MODELLING TRIPLE BOTTOM LINE OUTCOMES FOR SAN FRANCISCO'S INFRASTRUCTURE INVESTMENTS

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ABSTRACT

The San Francisco Public Utilities Commission (SFPUC) has developed a triple bottom line (TBL) model to perform alternatives analyses for its Sewer System Improvement Program (SSIP), which will invest approximately $6.9 billion in sewer, collection system, and treatment investments. This manuscript explains SFPUC's approach and rationale in establishing a TBL evaluation process and its general method of evaluation. It gives examples of how the TBL assessment model has been applied and metrics established to compare infrastructure solutions at both a single project and watershed level. The model uses existing San Francisco and California policies to establish the evaluation criteria and developed city specific calculators that automate the evaluation process thereby streamlining the TBL evaluations. TBL evaluations can be performed within two days for most projects within SSIP. Furthermore, the model has been developed to report the consequences of investments and the projected co-benefits to the City and County of San Francisco (City) residents and employees.

KEYWORDS

Triple Bottom Line Model, Decision-Making Processes, Life Cycle Assessment, Watershed Assessment, Alternative Analysis, Multi-Criteria Analysis, Community Benefits

1. INTRODUCTION

Public water agencies are often challenged to select the best infrastructure solution to address aging infrastructure, flooding, enhanced treatment, water delivery, and water quality issues identified in their system. As public entities, they are asked –if not required– to transparently show how they arrived at their recommended alternative after taking into consideration costs, impacts to the community, and the potential performance of alternatives. The final decision needs to not only describe the rationale clearly, but also balance multiple factors to arrive at a robust explanation that is defendable to the public, especially for major capital projects that will impact ratepayers. Water agencies have applied multiple methods when identifying a recommended alternative, including lowest costs, cost effectiveness, and multi-criteria evaluation methods. These methods have generally used capital costs and engineering performance as the primary explanations for selecting an alternative. However, a number of water agencies have recently been directed to apply a more holistic approach to identify solutions that take into account societal and environmental consequences in tandem with financial outcomes. Often referenced as a triple-bottom-line (TBL) analysis, water agencies are applying John Elkington's coined concept of TBL to establish a more balanced evaluation process that considers broader societal needs and environmental impacts.

1.1 Varied Approaches to Triple Bottom Line Analysis

Many cities, including Philadelphia, Vancouver, Melbourne, Christ Church, Sidney, and Seattle, are applying different forms of TBL assessment in their evaluations of infrastructure investments. Each assessment can differ in multiple ways from its process for weighting and scoring of TBL criteria, to Benefit-to-Costs Analysis, to a full Sustainable Return on Investment calculation. Others are performing multi-criteria assessments that incorporate various elements of sustainability, such as energy reduction, habitat, and employment in their evaluation of alternatives.

1.2 Application of Triple Bottom Line in San Francisco

The City and County of San Francisco (City) also established the principles of TBL to evaluate investments, recognizing that incorporating a sustainable rubric to their alternatives analysis will arrive at better community solutions. The San Francisco Public Utilities Commission (SFPUC) had established core principals of sustainability in its mission:

"Our mission is to provide our customers with high quality, efficient and reliable water, power, and sewer services in a manner that is inclusive of environmental and community interests, and that sustains the resources entrusted to our care."

In consideration of this mission and the sizeable capital program (i.e. approximately $6.9 billion) envisioned under the Sewer System Improvement Program (SSIP), SFPUC chose to establish a standardized TBL evaluation process as part of its infrastructure selection. In 2011, SFPUC agreed that it needed to provide a greater level of analysis and transparency in its project selection process under the SSIP. Joining other leading international public utilities, then General Manager of SFPUC, Ed Harrington, and key SFPUC leaders agreed to pursue the development of a TBL analysis tool. Such a tool would directly support SFPUC's mission of contributing to environmental and community interests.

This process needed to be transparent, replicable, and applied in an expedient manner. It also needed to be even in its approach, meaning different project managers with different values and objectives would arrive at the same TBL output. This output would then give managers the ability to compare different investment options.

1.3 TBL Tool Purpose

Through comparison of project alternative impacts, SFPUC uses the TBL tool for four primary objectives:

1. To inform and support the analytical process for developing and arriving at a preferred alternative by considering social and environmental components in the process alongside performance and financial considerations;
2. To provide decision-making support for SFPUC project leaders;
3. To increase project selection transparency; and
4. To facilitate the assessment of a project's actual TBL outcomes relative to predicted outcomes.

Since SFPUC chose to use the TBL model as decision-making support, the TBL tool itself does not result in a recommendation independent of other engineering factors. Rather it is up to project leaders and SFPUC staff to interpret the results of the analysis as well as other information to ultimately recommend an alternative.

1.4 TBL Framework Development

The TBL model framework development process began in November 2011 with a review of international TBL best practices as well as the work done previously within SFPUC, including the Urban Watershed Framework. Various TBL evaluation processes, including those from the Philadelphia Water Department, the Portland Bureau of Environmental Services, the New York Department of Environmental Protection, Cincinnati's Metropolitan Sewer District, and Melbourne, Australia's Water Department, were reviewed for their framework, approach, and evaluation criteria. Based on this review, an initial framework was proposed to and accepted by SFPUC.

As part of the overall framework, SFPUC identified the following defining decisions:

1. The TBL model should fit into SFPUC's larger project development process.
2. In recognition of the limits of any TBL analysis and its limited precision in determining the social, environmental, and financial consequences, the individual criteria will be ordinally ranked rather than arriving at a specific score. Scores are developed within each criteria, but no weighting is applied to create greater importance of individual criteria.
3. The TBL model will be made up of financial, social, and environmental categories that are based on existing SFPUC and other City agency policy objectives.

These directives were each carried through the model as well as through the development process.

1.5 Why Establish an Ordinal Process?

The Program Management Consultant (PMC) team and SFPUC debated the merits and drawbacks of monetizing, scoring, or performing benefit cost analyses. In the debate, some basic precepts led to the conclusion that an ordinal process was the most appropriate form of evaluation.

- **False precision.** At five percent engineering design, it is difficult to accurately calibrate the co-benefits of every infrastructure investment. Many details are unknown and estimating labor hours, greenhouse gas reduction, habitat gains, water quality improvements, and other key performance indicators results in a high standard error. However, at this level of design, it is possible to know that certain investments have significantly more impacts than others. Therefore, results could be explained as neutral, worse than the current condition, better than the current condition, and/or significantly worse/better than the current condition.
- **No weighting of performance criteria.** Initially, the team considered weighting the importance of key performance indicators (e.g. climate, employment, habitat, capital costs, recreation, etc.). In the end, staff concluded that it did not have the authority to weigh societal, environmental, or financial consequences over one another. Instead, the authority of setting importance of one decision criteria over another was solely in the hands of the political authority (i.e. the Commission). Staff would present the consequences or

externalities of investments evenly, while the Commission and the public overall could make decisions based on which externalities are more important to them (e.g. employment over recreation). This limits the potential risk of 'gaming' for a desired infrastructure investment as criteria weighting can be adjusted to arrive at the preferred infrastructure investment of a specific advocate of a given infrastructure alternative (i.e. one project generates the most employment and the project manager weights employment as the most important criteria thereby arriving at his/her preferred solution).

- **No monetization.** While it would be useful to arrive at a single unit of evaluation, the process to monetize all externalities would result in more argument over the form of evaluation than the actual TBL results. For example, how would SFPUC set the value of the potential savings to life or disability of an employee due to investments made in worker safety? Would SFPUC set the price of carbon based on the cap and trade price in California or would it base it on the Social Costs of Carbon under Executive Order 12866? Should SFPUC monetize the benefit of reduced hospital stays based on reduction in particulate matter and the corresponding marginal improvement in public health? In the end, these assumptions could lead to an increasing number of changing assumptions and additional false precision. The idea of monetization, also led to dissonance among the SFPUC's peer review committee. Simply put, it creates more controversy without necessarily giving clarity on which infrastructure asset should be selected.
- **Be conservative on your co-benefits.** While there are a number of marginal co-benefits that can be realized through different water infrastructure investments, the SFPUC agreed that it should focus on areas it can meaningfully impact. In other words, considering the improved aesthetics to neighborhoods from green infrastructure was not considered, whereas water quality, water use, habitat improvement, and carbon sequestration were considered.

This approach is not a universal truth across all water agencies, but is specific to SFPUC. Other agencies may choose that monetization is the best analytical method to provide numeric clarity in arriving at a single infrastructure investment. Others may have the authority to weigh social, environmental, and financial consequences over one another, especially if the Commission has expressly given staff the authority to do so.

1.6 Approach to TBL Evaluation

In the formulation of the model, SFPUC and the PMC team established a series of basic principles that informed the overall structure of the model.

1. Simple (easily understood but logically sound)
2. Comprehensive (by topic/criteria and indicators)
3. Consistent (across indicator types and project types)
4. Structurally Unbiased between Indicators as a model (unless explicitly weighted by the commission or statistically valid survey from the public)
5. Computable/Measurable (Need to be able to assess the impacts of combined infrastructure solutions and have quantifiable metrics that can be compared against one another)
6. Scalable (expandable by number of indicators; can work at local, watershed, City scales)
7. Aggregation capable (group indicators into indexes etc.)
8. Visually Representable (in a compelling, easy to grasp way)

These basic principles were consistently referenced in decisions on how to best structure the model. They guided the TBL model development team in building a system that did not express false precision, but explains the consequences and co-benefits of an infrastructure investment.

1.7 When Is TBL Applied?

Establishing when TBL analysis should be performed is just as important as considering societal and environmental consequences in tandem with financial consequences. If performed too early, available information to project TBL outcomes may not be available, and if performed too late, TBL becomes a method of justification rather than a form of analysis. As such, SFPUC identified the alternative analysis phase as the most appropriate period for evaluating TBL consequences. Note that additional details of financial, societal, and environmental outcomes are known at a later phase during the full environmental review process, which is performed at 30 percent design. In general though, deviating from the preferred alternative at this stage is difficult and more expensive. Moreover, meaningful decisions could be made during the alternatives analysis phase versus later phases of design.

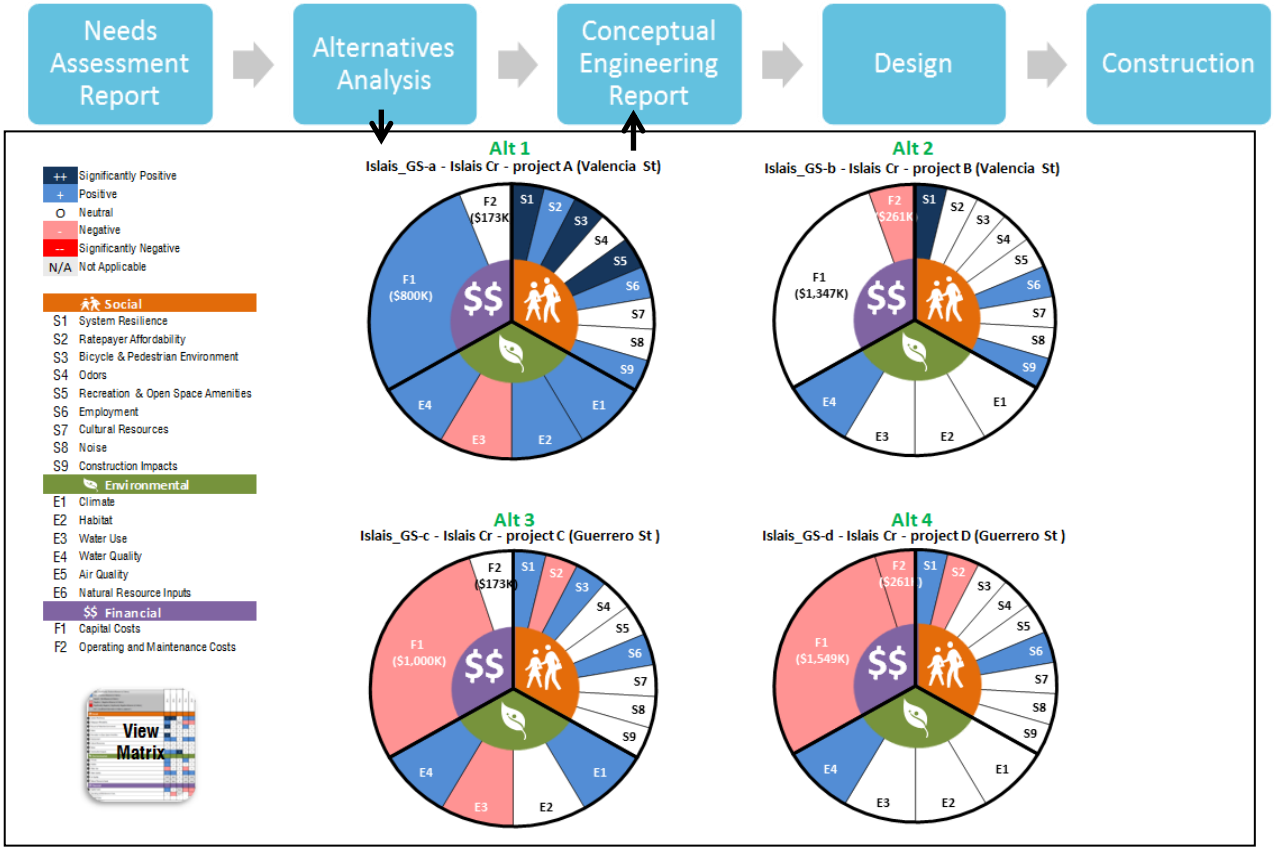

Figure 1: Project Delivery Process

1.8 Fatal Flaw Filter

SFPUC has set a series of filters that limit the alternatives analyzed to viable solutions. First, projects have to achieve the engineering objective identified in the Needs Assessment Report (NAR). Second, the project must meet the Levels of Service (LOS) standards set by the Commission. These LOS include:

- Critical functions are built with redundant infrastructure.
- Primary Treatment, with disinfection, must be on-line within 72 hours of a major earthquake

- Control and manage flows from a storm of a three hour duration that delivers 1.3 inches of rain.
- Limit odors to within the treatment facility's fence lines.
- Be a good neighbor. All projects will adhere to the Environmental Justice and Community Benefits policy.
- New infrastructure must accommodate expected sea level rise within the service life of the asset (i.e., 12 inches by 2050, 36 inches by 2100).
- Existing infrastructure will be modified based on actual sea level rise.
- Beneficial reuse of 100% Biosolids.
- Use nonpotable water sources to meet 100% of WWE facilities nonpotable water demands.
- Beneficially reuse 100% of biogas generated by WWE treatment facilities.
- Stabilize life cycle costs to achieve future economic stability.
- Combined Sewer and Water Bill will be less than 2.5% of average household income for a single family.

These two basic binary (i.e. yes/no) rules are applied as a simple filter. The filter also results in an alternative analysis where only those projects that achieve basic performance thresholds and are feasible to build are evaluated. This means that, essentially, staff could build and operate any of the alternatives under consideration. Thus, the TBL evaluation concerns itself with a meaningful evaluation of the costs, societal impacts, and environmental consequences of infrastructure solutions that achieve the core performance goal (e.g. retain water to reduce flooding in a given neighborhood).

2. METHODOLOGY

From the basic rules established by SFPUC and as described in the introduction, the PMC team and SFPUC set a clear process for building a TBL evaluation process. First, review SFPUC, City, and State policy to establish the core metrics or criteria that will be considered in an evaluation of infrastructure alternatives. The evaluation criteria are adopted policies, goals, and/or regulatory guidelines that have been vetted through a public process (e.g. greenhouse reduction goals). Second, create a core working group of City department staff and representatives to assist in the development and to review the rules of the TBL evaluation. In other words, staff from Recreation and Parks Department work with SFPUC to establish the scoring logic for potential water infrastructure investments that can also contribute to the City's recreation and open space environment. This gives the TBL tool citywide legitimacy and leads to interagency coordination. Third, build a logic engine that enables project managers to quickly review the TBL consequences. Establishing a replicable and robust enough analytical process without burdening project managers with significantly more analysis requirements was critical to the success of the TBL evaluation process. Thus, SFPUC built a model that can evaluate alternatives with 20 hours of effort versus 100 hours. For a major program with multiple projects, it was critical to establish a streamlined process in order to evaluate the multiple investments planned under the $6.9 billion program.

2.1 Ordinal Ranking

As stated in the introduction, SFPUC clearly directed that the output of the TBL model not result in a recommendation. Rather, it is up to project leaders and SFPUC staff to interpret the results of the TBL analysis. As such, the TBL model will not result in a single score or ranking for each project alternative, as most traditional TBL analyses do. The model categories, as well as the criteria within the categories, will NOT be scored and weighted, but are instead ordinally ranked. An ordinal ranking system allows decision makers to include intangible criteria when comparing project alternatives toultimately make a recommendation.

The ordinal ranking system used for the criteria within the categories is:

- Significantly positive (++)
- Positive (+)

- Neutral (o)
- Negative (-)
- Significantly negative (--)

While the criteria and indicators within the model are based on measurable, quantitative inputs, the model provides a summary, color-coded output for an at-a-glance understanding of a project alternative's rating. Where feasible, the TBL model attempts to align a "significantly negative" rating with a potential social or environmental consequence that could lead to significantly unavoidable impacts under the California Environmental Quality Act (CEQA). While each criterion does not necessarily align with CEQA categories, the basic checklist of standards of significance was applied to those that do align. The TBL team also considered "significantly positive" criteria as a meaningful positive change that could not be easily assigned to each project. For example, for open space and recreation, the project must first add recreation area *and* be in an area of defined need.

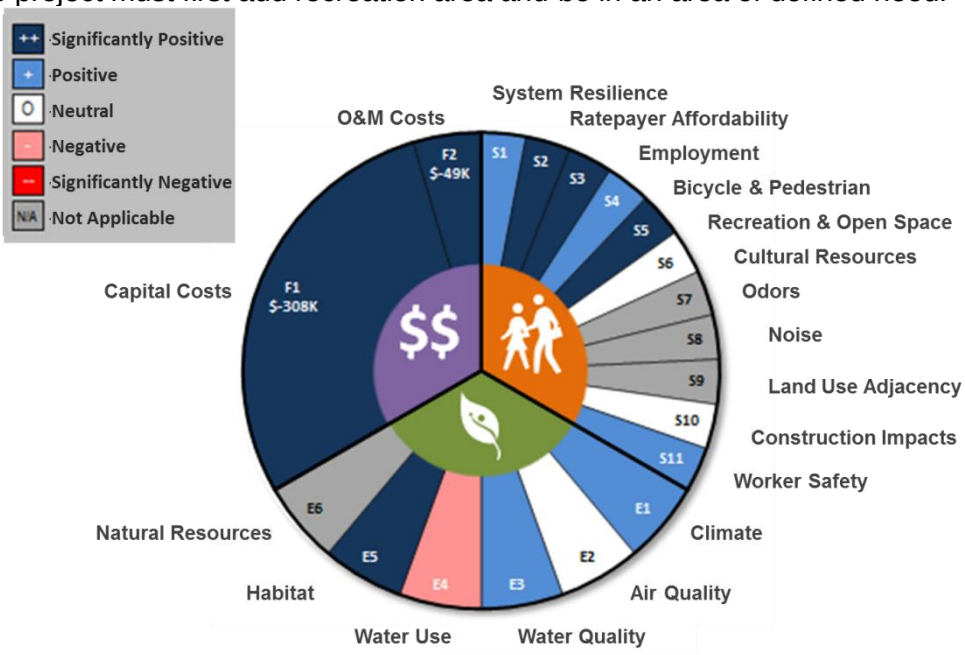

Figure 2: TBL Output Example

2.2 Detailed Indicator Data

In addition to the summary output, users also have access to more detailed ranking information, which can be used for reporting the financial, environmental, and social consequences of the selected projects. While the ordinal process is displayed at the criteria level, each criterion has a set of data points and metrics that can provide more quantitative outputs (e.g. acres of recreation space improvement per $1,000,000 invested). Figure shows example model metrics within each of the criteria. This allows project managers to both describe project outcomes at a more quantitative level and provide additional analysis should the project manager want to consider consequences beyond an ordinal score.

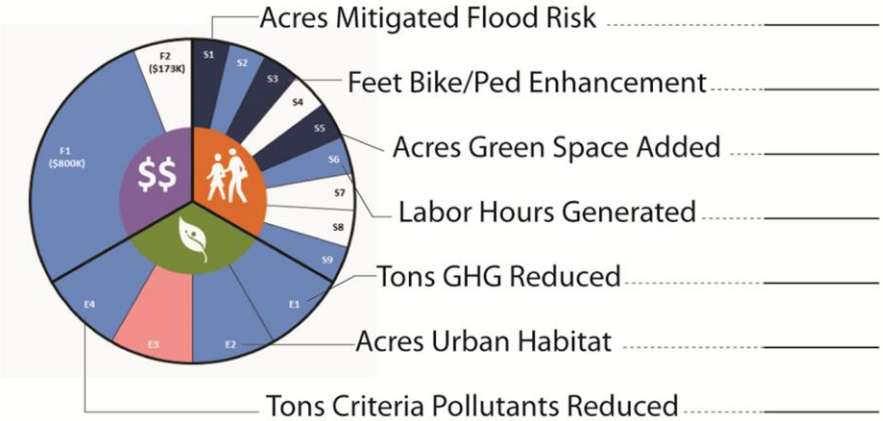

Figure 3: Sample Model Metrics

2.3 TBL Categories

The TBL tool compares proposed alternatives across three different categories:

1. **Financial** – Impacts to SFPUC based on a life cycle cost analysis
2. **Environmental** – Impacts on the City's environment and on climate change
3. **Social** – Impacts on City residents

Each category is made up of multiple criteria, which are in turn built on measurable indicators. While traditional TBL models use an "economic" category, which includes economic impacts to the general population, this model has defined the "financial" category as economic impacts to SFPUC. Thus, economic impacts incurred by ratepayers or the general population are considered under social criteria instead. This follows the basic TBL principles of "people, profit, and planet," which sees the impacts of employment under people rather than under economy.

2.4 TBL Category and Criteria Development

A significant portion of the TBL model development time has focused on development of the three categories and their associated criteria. Category and criteria development has followed the process listed below:

1. Extensive SFPUC and citywide policy review
2. Initial criteria and indicator development
3. SFPUC review
4. Presentation of initial criteria to SFPUC TBL working group
5. Review and refinement of initial criteria by TBL sub-working groups
6. Criteria and indicator revision based on working group and sub-working group input
7. Ordinal ranking development
8. TBL sub-working group review
9. Presentation of revised criteria and ranking to TBL working group
10. Draft TBL criteria and indicators
11. Early Implementation Project (EIP) Testing (green infrastructure projects)
12. Update of definitions and inclusion of treatment plant related TBL metrics
13. Ongoing revision of TBL criteria and indicators based on TBL model application and SFPUC review

The formation of multi-agency working groups and subsequent criteria sub-working groups has been crucial to the development of the various criteria. Having input from SFPUC and other agency representatives has ensured that the criteria reflect synergistic opportunities for SSIP projects to

support other City goals. In this way, the outputs of a TBL model analysis will be relevant to SFPUC and other City agencies.

2.5 Individual TBL Criteria

The following section outlines the list of criteria developed for evaluation within the TBL model. Each of the criteria and their underlying logic and policy references are described in a methodology report. This document is over 200 pages and not described herein. Rather, this manuscript describes the overall process and logic as it is assumed each agency would arrive at different logic specific to the policy of the local jurisdiction. In general, the methodology report outlines the criteria evaluation logic in the following manner:

- Criteria definition
- Description of criteria indicators (e.g. for Recreation and Open Space, there are three indicators including addition of recreation and open space, enhancement of recreation and open space, and reduction in beach postings)
- Model metrics which describe how externalities are calculated
- Criteria evaluation and ordinal process logic
- Explanation of method for evaluating multiple projects (i.e. combined investments) at a watershed and/or citywide level.
- List of baseline data and the method to update the baseline data
- List of questions to project managers to enable TBL evaluation
- Policy reference for the criteria indicators and underlying logic
- List of stakeholders that participated in the development of the criteria logic

Financial Criterion. The Financial criterion is a life cycle cost analysis of projects. This was developed with SFPUC finance staff and PMC SSIP cost estimators. It considers capital costs, operations and maintenance (O&M), renewal and replacement (R&R), and other cost categories where applicable. All projects use a standard set of financial assumptions to evaluate projects, including discount rate, escalation rate, bond costs, life span of infrastructure assets, operation and maintenance costs, avoided costs, and a number of other standardized metrics to evaluate the total life cycle cost of investments. Capital costs and legacy costs are separated because they generally are funded through different pools of funds, and therefore are considered differently.

Environmental and Social Criteria. The Environmental and Social criteria have been developed based on a review of current SFPUC and City regulatory and planning documents, as well as through participation of SFPUC staff and stakeholders from other City departments. This process is meant to ensure that the measures of the TBL tool are consistent with larger SFPUC and City goals, and that where possible, SFPUC sewer system projects may be evaluated on how well each contributes to goals beyond SFPUC's financial and operational goals.

Each environmental and social criterion is comprised of specific measurable or binary (i.e. yes or no) indicators. Each indicator evaluates the extent to which a project alternative impacts the given criterion. Depending on the extent and nature of the impact, the model will assign an ordinal ranking to each indicator, which will lead to an overall ordinal ranking of the project alternative for each criterion (significantly negative, negative, neutral, positive, and significantly positive). It is also important to note that, with very few exceptions, the criteria in the model measure a project alternative's long-term impact, rather than temporary impacts. The one exception is the construction impact criterion among the Social criteria, which evaluates noise and traffic impacts from the construction of the infrastructure investment.

The Environmental criteria included are:

1. Climate
2. Habitat
3. Water Use
4. Water Quality
5. Air Quality

6. Natural Resource Inputs

The Social criteria included are:

1. System Resilience
2. Ratepayer Affordability
3. Employment
4. Bicycle and Pedestrian Environment
5. Recreation and Open Space
6. Cultural Resources
7. Odor
8. Noise
9. Land Use Adjacency
10. Construction Impacts
11. Worker Safety

Note that not all criteria apply to each project evaluated. As such, the project manager can apply "not applicable" to his or her project, evaluating only those criteria relevant to the infrastructure solution being considered.

2.6 TBL Model

The TBL framework, criteria, and project inputs are pulled together into a user-friendly excel-based interface. The TBL model is designed to require as little input as possible from project managers, drawing on data from a variety of sources including SFPUC, Infoworks and GIS. The model output is a radial chart, coded by ordinal ranking for each evaluated criterion. An example of a project output is provided below.

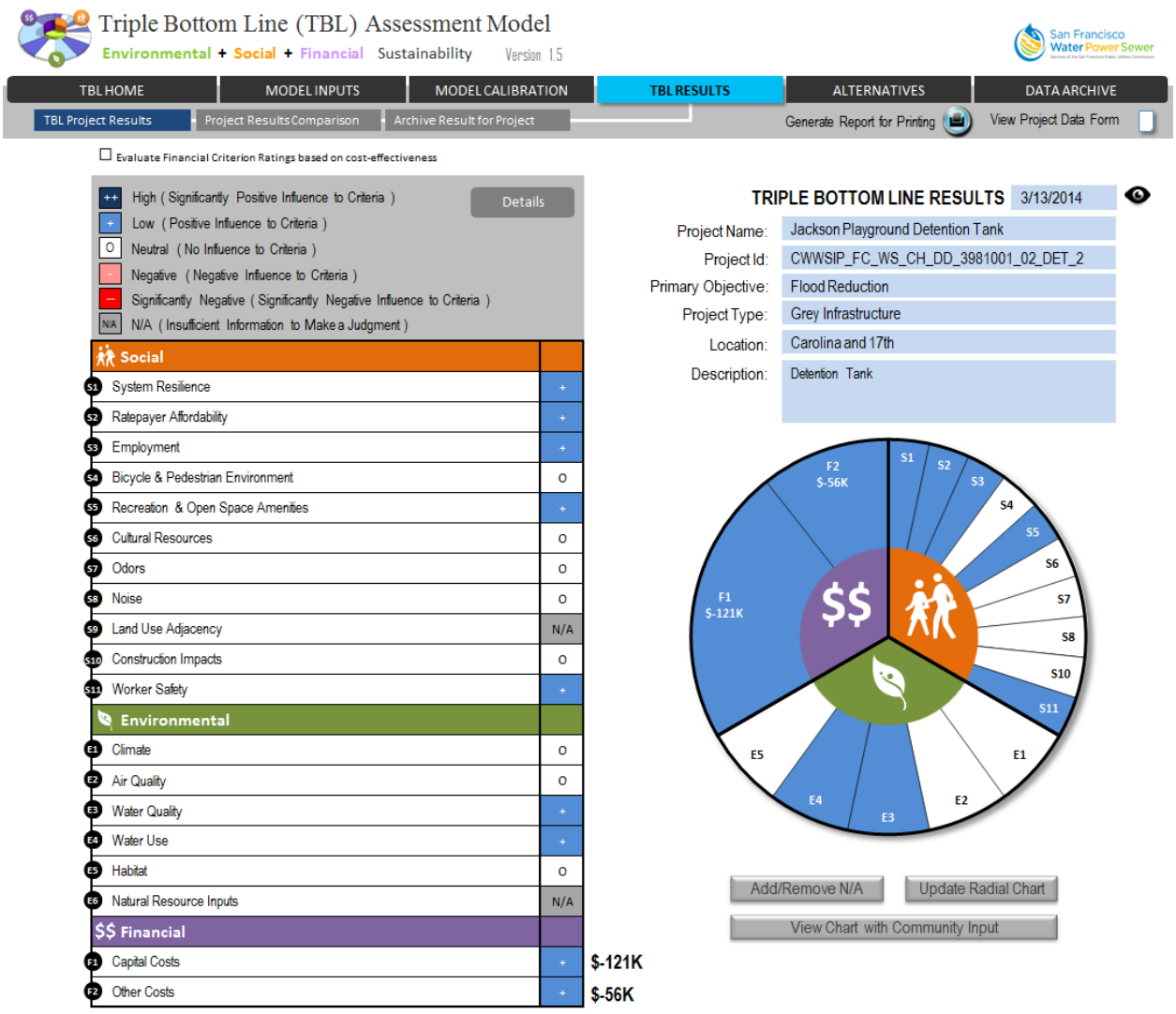

Figure 4: TBL Results for a single project

2.7 TBL Assessment Model Overview

The following sections describe the interface designed to carry out and present the analysis conducted as part of the TBL project evaluation. The model design directly impacts the TBL's four primary objectives, explained above.

The TBL model is designed as an excel-based interface. The model's successful development hinges on:

- An intuitive and graphical user interface
- A highly transparent and flexible calculation logic, rules and assumptions
- A graphical representation of process, results and summaries

2.8 Model Structure

The excel model is organized around 6 module tabs:

1. **TBL Home** – Includes an introduction to the model as well as user instructions.

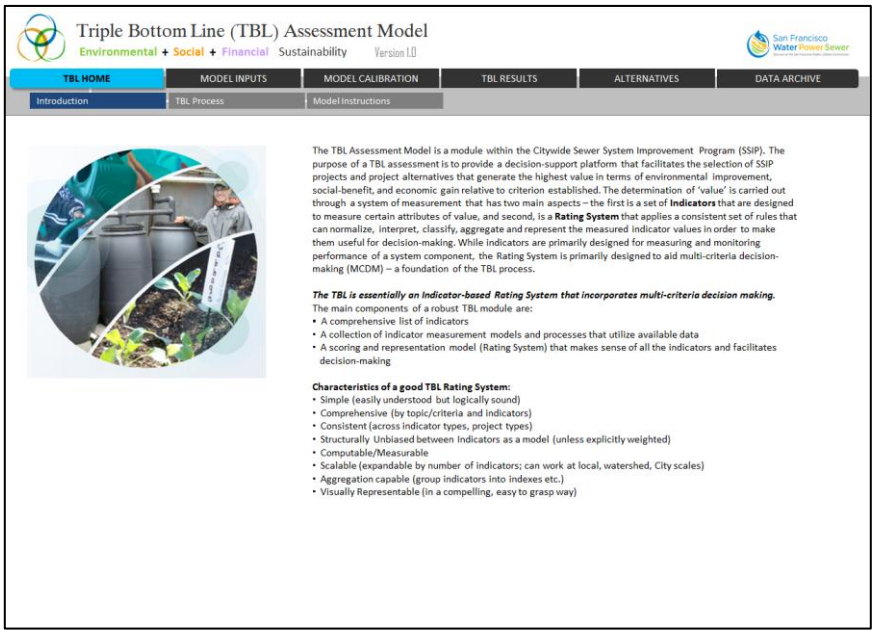

Figure 5: Introduction Tab

2. **Model Inputs –** Identifies necessary project inputs. This is the primary project entry tab.

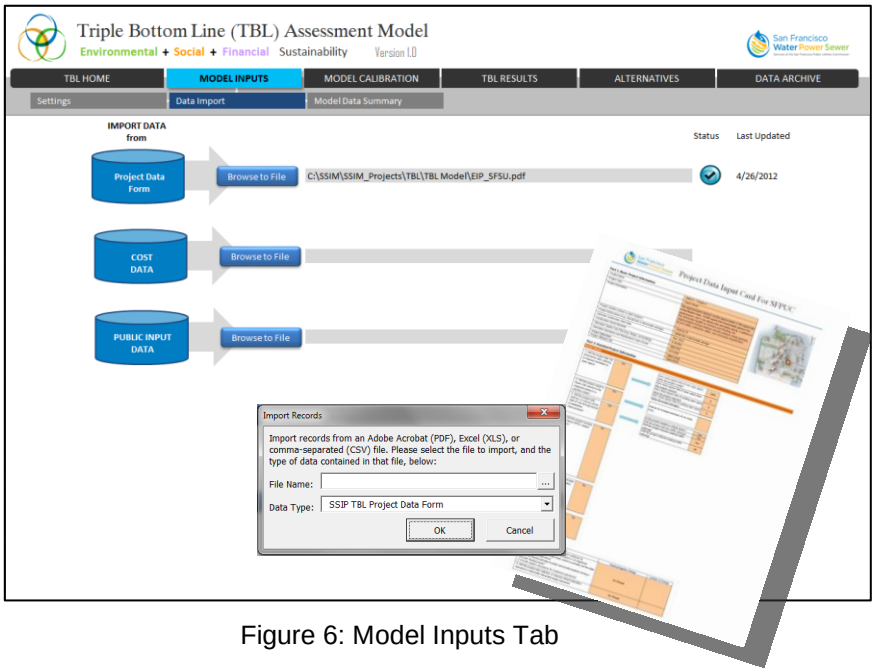

Figure 6: Model Inputs Tab

3. **Model Calibration** – Outlines the process, assumptions, ordinal ranking rules and calculations for each of the financial, environmental, and social criteria. Project managers are restricted in manipulating any of the assumptions and factors, but are allowed to view and understand the underlying logic for calculations. The Calibration Module is primarily meant for informational purposes and internal calculations. Authorized users can edit the assumptions to reflect additional information they might have.

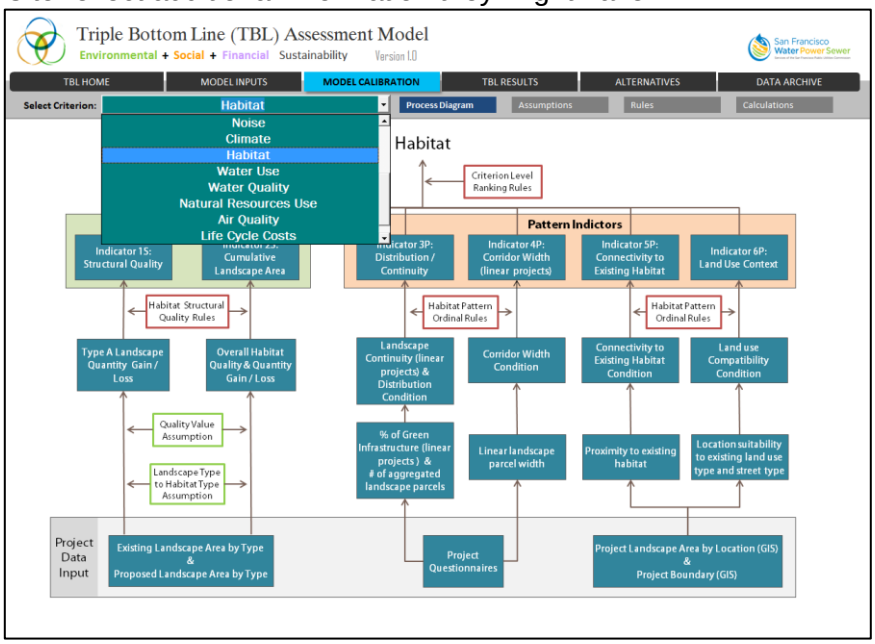

Figure 7: Model Calibration Tab

Because the TBL model is based on a number of measurable indicators and criteria, the model is necessarily data-driven. Data inputs to evaluate projects, summarized in the model calibration tab come from four key sources:

1. **Project Manager** - Project-specific data, such as project location, project size, etc., is entered by project managers at the time of evaluation
2. **InfoWorks** – Project performance information is drawn from the SFPUC's hydraulic and hydrologic model
3. **GIS** – Location-specific data is drawn directly from GIS data layers once the project location is identified by a project manager
4. **TBL Database** – Fixed inputs and assumptions approved by the SFPUC, such as project unit costs or historic combined sewer discharge (CSD) numbers, are saved within the TBL model database. These assumptions can be viewed, updated and overridden by project managers and SFPUC staff at any time.

Data from each of these sources are used in internal TBL calculations. Drawing from these various data sources is intended to reduce the burden on project managers and to streamline the evaluation process.

4. TBL Results – Presents the visual representation of the results of a given project.

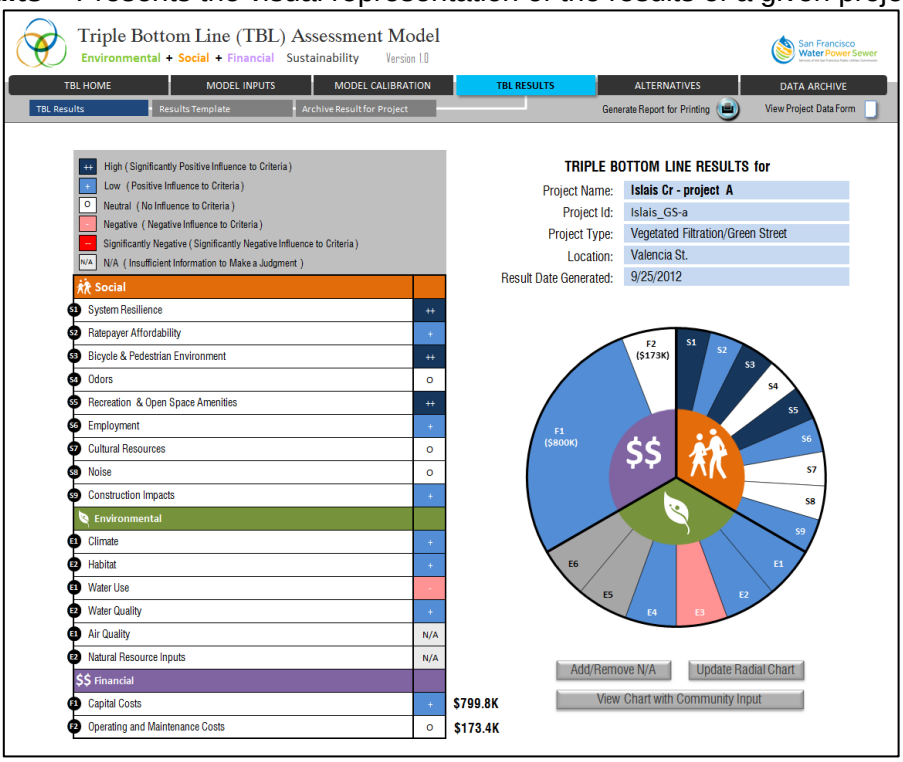

Figure 8: TBL Results Tab

In the TBL results tab, project evaluation results are displayed in both table and radial graph format. The table and graph are color coded to reflect the ordinal ranking assigned to each criterion. The ordinal ranking system applied is:

- Significantly positive (++) – Dark Blue
- Positive (+) – Light Blue
- Neutral (O) – White
- Negative (-) – Light Red
- Significantly negative (--) – Dark Red
- Not Applicable – Grey

In addition to the six ranking categories, criteria may also be left blank (grey), an indication that the criterion does not pertain to the project being evaluated. As part of the TBL results display, project managers will have the option of whether to show (radial chart on the left), or remove (radial chart on the right) non applicable criterion from the table and graph.

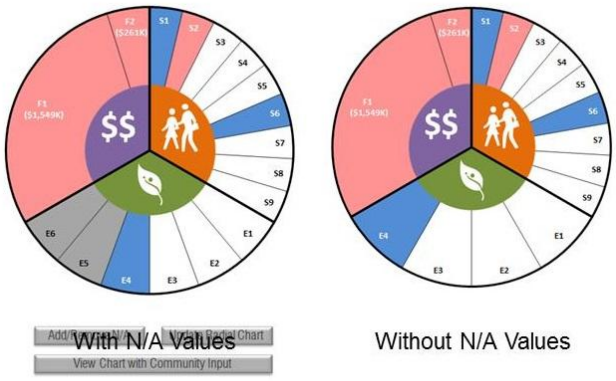

Figure 9: Radial Charts with and without N/A Values

A third display option includes the consideration of community input on social criteria. Through an extensive community outreach, the TBL effort surveyed residents in each of the eight watersheds about the importance of various social impacts on their neighborhoods. Based on the results of this survey, the project manager has the ability to visually "weight" social criteria by size, depending on how watershed residents valued given impacts, and then to display the results in a new radial graphic.

Model users can export any of the results from this tab as an Adobe Acrobat project summary sheet.

5. **Alternatives** – Allows for the comparison on a single screen of all of the alternatives for a given project. Project managers can select any project inputted into the TBL model for comparison. To date, the TBL model has over 200 projects in its database. This also allows the project managers to consider how his/her specific project performs against all other projects with the same performance objective (i.e. flood prevention, combined sewer overflow reduction, etc.). The comparison is represented in multiple graphical (radial) charts as well as a single, tabular (matrix) format.

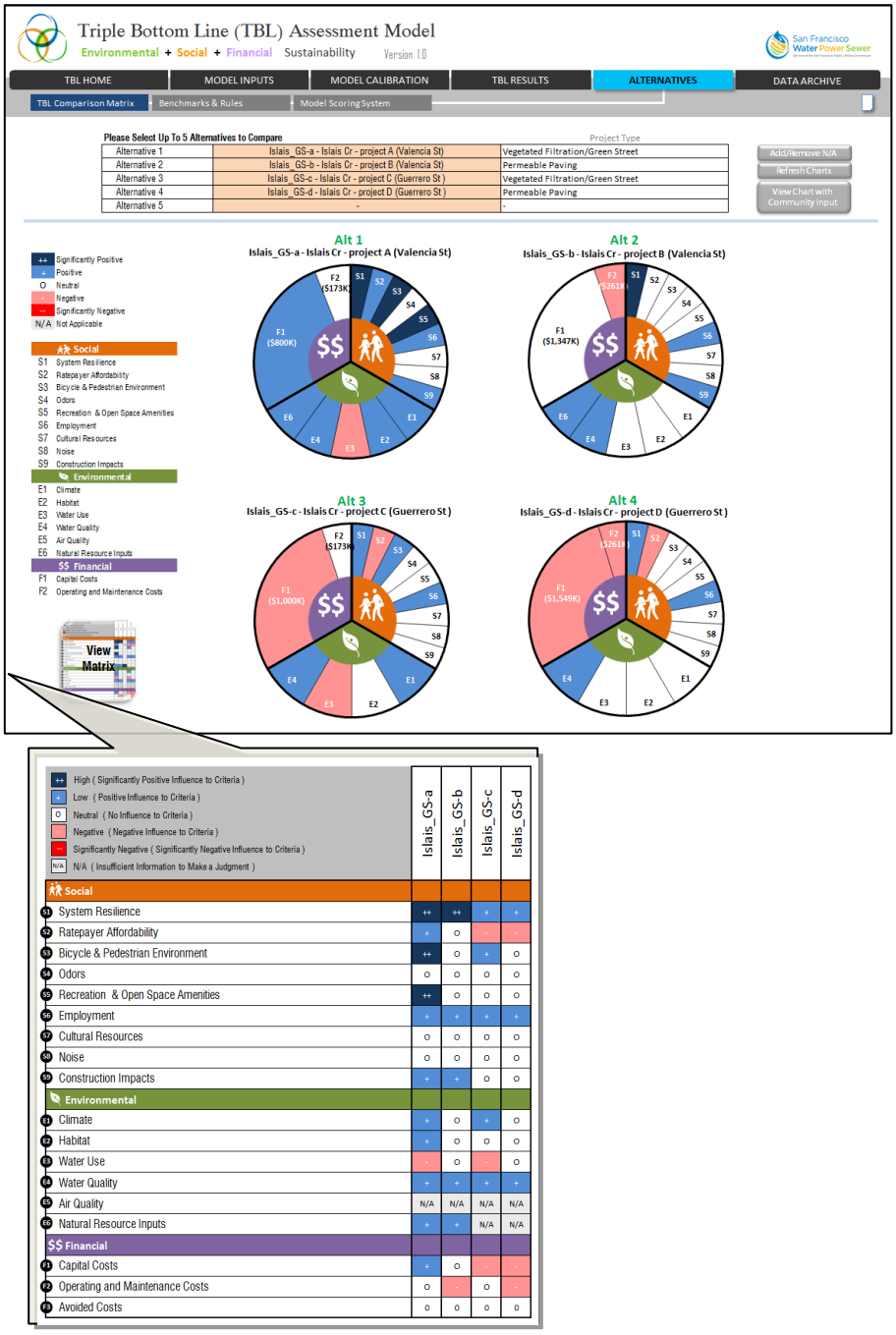

Figure 30: Alternatives Tab

6. **Data Archive** – Saves project data and performance statistics for future reference. This module is intended for data mining and analytics that would help in refining the model assumptions.

3. RESULTS

The TBL model has enabled SFPUC to rapidly, evenly, and transparently evaluate both single project options (Project Alternatives) and combined project options (Watershed Alternatives). The protocol established is defensible yet does not prescribe an answer. Rather, it is a decision support tool that enables project managers to recommend an infrastructure investment while displaying the externalities of all alternatives to SFPUC management and to the Commission, should either body wish to select another option. In addition, it allows SFPUC to report and track the community benefits of the selected Alternative.

3.1 Case Study

SFPUC evaluated three infrastructure alignment alternatives to reduce combined sewer overflows (CSOs) in the Lake Merced watershed. The green infrastructure investments considered a variety of alignments and configurations. From the potential list of options, the fatal flaw analysis was applied to arrive at three viable Project Alternatives (See Figure 11). While each performed similar levels of performance, Project 2 was ultimately selected as the Recommended Project Alternative.

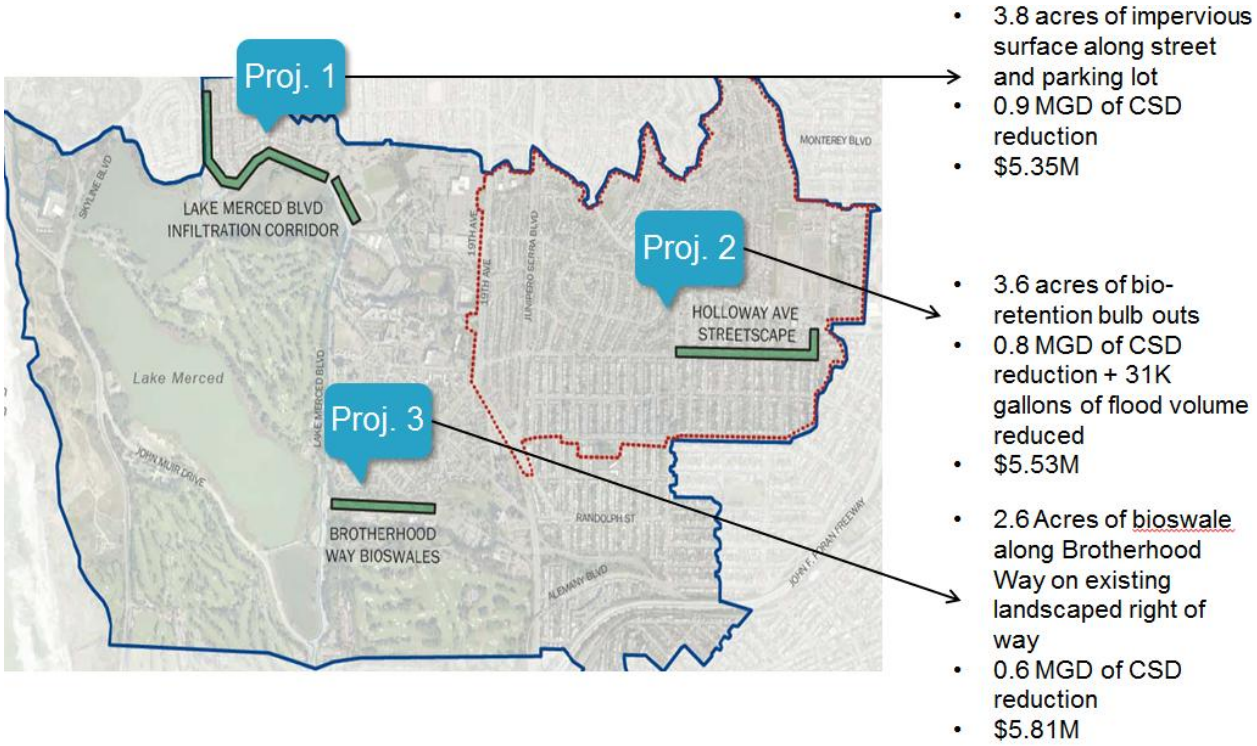

Figure 41: Lake Merced Project Alternatives

Project 2 resulted in lower life cycle costs, added bicycle and pedestrian enhancements in an area previously identified as a high priority pedestrian and bicycle investment zone, and would generate sufficient carbon sequestration benefits. Figure 12 is summary output of the TBL results for the three Project Alternatives. Figure 3 explains the logic of the individual scoring of Projects 1 and 2. These figures come from the TBL analysis that was performed in less than a week and helped establish the Recommended Alternative (Project 2).

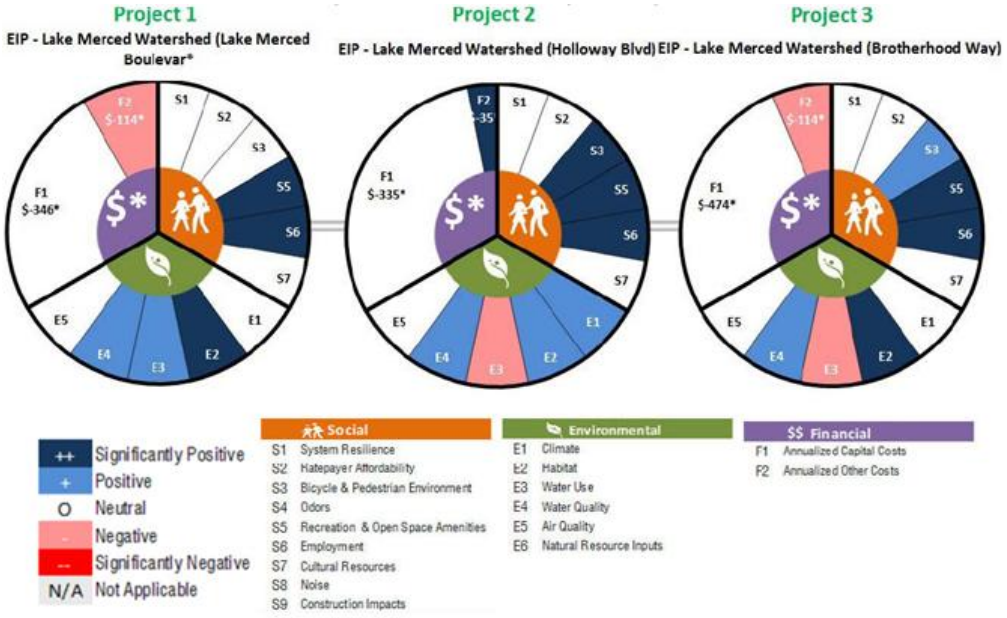

Figure 62: Lake Merced TBL Output

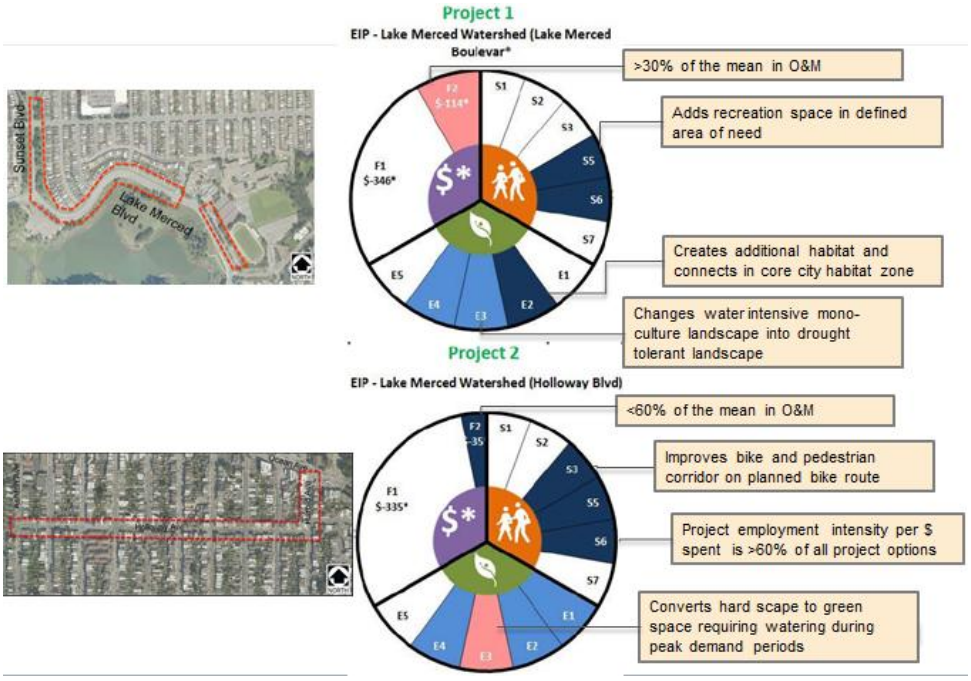

Figure 13: Example TBL Logic

The performance of the Project Alternative can then be stored and compared against other projects based on their cost effectiveness, their community impacts, and their environmental impacts. The TBL model has been adjusted as costs, greenhouse gas reduction, employment output data, and other model data become more developed. In other words, the model can be enhanced and modified to become a better predictor of actual outcomes.

4. DISCUSSION AND CONCLUSION

While TBL processes can take many forms, SFPUC has decided to establish a series of clear rules in its evaluation of financial, social, and environmental consequences for its infrastructure investments. The protocol establishes basic principles of transparency in the selection of projects as well as embodies the policies of the organization, the City, and the State, thereby making the TBL analysis more defensible. It uses an ordinal scoring system over a more complex scoring or monetization process. This is partially to limit controversy, but also to recognize the limits of predicting societal, financial, and environmental outcomes at five percent design.

What separates the TBL process from others considered is its analytical capability. While the outputs are simple, core metrics are evaluated and compared across multiple project alternatives. Projects can be added together to understand their combined TBL consequences. Outputs are intuitively displayed to be accessible to the broader public and SFPUC can quickly produce reports on how projects will impact communities. The geospatial interface can evaluate the relative distribution of community benefits and the extent to which they provide benefits in environmental justice zones.

4.1 TBL Limits

In the case of SFPUC, the TBL model does not ultimately make the decision. It gives the consequences of investments in ordinal terms and places the decision on the project team, management, and the Commission. There is no highest score alternative, which means SFPUC can interpret the results and arrive at its own conclusion. While in most cases there is differentiation among Project Alternatives, there are cases where the predicted consequences are similar. In these cases, the project team is inclined to take the lowest costs or more cost effective project. This can lead to disappointment if one project is slightly more environmentally friendly than another, but not significant enough to show an ordinal difference. This is – partially– the point. Predicted outcomes can be very different than actual outcomes, and, therefore, the model does not attempt to overstate the importance of marginal differences in greenhouse gas emissions, habitat, or other consequences that may ultimately end up very similar to one another.

4.2 Application of the TBL Model

The TBL model, its development, and its application can have broad uses across multiple infrastructure sectors, including water resources, transportation, and energy. The established criteria address broad externalities (e.g. employment, climate, natural resources) where the individual model metrics can be adapted to a given infrastructure type and location. It is set in policies specific to the locality, which gives it greater credibility. The geospatial platform and modeling tool allow it to be quickly recalibrated to another jurisdiction. Moreover, the overall model framework and interface can be replicated across any jurisdiction where geospatial information (e.g. location of parks, population, bicycle path investments, identified arterials, etc.) is readily available. To date, the TBL framework has been applied to two other jurisdictions (i.e. Alberta, Canada and Cape Cod, Massachusetts). Each jurisdiction has approached the process differently, and has used different performance criteria and analytical methods.

However, the core principles remain the following:

- Reflect the policies of the locality in the TBL evaluation process
- Minimize overstating benefit and limit false precision
- Establish core metrics that compare across varied infrastructure investments
- Convene a stakeholder group to review and validate the TBL logic
- Develop an evaluation tool that is transparent where project managers, decisiondecison makers, and the greater public can understand how the agency arrived at a particular decision

Developing a TBL evaluation process that is standardized and uses the same performance criteria and evaluation protocol each time is as important as setting up the model itself. Management

can more readily compare different investments since project managers are able to run the same process regardless of the infrastructure investment. Because independent weighting and unique criteria established by the project team are not considered, management is more enabled to make and/or validate recommendations. Ultimately, any TBL process should meaningfully weigh the consequences of investment, but also give sufficient evidence and confidence to select an option. The TBL process, in its essence, is about making decisions. It is the core objective of SFPUC's tool and its continued use and enhancement will be a testament to its utility to SFPUC.

5. REFERENCES

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