts at the same year for all projects, irrespective of when they may be expected to come online. This start year chosen for the analysis is 2025, given that project sponsors indicated potential start data of most projects across the entire decade from 2021-2030. The end year of the analysis is 2060, ten years past the horizon year. A residual value of the investment is added as a negative cost in 2060, to reflect the fact that assets with long lifespans would have remaining value beyond the analysis period.

A second BCR will also be calculated as part of the supplementary sensitivity analysis, using an analysis period of 55 years that continues until 2080. However, this metric will be used only as a secondary guidance, since predictions of benefits 20-30 years after the horizon year are less reliable.

Cost Streams

Methodology for calculating asset replacement costs over the analysis period and residual value is described in Table C.1 in Attachment C. These costs would be based on the lifetime of assets and simplifying assumptions will be made to estimate these costs relative to the initial capital cost, based on the asset class.

Benefit Streams

The general practice followed in benefit-cost analyses of transportation infrastructure is to assume that benefits are constant or consistently rising with metrics such as ridership over the lifetime of the asset, depending on the type of benefit. However, such assumptions may not hold strong in the case of divergent futures. The benefit streams will hence be forecasted using results of no-project baseline model runs. These model runs include existing and committed projects. TM1.5 and UrbanSim models will be run iteratively for a no-project scenario starting in 2015 at the least for every ten-year interval, but if possible at five-year intervals, until the horizon year 2050. This will provide us metrics such as auto hours, transit hours, walk/bike hours, air pollutant metric tons and VMT (to estimate number of collisions and noise). The trajectory of these metrics will be used as proxies to estimate the stream of project benefits over time. While it would be ideal to run the models iteratively for every individual project as well, the compute time requirements would be prohibitive barring a drastic reduction in run times of the models. REMI outputs have already been generated for every five-year interval until the horizon year. Benefits from 2051 until the end of the analysis period at 2060 will be assumed constant at the 2050 level.

For instance, in a future where there are no major external shifts, benefits from lowered emissions due to a major transit investment could be assumed to grow in a straight line over 20 years to the Horizon year value, if maximum ridership is assumed to be reached in the 20th year. However, if the electric vehicles are a high percentage of the fleet mix in a given future, then benefits from emissions may rise for the first ten years when the fleet is largely fossil-fuel powered, but eventually drop to a much lower value, as the horizon year benefits would be represented in the output of the Travel Model 1.5. Capturing the benefit that the transit investment provides in the interim period is critical to evaluate the benefit-cost ratio. The assumption for the stream of these benefits from reduced emissions may be tied to the penetration of electric vehicles into the fleet and other related factors.

All the above assumptions are illustrated in Figure D.1. The example used is a new bus rapid transit (BRT) project, with upfront capital costs of $300M, with a construction timeline of 3 years. The costs are split by major asset class as defined in Table A.4, $100M in buses, $150M in pavement, and $50 in

Despite more complicated calculations, this approach represents a stronger approach than that used in Plan Bay Area 2040, and it enhances the rigor of the benefit-cost assessment. For illustrative purposes, rough BCRs were calculated for two projects from Plan Bay Area 2040 using the streamed benefits and costs approach with present values. The BCRs from both approaches are compared against each other for both projects, shown in Table D.2. Project 2 scored higher than Project 1 during the last plan cycle. However, when Project 2's longer construction time and Project 1's higher magnitude of annual benefit are taken into account by the Horizon BCR approach, Project 1 scores higher.

Table D.1: Illustration of Benefit and Cost Stream Calculations for Sample BRT Project

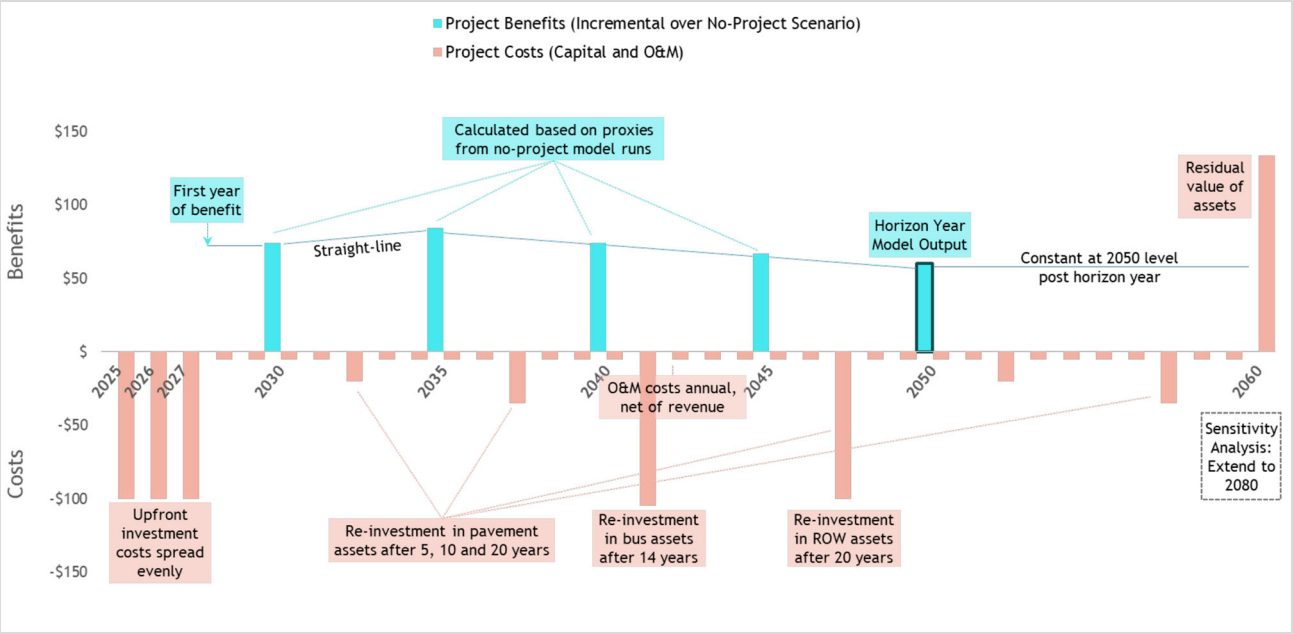


Table D.2: Comparison of BCR Calculation Methods for Two Sample Projects

BCR Calculation Line Item	Project 1 (higher magnitude of annual benefit)	Project 2 (longer implementation time)
Upfront Capital Costs ($m)	$820	$737
Annual O&M Cost ($m)	$62	$0
Annual Benefit (as estimated in Travel Model One) ($m)	$248	$95
BC Ratio calculation using annualized benefits and costs, as in PBA2040		
Annualized Cost (= annualized construction cost + annual O&M cost) ($m)	$121	$37
BC Ratio (as calculated in PBA2040)	**2.1**	**2.6**
BC Ratio calculation using Horizon present values methodology		
Construction Start Year Assumption	2021	2021
Construction / Implementation Duration	1 year	5 years
Useful Life Of Asset	14 years	20 years
Asset Replacement Cost ($m)	$820 in year 15	Assumed 0
BC Ratio (as calculated using PVs)	**2.4**	**1.3**

Attachment E – Supplemental Assessments to Benefit-Cost Assessment

Supplemental assessments evaluate limitations of the project performance results, to document the known shortcomings of the approach and better inform policy makers of the strengths and weaknesses of the analysis outcomes. Two assessments will be conducted in this regard: the Confidence Assessment, and Sensitivity Testing.

Confidence Assessment

The Confidence Assessment will address two main limitations of the Benefit-Cost Assessment:

1. Travel Model Accuracy
    a. Does the travel model have limitations in understanding a particular type of travel behavior (e.g. shared TNCs)?
    b. Does the travel model lack an understanding of smaller-scale project travel changes relative to the region (e.g. single infill station, expressway improvements)?
2. Framework Completeness
    a. Does the travel model output capture all of the primary benefits of the project (e.g. transit reliability, or recreational or tourism benefits)?

Various limitations that continue to persist despite model improvements will be highlighted through this assessment. For instance, Travel Model 1.5 does not have the ability to forecast weekend travel or transit reliability. The model also has limitations in considering some modes of travel separately, such as shared TNCs, or bicycling to transit. External forces in the futures such as penetration of automated technologies or natural disasters are represented by sweeping assumptions and hence travel model accuracy may be compromised.

Sensitivity Assessment

The Sensitivity Assessment evaluates how the Benefit-Cost Assessment outcomes change as a result of modifying some key assumptions. In contrast to the Confidence Assessment, this is a quantitative evaluation and determines if BCR rankings would change with different assumptions.

Given that Horizon will assess project performance in three different futures, each of which have different income distributions and hence different average valuations of time (which is used to interpret accessibility benefits), sensitivity testing will not be done on valuation of travel time. The new approach to calculating the BCR introduces new variables over which sensitivity could be tested.

Sensitivity tests of the benefit-cost assessment may include:

1. Increasing capital cost estimates
2. Extending the duration of the construction timeline
3. Considering a longer stream of benefits and costs that spans 55 years
4. Increasing the discount rate for all benefits except natural resources to 7%
5. Lowering the discount rate for natural resources to 0%
6. Increasing the safety benefits of AVs (i.e. percent decrease in collisions) to 90%, 40%, and 10% in the horizon year for Clean and Green, Back to the Future, and Rising Tides Falling Fortunes, respectively

Attachment F - Guiding Principles Assessment

The Guiding Principles reflect the core aspirations for the Bay Area through 2050 – to create a region that is **Affordable**, **Connected**, **Diverse**, **Healthy**, and **Vibrant**. The Principles are intended to inform each of the key elements of *Horizon*, including analysis of projects in the Project Performance Assessment, the prioritization of policies in the Perspective Papers, and the selection of metrics & strategies for each future evaluated through the process.

Within the Project Performance Assessment, the Guiding Principles Assessment will be integrated as a secondary, qualitative assessment alongside the benefit-cost assessment. Unlike past long-range planning cycles, the assessment will be used solely to bring to attention when project impacts may not be supportive one or more of the Principles. As such, the criteria for the Guiding Principles Assessment are narrowly defined to focus on significant negative impacts associated with the project itself, rather than the performance of the jurisdiction(s) where the project may be located. The intent of the assessment is to bring to attention potentially significant adverse impacts that projects may have. **Table E.1** below shows the criteria for each of the Guiding Principles.

Table F.1: Framework for Guiding Principles Assessment

Guiding Principle	Evaluation Question *If yes, the project is not supportive of the Guiding Principle*	Application of Evaluation Question *For a project to be flagged as not supportive of the Guiding Principle…*
Affordable	**Does the project increase travel costs for lower-income residents?**	• The project would have to actively eliminate a lower-cost travel alternative, rather than just offering a new travel option.
Connected	**Does the project increase travel times or eliminate travel options?**	• The project would have to increase travel time for one mode without decreasing it for another mode; exceptions would be made for projects with significant safety benefits that justify increased travel times, or… • … the project would have to eliminate a modal option from a travel corridor.
Diverse	**Does the project displace lower-income residents or divide communities?**	• The project would have to directly displace lower-income households through site acquisition, or… • The project would have to build an elevated structure through an existing neighborhood.
Healthy	**Does the project significantly increase emissions or collisions?**	• The project would have to yield a significant long-term net increase in emissions and/or collisions.
Vibrant	**Does the project eliminate jobs?**	• The project would have to directly result in a net reduction of jobs.

The assessment will check each project for alignment with each principle with respect to no-project conditions. Each project would be flagged as either supporting a principle or not supporting a principle. The decision on how these flags would be used in the overall Project Performance Assessment will ultimately be set by the MTC Planning Committee.

Attachment G - Equity Assessment

The equity assessment will consist of two components to evaluate project-level impacts. The first component is a geographic assessment, following the same methodology in Plan Bay Area 2040. The second component is a quantitative assessment that examines distributive impacts of accessibility benefits across income groups, using Travel Model outputs. This methodology is still being evaluated for feasibility.

Geographic Assessment

This assessment measures whether projects would serve a Community of Concern (CoC). Using GIS, the assessment will check whether a project provide a point of access directly to one or more CoCs, and provide a Yes/No scoring. Revised definitions of CoCs that were adopted in early 2018 will be used for this analysis, updated with the latest available demographic data.

Accessibility Benefits across Income Groups

Note: This methodology is still being evaluated for feasibility

This methodology seeks to examine the distributive impacts of accessibility benefits across income groups using Travel Model outputs.

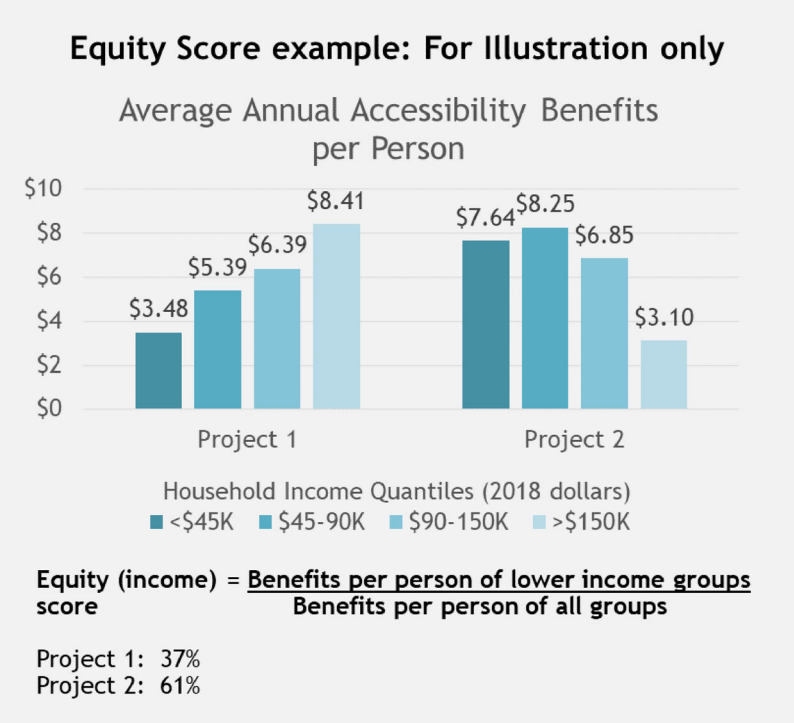
Travel Model 1.5 outputs of changes in accessibility benefits can be split by income group at the TAZ subzone levels[1]. The income groups were originally defined as approximate quartiles, but remained defined by income levels adjusted to 1999 dollars to be consistent with the requirements of the transportation model. The income categories, in 1999 dollars, are less than $30,000; from $30,000 to $59,999; from $60,000 to $99,999; and $100,000 and above. In 2018 dollars, the breakpoints between the categories are approximately $45,000, $90,000 and $150,000.

Average annual accessibility benefits per person can be calculated based on the model outputs and monetized using the same valuations that are used to calculate the benefit-cost ratio. An equity score can then be calculated as the ratio of benefits per person of the lower income groups to the benefits per person of all income groups, thus lending insight into which income groups benefit most from a project in terms of accessibility. This is illustrated in Figure G.1. A higher equity score means that a project provides more accessibility benefits to persons of the two lower income groups.

This methodology can be further extended by assigning weights to accessibility benefits of different income groups, based on the principle of diminishing marginal utility of accessibility gains, in order to calculate a weighted benefit-cost ratio. However, a sufficient methodology has not yet been found.

Accessibility benefits can also be split into population subgroups based on the number of vehicles in the household, and this will be explored to determine distributive impacts of projects on the basis of vehicle ownership. Given the current setup of the model, accessibility benefits cannot be split on the basis of age, race, gender or disabilities.

Figure G.1: Illustration of Equity Score Calculation for Two Sample Projects



1. TAZ refers to Transportation Analysis Zone; there are 1,454 TAZs in the Bay Area. TAZs are divided into subzones, which include ‘cannot walk to transit’, ‘short walk to transit’, and ‘long walk to transit’

Attachment H - Responses to Feedback Received post August RAWG

Benefits Estimation Methodology

Feedback		MTC Response
Accessibility	**How are accessibility benefits weighted by geography, as the use of household residence location-based weighing is biased against improvements in high job-density parts of the region where a greater proportion of travel is not household residence location based?**	Benefits from both household and non-household based trips accrue at the household level. However, we will not be attributing benefits to any particular geography given this is a regional assessment. Benefits of a project will represent the benefits delivered to the entire region.
	Consider measures of accessibility such as number of jobs or point-of-interest within X minutes of travel time by transit/driving.	This measure is implicitly taken into account in the calculation of the accessibility logsums, which represents utility. The closer destinations are to an individual or household (among various other factors such as cost, congestion etc.), the higher the utility. The destinations that the individual/household "chooses" is based on surveyed travel patterns, including "mandatory" trips (work/school) and "non-mandatory" trips (other points of interest such as park, grocery, etc.).
	Consider valuing recurring delay given this is substantial.	Recurring delay is estimated by the Travel Model and is one of the main inputs taken into account within the accessibility benefits. The travel time component of the accessibility logsums takes into account the free-flow time and recurring delay.
	Transit crowding may be a disbenefit for its users, but is it a benefit for the overall transportation network.	The accessibility benefits due to a project are the aggregate of benefits experienced by individuals in their use of the transportation network. The methodology thus captures benefits and disbenefits as experienced by all people within the network simultaneously. In this example of transit crowding, while some users may experience an accessibility loss (disbenefits) since their transit travel is crowded, other users may experience an accessibility gain (benefit) since there may be fewer auto trips and faster travel times.
Reliability	**"Inclusion of roadway reliability improvements but not transit reliability improvements may provide roadway projects benefit opportunities unavailable to transit projects." Was consideration given to quantifying transit travel time reliability benefits? Will there be a way of capturing travel time reliability improvements as a benefit in project scoring elsewhere?**	Travel Model 1.5 will capture both transit delay and transit crowding – a top priority for improvement during the development cycle for the new model. However, due to limited resources, the model cannot currently estimate a distribution of transit travel time. We recognize that improving transit reliability is also an important topic. Capturing explicit benefits of transit reliability may potentially be a topic of research for the next iteration of the Travel Model. In this assessment, potential benefits to transit travel time reliability due to a project can be captured qualitatively in the confidence assessment.
Emissions	**Use domestic valuation for emissions since global valuation is no longer acknowledged by federal government.**	Comment noted. However, the valuation proposed is consistent with other agencies in the state of California.
	Capture environmental effects of power plants that generate electricity for electric vehicles -	Environmental effects of power plants (i.e. upstream emissions) are applicable not only to electric vehicles, but also to conventional vehicles and transit. To

Feedback		MTC Response
	current methodology gives no disbenefit to electric vehicles over biking/walking,	consider this "wells-to-wheels" effect, we would have to make various assertions and assumptions, such as the projected change in the Bay Area's energy sources in the future, time of day that people charge their vehicles, improvements in battery technology to store energy, etc. Given resource constraints, and based on the recommendation of our state partners that such effects are taken into account by other partner agencies, we are choosing to focus on tailpipe emissions. We do recognize that the current methodology gives no disbenefit to EVs over biking/walking in terms of emissions, but there is disbenefit given to the congestion that EVs contribute to, as well as to vehicle ownership costs and operating costs per mile (which include the cost of electricity).
	Are valuations of emissions for horizon year only? In PBA2040, didn't some valuations vary by year?	PBA2040 calculated costs only for the horizon year, and so there was no need to consider valuations by year. However, in Horizon, valuations can be considered for multiple years, as this is available from the source. Please refer to the updated Table B.1.
Safety	**Is MTC providing guidance on what specific types of operational improvements may provide safety benefits?**	The list of Crash Reduction Factors (CRFs) that will be used are listed in Table A.2. Given feedback during RAWG that projects may not have design detail, we will consider only few specific safety improvements and associated CRFs that align with the typical profile of projects that have been submitted.
	Clarify calculation of change in number of collisions.	Please refer to updates in Table A.1, including the endnotes.
	Explain how to interpret Crash Reduction Factors (CRFs).	Please refer to updates in Table A.1, including the endnotes.
	Are only roadway operational improvements considered, as use of VMT as method for estimating collisions is only applicable to roadway? Also, is such VMT estimate link-specific / local, or based on some buffer of proximate links?	Based on the updates in the methodology, change in collisions arising specifically from safety improvements are not calculated using VMT. Please refer to Table A.2 for the specific improvements considered. Collisions are not limited to auto collisions; most transit and ped/bike collisions are accounted for as well, since they are part of the collision data in the TIMS database. Please note that the methodology to estimate change in collisions as a result of change in VMT continues to be used, as in PBA2040. The VMT-based estimate of collisions is not link-specific. It is based on area type (urban/rural), facility type, and the number of lanes.
	Inclusion of safety benefits and use of Crash Reduction Factors (CRFs) may provide roadway projects benefit opportunities unavailable to transit, pedestrian and bicycle projects.	CRFs are included for transit/ped/bike improvements; please refer to Table A.2. As mentioned above, CRFs of roadway projects will be applied to the collisions at that location, whether they are auto, transit, ped or bike.
	Negative Crash Reduction Factor (CRF) (i.e. increase in crashes) for lane expansion is only for 4 to 5 lane expansion - do other similar lane expansions *not* cause negative CRF?	Please refer to the updates in Table A.2. The prior table simply showed some example CRFs, rather than the all-inclusive list.

Feedback		MTC Response
	Are projects that increase VMT (w/o any explicit safety countermeasures) decreasing safety and by extension increasing costs?	Since our method to calculate change in number of collisions is based on VMT, and the change is positively correlated with increase in VMT, any project that increases VMT will 'increase' the number of collisions, which is a disbenefit to the project (not cost). This is the same methodology as in PBA2040.
	Having "Safety" address only road and highway projects, without considering transit systems, overlooks a major statutory initiative of the Federal Transit Administration. Why?	As mentioned in the updated methodology, in Table A.1, both methods (i.e. VMT-based method and CRF method) take into account transit, pedestrian and bicycle collisions. SWITRS data as reported in TIMS indicates if the collision involved a transit vehicle or ped/bike. (https://tims.berkeley.edu/)
Physical Activity	**Physical Activity - Please provide methodology?**	Please refer to updated document for the methodology used to capture benefits from increased physical activity, in Table A.1. Note that an R-based ITHIM tool is in development by Neil Maizlish at UC Davis. This is expected to be ready in time for Project Performance runs, and will be tested for feasibility.
Noise	**Are noise benefits / disbenefits allocated by proximity (i.e. exposure)? How does this relate to equity analysis?**	While no changes have been made since the last project performance assessment, we have made a simplifying assumption. Detailed modelling would require resources we do not have. We do however conduct noise impact modelling in the EIR.
	Why do [noise] auto costs increase due to inflation, but truck costs do not?	Both auto and truck noise costs have been adjusted for inflation. This is not apparent in the numbers shown due to rounding.
Natural Land Value	**Clarify position on natural lands from an accounting perspective - since conversion of land can lead to tax revenue / higher productivity and output.**	Economic impacts are not considered within the benefit-cost assessment for two reasons. First, the causal relationship between travel time savings (from a project) and economic development is difficult to quantify and MTC does not currently have a method for developing this estimate at the project-level, especially given the wide variety of projects being evaluated. Second, economic impacts are examples of "follow-on" benefits that indirectly follow cost and time savings from the project. Adding the economic benefits to the benefit-cost assessment might lead to double-counting of the direct travel time and cost benefits. On the other hand, the disbenefit from the conversion of natural lands that is being considered in this assessment represents a loss of social benefit that the land currently offers, expressed as a monetary value.
	We also encourage MTC to consider additional ways the Greenprint tool could be used in the PPA process, such as an assessment tool for hazards and a method to investigate the impacts of a proposed transportation project on existing urban greening amenities or urban greening needs.	Comment noted. The disbenefit from replacing natural lands with transportation projects would primarily apply to projects in non-urbanized areas, but also those that may take over natural land that is located in undeveloped locations within the urban footprint, as per the suggested land categories. Transportation projects will not be assessed relative to other potential uses of land that do not already exist.
Other	**What about land developed into housing / other uses due to transportation expansion (induced demand)? We also encourage MTC to**	We are limited by model run times and cannot evaluate land use impact at a project level. Land use impacts will certainly be modeled through the futures to understand induced development patterns.

Feedback		MTC Response
	consider how the transportation projects under review may induce particular development patterns and include an estimation of the effects of this induced development in the Benefit/Cost analysis.	
	Hedonic pricing of homes - Post processing forecast on hedonic pricing of homes from policies being considered in the travel demand model.	This is done through the interaction of the land use model (UrbanSim) and travel model through the futures - accessibility outputs from the travel model are inputs into the land use model. However, compute time requirements prohibit such feedback between the models at the project level.
	Table A.1 - separate benefits from disbenefits or add another column to indicate how each factor correlates with project benefits.	A new column "Accrual" has been added to Table A.1 to clarify this.
	Are there any means to account for weekend travel since the proposed analysis would certainly undermine the benefits of projects that have extensive use outside peak work week travel?	The modelling is for a typical weekday (in the horizon year 2050) for five time periods – early morning, AM peak, midday, PM peak, late evening. There is no means to account for weekend travel within the current model framework. If a project caters specifically to addressing weekend congestions, this will be highlighted within the confidence assessment. There will also be other avenues later on the process to raise this, by submitting a compelling case, as we have done in the past.
	Consider shovel-ready projects vs. visionary projects and also projects that complement and/or complete other projects such as "gap closure projects"	All projects will need to be evaluated consistent with other projects. Existing projects AND committed projects are part of the baseline network; so if the project being evaluated is complimentary, the effect would be captured.

AV/EV Assumptions

Feedback	MTC Response
Assumptions about electric vehicle fleet penetration and the potential effects are largely speculative and may result in modal biases when calculating benefits. What is the basis for assumptions about EV penetration in the fleet mix?	The assumptions for EV penetration in the horizon year were defined by experts when the three diverging futures were ascertained. This process involved peer exchange, gathering feedback from partners, and developing what-if scenarios. As an overall note, Horizon attempts to stretch assumptions to stress-test the benefits of projects and some of these assumptions may be considered speculative. The Preferred Scenario for Plan Bay Area 2050 will be based on assumptions in the state's EMFAC emissions model, as in the past cycle.
What is the relationship between EV penetration and AV penetration?	There is no specific relationship defined. EV penetration, as shown as a percentage of fleet in the endnotes of Attachment A, will be applied to both AVs and conventional vehicles uniformly.
Will EV penetration assumptions be varied for all project evaluations?	Yes – all projects will be evaluated with same assumptions. Please refer to the updated document for more information on trajectories towards the penetration rate in the interim years and other questions.'
Does EV fleet penetration affect noise?	We will not be investigating this effect at this point due to limited resources.

Feedback	MTC Response
What is the basis assumptions about AV penetration in fleet mix? Is fleet mix or "trip mix" the right measure (i.e. will AVs be individually owned or part of managed fleets)? Will a variety of AV assumptions be made within each one of the larger Futures scenarios?	Assumptions on penetration of AVs for each future have been added to the endnotes of Table A.2. The percentages refer to fleet mix, as decided during the process of developing the assumptions for the futures.
Assumptions about the potential safety benefits of automated vehicles are largely speculative and may result in modal biases when calculating benefits. What empirical evidence is used to justify assumption that AVs will provide safety benefits?	Safety benefits of AVs will be considered in the 'Clean and Green' and 'Back to the Future' futures, where the AV fleet penetration is 95% and 75% by the horizon year, respectively. We intend to use assumptions from the Future Mobility Research Program work, including a Delphi survey conducted with subject area experts (e.g., 40% to 90% reduction in collisions in fully-automated future based on survey results). The trend towards this reduction in collisions would not be assumed to be linear; we are cognizant of research on the potential disbenefits of mixing of human/AV fleets. We recognize the speculative nature of these assumptions, and we intend to highlight this in the methodology and the Confidence Assessment. Please find specific assumptions on percentage decrease in collisions in the updated document.
Assumptions about electric vehicle fleet penetration and the potential effects are largely speculative and may result in modal biases when calculating benefits. What is the basis for assumptions about EV penetration in the fleet mix?	The assumptions for EV penetration in the horizon year were defined by experts when the three diverging futures were ascertained. This process involved peer exchange, gathering feedback from partners, and developing what-if scenarios.

Benefit Valuations

Feedback	MTC Response
Are the current TM2 implied regional wage rates consistent with current median regional wage rate ($25.43)?	The input data into Travel Model 1.5 on persons is derived from PUMS data and is described here: https://github.com/BayAreaMetro/modeling-website/wiki/PopSynPerson. Income is available only as an annual gross personal income (which may include sources apart from wage). For all persons employed full-time, the median figure is $54,390 (in 2018$). The median regional wage rate used for valuation, $25.43, times 2,000 working hours in a year is $50,860.
Why are auto operating costs lower in Horizon than in PBA2040? If $0.20 is assumption based on efficiencies in 2050, are higher values used in interim years, before these efficiencies are achieved?	Auto operating costs of $0.20 is based on fuel and maintenance/repair costs. This is not used explicitly for calculating benefits; it is an input into the Travel Model logsum calculations. The value of $0.30 stated previously included depreciation costs, but regardless, it was never used for any purpose, since the input to TM1 did not include depreciation either.
Do transit O&M costs also reflect these types of efficiency gains?	Aside from the fact that the auto operating costs do not represent efficiency gains, if sponsors believe that O&M costs have efficiency gains, this should be part of the factsheets. We do not assume any change in the cost to traveler as a result of changes in transit O&M. Fares stay consistent with today's fares in real terms.
Do auto operating cost assumptions vary by year (for interim year forecasts required for calculating present value) ?	Auto operating cost inputs do vary in interim years. The last column in Table B.1 has been updated to reflect this.

Feedback	MTC Response
What does "no major external forces $31.18" under auto operating cost mean?	This was a typo and has been corrected.
Auto ownership valuation seems to lower than other published data - could source link be provided?	The valuation represents average ownership costs across all vehicle types, as found in: https://newsroom.aaa.com/tag/driving-cost-per-mile/. The valuation will be aligned with that used in the Travel Model.
Why are the fatality, injury, and property damage valuations lower in Horizon than in PBA2040?	This is due to updated guidance from USDOT. The valuation in the Horizon methodology reflects the latest USDOT guidance that was released in 2016.
Are there costs associated with re-use of urbanized lands for transportation infrastructure?	The methodology does not count this as a disbenefit.

Cost Estimation

Feedback	MTC Response
What does "upfront investment cost" mean?	This refers to the initial capital costs of construction/implementation.
Are financing costs considered? If so, what are these assumptions? If not, does timing of project reflect when 100% of funds are available? If new method captures benefits of quick implementation, does the method assume we have all the money required for such an implementation?	Guidance for benefit-cost analyses suggests that costs should be recorded in the year they are expected to be incurred, regardless of when payment is made for those expenses. We expect similar benefit-cost results regardless of whether costs are incurred upfront or over a long-term debt repayment plan. This is because we are proposing to discount present value of costs using a real discount rate.
Note that incorporating the lifecycle costs is a significant change from prior PBA cycles, and will likely result in a significant increase in project costs, especially for projects such as transit vehicles.	Yes, this is the correct, especially since we would like to analyze project benefits uniformly across all projects for the same analysis period. Project benefits would see a similar significant increase.
The memo indicates MTC will net out transit revenue from costs. How will this strategy apply to projects such as a means-based fare program? For projects that will see revenue from tolling, will that also be netted out of the project cost?	This has been revised in the updated methodology. Best practice in B/C ratio calculation suggests that since all tolls/transit fares are transfer payments, they should not be counted as benefits or costs - they should simply not appear in the calculation. The impact of this is discussed in Attachment C.
What is the temporal resolution of the benefits stream? What intervals required to capture the non-linear time effects of different costs and benefits (e.g. EV fleet penetration over time, and the impacts on emissions valuations)? At what intervals (for what years) will TM2 be run to calculate the stream of benefits? At what intervals (for what years) will REMI and UrbanSim be run?	The forecast of the benefit streams will be based on the results of Round 1 Futures runs, which include committed projects and projects that were rated as "high performers" from PBA2040. We plan to iteratively run both Travel Model 1.5 and UrbanSim models starting in 2015 at the least for every 10 year interval, but if possible at 5 year intervals. This will provide us metrics to be used as proxies to estimate benefits of projects over time. While it would be ideal to run the models iteratively for every individual project as well, the compute time requirements would be prohibitive barring a drastic reduction in run times of the models. REMI outputs have already been generated for every 5 year interval until the horizon year.

Feedback	MTC Response
When is information in the stream is updated directly versus interpolated, as these will all influence the present value?	Benefits for projects will only be calculated for horizon year and interpolated using proxies from the futures iterative model runs, as discussed above.
There should be accounting for the value of time in calculating benefits and cost.	The discount rate within the methodology accounts for the time value of money.
What method or tool will be used to determine the residual value of a certain project?	Please refer to Table A.3 in the methodology.
The proposal to look at different capital costs, construction timelines, longer benefit streams and different discount rates, and how these relate to confidence intervals, and relationships to other assumptions (e.g. different land use, different EV/AV penetration rates) is appropriate, but transparency about how each of these assumptions influences individual project evaluations is essential.	Please refer to the Sensitivity Analysis (Attachment D) for the assumptions we would look to test. Adjusted outputs will be provided for outputs such as the B/C ratio, equity score, guiding principles assessment, for each future.

Benefit-Cost Ratio Calculation

Feedback	MTC Response
Discount rate of 7% is too high relative to those used elsewhere (e.g. 2% is used by FTA).	The 2% rate used by FTA, which represents U.S. Treasury bond rates, is for cost-effectiveness analyses, which is different from benefit-cost analyses that quantify public benefits such as travel time savings or collision reductions. US Office of Budget and Management (OMB) suggests a discount rate of 7% for all B/C analyses that involve benefits to the general public, which represents the real discount rate on private investment. Based on the feedback received, we have revised the discount rate to be used as 4%, which reflects Caltrans guidance for B/C analyses.
We recommend that MTC uses a 0% discount rate for natural lands, rather than the proposed 3.5% annual discount rate, to better align with the scientific consensus regarding the ongoing benefits these lands provide.	The discount rate for natural resources has been lowered to 2.5%, to be consistent with other Bay Area agencies.
Starting analysis period in 2021 is disadvantageous for megaprojects that may not start until later. Suggestion to start the analysis period at the potential year of project adoption.	To evaluate all projects along similar timelines, and to keep the analysis consistent and easier since we are evaluating over 90 projects, we will start the analysis period on one single year. We have changed this from 2021 to 2025 based on feedback that the next plan will be released only in 2021, and also that sponsors have indicated the potential start date of most projects across the entire decade from 2021-2030.
Analysis period of 30 years is not sufficient.	Please refer to the updated methodology - analysis period has been extended to 35 years including construction time (55 years for sensitivity analysis). Longer analysis periods are generally not

Feedback	MTC Response
	considered since there is a limit to the utility of modeling project benefits over very long time periods. This methodology would generally account for 25 years of operation post construction at a minimum, if not more (45 years in the sensitivity analysis).
If lifecycle of project is less than analysis period (considering both project completion date and 2050 horizon date), how is this handled? How does lifespan vary by project, and what is the interaction between project timing (when project comes online and benefits accrue), project life span and calculation of present value? Does method account for when projects come online?	If this comment is referring to the life of a capital investment being less than analysis period, then the methodology calls for a re-investment in the capital asset at the end of its useful life, for replacement. Please refer to the details of the methodology in Attachment C.
Does return on investment figure into the analysis (e.g. one could have a project with a modest BC ratio, but with a huge net return)?	We intend to display the B/C ratio along with the magnitude of incremental benefits and costs as well. When comparing a large number of projects, the B/C ratio best helps identify effective ways to spend constrained financial resources, but the magnitude of the benefit will also be considered. In reviewing the methodology, it is important to recognize that the intent of this assessment is to make broad comparisons with the best information available and identify outliers.
Use annualized cost formula as in FTA's Standard Cost Category worksheets for residual value.	While the methodology to calculate costs is equivalent to this formula in the FTA SCC worksheet, given we are considering both benefit and cost streams over the analysis period, and that benefit streams will have varying trajectories by future, we will not be using this formula.
Some useful life assumptions maybe too short; refer to FTA's guidance.	These will be reviewed with the cost consultant and will be determined in line with federal/state guidance as well. We are also using useful asset life benchmarks that agencies self-report to MTC to cater to conditions in the Bay Area.
Add bike lane to asset classes.	Bike lanes will be classified under pavement

Guiding Principles Assessment

Feedback	MTC Response
It is still difficult to imagine what types of projects would be flagged as not supportive of the guiding principle using the evaluation criteria. What types of projects do you anticipate would perform poorly for each?	The purpose of this assessment is to bring to attention when a project has an impact that does not align with the Guiding Principles. The following example project types may have impacts that are not supportive of the guiding principles: *Affordable - New train service that eliminates a cheaper bus option *Connected - Express lane project that increases travel time for general purpose lanes *Diverse - Building a connected roadway that displaces households, or an elevated transit line through an existing neighborhood *Healthy - A roadway project that leads to greater auto usage (and thereby greater emissions) relative to a no-project scenario *Vibrant - Autonomous shuttle project to replace existing bus routes
Penalizing transit projects with aerial structures to avoid dividing communities could deter transit-oriented development or lead to prohibitive costs (for underground) /	Building elevated structures that divide existing communities or land acquisition that results in displacement of lower-income households does not align with the Diverse principle. If the project improves job access, these effects will be reflected in the accessibility benefits within the Benefit-Cost Assessment. Division of communities or

Feedback	MTC Response
projects with land acquisition for new stations in low income neighborhood would be unfairly penalized even if it improved job access.	displacement of households however is a critical impact that the Guiding Principles Assessment seeks to bring to attention. All the assessments (i.e. Benefit Cost, Guiding Principles and Equity) will be taken into account together in evaluating the projects.
Affordable: How would you evaluate tolling projects such as cordon pricing? Currently driving may be the lowest-cost mode, which would be priced higher under a cordon pricing situation. Would MTC consider a project to still be considered affordable if additional transit service is provided, with upgrades to bicycle and pedestrian access?	If the project eliminates a lower-cost travel alternative for low-income residents, it would not align with the Affordable principle, unless the project has provisions to maintain the existing cost. In the case of a cordon pricing project, drivers who would otherwise not pay a toll and who may not have a convenient transit alternative would lose an existing affordable option. The Guiding Principles Assessment seeks to bring to attention that such a project has impacts that do not support the Affordable principle.
Healthy: We could imagine a project that would significantly increase VMT (and potentially trigger higher rates of collisions) but, depending on assumptions about EV adoption, could still result in a net decrease in emissions. How will MTC address these tradeoffs since a healthy transportation system isn't as straightforward as simply looking at emission reductions?	The Guiding Principles Assessment checks for alignment with principles with respect to a no-project scenario in the horizon year, within the same future. A project that significantly increases VMT relative to the no-project scenario would increase emissions regardless of the EV assumptions. Further, based on this feedback, we have added an evaluation question based on collisions to the 'Healthy' principle, please refer to the updated table F.1.
Recommend penalizing flagged projects only if they are on the margin of the benefit-cost threshold for high performance - Flagged projects close to the threshold could move out of the high priority category, and non-flagged projects just below the threshold could move into the high priority category.	The Guiding Principles Assessment will be applied uniformly to all projects, independent of the Benefit-Cost Assessment, to highlight potential impacts that may not be captured within the Benefit-Cost Assessment. The framework for evaluation of projects based on the results of all three assessments (Benefit-Cost Assessment, Guiding Principles Assessment and Equity Assessment) will ultimately be set by the MTC Planning Committee in 2019.

Equity Assessment

Feedback	MTC Response
Number of Jobs within 30 mins of transit for areas with higher than average percent of low income households, elderly population, population with disabilities.	Please refer to the Attachment F in the document for the updated methodology. We may explore more methods such as this down the road, especially related to the futures equity assessment, but are unable to commit to such methods as of now due to resource constraints.
Please confirm you will use the Communities of Concern (COC) definitions approved earlier this year by the SFCTA Board and by MTC staff.	Yes, confirmed. Also, we will update the definitions using latest available demographic data when we conduct the assessment.
How will equity analysis consider exposure/proximity (emissions, noise)? Are emissions quantified at regional level, or sub-regional level?	Emissions are quantified only at the regional level for the Project Performance Assessment. We do not have a methodology or resources to capture effects of emissions or noise at a sub-regional level to conduct such an equity analysis. Hence, the equity analysis at the

Feedback	MTC Response
Is there an emissions exposure component to the equity analysis to capture negative health effects?	project level will not consider exposure/proximity, with the exception of transit access points in COCs.
Is equity analysis focused on accessibility (as the analysis in PBA2040 did)?	The analysis in PBA2040 focused more on geographic location of transit access points. While we will repeat this assessment, we have also proposed a new methodology (to be tested for feasibility) that focuses on accessibility impacts across income groups.
Will this assessment use disaggregate activity based model (ABM) outputs rather than aggregate geographic outputs?	Yes, the new methodology outlined for the equity assessment relies on these disaggregate outputs. Please note that model outputs (i.e. change in logsums) are "disaggregate" in that they represent an average household belonging to a specific income group within each TAZ. They are not fully disaggregate for each individual household.
Could equity analysis be more rigorous that "targets assessment" (i.e. incorporate data from BCA more directly/explicitly)? Could equity analysis exploit disaggregate nature of Travel Model Two rather than rely on aggregate COC geographies, to avoid aggregation biases?	Yes, the new methodology attempts to do this.
Prior COC analysis has acknowledged that half of Bay Area population qualifying for low income/minority status under the COC definition live outside of COCs. How will the equity analysis capture benefits of projects to that population?	We hope to overcome this issue with the proposed methodology. The methodology calculates total change in accessibility benefits of people belonging to different income quantiles, regardless of their location in the Bay Area.
When will the Regional Equity Working Group (REWG) be convened to allow the community to discuss these important considerations for a significant portion of the Region's population?	Equity stakeholders have been invited and are welcome to attend the RAWG meetings and provide feedback. As needed, equity stakeholders will convene as a working group during the Plan Bay Area 2050 process.
Fundamental to the success of the Sustainable Communities Strategy is the performance of Priority Development Areas (PDAs) in meeting the goals of VMT reduction, inclusive housing for all, adequate levels of transit service, various community amenities, and resistance to sea level rise. Yet the methodology and current documentation address these key issues to a limited extent, if at all.	This is not within the scope of Project Performance Assessment, and will be addressed during Plan Bay Area 2050. This topic is also being discussed in the development of the Perspective Paper on Regional Growth Strategies.
Finally, we are attaching two letters sent to MTC earlier this year which provide information that makes it clear Plan Bay Area 2050 needs to be significantly different from PBA2040 if the Sustainable Communities Strategy is to be a success.	Thank you for your input on Plan Bay Area 2050. Horizon attempts to set a stage for the development of the plan and we look forward to taking this feedback and working with all stakeholders during the Plan Bay Area 2050 process.

PROJECT PERFORMANCE ASSESSMENT

HORIZON

Attachment B: Draft List of Major Transportation Projects (Total: 93 Projects)

A. Uncommitted Major Projects from Plan Bay Area 2040 (>$250 million)		31 Projects
Local & Express Bus	1	AC Transit Local Service Frequency Increase
	2	Sonoma Countywide Service Frequency Increase
	3	Muni Forward + Service Frequency Increase
Bus Rapid Transit (BRT)	4	San Pablo BRT
	5	Geary BRT (Phase 2)
	6	El Camino Real BRT
BART	7	BART Core Capacity
	8	BART DMU to Brentwood
	9	BART to Silicon Valley (Phase 2)
Commuter Rail	10	Caltrain Downtown Extension
	11	Caltrain Modernization (Phase 2)
	12	SMART to Cloverdale
Light Rail (LRT)	13	Downtown San Jose LRT Subway
	14	San Jose Airport People Mover
	15	Stevens Creek LRT
	16	Vasona LRT (Phase 2)
	17	Eastridge LRT
Ferry	18	WETA Service Frequency Increase
	19	WETA Ferry Network Expansion (Berkeley, Alameda Point, Redwood City, Mission Bay)
Pricing	20	Regional Express Lanes (MTC + VTA + ACTC + US-101)
	21	SR-239 Tollway
	22	SR-152 Tollway
	23	Downtown San Francisco Congestion Pricing
	24	Treasure Island Congestion Pricing
Freeways & Interchanges	25	I-680/SR-4 Interchange + Widening (Phases 3-5)
	26	SR-4 Operational Improvements
	27	SR-4 Widening (Brentwood to Discovery Bay)
	28	I-80/I-680/SR-12 Interchange + Widening (Phases 2B-7)
Other	29	Bay Bridge West Span Bike Path
	30	Bay Area Forward (Phase 1)
	31	Better Market Street

B. Transformative Projects from Public Agencies (>$1 billion)			37 Projects
Local & Express Bus	32	AC Transit Transbay Service Frequency Increase	
	33	AC Transit Rapid Network	
BART	34	I-680 BART	*
	35	BART Evening Service Frequency Increase	
	36	BART to Cupertino	*
	37	BART to Gilroy	
	38	BART Gap Closure (Millbrae to Silicon Valley)	*
Commuter Rail	39	Caltrain Grade Separation Program	
	40	Caltrain Enhanced Blended System	
	41	SMART to Solano	
	42	Dumbarton Rail	*
	43	ACE Expansion	
	44	Valley Link (Dublin to San Joaquin Valley)	
Light Rail (LRT)	45	Cupertino-Mountain View-San Jose Rail Loop	
	46	SR-85 Rail	
	47	North San Jose LRT Subway	
	48	VTA LRT Elevation	
	49	Muni Metro Southwest Subway	*
	50	Muni Metro to South San Francisco	*
	51	Fremont-Newark LRT	
Freeways & Interchanges	52	SR-37 Widening + Resilience Project	*
	53	SR-12 Widening	
	54	SR-92 Widening	
	55	I-580/I-680 Corridor Enhancements	*
	56	San Francisco Freeway GP-to-HOT Lane Conversions	*
Bridges & Tunnels	57	Richmond-San Rafael Bridge Replacement	
	58	Webster/Posey Tube Replacements	
	59	SR-87 Tunnel	
Networks *Individual components of network proposals may be required to undergo further project-level analysis for consideration in Plan Bay Area 2050.*	60	South Bay Rail + Resilience Project	
	61	Megaregional Rail Network + Resilience Project	*
	62	VTA LRT/BART South Bay Network	*
	63	I-80 Busway + BART to Hercules	*
	64	Oakland/Alameda Gondola Network	
Multimodal / Next Generation	65	Alameda County BRT Network + Connected Vehicle Corridors	*
	66	I-680 Multimodal Improvements (BRT, SAVs, Gondolas)	*
	67	Contra Costa Autonomous Shuttle Program	*
	68	Mountain View Autonomous Vehicle Network	*

** Submitted by member of public/NGO as well (either partially or fully)*

C. Transformative Projects from Individual/NGOs (>$1 billion)			6 Projects
Jury Selected *Individual components of network proposals may be required to undergo further project-level analysis for consideration in Plan Bay Area 2050.*	69	**Optimized Express Lane Network + Regional Express Bus Network**	
	70	**Bus Rapid Transit (BRT) on All Bridges**	
	71	**SMART to Richmond via New Richmond-San Rafael Bridge**	
	72	**I-80 Corridor Overhaul**	
	73	**Regional Bicycle Superhighway Network**	**
	74	**Bay Trail Completion**	**
D. Transformative Operational Strategies			**6 Projects**
Jury Selected	75	**Integrated Transit Fare System**	
	76	**Free Transit**	
	77	**Higher-Occupancy HOV Lanes**	
	78	**Demand-Based Tolls on All Highways**	
	79	**Reversible Lanes on Congested Bridges and Freeways**	
	80	**Freight Delivery Timing Regulation**	
E. Transbay Crossing Projects			**6 Projects**
Crossings	81	*Bay crossing project #1*	
	82	*Bay crossing project #2*	
	83	*Bay crossing project #3*	
	84	*Bay crossing project #4*	
	85	*Bay crossing project #5*	
	86	*Bay crossing project #6*	
F. Resilience Projects			**7 Projects**
Earthquakes	87	BART Caldecott Tunnel Resilience Project	
Sea Level Rise	88	I-580/US-101 Marin Resilience Project	
	89	US-101 Peninsula Resilience Project	
	90	SR-237 Resilience Project	
	91	Dumbarton Bridge Resilience Project	
	92	I-880 Resilience Project	
	93	VTA LRT Resilience Project	

*** While recognized by the jury as transformative transportation investments, this project may not go through benefit-cost analysis/project performance as it is considered non-capacity-increasing under federal guidelines.*

**** Bay crossing projects are still being defined as part of Horizon Perspective Paper #4 - Bay Crossings - in collaboration with regional and local partner agencies.*

A handful of additional projects not previously assessed in Plan Bay Area 2040, costing between $250 million and $1 billion, are likely to be submitted for evaluation in early 2019 via the Call for Projects.