ConnectSF

Active Transportation Study – Preferred Network Option & Evaluation Framework Methodology Memo

SUMMARY AND PREFERRED NETWORK OPTION

This is the final memo for the Active Transportation Study. This memo identifies the Preferred Network Option for the Active Transportation Study and the process used in its selection. The Preferred Network Option is the "Equity Access" network, which prioritizes bike network development in Equity Priority Communities and access to "Mobility Hubs" across the city. Through prioritization of Mobility Hub access, meaning easy access existing or future rapid transit by means of a wide variety of active transportation options, this preferred network will optimize multi-modal travel times for residents across the city's west, south and southeast.

Figure 1: Preferred Network Option

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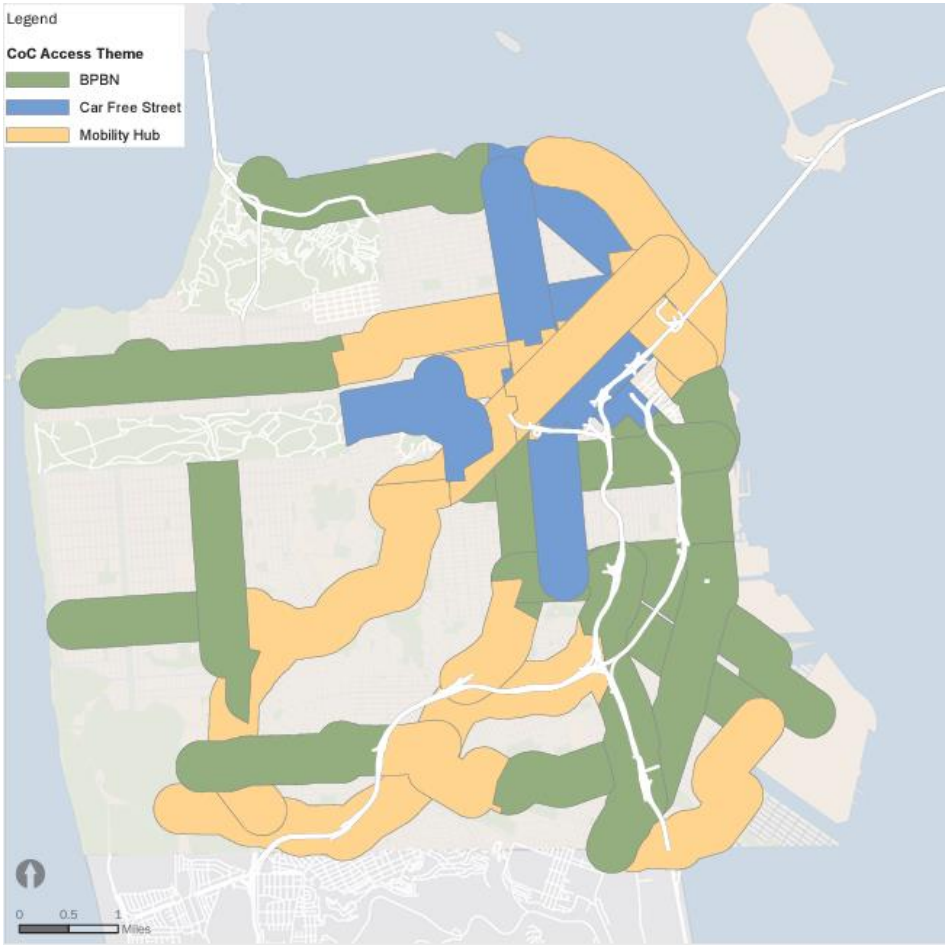

This network option was selected after being run through an Evaluation Framework that measured a range of technical criteria, cost effectiveness, and public input for three different Network Builds.

BACKGROUND

The previous memo outlined the process that the ATS team took in developing the network builds. Following completion of the network build task, the team moved forward with the evaluation of the builds.

The purpose of the Evaluation Framework is to score and prioritize the three different network builds for the Active Transportation Study. The Evaluation Framework should be able to gauge how well each network build advances the five goals of ConnectSF.

The Evaluation Framework represents a final step for the ATS in ConnectSF, meant to inform a preferred network build option that can be integrated into the Transportation Element update.

At the end of this memo is a discussion of constraints the ATS team encountered in the development of the Evaluation Framework, which influenced the choices made for evaluation criteria and the technical process of evaluation.

METHODOLOGY

The ATS team developed a draft Evaluation Framework in January, loosely based off of the framework developed for the Transit Corridors Study. The ATS team began with the metrics identified in the Data Profiles Memo, then assessed the applicability of those metrics to an Evaluation Framework. Potential metrics were evaluated for their applicability, relevance to ConnectSF Goal Areas, and likelihood to display differentiation between network build options. To understand equity impacts, several of the metrics are looked at by Equity Priority Communities (EPCs, formerly known as Communities of Concern) and by low-income households. These metrics were used in the Corridor and Zone analysis that informed the development of the Core Network and the three Network Build alternatives.

Table 1: Initial Metrics

Criterion	Metric	Equity	Environmental Sustainability	Economic Vitality	Safety & Livability	Accountability & Engagement
1	Bike Mode Shift		x			
1a	… in EPCs	x				
1b	… for Low-Income HHs	x				
2	Increase in Short Trips		x		x	
2a	… in EPCs	x				
2b	… for Low-Income HHs	x				
3	Coverage of HIN				x	
3a	… in EPCs	x				
4	LTS 1/2 Access to Regional/Rapid Transit			x		
4a	… in EPCs	x				
5	LTS 1/2 Access to Activity & Job Centers			x		

5a	… in EPCs	x				
6	Maximize Cost Effectiveness					x

Narrowing Metrics

The project team narrowed these metrics in order to establish a final set of evaluation metrics. The criteria for narrowing these metrics were:

- Availability of data/analysis
- Applicability to the corridors in the 3 network builds
- Criteria delivering actionable results for evaluation purposes
- Narrowed criteria still representing all ConnectSF Goal Areas

As expanded upon further at the end of this memo, constraints in the SF-CHAMP model were such that it was not feasible to evaluate citywide outcomes from changes in the bike network such as mode shift, safety impacts, or reductions in GHG. Because of these constraints, evaluation instead focused on the likeliest corollaries to positive outcomes associated with the different ConnectSF Goal Areas.

Table 2: Metrics for the Evaluation Framework

	Metric	ConnectSF Goal Area
1	Coverage in High-Growth areas	Environmental Sustainability
1a	… in Equity Priority Communities	Equity
2	Coverage in High Short-Trip/High Car-Trip areas	Environmental Sustainability
3	Coverage of High Injury Network	Safety & Livability
3a	… in Equity Priority Communities	Equity
4	Level of Traffic Stress 1/2 in Access to Regional/Rapid Transit	Economic Vitality
5	Level of Traffic Stress 1/2 in Access to Activity & Job Centers	Economic Vitality

All three Network Build options had comparable costs, especially when compared to counterpart projects for the Transit Corridor Study or the Streets & Freeway Study. Because the Evaluation Framework's purpose is to score differentiation between Network Builds in order to select a Preferred Network Option, "Project Cost" as a metric was eliminated from evaluation because it

would render equal scores across all three Network Builds, contributing no differentiating information for evaluation purposes.

GIS ANALYSIS

All analysis of metrics for the Evaluation Framework were conducted in GIS. Staff obtained relevant spatial data as inputs for the analysis, and the methodology for measuring each metric is listed below. Each metric represents its own spatial map, identifying areas with the greatest correlation to positive active transportation outcomes. For example, a spatial map representing high-growth areas correlates to a higher potential for new trips to be made by active modes. As another example, a spatial map representing activity & job centers represents the potential to support economic vitality through more trips by active modes.

Table 3: Data sources used for each Evaluation Framework metric

Criterion	Metric	Data and source	Methodology
1	Coverage in high-growth areas	2015 and 2050 Land Use Allocation (number of people and jobs) by TAZ *Source: ConnectSF*	GIS analysis to calculate coverage of high growth areas within each network build Used the change in the number of housing and jobs between 2015-2050; this was converted into a density measure (number of people per acre) High growth areas are the top quantile of the density measure (change in jobs and population is 25 people per acre or greater)
1a	… in EPCs	Equity Priority Communities (formerly Communities of Concern) *Source: SFCTA (2017)*	GIS analysis to calculate coverage of high growth area for EPCs within each network build
2	Coverage in High Short-Trip/High Car-Trip areas	Top quantile of TAZs for short trips (under 2 miles) generated and top quartile of TAZs for trips taken by car	GIS analysis to calculate coverage of the top quantile of high short-

		Source: SF-*CHAMP model*	trip/high car-trips areas within each network build
3	Coverage of High Injury Network	High Injury Network (2017) *Source: SFMTA/SFDPH*	GIS analysis to calculate coverage of high injury network within each network build
3a	… in EPCs	Equity Priority Communities *Source: SFCTA (2017)*	GIS analysis to calculate coverage of high injury network in EPCs within each network build
4	LTS 1/2 Access to Regional/Rapid Transit	Muni rapid stations – SFMTA BART stations (source: Planning Dept) Caltrain stations – Caltrain SFMTA comfort index (2017)	Network analyst to calculate percentage of LTS 1 and 2 streets that can be used to access regional/rapid transit with each network build
5	LTS 1/2 Access to Activity & Job Centers	Government and institutions – DataSF Healthcare facilities (hospitals and community clinics) – (source: Planning Dept) Major universities and colleges (source: DataSF) Major parks: Golden Gate Park, McLaren Park, Twin Peaks *Source: SF Recreation and Parks and Department)* SFMTA comfort index (2017)	Network analyst to calculate percentage of LTS 1 and 2 streets that can be used to access activity and job centers with each network build

NETWORK SCORING

Because each Network Build is made up of ¼-mile buffered corridors across the city, and each of those corridors is made up of corridor sections with different bike network typologies applied to those segments, analysis scored for where each corridor segment overlapped with the spatial map of the metric in question.

Network scoring, then, consisted of 21 scores for each of the three Network Builds, resulting in 63 individual evaluation scores. Each Network Build was organized by the three different bike network

typologies: Best Practice Bike Network, Car-Free Streets, and Mobility Hubs. Each of these typologies then received a separate score for each of the 7 Evaluation Framework metrics based on how much overlap they had with each metric spatial map.

Individual metric scores for each typology in each of Network Build were then consolidated into a single score for each evaluation metric.

METRIC WEIGHTING

Rather than having a separate scoring metric for public input, the ATS team decided to apply public input across all other metrics in the Evaluation Framework. This public input was gathered through the Streets and Freeway survey, with data collected from the public in the summer of 2021. Survey respondents were asked about the importance of the primary goal behind each bike network typology in the Active Transportation Study.

Table 4. ATS-related Survey Results

ATS Typology	Description in survey	Important	Not Sure	Less Important
Car-Free Streets	Reduce speeds and create space on neighborhood streets to support walk and bike trips within my neighborhood or to nearby commercial areas	71%	13%	16%
Best Practice Bike Networks	Separated, high quality bike networks that help me travel between neighborhoods and to major destinations like downtown	69%	15%	16%
Mobility Hubs	Make it easier to walk or bike to transit	69%	15%	15%

The team found that the survey results showed that there was little differentiation in the importance of the typologies by survey respondents. The ATS team applied a slight weighting scheme to represent the close results from public input:

- Car-Free Streets: **1.05x** weighting
- Best Practice Bike Network: **0.95x** weighting
- Mobility Hubs: **0.95x** weighting

EVALUATION RESULTS

After scoring and weighting, all metrics were converted to a 1-5 scale for evaluation. As none of the evaluation metrics represent potential for positive outcomes rather than precise, measured ones, the ATS team determined it would be better to show scores on an approximate scale. Because the scores for each Network Build are aggregates of scores for each of the three typologies within that Network Build, it is impossible for a given Network Build to achieve a perfect score.

Table 5. Evaluation Results

	Mode Shift Network Build	Vision Zero Network Build	Equity Access Network Build
Coverage of High-Growth Areas	3.6	3.1	3.9
… in Equity Priority Communities	3.4	3.6	3.9
Coverage of High Short-Trip/High Car-Trip Areas	3.1	3.3	3.2
Coverage of the High Injury Network	2.4	3.1	2.8
…in Equity Priority Communities	2.6	3.3	3.2
LTS 1/2 Access to Regional/Rapid Transit	3.2	3.8	3.8
LTS 1/2 Access to Activity & Job Centers	3.7	3.0	3.1
Combined Score	**22**	**23.2**	**23.9**

From this evaluation, the Equity Access Network Build was chosen as the Preferred Network Option.

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APPENDIX

CHALLENGES AND LIMITATIONS

SF-CHAMP Limitations

SF-CHAMP modeling was only conducted for the Core Network, the baseline set of network improvements from which the 3 network build options were built. Following discussion with SFCTA modeling staff in late 2020 on the results of modeling for the Core Network, it was decided to not conduct modeling for each of the three network build options.

This decision was made due to the limitations of the model; modeling for each of the three network builds would render almost identical outputs for two primary reasons:

- The lack of outstanding examples and case studies of impacts for Car-free street networks and for Mobility Hubs for active transportation meant there was no adequate way to model their impact within SF-CHAMP.
- The impedances for different types of populations and different types of trips built into the model assumption results in very small gains in bike trips & mode share regardless of changes to the bike network. The ATS team conducted limited case study research to justify changes to these impedance limits, but were not integrated into SF-CHAMP due to time constraints and inability to model for Car-Free networks & Mobility Hubs as mentioned above[1].

Because the three network builds are made up of almost identical sets of corridors, and the primary differentiation being the application of bike network treatments within the network, running modeling for the three network builds under such constraints would not render outputs representative of likely network impacts.

Developing Metrics for Evaluation Framework

Evaluation of impacts for each of the three network builds in ArcGIS is further complicated by the fact that the network builds share an almost identical set of corridors. The primary differentiation between network builds rather comes from the application of bike network typologies: Best Practices Bike Network, Car-Free Streets, and Mobility Hubs. For each network build, certain metrics from the Data Profiles Memo were prioritized for selection of typologies.

Given that ArcGIS analysis of bike networks is largely a function of assessing network-coverage (I.e. mileage) against a certain metric, analysis of three network builds with near-identical corridors would yield extremely similar results. In an effort to provide greater differentiation of impact, the ATS team identified evaluation metrics that have alignment with certain typologies (for example, Car-Free Streets aligning with Vision Zero/High Injury Network goals).

This creates a potential conflict in evaluation, as similar applications of these metrics from the Data Profiles Memo were used to look at metrics by zones, corridors and corridor segments to assign typologies across the three network builds.

Sustainability Metric

The project team needed to choose a metric for environmental sustainability, but faced some difficulty due to lack of desired data. Ideally, the metric would have been number of short trips taken by car which would represent high opportunity to shift trips towards active transportation. The data available for corridor segments included short trips and total trips by each mode, but not short trips by mode. The team put together five potential options that could serve as a proxy:

1. **Use only car mode share** (higher car share = higher priority)
    a. This option would be simple to use and easy for others to understand. It does not account for the possibility that many of those car trips could not be replaced by active modes (e.g. trips across the Bay Bridge).
2. **Use only short trip share** (higher short trip share = higher priority)
    b. This option would also be simple to use and easy for others to understand. It does not account for the fact that most or all of those short trips may already be by active modes and thus would not represent opportunity for mode shift.
3. **Trips as a percentage of total trips** (higher percent trips = higher priority)
    c. This is another simple to use, easy option for others to understand. It captures the raw benefit of impacting more trips, whether improving current active trips or helping shift car trips. It misses the complexities of modal split per segment.
4. **Short trips + car trips - absolute number** (more = higher priority)
    d. This would be a closer proxy for segments with short (i.e. shiftable) car trips. It is not 1-1 for actual short car trips, though.
5. **Bike % + walk %** (lower = higher priority)
    e. This option captures areas with the lowest active mode split to prioritize. Transit is not included because pulling people off of transit is not necessarily bad – less crowding on transit attracts more people to take transit. The environmental benefit of moving people from transit to active modes is much less directly impactful than cars, though.

Ultimately, the team decided to use option 4: number of short trips in the segment plus number of car trips in the segment. Beyond being the closest proxy available for short car trips, it also potentially represented corridor segments with lots of active short trips and lots of car trips – typically two modes that do not mix well. Improving these corridor segments could represent an environmental benefit by improving important active network segments and making them even more attractive and safe, thereby encouraging more active trips.

Outreach Challenge

The specifics of ConnectSF outreach in the summer of 2021 also provided a limiting factor for the establishment of the Evaluation Framework for the ATS. Because the ATS had no dedicated funding or support for public outreach, there were limited opportunities to present ATS materials to the public – especially the three proposed Network Builds. Despite these limitations, the ATS team believed public input to be critical in the evaluation of network build alternatives and validation of ATS findings.

The ATS team sought to find innovative methods to secure public input, either by inserting ATS concepts into pre-existing outreach efforts or to glean public input data on related efforts to apply in some capacity to the Evaluation Framework. The most direct opportunity was through the Streets and Freeways outreach efforts, conducted in July of 2021.

Given the metrics in the Evaluation Framework are primarily measured by network coverage, the network builds show very similar scores when showing no differentiation between the distribution of bike network typologies within each network build. The ATS team decided the best approach towards integrating public input was to apply a weighting scheme by typologies to the metrics in the Evaluation Framework, with the weighting dictated by public input. Several methods of weighting were evaluated, but the eventual preferred method was:

Seek input from the public on which bike network typology they felt best achieved the outcome measured under each Evaluation Framework criterion.

This format would have presented members of the public with a matrix, where they could rank each bike network typology under each criterion. An example matrix is below:

	Best Practice Bike Network	Car-Free Streets	Mobility Hubs
Generate the most trips by bike			
Generate the most short trips by bike			
Eliminate fatalities & serious injuries			
Best access to jobs & activities			
Best access to transit			
Benefits low-income residents & Equity Priority Communities			

By seeking direct ranking input from the public, this would allow the ATS team to apply weighting by typology unique to each criterion. This would allow for a strong differentiation in scoring of network builds due to their different application of typologies across each network. By creating weighting schemes unique to each criterion, the hope was to not overly prejudice the evaluation towards a single typology. Because each of the three network builds have a built-in disposition towards one of the three bike network typologies in their construction, it was feared a weighting scheme by typology

applied universally across all criterion would lead to the selection of the network build most associated with that typology.

In June meetings with agency directors, this matrix was deemed to be too complex for the public outreach process. A simplified series of questions based around preference for bike network typologies was added in its stead. During these June meetings, it was also decided by agency directors not to show the public any of the 3 proposed Network Builds, substituting a high-level "gap analysis" map that bore little resemblance to the ATS analysis to date.

Given these constraints, the ATS team pivoted the Evaluation Framework to applying universally weighed typologies across all criterion, as described in sections above. Robust testing was conducted to understand the impacts of universal weighting across all criterion.