RECLAMATION

Managing Water in the West

San Diego Basin Study

Task 2.5 – Trade-Off Analysis and Opportunities




U.S. Department of the Interior
Bureau of Reclamation

City of San Diego
Public Utilities Department

June 2019

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The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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San Diego Basin Study

Task 2.5 – Trade-Off Analysis and Opportunities

June 2019

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Acronyms and Abbreviations

ACS	American Community Survey
AF	acre-feet (1 AF = 43,560 cubic feet = 325,851 gallons)
AF/y	acre-feet per year
Basin Study	San Diego Basin Study
BIOS	California Biological Information and Observation System
BMP	Best Management Practice
CAL FIRE	California Department of Forestry and Fire Protection
CFS	cubic-feet per second
CMIP5	Coupled Model Intercomparison Project, Phase 5
CNDDB	California Natural Diversity Database
CoSMoS	Coastal Storm Modeling System
DAC	Disadvantaged Community
DWR	California Department of Water Resources
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
GHG	Greenhouse Gas Emissions
GIS	Geographic Information System
IID	Imperial Irrigation District
IRWM	Integrated Regional Water Management
ISO	Independent System Operator (California)
LMP	Locational Marginal Price
MCDA	Multi-Criteria Decision Analysis

MGD	million gallons per day
MHPA	Multi-Habitat Planning Area
Mi^2	square miles
MSCP	San Diego County South County Multiple Species Conservation Program
MWD	The Metropolitan Water District of Southern California
MWh	megawatt-hour
OEHHA	California Office of Environmental Health Hazard Assessment
RAC	IRWM Regional Advisory Committee
Report	San Diego Basin Study Task 2.5 Interim Report
U.S.	United States
SDBS/Study	San Diego Basin Study
SDCWA	San Diego County Water Authority
SLR	Sea Level Rise
SRA	State Responsibility Area
STAC	Basin Study Technical Advisory Committee
TMDL	Total Maximum Daily Load
UWMP	SDCWA Urban Water Management Plan
WRF	Water Reclamation Facility
WRP	Water Reclamation Plant
WWTP	Waste Water Treatment Plant

Glossary

Central Tendency:

(1) For climate change scenarios, the central tendency is the 50th percentile of temperature change and precipitation change from the Coupled Model Intercomparison Project, Phase 5 (CMIP5) temperature and precipitation projections.

(2) For statistical analysis, the central tendency is a central or typical value for a probability distribution. The most common measures of central tendency are the arithmetic mean, median, and mode.

Concept: San Diego Basin Study (SDBS) Concepts represent groups of similar strategies or projects that could be used to meet the water demands of the region. These Concepts are used as the basis for analysis in the Study. Concepts were defined to characterize existing and potential future approaches. Concepts are defined by one or more projects.

Evaluation Objective: Criteria developed through stakeholder input to characterize desired outcomes.

IRWM Program: A California Department of Water Resources (DWR) program for supporting water resources planning under the Regional Water Management Planning Act (SB 1672). Integrated Regional Water Management (IRWM) is a collaborative effort to manage all aspects of water resources in a region. The fundamental principle of IRWM is that regional water managers, who are organized into regional water management groups, are best suited and best positioned to manage water resources to meet regional needs.

Performance Measures: Metrics to calculate Evaluation Objective scores based upon a combination of survey responses, modeling results and/or GIS analyses.

Portfolios: Portfolios were developed for the purpose of simulating and analyzing groups of related Concepts. Each Portfolio contains a subset of Concepts.

Projects: Projects represent actual or theoretical proposed modifications to existing facilities, construction of new facilities, modifications to system operations, modifications to policy, or other proposed activities. Most SDBS projects are based on actual proposed projects, including projects listed as verifiable, additional planned, and conceptual in the 2015 SDCWA Urban Water Management Plan (UWMP); the 2013 San Diego County Water Authority (SDCWA) Master Plan; the 2013 IRWM Plan; the 2017 Stormwater Resources Plan or other similar planning documents and lists. Other projects represent a theoretical project idea or type of project, but are not tied to a specific proposed implementation.

San Diego Basin Study Area: The area bounded on the north, west, and south by the San Diego County boundary and on the east by the boundaries of 11 Study Watersheds. The Study Area is the same as the San Diego IRWM Planning Region.

Study Watersheds: The entirety of the San Luis Rey, Carlsbad, San Dieguito, Peñasquitos, San Diego River, Pueblo, Sweetwater, and Otay watersheds and the portions of the San Juan, Santa Margarita, and Tijuana watersheds within San Diego County.

Urban Water Management Plans: Plans prepared and submitted to DWR by California's urban water suppliers every five years to meet the requirements identified in the California Water Code, Sections 10608 – 10656. Every urban water supplier that either provides over 3,000 acre-feet of water annually, or serves more than 3,000 urban connections, is required to assess the reliability of its water sources over a 20-year planning horizon, and report its progress on a 20% reduction in per-capita urban water consumption by the year 2020, as required in the Water Conservation Act of 2009.

Watershed: Surface drainage area upstream of a specified point on a watercourse. A geographical portion of the Earth's surface from which water drains or runs off to a single point.

Executive Summary

Study and Task 2.5 Overview

The purpose of the San Diego Basin Study (Study) is to determine potential climate change impacts on water supplies and demands within the San Diego region, and to analyze structural and non-structural concepts that can assist the region in adapting to the uncertainties associated with climate change. The primary purpose of Task 2.5 was to compare Concepts for meeting the San Diego region's water demands and addressing the impacts of increasing demand and climate variation through the 2050s.

The Concepts represent a set of planned or conceptual projects that are being considered in the region for the purposes of improving operations of existing facilities and supplies, and/or developing new water supply sources. The 12 Concepts evaluated in this analysis were:

- Conveyance Improvement
- Enhanced Conservation
- Gray Water Use
- Groundwater
- Imported Water Purchases
- Potable Reuse
- Recycled Water
- Seawater Desalination
- Stormwater Best Management Practices (BMPs)
- Stormwater Capture
- Urban and Agricultural Water Use Efficiency
- Watershed and Ecosystem Management

Each Concept will result in a variety of benefits and costs, both direct and indirect, which could accrue inside or outside the project area. Some of the benefits and costs are quantifiable and can be monetized, some are quantifiable but cannot be monetized, and some are unquantifiable and cannot be monetized. Trade-off analysis is a technique that provides a basis for comparing the effects of Concepts across the various types of benefits and costs. Task 2.5 included a trade-off analysis as well as a supplemental economic assessment.

This Task 2.5 Interim Report (Report) describes the trade-off analysis methodology used for the Basin Study, the data required and used to complete the trade-off analysis, results of the trade-off analysis, and an assessment of quantifiable economic benefits and costs for the Study Area. The trade-off analysis results were used to identify the strengths and weaknesses of Concepts as measured by Evaluation Objectives. Evaluation Objectives represent the range of criteria that stakeholders and decision-makers may want to consider when comparing Concepts. The results provide information that is directly relevant to water managers in the region who are making decisions about potential future investments. The economic assessment provides supplemental information on the economic effects associated with each Concept for those effects that can be quantified and monetized.

The Basin Study is a technical assessment and does not provide recommendations or represent a statement of policy or position of Reclamation, the Department of the Interior, or the City of San Diego. The Basin Study does not propose or address the feasibility of any specific project, program or plan. Nothing in the Study is intended, nor shall the Study be construed, to interpret, diminish, or modify the rights of any participant under applicable law. Nothing in the Study represents a commitment for provision of Federal funds.

Methodology

Two evaluations were completed as part of Task 2.5, a trade-off analysis and a supplemental economic assessment. Although the two evaluations share some common measures, they represent very different perspectives. An economic assessment is based only on effects that can be quantified and monetized while a trade-off analysis can include a wider range of effects because monetization of effects, and in some cases precise quantitative measures, are not necessary as part of a trade-off analysis. If all the relevant benefits and costs associated with a project can be quantified in monetary terms, an economic analysis would produce the same results as a trade-off analysis because both analyses include the same effects and use the same unit of measure for comparison (dollars). However, in most cases, non-monetized benefits and costs are an important consideration in evaluating projects, so a trade-off analysis provides important information for decision-makers that is not included in an economic assessment.

Trade-Off Analysis

There are four basic steps involved in a trade-off analysis:

1. Identify Evaluation Objectives to quantify benefits and challenges of Concepts
2. Determine the Relative Importance of Evaluation Objectives
3. Place Values on Evaluation Objectives using Performance Measures
4. Evaluate and Combine Evaluation Objective Scores for Each Concept

Each Evaluation Objective was quantified on a 1 to 5 scale so that different Evaluation Objectives could be added, averaged, or otherwise compared. The 13 Evaluation Objectives used in this Report include the following:

- Address Climate Change Through Greenhouse Gas Reduction
- Climate Resilience
- Cost Effectiveness
- Environmental Justice
- Optimize Local Supplies/Independence
- Project Complexity
- Protect Habitats, Wildlife, and Ecosystems
- Provide for Scalability of Implementation
- Reliability and Robustness
- Quality of Life/Recreation
- Regional Economic Impact
- Regional Integration and Coordination
- Water Quality and Watersheds

A total of 26 Performance Measures was developed to quantify the 13 Evaluation Objectives associated with the different Concepts. Performance Measures were quantified using outputs from a water system simulation model, Geographic Information Systems (GIS) analyses, surveys of identified experts and stakeholders, or combinations of the three sources.

The relative importance of each Evaluation Objective was based on the results of an online survey implemented by the City of San Diego. A copy of the survey is included in Appendix B – Surveys Used to Gather Data for Task 2.5. The survey consisted of 13 questions that allowed stakeholders to rate the Evaluation Objectives on a scale of least important to most important. The survey, which was sent to the Study Technical Advisory Committee (STAC) and the Integrated Regional Water Management (IRWM) stakeholder list, resulted in 71 responses representing 13 areas of expertise including Water Utility Operations, Environmental Policy, and Community Outreach and Education.

After identifying the Evaluation Objectives, determining the relative importance of Evaluation Objectives, and placing values on the Concepts for each Evaluation Objective using the Performance Measures, the Evaluation Objective values associated with each Concept were combined with the relative importance of the Evaluation Objectives to estimate a total trade-off analysis score accounting for all effects. Additional statistical analysis was also completed to evaluate the potential for bias in the trade-off analysis results that stem from using mean survey results to calculate Performance Measure values, and the trade-off analysis scores were re-calculated using median survey results as a sensitivity analysis. In addition, two trade-off analyses using example subsets of Evaluation Objectives were completed to demonstrate how stakeholders may apply the trade-off analysis process and data to meet their specific needs.

Supplemental Economic Assessment

The economic assessment provides supplemental information to the trade-off analysis. It examined the effects of Concepts for three categories of benefits that could be quantified in monetary terms: municipal and industrial water supply reliability, recreation, and energy usage. This assessment was based on the estimated quantitative impacts each Concept would have on resources and activities based on Task 2.5 model results, and the economic value of these resources and activities obtained from previously completed studies that provide benefit estimates for similar activities, resources, and resource conditions within the Study Area. The values were computed relative to the Baseline model results, which represented the system as it existed in 2015, with some minor modifications to include water supplies that have been or are certain to be implemented.

Results

Trade-Off Analysis

The average importance ratings for the Evaluation Objectives for all respondents normalized on a 1 to 10 scale (10 is most important and 1 least important) are shown in Table ES-1. The Evaluation Objective weights developed from the survey responses indicated Reliability and Robustness, Water Quality and Watersheds, Climate Resilience, Optimize Local Supplies, and Protect Habitats, Wildlife, and Ecosystems had the highest level of importance, with average importance weights that were 9.2 or higher on a 10-point scale. Concepts targeting and generating positive effects for these five Evaluation Objectives will tend to provide the greatest level of overall benefit to the region. However, other impact categories are still important and should not be ignored. The next tier of importance included Environmental Justice, Cost Effectiveness, Regional Integration and Coordination, and Address Climate Change Through Greenhouse Gas Reduction, with importance weights ranging from 8.7 to 8.2 on a 10-point scale. The third tier of importance included Regional Economic Impact, Scalability of Implementation, Quality of Life/Recreation, and Project Complexity with importance weights ranging from 7.8 to 7.3.

Table ES-1. Evaluation Objective importance weights based on average of all responses.

Evaluation Objective	Average of all responses
Reliability and Robustness	10.0
Water Quality and Watersheds	10.0
Climate Resilience	9.6
Optimize Local Supplies	9.4
Protect Habitats, Wildlife, and Ecosystems	9.2
Environmental Justice	8.7
Cost Effectiveness	8.5
Regional Integration and Coordination	8.5
Address Climate Change Through Greenhouse Gas Reduction	8.2
Regional Economic Impact	7.8
Scalability of Implementation	7.7
Quality of Life/Recreation	7.4
Project Complexity	7.3

The trade-off analysis results using mean survey results to calculate Performance Measures are summarized in Figure ES-1. The Evaluation Objective scores are unitless measures of relative effects. Therefore, they can be summed to derive a total score that accounts for the effects of a Concept on all Evaluation Objectives and accounts for the importance of each Evaluation Objective. However, due to missing project-level survey data and/or inability to map some projects for GIS analysis, the information available for scoring the Enhanced Conservation, Imported Water Purchases, Seawater Desalination, and Gray Water Use Concepts was limited, resulting in these Concepts only receiving scores for a subset of the Evaluation Objectives. These Concepts are presented separate from the Concepts scored for all Evaluation Objectives because they cannot be directly compared.

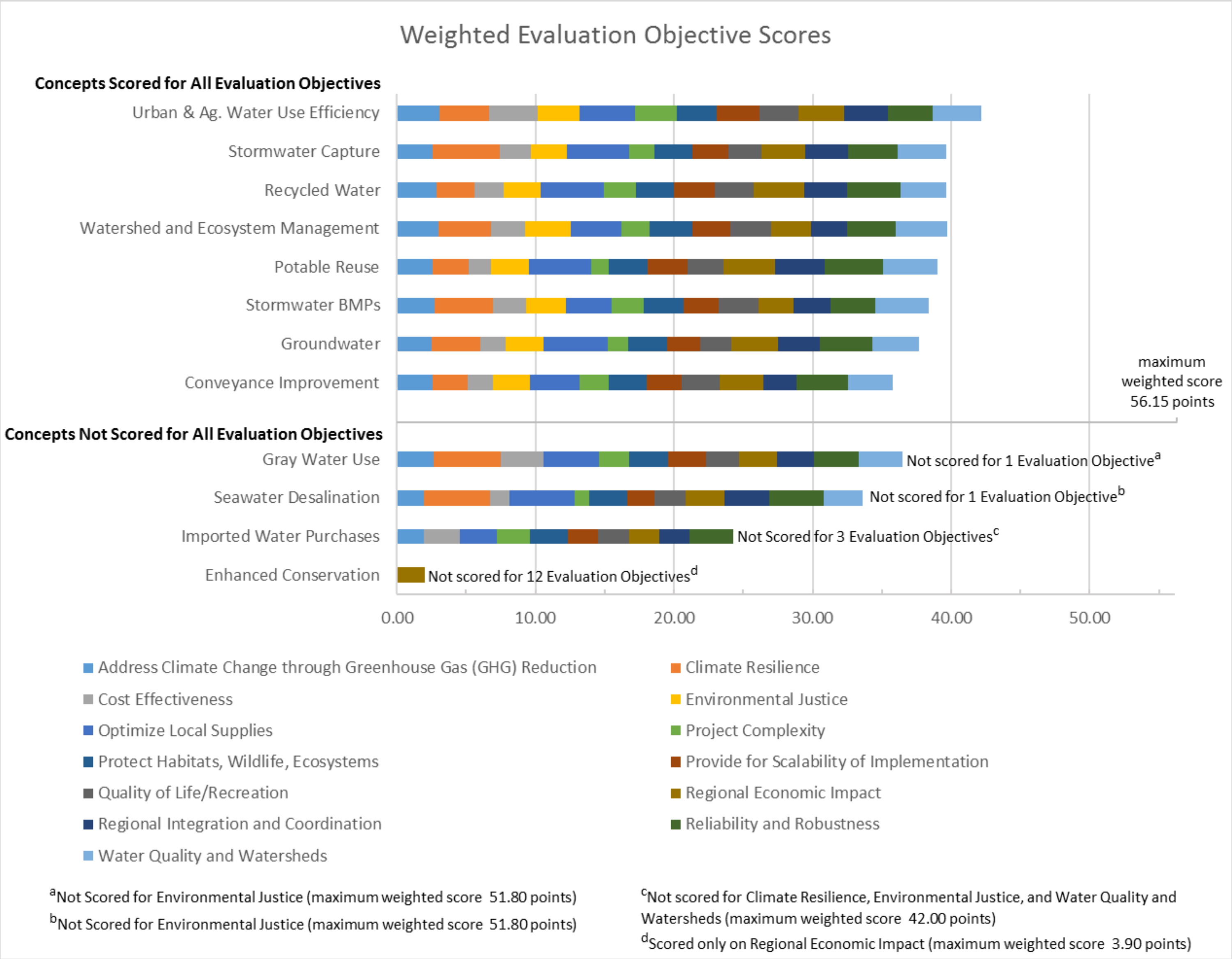


Figure ES-1. Trade-off analysis results for each Concept by Evaluation Objective, using mean survey scores for calculation of Performance Measures.

The trade-off analysis using all Evaluation Objectives indicated that the Urban and Agricultural Water Use Efficiency Concept generates the greatest overall positive benefits as defined by the Evaluation Objectives. Stormwater Capture, Recycled Water, Watershed and Ecosystem Management, Potable Reuse, and Stormwater BMPs also generated high overall positive effects, although markedly less than Urban and Agricultural Water Use Efficiency. The Conveyance Improvement and Groundwater Concepts scored the lowest based on all Evaluation Objective scores combined.

The use of average (mean) values from the survey data to represent differences in performance measures and Evaluation Objectives across Concepts was tested using statistical analysis of differences in mean values. There was a negligible difference in Evaluation Objective scores using median values relative to using mean values, indicating that there is minimal potential for bias from using mean values.

Trade-off analyses can also be completed to evaluate specific subsets of Evaluation Objectives that are of interest to decision-makers. As examples, two additional trade-off analyses were completed using two subsets of Evaluation Objectives. The first subset included Evaluation Objectives that represent cost and feasibility aspects: Cost Effectiveness; Project Complexity; Provide for Scalability of Implementation; and Regional Integration and Coordination. The second example subset included Evaluation Objectives that represent environmentally-related factors: Address Climate Change through Greenhouse Gas (GHG) Reduction; Climate Resilience; Environmental Justice; Protect Habitats, Wildlife, and Ecosystems; and Water Quality and Watersheds. The results of these two example subset trade-off analyses are presented in Table ES-2, Figure ES-2, and Figure ES-3.

Including only a subset of Evaluation Objectives clearly changes the order of the Concepts in the trade-off analysis results from the order using all Evaluation Objectives. Both the trade-off analysis including all Evaluation Objectives and the trade-off analysis using the cost/feasibility subset of Evaluation Objectives resulted in the Urban and Agricultural Water Use Efficiency Concept having the greatest number of points, while the analysis including environmentally-related Evaluation Objectives dropped the Urban and Agricultural Water Use Efficiency Concept to fourth highest. Watershed and Ecosystem Management was raised to the highest ranking in the subset including environmentally-related Evaluation Objectives, from the second-ranked Concept including all Evaluation Objectives (using mean survey responses). This demonstrates the potentially large influence that different perspectives on regional objectives, as reflected through the use of different subsets of Evaluation Objectives, can have on the trade-off analysis results.

Table ES-2. Trade-off analysis rankings based on all Evaluation Objectives, cost/feasibility Evaluation Objectives, and environmentally-related Evaluation Objectives for Concepts that received scores for all Evaluation Objectives.

Concept	Rank Based on All Evaluation Objectives	Rank for Cost and Feasibility Evaluation Objectives Subset	Rank for Environmentally-Related Evaluation Objectives Subset
Urban & Ag. Water Use Efficiency	1	1	4
Watershed and Ecosystem Management	2	4	1
Stormwater Capture	3	6	3
Recycled Water	4	3	7
Potable Reuse	5	7	6
Stormwater BMPs	6	5	2
Groundwater	7	10	5
Conveyance Improvement	8	9	8
Gray Water Use	NA	2	NA
Seawater Desalination	NA	11	NA
Imported Water Purchases	NA	8	NA
Enhanced Conservation	NA	NA	NA

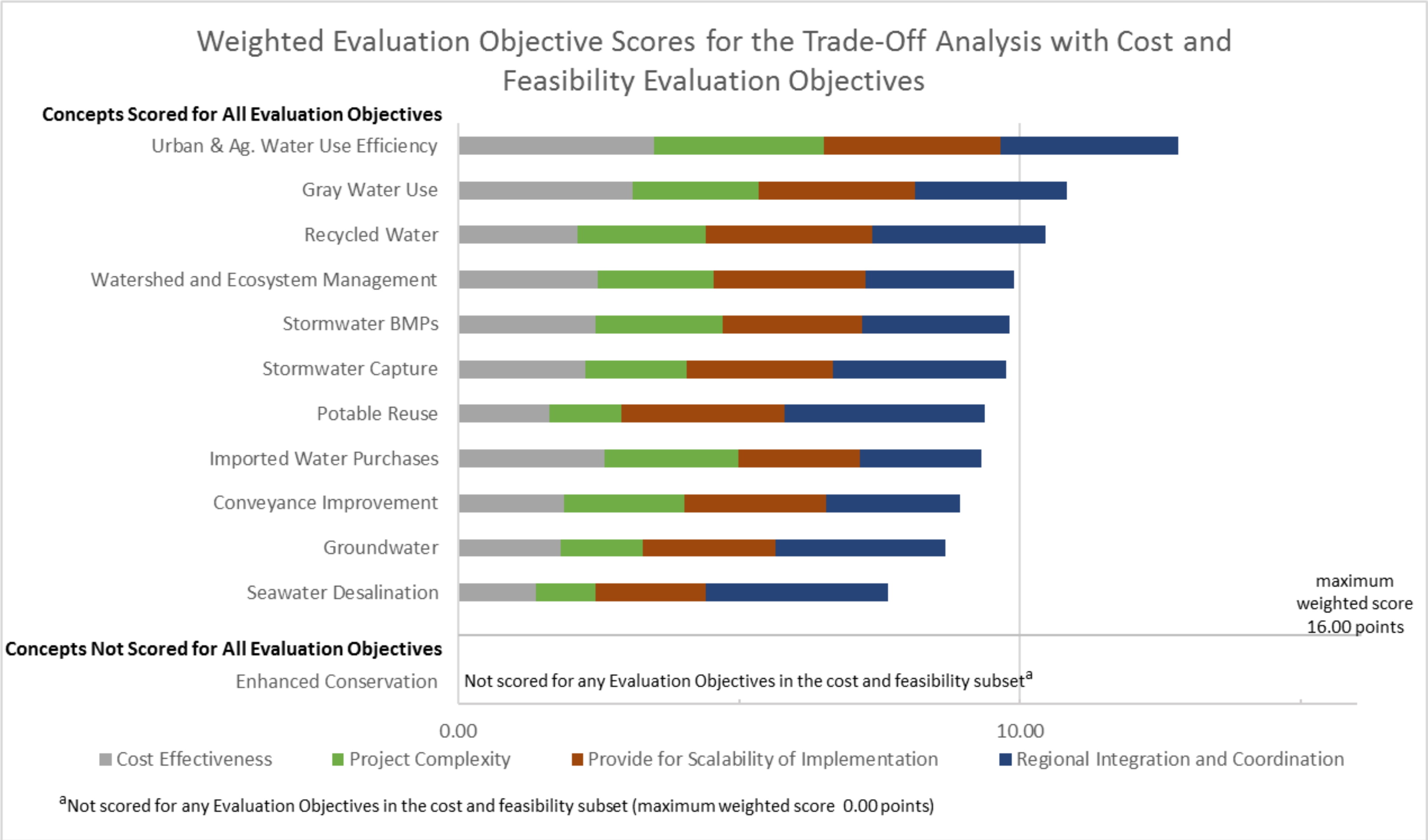


Figure ES-2. Trade-off analysis results using a subset of cost- and feasibility-related Evaluation Objectives.

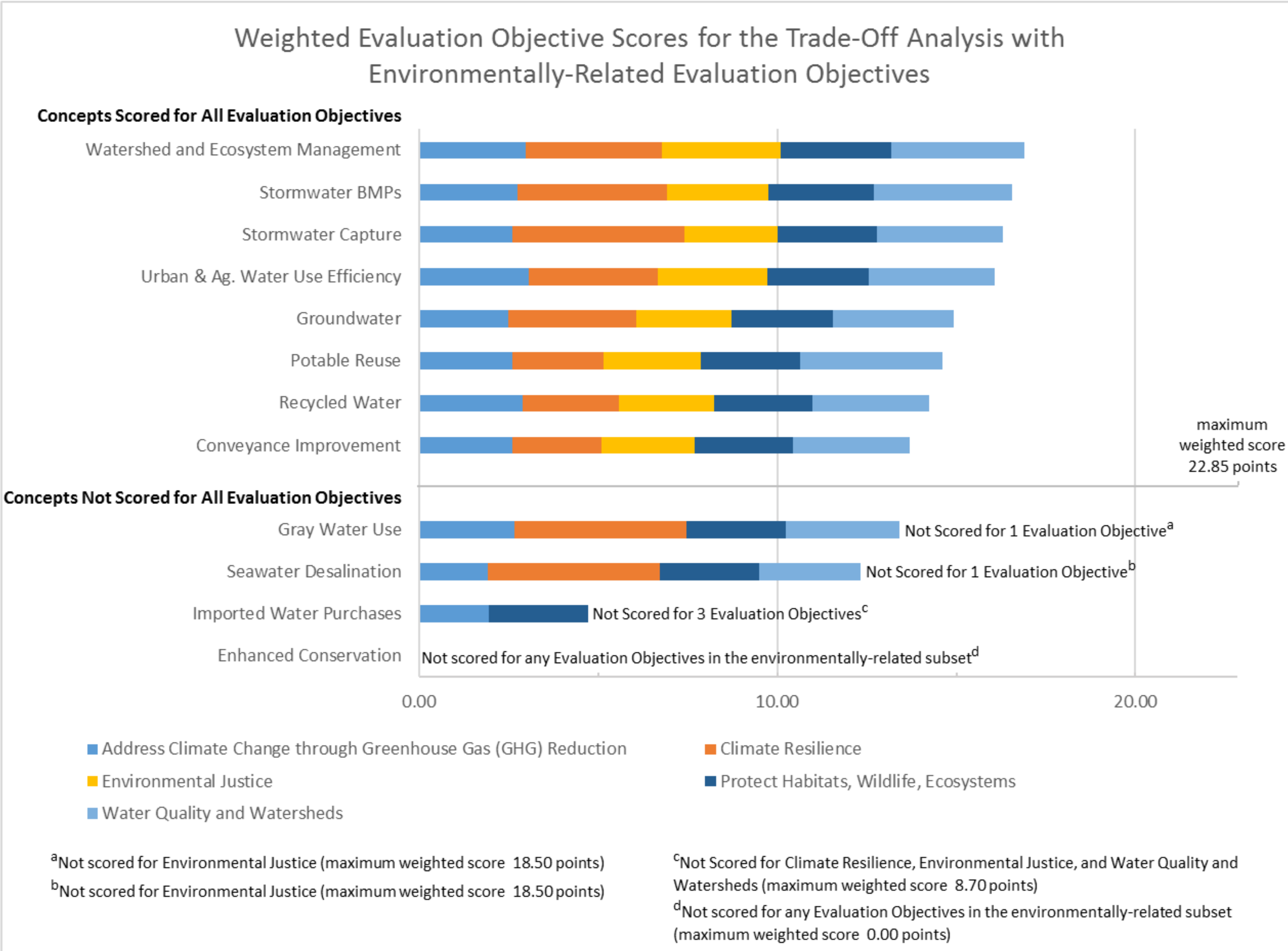


Figure ES-3. Trade-off analysis results for a subset of environmentally-related Evaluation Objectives.

Supplemental Economic Assessment

The economic assessment examined effects of Concepts in three categories of benefits (municipal and industrial water supply reliability, recreation, and energy usage) that could be quantified in monetary terms based on Task 2.5 model results and economic values from literature. The assessment supplemented the trade-off analysis by providing a sense of the differences in economic value associated with the Concepts compared to the Baseline model run, which represented the system as it existed in 2015, with some minor modifications to include water supplies that have been or are certain to be implemented. However, the economic values in this assessment only represented a small subset of the total effects included in the trade-off analysis. The activities and resources that cannot be monetized still have value, and therefore, this economic assessment should not be considered a complete economic analysis for use in a full benefit-cost type of analysis. However, the assessment does provide information that can be used to assess the economic effects of each Concept on water supply reliability, recreation, and energy use. The results of the economic assessment are presented in Table ES-3.

Table ES-3. Estimated value of quantified and monetized effects relative to the Baseline.

Concept	Annual Value of a Change in Water Shortages Relative to Baseline	Annual Change in the Value of Recreation Opportunities Relative to Baseline	Annual Value of a Change in Net Power Relative to Baseline	Net Annual Value of Quantified and Monetized Economic Effects Relative to Baseline
Conveyance Improvement	$167,800	$319,300	-$139,297	$347,803
Enhanced Conservation	$3,228,600	$69,549	$17,935,706	$21,233,855
Gray Water Use	$272,800	$1,123	$230,735	$504,658
Groundwater	$1,305,300	$3,083	$1,147,135	$2,455,518
Imported Water	$237,300	-$72	$520,798	$758,026
Potable Reuse	$2,185,100	$163,309	$4,948,425	$7,296,834
Recycled Water	$1,419,900	$2,032	$2,751,385	$4,173,317
Seawater Desalination	$1,883,700	$406	-$1,928,869	-$44,763
Stormwater BMPs	$8,200	$143	$8,031	$16,374
Stormwater Capture	$68,200	$311	$53,416	$121,927
Urban & Agricultural Water Use Efficiency	$230,500	$406	$268,484	$499,390
Watershed & Ecosystem Management	$195,700	-$82,790	$459,355	$572,265

The economic assessment indicated there are positive reduced water supply shortage benefits associated with all the Concepts relative to baseline conditions. Similarly, there were positive or near zero benefits associated with the value of recreation activity for all the Concepts except Watershed and Ecosystem Management, which had negative recreation benefits due to the inclusion of the Hodges Water Quality Improvement Program as one of the two projects in this Concept that could be modeled. This project enables larger releases of stored water, resulting in lower reservoir elevations. The benefits and costs associated with the net value of energy usage was highly variable and Concept-dependent. The net annual values, including all three quantified and monetized effects for each Concept, are shown in Figure ES-4. Enhanced Conservation provided the highest net value for the three benefit categories that were analyzed, mainly as a result of its high positive energy usage reduction values (less energy used compared to Baseline). The negative net benefits associated with the Seawater Desalination Concept were driven by the negative net energy usage reduction value (more energy used compared to Baseline). Water supply reliability had only a moderate impact on overall Concept ranking for the economic assessment, and recreation values played a comparatively small role in the economic assessment results.

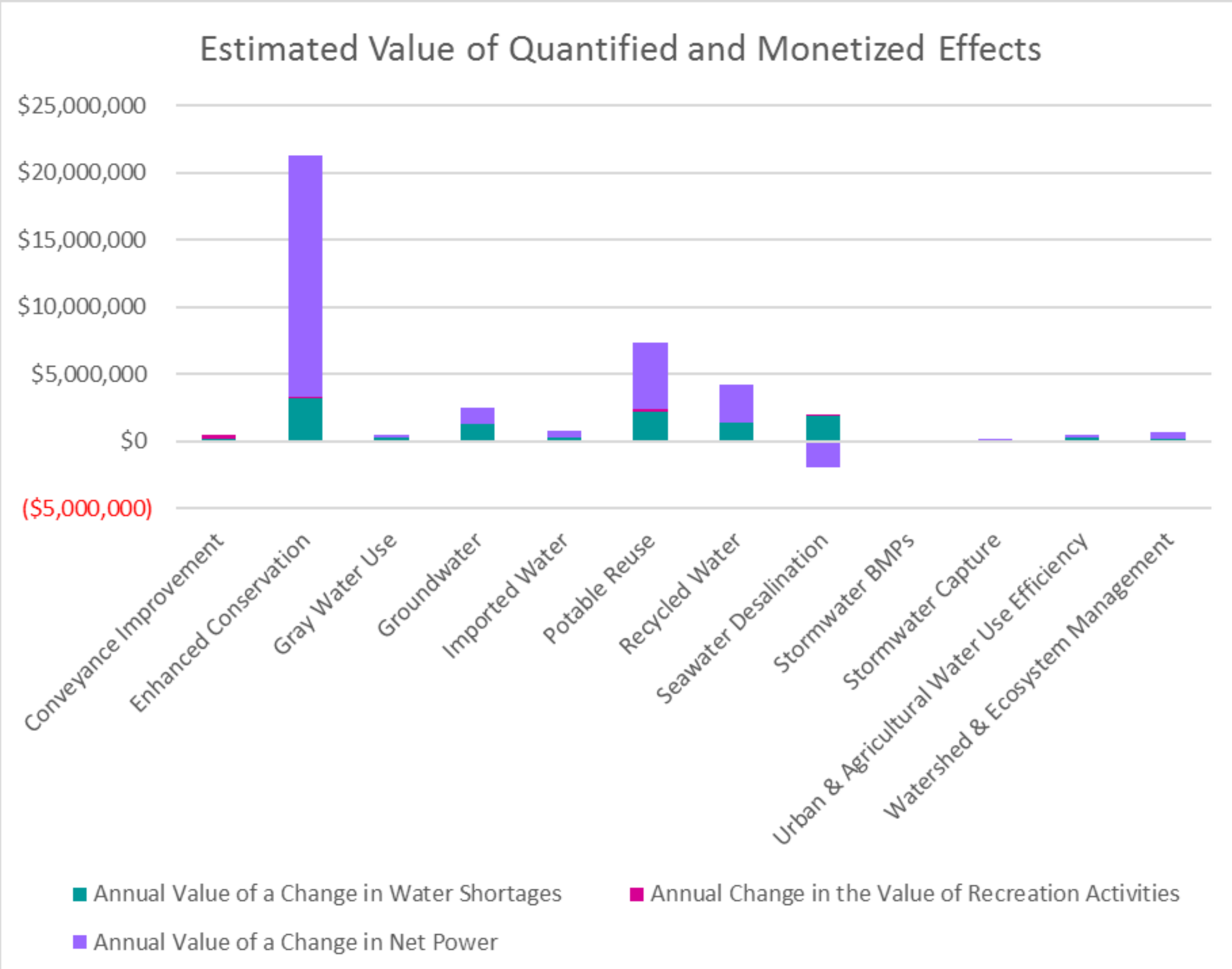


Figure ES-4. Net annual value of quantified and monetized effects for each Concept for the three categories of benefits analyzed in the economic assessment.

Discussion and Conclusions

Trade-off analysis serves as a valuable tool to compare the ability of Concepts to achieve Evaluation Objectives defined by regional stakeholders. An outcome of this analysis is the relative ranking of Concepts. The Concept rankings are determined by the specific set of Evaluation Objectives included, the data used to calculate Performance Measures, and the weights determined from the Basin Study survey, and are intended to be used as a screening of promising Concepts rather than a prioritized list of recommended approaches.

Key findings of the trade-off analysis include:

- Concepts can be divided into three groups based on the weighted scores for all Evaluation Objectives using mean survey scores, plus a fourth group that is not directly comparable to the other groups because the Concepts were not scored on all Evaluation Objectives.
    - Top Scoring Concept
        - Urban and Agricultural Water Use Efficiency
    - Concepts Scoring within 10% of the Top Scoring Concept
        - Watershed and Ecosystem Management
        - Stormwater Capture
        - Recycled Water
        - Potable Reuse
        - Stormwater BMPs
    - Concepts Scoring within 15% of the Top Scoring Concept
        - Groundwater
        - Conveyance Improvement
    - Concepts Not Scored on All Evaluation Objectives
        - Imported Water Purchases
        - Enhanced Conservation
        - Seawater Desalination
        - Gray Water Use
- Stakeholders identified Reliability and Robustness and Water Quality and Watersheds as the most important Evaluation Objectives in the survey that asked respondents to rank Evaluation Objectives on their relative importance. Climate Resilience was the next most important, followed by Optimize Local Supplies.
- Potable Reuse was the highest-scoring Concept for both Reliability and Robustness and Water Quality and Watersheds, the Evaluation Objectives weighted with the highest importance by stakeholders. Gray Water Use scored highest for Climate Resilience, and Seawater Desalination scored highest for Optimize Local Supplies.
- Urban and Agricultural Water Use Efficiency, the highest scoring Concept for all Evaluation Objectives, scored higher than neutral for all Evaluation Objectives and did not receive an unweighted Evaluation Objective score below a neutral value of 3.00.
- The top overall scoring Concepts had individual Evaluation Objective scores that were consistently in the top tier of Concepts, although they were not necessarily the top scoring Concepts for every Evaluation Objective.
- Generally, most Concepts did not perform poorly for any particular Evaluation Objective, except Project Complexity and Cost Effectiveness. Most Concepts scored relatively

poorly for Project Complexity, with an average unweighted score of 2.70, and Cost Effectiveness, with an average unweighted score of 2.74.

- No Concept received a less than neutral (3.00) score for Environmental Justice; Protect Habitats, Wildlife, and Ecosystems; Quality of Life/Recreation; or Reliability and Robustness.
- The Project Complexity Evaluation Objective had the largest range of unweighted scores, ranging from a low of 1.47 for Seawater Desalination to a high of 4.13 for Urban and Agricultural Water Use Efficiency.
- Protect Habitats, Wildlife, and Ecosystems had the smallest range of unweighted scores, ranging from 3.00 for seven Concepts to 3.35 for Watershed and Ecosystem Management.
- All Concepts had at least one Evaluation Objective with an unweighted score above 4.0 except for Imported Water and Enhanced Conservation. Imported Water received a maximum unweighted score of 3.26 (for Project Complexity) and was not scored for three Evaluation Objectives.
- Analysis of significant differences between Concepts using mean survey results indicated low potential for bias, and sensitivity analysis of overall trade-off analysis results using median scores indicated only minor changes in Concept ranking.

The supplemental economic assessment evaluated three categories of benefit that could be quantified and monetized relative to Baseline conditions: municipal and industrial water supply reliability (reduced shortages), recreation (reservoir visitation), and net energy usage. The economic assessment does not represent a full accounting of all economic effects that would be expected from each of the Concepts.

Key findings of the economic assessment include:

- Value of Water Supply Reliability
  - All the Concepts generated positive benefits associated with reducing water shortages.
  - Enhanced Conservation generated the greatest reduced water shortage benefits compared to the Baseline conditions, followed by Potable Reuse and Seawater Desalination.
- Value of Recreation
  - Differences in the value of recreation activities relative to the Baseline were significantly smaller than differences in the value of water shortages and the change in the value of net power.
  - Conveyance Improvement generated the greatest recreation benefit, followed by Potable Reuse and Enhanced Conservation.

- Value of Energy
    - The difference in net energy usage relative to the Baseline was large and positive for Enhanced Conservation, Potable Reuse, Recycled Water, and Groundwater.
    - Net energy usage values relative to the Baseline were negative for Seawater Desalination and slightly negative for Conveyance Improvement, indicating an increase in energy usage would be required for those Concepts compared to Baseline.
- Net Value of Water Supply Reliability, Recreation, and Energy
    - The combined quantified and monetized economic effects for the three categories of benefits analyzed are positive relative to the Baseline for all Concepts except Seawater Desalination.
    - Enhanced Conservation generated the greatest overall positive benefit relative to the Baseline for the three categories of benefits analyzed and had a net annual value more than three times larger than any other Concept.

1. Introduction

1.1. Study Overview and Purpose

The purpose of the San Diego Basin Study (Basin Study or SDBS) is to determine potential climate change impacts on water supplies and demands within the San Diego region, and to analyze structural and non-structural concepts that can assist the region in adapting to the uncertainties associated with climate change. The Basin Study is investigating potential changes to existing operating policies for regional water supply facilities (i.e., dams, reservoirs, conveyance facilities, and water treatment and water recycling plants), modifications to existing facilities, development of new facilities that could optimize reservoir systems, and additional new water supply options including desalination and indirect potable reuse options. This analysis is designed to assist in decision-making as the San Diego region considers future investments in water supply management.

The Study's two primary objectives are:

1. Determine how climate change will impact the current and future water supply portfolio of the San Diego region; and

2. Develop structural and non-structural concepts within the San Diego region that can serve as strategies to manage climate change impacts, focusing on improving operations of existing facilities and supplies, and further developing new core water supply sources.

The Basin Study is divided into two interrelated tasks. Task 1 comprises the project management aspects of the work, while Task 2 addresses the detailed scientific, engineering, and economic analyses that are being completed to meet the Study objectives. Task 2 is further divided into the following sub-tasks 2.1 through 2.6:

- 2.1 – Water Supply and Water Demand Projections
- 2.2 – Downscaled Climate Change and Hydrologic Modeling
- 2.3 – Existing Structural Response and Operations Guidelines Analysis
- 2.4 – Structural and Operations Concepts
- 2.5 – Trade-Off Analysis and Opportunities
- 2.6 – Final Report

1.2. Overview of Task 2.5

This Interim Report (Report) describes the methodologies and findings for the Study's Task 2.5 – Trade-Off Analysis and Opportunities. The primary purpose of Task 2.5 was to compare Concepts for meeting the San Diego region's water demands and addressing the impacts of increasing demand and climate variation through the 2050s. The Concepts represent a set of planned or conceptual projects that are being considered in the region for the purposes of improving operations of existing facilities and supplies, and/or developing new water supply sources. Each Concept will result in a variety of benefits and costs, both direct and indirect, which could accrue inside or outside the project area. Some of the benefits and costs are quantifiable and can be monetized, some are quantifiable but cannot be monetized, and some are unquantifiable and cannot be monetized. An example of a direct benefit would be improved water supply reliability for water users because of recycling and reuse. An example of an indirect benefit would be the value of habitat improvements for fish and wildlife. To compare the Concepts and account for the different types of benefits and costs, Task 2.5 included two components:

1. Trade-off analysis (Chapters 3 through 5) to evaluate and compare different categories of benefits and costs, including categories of benefits and costs that cannot be quantified and monetized.

2. Supplemental assessment of potential economic benefits and financial effects associated with the Concepts (Chapter 6). This assessment was separate from the trade-off analysis and is intended to provide supplemental information, focusing only on those benefits and costs that can be quantified and monetized.

Chapter 2 of the report includes a general discussion of the San Diego Basin Study including background of the Study, an overview of the Study Area, and the water management strategies evaluated in this Task. Chapter 3 of the report describes the methodology for the trade-off analysis, including a general overview of the process and a detailed discussion of scoring procedures. Chapter 4 provides the results of the trade-off analysis scoring by Evaluation Objective. Chapter 5 presents overall trade-off analysis results for all Evaluation Objectives and a subset of Evaluation Objectives. Chapter 6 describes the supplemental economic assessment, focusing on the methods that are used to estimate economic benefits and costs. Chapter 7 discusses the results of the trade-off analysis and describes how the trade-off analysis methodology and results can aid in project planning and evaluation.

1.2.1. Trade-off Analysis

Trade-off analysis is a methodology that can be used to compare different types of benefits and costs that cannot all be precisely quantified or cannot be quantified in monetary terms. If all the relevant benefits and costs associated with a project can be quantified in monetary terms, a traditional economic analysis would produce the same results as a trade-off analysis because dollars would be a common measure for all effects. However, in most cases, non-monetized benefits and costs are an important consideration in evaluating alternatives. A trade-off analysis can include a broader range of criteria than an economic analysis alone because the effects do not need to be translated into monetary terms for comparison.

The San Diego Basin Study trade-off analysis included the following:

- An estimate of the effects of each Concept on various aspects of the San Diego region as defined by relevant Evaluation Objectives (defined in Section 3.1),
- A relative comparison (strengths and weaknesses) of Concepts for each Evaluation Objective based on defined Performance Measures (identified in Section 3.3.1), and
- Identification of Concepts that are effective in meeting priority outcomes as identified by the Evaluation Objectives.

1.2.2. Supplemental Economic Assessment

An economic assessment usually includes an evaluation of the benefits and costs to society from building a project and/or implementing a policy, considering only those benefits and costs that can be quantified and monetized. A project is considered economically feasible or justified if the economic benefits to all those affected by the project, directly or indirectly, are greater than the costs of the project. Examples of potential economic benefit categories include municipal and agricultural water supplies, water quality, and environmental quality. Economic feasibility implies that society is better off with the project than without the project.

An economic assessment also frequently includes an evaluation of the effect of a project on cash flows from the perspective of individual businesses, households, and agencies that would be required to pay project costs. This type of analysis, known as a financial analysis, generally includes information on project costs, revenues and/or services generated by the project, and the financial resources available to pay for the project compared to project costs. A project is considered financially feasible if the financial resources of project beneficiaries are sufficient to pay the capital and annual operation and maintenance costs associated with the project. Similarly, a project is considered cost effective if it can provide the desired output at the lowest possible cost or lowest cost per unit produced.

An important limitation of an economic assessment is the exclusion of benefits and costs that cannot be precisely quantified in monetary terms. There are many potential benefits associated with environmental and social improvements, flood risk mitigation, and environmental justice, but such benefits cannot be evaluated quantitatively. For projects where these unquantified and/or non-monetized benefits are very important and potentially large, an economic analysis alone may not provide the information needed to make a sound economic decision that increases net benefits and social welfare.

2. Study Background and Study Area

2.1. Study Background

For more than 70 years, the San Diego area has relied on imported water as the primary source of supply for the region. With a strong military presence before, during, and immediately after World War II, San Diego's growing population was in desperate need of water supply solutions. In response, the Department of the Navy and the Bureau of Reclamation constructed the San Diego Project, two large-diameter pipelines that connect the area to The Metropolitan Water District of Southern California's (MWD) water supply infrastructure, to bring in supplemental supplies from the Colorado River. The first pipeline was completed in 1947 and the second in 1954 (together known as the 'First Aqueduct'), which the San Diego County Water Authority (SDCWA) now owns and operates along with three additional large-diameter pipelines (collectively, the 'Second Aqueduct') that deliver imported supplies into the region. Imported water from the Colorado River Basin and State Water Project remain the region's predominant source of supply, comprising approximately 70% to 90% of the supplies utilized within the region. These imported supplies consist of water purchased from MWD and other imported supplies resulting from agreements that provide access to senior water rights on the Colorado River via long-term transfers. Imported water purchases are dependent on availability of water from MWD, while the long-term transfer agreements guarantee 130,000 acre-feet per year (AF/y) and increasing to 200,000 AF/y by 2021 of conserved water from the Imperial Irrigation District (IID) and an additional 80,200 AF/y of water conserved through canal lining projects. The imported water purchases, the IID transfer water, and the canal lining water are wheeled through MWD's conveyance facilities and delivered to SDCWA's aqueducts.

Prior to the introduction of imported water supplies to the region, surface water reservoirs served as the primary source of water supply for the region. As of 2015, local surface water (estimated to provide approximately 51,680 AF/y of supply, although it can vary substantially from year to year due to fluctuating hydrologic cycles) and seawater desalination (Carlsbad Desalination, with a production capacity of 56,000 AF/y) provided the majority of local supplies (San Diego County Water Authority, 2016).

Two additional local supplies include recycled water and groundwater. Although groundwater provides some water to the San Diego region, San Diego, unlike other large metropolitan areas within southern California, such as those located within the Los Angeles or Santa Ana watersheds, does not have large productive groundwater basins within its borders. This is due to several factors including limited productive sand and gravel (alluvial) aquifers, the relatively shallow nature of most existing alluvial aquifers, lack of rainfall and groundwater recharge, and degraded water quality resulting from human activities (San Diego County Water Authority, 2016).

While SDCWA and its member agencies have taken steps to diversify the region's supply portfolio through the development of local supplies, through the formation of agreements to access senior water rights on the Colorado River, and through conservation and water use efficiency improvements, the region remains highly reliant on imported water sources. The reliability of imported water deliveries to the San Diego region is uncertain due to periodic droughts in northern California and the Colorado River Basin, regulatory restrictions related to endangered species in the Bay-Delta that limit State Water Project deliveries, the potential for catastrophic events such as earthquakes, and climate change. Over the last 25 years, multi-year supply cutbacks have been experienced on three separate occasions (San Diego County Water Authority, 2009).

Future changes are anticipated to affect both water supply and demand in the San Diego region. As the San Diego region continues to grow in population, water demands are anticipated to increase (San Diego County Water Authority, 2016; San Diego County Water Authority, 2018). Climate change is anticipated to impact local supply availability from surface water, as well as regional water demand, particularly for outdoor and agricultural uses. An increase in median annual precipitation of 0% to 12% and an increase in median annual temperature of 1.5 to 4.5 degrees Fahrenheit, is projected depending on the climate model selected. This results in surface water inflows to reservoirs ranging from 78% to 128% of current climate inflows (Bureau of Reclamation, 2018). Climate change is also anticipated to affect imported water supplies as a result of climate change impacts on the Sacramento-San Joaquin (Bureau of Reclamation, 2016) and Colorado River (Bureau of Reclamation, 2012) Basins.

To meet current and future water supply reliability goals, it is essential that the region evaluate its existing system, identify ways to improve the ability to store imported and local water supplies when available, and develop new water supplies, making the region less vulnerable to drought, climate change, and water delivery service interruptions.

2.2. Study Area Overview

The Study Area (Figure 1) delineates the area for which water supplies and demands are examined in the Basin Study. It is equivalent to the planning regions of the San Diego IRWM Plan and the SDCWA 2015 Urban Water Management Plan. The Study Area is bounded on the north, west, and south by the San Diego County boundary and on the east by the boundaries of

11 regional watersheds (the Study Watersheds) (Table 1). Eight of the Study Watersheds are completely within the Study Area (San Luis Rey, Carlsbad, San Dieguito, Los Peñasquitos, San Diego, Pueblo, Sweetwater, and Otay). Two northern watersheds (San Juan and Santa Margarita) and one southern watershed (Tijuana) are partially within the Study Area.

SDCWA and its member agencies (Table 2) are the primary suppliers of water within the Study Area. The SDCWA service area is entirely within the Study Area and encompasses most of the western portion of San Diego County. It is divided into 24 member agency service areas, the largest of which is the City of San Diego, which makes up approximately one-third of the SDCWA service area (Figure 2). The Study Area overlaps numerous other municipal and water agency boundaries. Many other ongoing planning efforts examine portions of the Study Area, such as the Urban Water Management Plan produced by the City of San Diego (San Diego County Water Authority, 2016) and Urban Water Management Plans produced by other individual SDCWA member agencies.

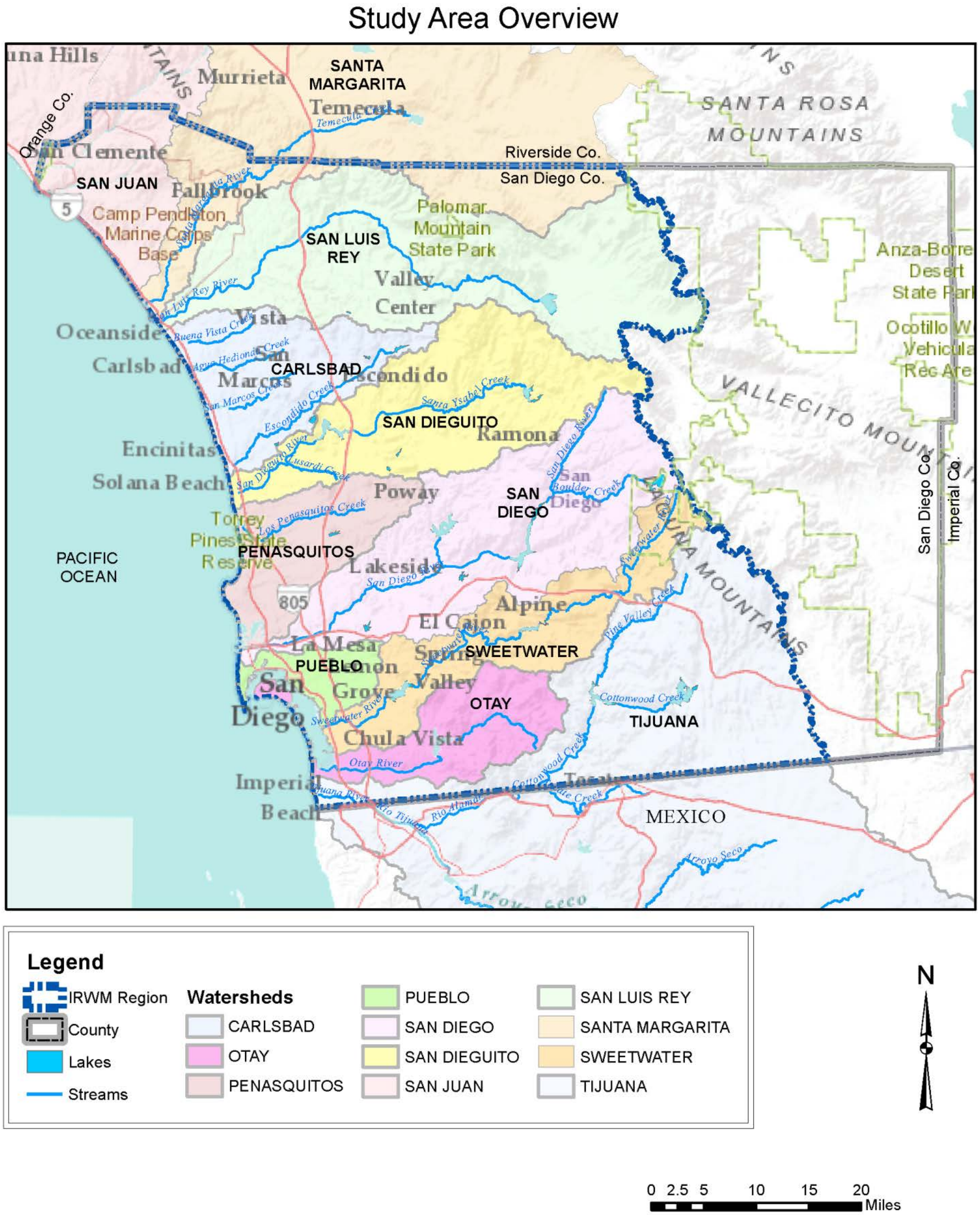


Figure 1. Overview of the San Diego Basin Study Area.

Table 1. Study watersheds.

Watershed	Area (mi^2)	Major Drainages in Study Area	Groundwater Basins	Reservoirs
San Juan	496 (150 in Study Area)	San Mateo Creek	San Mateo Valley San Onofre Valley	None
Santa Margarita	750 (200 in Study Area)	Santa Margarita River	Santa Margarita Valley	None
San Luis Rey	562	San Luis Rey River	San Luis Rey Valley Warner Valley Ranchita Town Area	Henshaw Turner
Carlsbad	211	small stream systems draining to coast	Batiquitos Lagoon Valley San Elijo Valley San Marcos Area Escondido Valley	Wohlford Dixon Olivenhain San Dieguito
San Dieguito	346	San Dieguito River	San Pasqual Valley Santa Maria Valley San Dieguito Valley Pamo Valley	Sutherland Ramona Poway Hodges
Peñasquitos	162	small streams	Poway Valley	Miramar
San Diego River	440	San Diego River	Mission Valley San Diego River Valley (including Santee-El Monte) El Cajon	El Capitan San Vicente Cuyamaca Jennings Murray
Pueblo	60	none	Sweetwater Valley	none
Sweetwater	230	Sweetwater River	Sweetwater Valley	Loveland Sweetwater
Otay	160	Otay River	Otay Valley	Upper and Lower Otay
Tijuana	1,750 (467 in Study Area)	Tijuana River	Tijuana Cottonwood Valley Campo Valley Portrero Valley	Morena Barrett

Table 2. SDCWA Member Agencies.

SDCWA Member Agencies	
Camp Pendleton Marine Corps Base	Padre Dam Municipal Water District
Carlsbad Municipal Water District	Rainbow Municipal Water District
City of Del Mar	Ramona Municipal Water District
City of Escondido	Rincon del Diablo Municipal Water District
City of Oceanside	San Dieguito Water District
City of Poway	Santa Fe Irrigation District
City of San Diego	Sweetwater Authority (City of National City and South Bay Irrigation District)
Fallbrook Public Utility District	Vallecitos Water District
Helix Water District	Valley Center Municipal Water District
Lakeside Water District	Vista Irrigation District
Olivenhain Municipal Water District	Yuima Municipal Water District
Otay Water District	

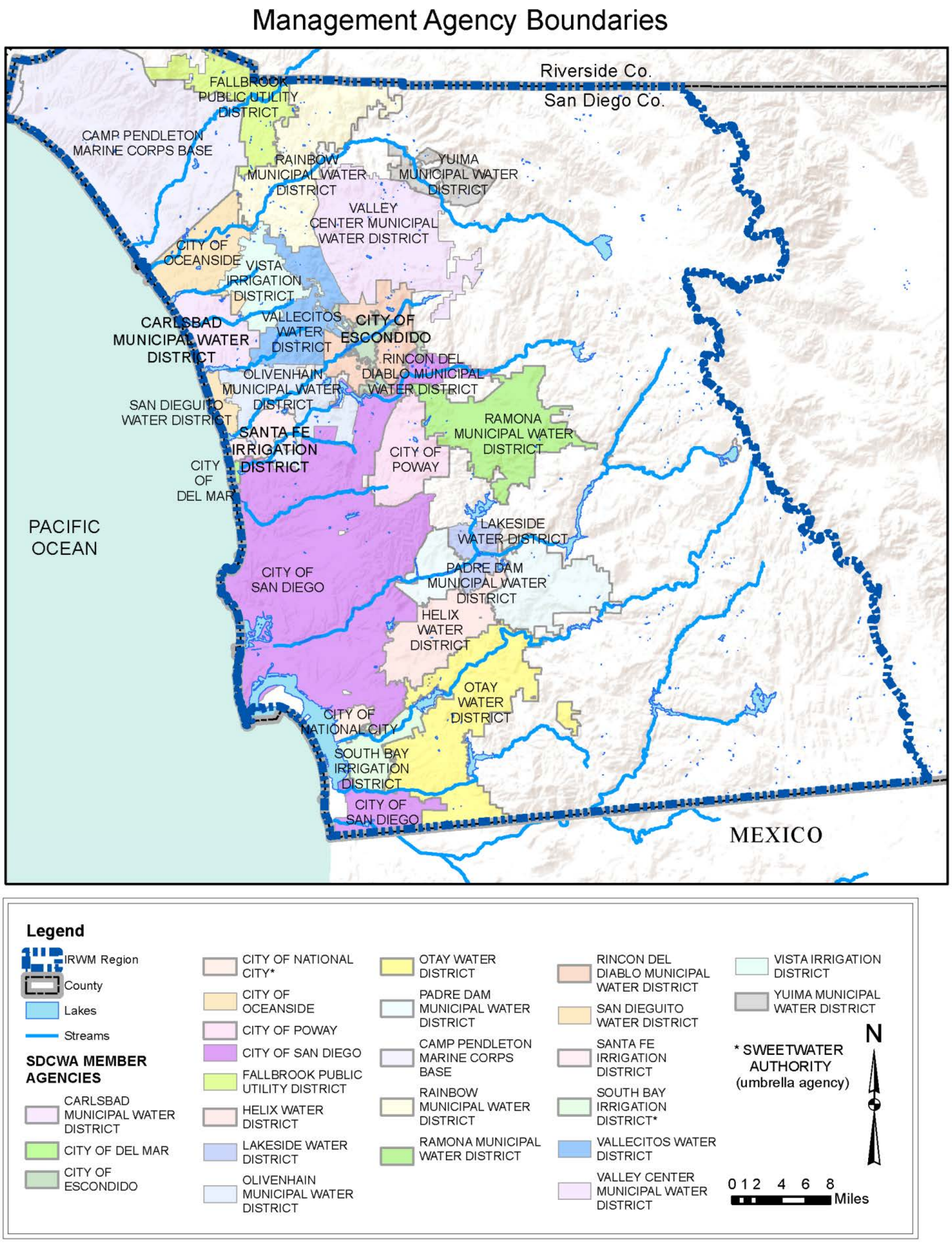


Figure 2. SDCWA member agency boundaries.

2.3. Concepts and Projects

The primary purpose of Task 2.5 was to compare Concepts for meeting the San Diego region's water demands and addressing the impacts of increasing demand and climate variation through the 2050s. Concepts used in this Study (Table 3) represent groups of similar strategies or projects that could be implemented to meet the water demands of the region. They were defined to characterize existing and potential future water management strategies. These Concepts were developed through review of existing studies, regional plans, and projects, as well as consultation with stakeholders at IRWM Regional Advisory Committee (RAC) meetings and Basin Study Technical Advisory Committee (STAC) meetings in the fall of 2017.

Table 3. San Diego Basin Study Concepts.

Concept[1]	Narrative Concept Description
Conveyance Improvement	Improve local and regional conveyance systems to increase supply reliability, increase operational flexibility, and reduce greenhouse gas emissions (GHG) by utilizing existing conveyance facilities and natural water courses and modifying existing pump stations, pipelines, interties and bypasses.
Enhanced Conservation	Implement long-term or permanent restrictions in water use to decrease demand. Restrictions or allocations may be imposed at the local, regional, or State levels, and may include restrictions or allocations by water purveyors such as MWD.
Gray Water Use	Offset potable water usage by encouraging, supporting, and/or providing incentives for gray water system installation by residential customers.
Groundwater	Provide water supply by extracting and treating and/or desalinating groundwater from local freshwater and brackish aquifers and maintain sustainable groundwater supplies through projects to recharge groundwater basins with injected or infiltrated rainfall, recycled water, imported water, or a combination.
Imported Water Purchases	Provide water supply by purchasing treated or untreated water from a water wholesaler outside the region, such as MWD.
Potable Reuse	Provide water supply by producing advanced treated water from wastewater for direct or indirect (e.g., reservoir or groundwater augmentation) potable use.
Recycled Water	Offset potable water use by providing non-potable recycled water use for landscape irrigation, industrial purposes, or to recharge groundwater.
Seawater Desalination	Provide water supply by utilizing or expanding existing facilities or constructing new facilities to remove salts from seawater.
Stormwater BMPs	Reduce adverse water quality impacts of stormwater through implementation of stormwater Best Management Practices (BMPs). BMPs are structural, vegetative, or management practices used to treat, prevent, or reduce stormwater runoff and pollution.

Concept[1]	Narrative Concept Description
Stormwater Capture	Provide water supply by capturing stormwater through both centralized projects and regional decentralized efforts and treating it for both potable and non-potable uses.
Urban and Agricultural Water Use Efficiency	Increase water use efficiency by encouraging long-term behavioral change and implementing water use efficiency programs (e.g., rain barrel rebates, turf replacement credits, rebates for more efficient irrigation or plumbing fixtures, gray water system rebates).
Watershed and Ecosystem Management	Promote sustainable, high quality local water supplies through practices that support healthy ecosystems and improve or restore the condition of landscapes and biological communities. Such practices may include invasive species removal, restoration of native ecosystems, land acquisition for protection or enhancement, brush/forest management for wildfire risk reduction, remediation of aquifer and reservoir water quality through engineered or biological controls, management of non-point and point source pollution, and low impact development.

[1] Concepts that were only included in the Baseline Portfolio analysis of the Task 2.4 Interim Report, such as Drought Restriction/Allocation, Firm Water Supply Agreements, and Local Surface Water Reservoirs, were not evaluated in the Task 2.5 Trade-off Analysis.

Concepts are defined by one or more ‘projects’ which represent actual, potential, or theoretical proposed modifications to existing facilities, construction of new facilities, modifications to system operations, modifications to policy, or other proposed activities. Most SDBS projects are based on actual proposed projects, including projects listed as verifiable, additional planned, and conceptual in the 2015 SDCWA Urban Water Management Plan (UWMP) (San Diego County Water Authority, 2016), the 2013 SDCWA Master Plan (San Diego County Water Authority, 2013), the 2013 IRWM Plan (San Diego Integrated Regional Water Management Group, 2013), the 2017 San Diego Stormwater Resources Plan (San Diego Region Copermittees and San Diego County Public Works, 2017), or other similar planning documents and lists. Other projects represent a theoretical project idea or type of project, but are not tied to a specific proposed implementation. See Appendix E: San Diego Basin Study Projects for a complete list of projects.

3. Trade-Off Analysis Methodology

A trade-off analysis is an application of Multi-Criteria Decision Analysis (MCDA), which is a general framework for evaluating complex decision-making situations with multiple and often conflicting objectives. MCDA can address the inevitable trade-offs that occur when a decision leads to a desirable change in one or more objectives while simultaneously resulting in an undesirable change in another objective. Most multi-criteria problems have conflicting criteria and as a result there is no unique solution that can optimize all the criteria simultaneously. Multi-criteria decision-making analyses, such as a trade-off analysis, incorporate several decision-making steps including development of evaluation criteria, weighting of criteria, criteria scoring for concepts or alternatives, and comparing concepts or alternatives based on the criteria weights and scores.

The San Diego Basin Study trade-off analysis compared the Concepts described in Section 2.3 based on a set of 13 Evaluation Objectives, which were weighted and then scored using one or more Performance Measures. These Concepts represent a set of planned or conceptual projects that are being considered in the region. The intent of the trade-off analysis is to provide information that can help make decisions about future investments. Therefore, the trade-off analysis does not evaluate existing assets or projects (e.g., projects within the Baseline Portfolio, as defined in the Task 2.4 interim report). The information gathered to score the Concepts was rooted in model results and project-specific data, supplemented by information gathered about each Concept as a whole. An overview of the steps used to complete the San Diego Basin Study trade-off analysis is included below and sections detailing each of the steps follow.

Step 1: Identify Evaluation Objectives

First, a set of 13 Evaluation Objectives was identified to allow comparison between Concepts. Evaluation Objectives represent the range of criteria that stakeholders and decision-makers may want to consider when comparing Concepts. Each Evaluation Objective was quantified on a 1 to 5 scale so that different Evaluation Objectives could be added, averaged, or otherwise compared.

Step 2: Determine the Relative Importance of Evaluation Objectives

Second, the relative importance of the Evaluation Objectives was determined using a survey. To make objective choices between the Concepts, which have varying effects as measured by the Evaluation Objectives, information was needed to evaluate the relative importance of the 13 Evaluation Objectives. In a trade-off analysis, the relative importance of different effects is typically accomplished by either asking a representative sample of the affected population for comparisons of value for different objectives/effects, reviewing completed studies that have estimated values for different objectives/effects, or by reviewing laws and regulations that apply to different objectives/effects. A survey was implemented as part of the SDBS to gather opinions and values of the population affected by water management in the San Diego region to determine the relative importance of the different Evaluation Objectives. The weighting of the Evaluation Objectives reflects the preferences of affected groups, agencies, and decision-makers within the Study Area. The weighted sum of the Evaluation Objectives scores leads to an aggregate function that can be used to compare Concepts.

Step 3: Place Values on Evaluation Objectives using Performance Measures

Third, one or more Performance Measures for quantifying the value of the Evaluation Objectives for each Concept was identified for each Evaluation Objective. Performance Measures were calculated using data from model run output metrics, literature review, geospatial analysis, quantitative or qualitative estimates of value from surveys of identified experts and stakeholders, or a combination of data sources.

Step 4: Evaluate and Combine Evaluation Objective Scores for Each Concept

The final step of the trade-off analysis was to aggregate the individual Performance Measures scores associated with each Concept for the Evaluation Objectives and combine the scores with the relative importance of the Evaluation Objectives to estimate a total score for the Concept across all Evaluation Objectives. The results provide a baseline evaluation of the Concepts and provide information that is directly relevant to water managers in the region who are making decisions about potential future investments. The number of Evaluation Objectives included in the trade-off analysis can be changed to evaluate the sensitivity of alternative preferences to the types of objectives that are considered important by decision-makers and the public. A decision-making tool was developed as an affiliate product of this report, which is a Microsoft Excel spreadsheet entitled "Customized Tradeoff Analysis Tool" included in Appendix D: Customized Trade-Off Analysis. This tool enables users to customize the trade-off analysis to reflect their preferences. Options for customization include selecting a subset of Evaluation Objectives to include in the trade-off analysis and adjusting Evaluation Objective weights or scores. This decision-making support tool also enables the trade-off analysis to be updated as new information and science becomes available or as priorities in the region change.

3.1. Identification of Evaluation Objectives

The first step in the SDBS trade-off analysis was to identify the Evaluation Objectives that were used for comparison of Concepts. Evaluation Objectives represent the range of criteria that stakeholders and decision-makers may want to consider when comparing Concepts. They were developed in the summer of 2017 through consultation with the STAC and public stakeholders, including discussions at two IRWM Regional Advisory Committee meetings in October and December 2017. These Evaluation Objectives were used as the basis for comparison of Concepts in the Task 2.5 trade-off analysis.

The 13 Evaluation Objectives considered in this analysis (Table 4) are an inclusive but not exhaustive list of the effects associated with the Concepts evaluated in the trade-off analysis. For example, other potential effects such as changes in flood damages and greenhouse gas emissions were not included due to limitations in data and understanding of connections between Concepts and effects on resources and activities. There are likely to be other examples of potential effects that were not included in the analysis in addition to the two mentioned above, but discussions among the Bureau of Reclamation, the City of San Diego, IRWM stakeholders, and the STAC identified the 13 primary Evaluation Objectives included in this analysis.

Table 4. Evaluation Objective definitions.

Evaluation Objective	Narrative Objective Description
Address Climate Change Through Greenhouse Gas Reduction	Concepts that reduce greenhouse gas emissions through energy efficiency improvements, industrial process modifications, transitions from fossil fuel to renewable energy sources, or by increasing carbon sequestration through habitat protection, restoration, or other activities that store carbon.
Climate Resilience	Concepts that directly or indirectly improve the regional resilience to the impacts of climate change: sea level rise, flooding, wildfire, and extreme heat. *Note that data for directly evaluating resilience was not readily available or known for the majority of projects and, thus, an analysis of a project's ability to increase climate resilience was outside the scope of the study. Therefore, the Performance Measures in the Climate Resilience Evaluation Objective were focused on evaluating the vulnerability of individual projects to the impacts of climate change (e.g., warming and fire, sea level rise, and flooding). Also note that Regional resilience to drought was included in the Evaluation Objective, Reliability and Robustness.*
Cost Effectiveness	Concepts that reduce capital and operation and maintenance costs to the region and/or have a strong potential for external funding.
Environmental Justice	Concepts that consider environmental justice issues, provide access to reliable/cost effective drinking water, distribute project benefits equitably throughout the basin, and/or directly benefit Disadvantaged Communities (as defined by the Department of Water Resources).
Optimize Local Supplies	Concepts that increase local water supplies and/or reduce the reliance on imported water.
Project Complexity	Concepts that reduce inherent challenges associated with project complexity or feasibility (e.g., regulatory compliance, number of agencies/approvers, property ownership, public opinion/acceptance/practicality of implementation).
Protect Habitats, Wildlife, and Ecosystems	Concepts that reduce impacts to ecosystems and threatened or endangered species.
Provide for Scalability of Implementation	Concepts that provide flexibility in project phasing and expansion.

Evaluation Objective	Narrative Objective Description
Quality of Life/Recreation	Concepts that increase green/open space benefits and other improvements to quality of life, including recreational opportunities such as swimming, boating, and fishing.
Regional Economic Impact	Concepts that increase the potential for local job creation and regional economic activity (e.g., tourism and other industries).
Regional Integration and Coordination	Concepts that support community engagement, education, and coordination with regional partners to leverage existing assets and projects, reduce project barriers, and/or build community support and knowledge of water issues.
Reliability and Robustness	Concepts that provide a reliable supply of drinking water, capable of meeting regional demand under normal, drought, and emergency conditions. This Objective includes management strategies to optimize infrastructure for the purposes of providing robust and reliable water supply.
Water Quality and Watersheds	Concepts that reduce stormwater and wastewater discharges to rivers and the ocean, and reduce water quality impacts to water resources, including groundwater basins, surface waters, and 303(d) listed water bodies.

3.2. Determination of the Relative Importance of Evaluation Objectives

The second step in the San Diego Basin Study Trade-off Analysis was to gather opinions and values of the population affected by water management in the San Diego region to determine the relative importance of the different Evaluation Objectives. A survey was determined to be the most effective approach to estimate the Evaluation Objective weights.

3.2.1. Survey

In order to solicit the input of stakeholders on the relative importance of Evaluation Objectives, an online survey was distributed by the City of San Diego to the region's stakeholders. The survey consisted of 13 questions that allowed stakeholders to rate the Evaluation Objectives on a scale of least important to most important. Results of this survey were used to develop weights that reflect the importance of each Evaluation Objective to the San Diego Basin Study Area, which were then used to calculate weighted scores for each Concept.

The survey was developed, distributed, and compiled by the City of San Diego. It was distributed via email in November 2017 to 546 people, including the IRWM stakeholder list and 59 tribal contacts, and was open until early February 2018. As part of the survey, respondents were asked to provide their affiliation and area of expertise. In total, the survey received 71 responses from 13 different areas of expertise. This equates to a 13% response rate, though it should be noted that some emails were undeliverable and, therefore, the response rate may be underestimated. The sum of respondents for all areas of expertise illustrated in Table 5 is greater than the total number of survey responses because several respondents indicated multiple areas of expertise.

Table 5. Areas of expertise represented.

Area of Expertise	Number of Respondents
Ecology/Biology	15
Watershed Science/Limnology	20
Conservation, Restoration, Mitigation	22
Oceanography/Marine Science	6
Engineering – Design	16
Engineering – Construction	12
Climate Change	18
Community Outreach and Education	19
Environmental Policy/Planning/Analysis	28
Disadvantaged Communities	9
Finance	8
Water Utility – Operations	21
Other[1]	18

[1] Other areas of expertise included Water Use Efficiency and Demand Mitigation, Real Estate, Solid Waste/Recycling, Environmental Program Management, Leak Detection, and Conservation Non-Profit.

3.2.2. Calculation of Evaluation Objective Weights

Next, the Evaluation Objective weights were calculated by estimating the average importance rating for each Evaluation Objective for all respondents and for each discipline/area of interest. The average importance rating was estimated for each Objective and then normalized by the score for the highest rated Evaluation Objective. For example, if the highest average importance rating is a 9 out of 10, then all average ratings are divided by 9 and the result multiplied by 10 to obtain the normalized rating. These results are presented in Table 6. N represents the number of observations.

Table 6. Normalized Evaluation Objective importance ratings by discipline/area of interest.

Evaluation Objective	All	Engineers	Conservation	Utility operations	Community outreach	Finance	Environmental policy	Climate change	Other
	N = 71	N = 17	N = 15	N = 8	N = 8	N = 3	N = 7	N = 3	N = 10
Reliability and Robustness	10.0	10.0	9.2	10.0	7.5	9.3	10.0	9.0	9.9
Water Quality and Watersheds	10.0	8.3	10.0	8.8	10.0	9.0	10.0	10.0	10.0
Climate Resilience	9.6	8.2	9.9	8.0	8.8	9.7	8.9	9.7	9.9
Optimize Local Supplies	9.4	9.4	8.5	9.1	6.8	10.0	9.0	9.0	9.8
Protect Habitats, Wildlife, and Ecosystems	9.2	8.1	9.6	7.1	8.7	9.8	9.7	10.0	8.0
Environmental Justice	8.7	7.2	9.3	7.1	8.4	9.7	8.7	8.3	8.1
Cost Effectiveness	8.5	9.2	7.1	8.2	6.8	6.9	8.9	7.2	8.3
Regional Integration and Coordination	8.5	7.4	8.2	7.6	8.3	8.6	7.9	7.2	8.9
Address Climate Change through Greenhouse Gas Reduction	8.2	6.0	8.7	7.0	9.7	9.3	7.6	9.7	7.4
Regional Economic Impact	7.8	7.3	6.8	7.1	6.8	7.6	7.5	7.6	8.7
Provide for Scalability of Implementation	7.7	7.6	6.9	6.2	5.5	7.6	8.7	6.6	9.0
Quality of Life/Recreation	7.4	5.9	7.8	5.8	6.8	9.3	7.9	8.3	7.0
Project Complexity	7.3	7.8	6.4	6.4	4.9	7.6	6.8	4.8	8.9

If the average importance ratings shown in Table 6 are used as the importance weights to represent the importance of each Evaluation Objective, then it is assumed the number of responses for each discipline/area of interest is the appropriate weight for representing importance. A second set of Evaluation Objective weights was derived assuming each discipline/area of interest was weighted equally. The results using the two methods for deriving weights are shown in Table 7. The resulting weights and ranks of importance were very similar, so the simple averages using all responses combined were used to estimate weights of importance.

Table 7. Evaluation Objective importance weights and rankings based on the average of all responses and on equally weighted expertise area ratings.

Evaluation Objective	Average of all responses		Each expertise area weighted equally	
	Importance Weight	Rank	Importance Weight	Rank
Water Quality and Watersheds	10.0	1	10.0	1
Reliability and Robustness	10.0	1	9.8	2
Climate Resilience	9.6	3	9.6	3
Optimize Local Supplies	9.4	4	9.4	4
Protect Habitats, Wildlife, and Ecosystems	9.2	5	9.4	4
Environmental Justice	8.7	6	8.8	6
Regional Integration and Coordination	8.5	7	8.4	8
Cost Effectiveness	8.5	7	8.2	9
Address Climate Change Through Greenhouse Gas Reduction	8.2	9	8.6	7
Regional Economic Impact	7.8	10	7.8	10
Provide for Scalability of Implementation	7.7	11	7.5	12
Quality of Life/Recreation	7.4	12	7.7	11
Project Complexity	7.3	13	7.0	13

The importance weights used in the trade-off analysis and the standard deviation for each objective are shown in Table 8. The standard deviation measures the amount of variation, or dispersion, of values within a data set. A relatively small standard deviation indicates that the data tends to be close to the mean, and a high standard deviation indicates wider dispersion of the data. The highest weighted Evaluation Objectives generally have lower standard deviations, indicating general agreement for the higher ranked Evaluation Objectives.

Table 8. Evaluation Objective weights and standard deviations based on the average of all responses.

Evaluation Objective	Average of all responses	
	Average Importance Weight	Standard deviation
Water Quality and Watersheds	10.0	1.77
Reliability and Robustness	10.0	2.03
Climate Resilience	9.6	1.76
Optimize Local Supplies	9.4	1.95
Protect Habitats, Wildlife, and Ecosystems	9.2	2.10
Environmental Justice	8.7	2.37
Regional Integration and Coordination	8.5	1.97
Cost Effectiveness	8.5	2.02
Address Climate Change Through Greenhouse Gas Reduction	8.2	2.60
Regional Economic Impact	7.8	2.28
Provide for Scalability of Implementation	7.7	2.20
Quality of Life/Recreation	7.4	2.58
Project Complexity	7.3	2.39

3.3. Placement of Values on Evaluation Objectives Using Performance Measures

Each Evaluation Objective was measured by one or more Performance Measures. Performance Measures were scored through use of model metrics, surveys of identified experts and stakeholders, and/or geospatial analysis using GIS software. Performance Measures are listed and described in Table 9 and the types of input data are described in detail below.

Table 9. Performance Measures associated with Evaluation Objectives.

Performance Measure	Performance Measure Description	Type of Input Data
Address Climate Change through GHG Reduction		
GHG Mitigation	Mitigate greenhouse gas emissions through carbon storage and sequestration (e.g., habitat conservation and/or restoration)	Survey Responses
Climate Resilience[1,2]		
Sea Level Rise Vulnerability	Vulnerability to sea level rise: Project/Concept is located in an area with low risk to structural damage from sea level rise	GIS
Flood Risk Management	Effect on the likelihood and/or the impact of floods due to precipitation through prevention (e.g., avoiding infrastructure development in flood prone areas), protection (e.g., constructing flood control and protection facilities), preparedness (e.g., informing and educating citizens of flood risks, developing emergency response plans), and management (e.g., reservoir operation modifications to store water during floods, smooth out peak hydrographs, and transfer water to other locations)	GIS
Warming and Fire Vulnerability	Vulnerability to extreme weather (e.g., heat waves), and wildfire (e.g., portfolio reduces vulnerability of the region to extreme heat and/or fire)	GIS
Cost Effectiveness		
Capital Costs	Total present value capital costs to the region and customers/developers, over planning period	Survey Responses
O&M Costs	Total present value O&M costs to the region and customers/developers	Survey Responses
Potential for External Funding	Potential for external funding	Survey Responses
Environmental Justice		
Environmental Justice	Effect on fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (considering interests of stakeholders both inside and outside of the Basin)	GIS & Survey Responses
Disadvantaged Communities (DACs)	Effect on Disadvantaged Communities (areas throughout California which most suffer from a combination of economic, health, and environmental burdens. These burdens include poverty, high unemployment, health conditions like asthma and heart disease, as well as air and water pollution, and	GIS

Performance Measure	Performance Measure Description	Type of Input Data
	hazardous wastes). *Note: DWR defines a DAC as a community that has a median household income of less than 80% of the State's median household income ($51,026 in 2015). A severely disadvantaged community is defined as having a median household income less than 60% of the State's median household income ($38,270 in 2015) (California Department of Water Resources, 2016).*	
Optimize Local Supplies/Independence		
Local Supply	Level of local supply	Survey Responses
Project Complexity		
Project Complexity and Feasibility	Complexity and feasibility related to regulatory compliance, number of agencies/approvers, property ownership, public opinion/acceptance/practicality of implementation	Survey Responses
Protect Habitats, Wildlife, and Ecosystems		
Impacts to Ecosystems	Impact on ecosystems and ecosystem services	Survey Responses & GIS
Impacts to Native Species	Impact on native species	Survey Responses & GIS
Impacts to Threatened/Endangered Species	Impact on endangered/threatened species	Survey Responses & GIS
Provide for Scalability of Implementation		
Project Phasing	Flexibility for project phasing and expansions	Survey Responses
Quality of Life/Recreation		
Green Space/Open Space	Potential for green space/open space benefits and other improvements to quality of life	Survey Responses
Recreation Opportunities	Impact on recreation opportunities such as swimming, boating, and fishing as an incidental benefit to water supply storage and conveyance	Literature Review, Survey Responses, & Model Metrics

Performance Measure	Performance Measure Description	Type of Input Data
Regional Economic Impact		
Regional Economic Impact	Potential for local job creation and regional economic impact (e.g., to tourism and other industries)	Survey Responses and Expert Panel
Regional Integration and Coordination		
Coordination	Level of integration and/or coordination with other projects/entities, leveraging existing assets or bolstering existing projects	Survey Responses
Education and Outreach	Level of community involvement/engagement, education and outreach to encourage water use efficiency, conservation, and water quality protection through special events, print and online educational materials, demonstration projects, and other outreach activities	Survey Responses
Reliability and Robustness[2]		
Water Shortage Volume	Water shortage volume	Model Metrics
Vulnerability of Water Supply Facilities and Infrastructure	Vulnerability of water supply facilities and infrastructure (e.g., diversity of supplies, resilience of conveyance system, age of infrastructure, ability to meet growth demands, etc.)	Survey Responses
Carryover Storage & Reservoir Augmentation	Effect on the ability to use the storage capacity of surface storage reservoirs for carryover storage, emergency storage, surface water capture, potable reuse, and optimizing supplies in drought situations	Survey Responses
Water Quality and Watersheds		
Stormwater and Wastewater Discharges	Effect on volume of stormwater and wastewater discharge to rivers and ocean	Survey Responses
Groundwater Quality	Potential water quality impacts to local groundwater basins.	Survey Responses, GIS
Surface Water Quality	Effect on surface water bodies listed on the EPA's 303(d) list.	Survey Responses, GIS

[1] Data for directly evaluating resilience was not readily available or known for the majority of projects and, thus, an analysis of a project's ability to increase climate resilience was outside the scope of the study. Therefore, the Performance Measures for the Climate Resilience Evaluation Objective were focused on evaluating the vulnerability of individual projects to the impacts of climate change (e.g., warming and fire, sea level rise, and flooding).
[2] Regional resilience to drought was included in the Evaluation Objective Reliability and Robustness.

3.3.1. Types of Performance Measure Inputs

Performance Measures were scored through use of model metrics, surveys of identified experts and stakeholders, and geospatial analysis using GIS software. Economic analysis would typically only include purely quantitative measures. However, a majority of the Evaluation Objectives could not be quantified solely by Performance Measures calculated from GIS and/or model metrics. Therefore, quantitative data (model metrics and GIS analysis) was combined with quantification of qualitative data through surveys of identified experts and stakeholders to place values on the Performance Measures. The combination of quantitative and qualitative data is made possible through the trade-off analysis process.

3.3.1.1 Model Metrics

Task 2.5 of the Basin Study used the CWASim model to simulate operations of the water supply system in the Study Area under each Concept. CWASim is a GoldSim model originally developed for SDCWA by Jacobs in support of the 2013 Regional Facilities Optimization and Master Plan Update (San Diego County Water Authority, 2013). GoldSim is a general purpose simulation software for dynamically modeling complex systems in business, engineering, and science.

CWASim runs on a daily timestep and represents the system with elements and connectors representing reservoirs, water treatment plants, pipelines, delivery points, and other water supply infrastructure components. The model includes representation of local and imported supply sources, member agency demands, SDCWA facilities, and member agency facilities that are connected to the SDCWA system. It does not include representation of member agency facilities that are not connected to the SDCWA system. Operational logic describes how water is distributed throughout the system at each simulation timestep. Input data provides the water supply and demand volumes that drive the operations of the system. Additional information for the CWASim model is discussed in the Task 2.3 and Task 2.4 reports.

Thirteen model runs were performed for Task 2.5 of the Basin Study. The first model run was conducted for the Baseline, which represents the water supply system in the Study Area with projects and infrastructure that existed or were verifiable in 2015 (see Task 2.3 and Task 2.4 reports for additional details on the Baseline). Projects that were included in the Baseline model run were included in all additional model runs. Additional model runs were performed for each of the following Concepts:

- Conveyance Improvement
- Enhanced Conservation
- Gray Water Use
- Groundwater
- Imported Water Purchases

- Potable Reuse
- Recycled Water
- Seawater Desalination
- Stormwater BMPs
- Stormwater Capture
- Urban and Agricultural Water Use Efficiency
- Watershed and Ecosystem Management

Each run was performed under the 2050s central tendency climate scenario and 2050 demand projections. The 2050s central tendency climate scenario represents the 50^{th} percentile of temperature change and precipitation change from the Coupled Model Intercomparison Project, Phase 5 (CMIP5) temperature and precipitation projections for the period 2050-2059. The 2050 demand scenario represents projected demands for the year 2050 based on an extension of the 2035 to 2040 demands from the SDCWA 2015 UWMP. Further details on the development of the climate and demand projections used in the CWASim model can be found in the Task 2.4 report. The 2050s climate and 2050 demand projections were selected because they represent the most extreme changes in climate and demand from current conditions and would therefore best illustrate the potential benefits and drawbacks of future projects. The central tendency climate projection was selected because it is the midpoint of the available projections.

The model runs performed for Task 2.5 were separate from model runs performed for Task 2.4. While Task 2.4 model runs grouped projects into Portfolios of Concepts, the Task 2.5 model runs were performed individually for each Concept, and projects from only a single Concept were implemented for each run (i.e., only Conveyance Improvement projects were implemented in the Conveyance Improvement model run for Task 2.5). The only exception was that projects implemented in the Baseline model run were implemented in all model runs (i.e., Baseline projects were included in the Conveyance Improvement model run in addition to Conveyance Improvement projects beyond the Baseline). Table 10 through Table 22 summarize the model runs for Task 2.5. Projects were modeled based on the best available information about their capacities and water supply volumes at the time the model runs were performed. However, since many projects were at a very early stage of planning, changes were made to anticipated volumes or capacities for some projects after the model runs for the Study were completed. Some projects were not able to be modeled because they did not provide a specific water supply volume or have an operational impact on water supply or conveyance. Gross water demand projections used in the Task 2.5 model runs were the same as the demand projections used in Task 2.4. While Task 2.4 model runs were simulated for 2015, 2025, and 2050 demands for current climate, central tendency, hot-dry, warm-dry, hot-wet, and warm-wet climate, the Task 2.5 model runs were only simulated for central tendency climate during 2050 demands. Additional details on each model run are provided in sections below.

Model outputs were used in the scoring process for the Quality of Life/Recreation and Reliability and Robustness Evaluation Objectives. See Sections 3.4.9 and 3.4.12 and Appendix A: Decision Trees for All Evaluation Objectives and Performance Measures for additional details on the scoring of these Evaluation Objectives.

3.3.1.1.1. Baseline

The Baseline run represented the system as it existed in 2015, with some minor modifications to include water supplies that have been or are certain to be implemented (e.g., Carlsbad Desalination Plant and the full Colorado River Quantitative Settlement Agreement annual transfer volume). Water supplies included in the Baseline are from projects that were designated as verifiable in SDCWA's 2015 UWMP. Infrastructure simulated in the CWASim model for the Baseline included 18 reservoirs connected to the regional system, the Carlsbad Desalination Plant, and pipelines, pump stations, and water treatment plants at 2015 facility capacities. The Baseline model run for Task 2.5 was simulated for central tendency climate under 2050 demands. Projects included in the Task 2.5 Baseline model run are shown in Table 10.

Table 10. Projects included in the Task 2.5 Baseline model run.

Project	2050 Scenario
Conveyance Improvement	
Alvarado Water Treatment Plant	134,506 AF/y (120 million gallons per day [mgd]) production capacity
Badger Water Treatment Plant	44,835 AF/y (40 mgd) production capacity
Crossover Pipeline	144,890 AF/y (200 cubic feet per second [cfs]) capacity
El Monte Pipeline	108,667 AF/y (150 cfs) capacity
Escondido Pump Station	14,489 AF/y (20 cfs) capacity
Escondido-Vista Water Treatment Plant	100,880 AF/y (90 mgd) production capacity
La Mesa-Sweetwater Extension Treated	Modeled through ECRTWIP[1]
Lake Hodges Pump Station	550,580 AF/y (760 cfs) capacity
Levy Water Treatment Plant	118,814 AF/y (106 mgd) production capacity
Miramar Pump Station	43,467 AF/y (60 cfs) capacity
Miramar Water Treatment Plant	161,408 AF/y (144 mgd) production capacity
Moreno-Lakeside Pipeline	67,374 AF/y (93 cfs) capacity west to east, 89,832 AF/y (124 cfs) capacity east to west

Project	2050 Scenario
North County Distribution Pipeline	Modeled in aggregate fashion by delivery of water from Second Aqueduct
Olivenhain Pump Station	227,477 AF/y (314 cfs) capacity
Olivenhain Water Treatment Plant	38,110 AF/y (34 mgd) production capacity
Olivenhain-Hodges Pipeline	550,580 AF/y (760 cfs) capacity
Otay Water Treatment Plant	38,110 AF/y (34 mgd) production capacity
P12	137,645 AF/y (190 cfs) capacity
Perdue Water Treatment Plant	33,627 AF/y (30 mgd) production capacity
Pipeline 1 and 2 (First Aqueduct)	137,600 AF/y (190 cfs) at MWD Delivery Point
Pipeline 3 (Second Aqueduct)	P5 + P3 = 521,603 AF/y (720 cfs) 170,245 AF/y (235 cfs) downstream of Twin Oaks Valley (TOV) Capacity before Pipeline 5 Relining Project of 565,100 AF/y (780 cfs)
Pipeline 4 (Second Aqueduct)	340,300 AF/y (470 cfs) before Pipeline 4 Relining Project
Pipeline 4 (Second Aqueduct) Relining	Reduces capacity at Delivery Point to 286,157 AF/y (395 cfs)
Pipeline 5 (Second Aqueduct)	P5 + P3 = 521,603 AF/y (720 cfs) Downstream of TOV conveyance capacity of 460,749 AF/y (636 cfs) Capacity before Pipeline 5 Relining Project of 565,100 AF/y (780 cfs)
Pipeline 5 (Second Aqueduct) Relining	Reduces capacity of P5 + P3 to 521,603 AF/y (720 cfs)
Pomerado Pipeline	159,379 AF/y (220 cfs) capacity
Ramona Pipeline	75,343 AF/y (104 cfs) capacity
Rancho Pipeline	434,669 AF/y (600 cfs) capacity
San Vicente Pump Station	217,334 AF/y (300 cfs) capacity
San Vicente Pipeline/Tunnel	321,655 AF/y (444 cfs) capacity
SD12 Pipeline	108,667 AF/y (150 cfs) capacity

Project	2050 Scenario
Sutherland-San Vicente Conduit	36,222 AF/y (50 cfs) capacity
The 30-Inch Pipeline	54,334 AF/y (75 cfs) capacity
The 30-Inch Pipeline Relining	50,711 AF/y (70 cfs) capacity
Tri-Agency Pipeline	Modeled in aggregate fashion by delivery of water from Second Aqueduct
Twin Oaks Valley Pump Station	Minimum flow of 22,418 AF/y (20 mgd) to keep plant from shutting down. Downstream conveyance capacity of 460,749 AF/y (636 cfs).
Twin Oaks Valley Water Treatment Plant	112,090 AF/y (100 mgd) production capacity. Minimum flow of 22,418 AF/y (20 mgd) to keep plant from shutting down.
Valley Center (P2A) Pump Station	29,702 AF/y (41 cfs) capacity
Weese Water Treatment Plant	28,023 AF/y (25 mgd) production capacity
Drought Restriction/Allocation[2]	
Local Drought Restriction/Allocation	Not modeled
MWD Allocation	Uses model logic
Firm Water Supply Agreements[2]	
Quantification Settlement Agreement	Full agreement amount of 280,200 AF/y available
Groundwater	
Groundwater Production Well 101	130 AF/y
Groundwater Production Wells	9,740 AF/y
Mission Basin Desalter Facility - 1st & 2nd Phase of Desal Expansion & IPR	3,700 AF/y
Mutual Water Company wells within district	7,000 AF/y
National City Well Field	2,100 AF/y
Richard A. Reynolds Desalination Facility (for City of San Diego)	2,600 AF/y
Richard A. Reynolds Desalination Facility (for Sweetwater Authority)	6,200 AF/y

Project	2050 Scenario
San Vicente GW Production Well	500 AF/y
Vine Street Groundwater Production Facility	700 AF/y
Imported Water Purchases	
MWD Imported Water	Uses model logic
Local Surface Water Reservoirs[2]	
Barrett Reservoir	37,900 AF modeled capacity
Dixon Reservoir	2,610 AF modeled capacity
El Capitan Reservoir	112,807 AF modeled capacity
Hodges Reservoir	33,600 AF modeled capacity
Lake Henshaw	53,400 AF modeled capacity
Lake Jennings	9,790 AF modeled capacity
Lake Poway	3,320 AF modeled capacity
Lake Wohlford	6,940 AF modeled capacity
Loveland Reservoir	25,400 AF modeled capacity
Lower Otay Reservoir	49,849 AF modeled capacity
Miramar Reservoir	6,050 AF modeled capacity
Morena Reservoir	50,200 AF modeled capacity
Murray Reservoir	5,200 AF modeled capacity
Olivenhain Reservoir	25,382 AF modeled capacity
San Dieguito Reservoir	883 AF modeled capacity
San Vicente Reservoir	272,528 AF modeled capacity
Sutherland Reservoir	31,960 AF modeled capacity
Sweetwater Reservoir	27,700 AF modeled capacity
Potable Reuse	
San Luis Rey WRF - Short/Long-Term Expansion	3,300 AF/y

Project	2050 Scenario
Recycled Water	
4S Ranch WRF/Olivenhain MWD	915 AF/y
Carlsbad WRF/Carlsbad MWD	2,831 AF/y
Connection #1-North City Water Reclamation Plant/City of San Diego	623 AF/y
Connection #2-North City Water Reclamation Plant/City of San Diego	20 AF/y
Fallbrook Plant #1/Fallbrook PUD	1,200 AF/y
Gafner WRF/Leucadia CWD	247 AF/y
Hale Avenue RRF/WRF/City of Escondido (for City of Escondido)	4,400 AF/y
Hale Avenue RRF/WRF/City of Escondido (for Rincon del Diablo Municipal Water District)	4,000 AF/y
Meadowlark WRF (via Mahr Reservoir)/Vallecitos WD	2,000 AF/y
North City WRP/City of San Diego (for City of Poway)	645 AF/y
North City WRP/City of San Diego (for City of San Diego)	12,500 AF/y
North WWTPs/USMC	Not modeled
Northwest Quadrant /Meadowlark WRF/Vallecitos WD	459 AF/y
R. W. Chapman WRF/Otay WD	1,100 AF/y
Ray Stoyer WRF (Existing)/Padre Dam MWD – Landscape	896 AF/y
Ray Stoyer WRF (Existing)/Padre Dam MWD – Replenishment of Santee Lakes	1,120 AF/y
San Elijo WRF/San Elijo JPA (for Santa Fe Irrigation District)	500 AF/y
San Elijo WRF/San Elijo JPA (for City of Del Mar)	150 AF/y

Project	2050 Scenario
San Elijo WRF/San Elijo JPA (for San Dieguito Water District)	800 AF/y
San Luis Rey WWTP/City of Oceanside - Phase 1 Expansion	3,500 AF/y
San Vicente WRP/Ramona MWD	525 AF/y
Santa Fe Valley WRF/Rancho Santa Fe CSD	140 AF/y
Santa Maria WRP/Ramona MWD	230 AF/y
SEJPA1-Quail Gardens	50 AF/y
SEJPA2-Village Park, Manchester Phase I	236 AF/y
Sewage Treatment Plants #11 & #12/USMC	Not modeled
South Bay WRP/City of San Diego (for City of San Diego)	1,150 AF/y
South Bay WRP/City of San Diego (for Otay Water District)	5,400 AF/y
South WWTPs/USMC Baseline Recycled Water	Not modeled
Woods Valley Ranch WRF (Phase 2)	184 AF/y
Woods Valley Ranch WRF/VCMWD	47 AF/y
Seawater Desalination	
Carlsbad Desalination Plant	Production Capacity is 55,991 AF/y or 50 mgd
Urban and Agricultural Water Use Efficiency	
Conservation from 2015 UWMP	155,468 AF/y

[1] East County Regional Treated Water Improvement Program
[2] Concepts that were only included in the Baseline model run, such as Drought Restriction/Allocation, Firm Water Supply Agreements, and Local Surface Water Reservoirs, were not evaluated in the Task 2.5 Trade-off Analysis; therefore, additional model runs were not performed for these Concepts.

3.3.1.1.2. Conveyance Improvement

Projects that were implemented in the Conveyance Improvement model run aim to improve local and regional conveyance systems to increase supply reliability, increase operational flexibility, and reduce GHG emissions by utilizing existing conveyance facilities and natural water courses along with constructing or modifying existing pump stations, pipelines, interties and bypasses.

For the Conveyance Improvement model run, all projects categorized by the Conveyance Improvement Concept were simulated under central tendency climate and 2050 demands. Table 11 lists projects that were included in this model run in addition to the projects included in the Baseline run (see Table 10 for projects included in the Baseline).

Table 11. Projects included in the Conveyance Improvement model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Conveyance Improvement	
Dulzura Conduit Replacement	Increases capacity from 21,300 to 44,800 AF/y (19 to 40 mgd) and reduces loss from 10% to 0%
Mission Trails Projects Alternative 1	Increases untreated conveyance capacity south of Miramar WTP from 159,379 to 268,046 AF/y (220 to 370 cfs) and south of Alvarado WTP from 50,711 to 101,423 AF/y (70 to 140 cfs)
Pipeline 3/Pipeline 4 Conversion	Alleviates untreated water delivery constraint. P3 + P5 capacity is 521,600 AF/y (720 cfs) except for OEF Portfolio 2050s scenarios, when it is 648,400 AF/y (895 cfs) Pipeline 4 capacity is 286,200 AF/y (395 cfs) except for OEF Portfolio 2050s scenarios, when it is 97,800 AF/y (135 cfs).
San Diego County Reservoir Intertie	Uses model logic to integrate the San Vicente Reservoir, El Capitan Reservoir, and the El Monte groundwater basin
San Vicente 3rd Pump Drive and Power	Increases capacity from 217,334 to 321,655 AF/y (300 to 444 cfs)
Second Crossover Pipeline	Increases untreated water conveyance between the 2nd and 1st Aqueduct by approximately 94,000 AF

3.3.1.1.3. Enhanced Conservation

The only project implemented in the Enhanced Conservation model run was Enhanced Conservation, which implemented long-term or permanent restrictions in water use to decrease demand. For the Enhanced Conservation model run, all projects categorized by the Enhanced Conservation Concept were simulated under central tendency climate and 2050 demands. Table 12 lists projects that were included in this model run in addition to the projects included in the Baseline run (see Table 10 for projects included in the Baseline).

Table 12. Projects included in the Enhanced Conservation model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Enhanced Conservation	
Enhanced Conservation	179,582 AF/y

3.3.1.1.4. Gray Water Use

Projects implemented in the Gray Water Use model run offset potable water usage by encouraging, supporting and/or providing incentives for gray water system installation by residential customers. For the Gray Water Use model run, all projects categorized by the Gray Water Use Concept were simulated under central tendency climate and 2050 demands. Table 13 lists projects that were included in this model run in addition to the projects included in the Baseline run (see Table 10 for projects included in the Baseline).

Table 13. Projects included in the Gray Water Use model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Gray Water Use	
Conservation Home Makeover in the Chollas Creek Watershed	10.7 AF/y
Gray Water pilot project	2,575 AF/y

3.3.1.1.5. Groundwater

Projects implemented in the Groundwater model run provide water supply by extracting and treating and/or desalinating groundwater from local freshwater and brackish aquifers in order to maintain sustainable supplies through recharging groundwater basins with injected or infiltrated rainfall, recycled water, imported water, or a combination thereof. For the Groundwater model run, all projects categorized by the Groundwater Concept were simulated under central tendency climate and 2050 demands. Table 14 lists projects that were included in this model run in addition to the projects included in the Baseline run (see Table 10 for projects included in the Baseline).

Table 14. Projects included in the Groundwater model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Groundwater	
Middle Sweetwater River Basin Groundwater Well System	1,000 AF/y
Mission Valley Brackish Groundwater Recovery Project	1,680 AF/y
Otay Mesa Lot 7 Groundwater Well System (capacity)	400 AF/y
Otay River Valley GW Aquifer Studies & Field Investigations	3,900 AF/y
Rancho del Rey Groundwater Well Development (capacity)	500 AF/y
San Diego Formation - Southeastern San Diego, including Mt. Hope	1,600 AF/y
San Dieguito River Basin Brackish GW Recovery and Treatment	560 AF/y
San Luis Rey Groundwater Study	4,000 AF/y
San Pasqual Brackish Groundwater Recovery Project	1,325 AF/y
Santa Margarita Conjunctive-Use Project - Local surface water recharge and expansion of Camp Pendleton groundwater recovery program	3,100 AF/y
Santee/El Monte Groundwater Extraction	1,300 AF/y

3.3.1.1.6. Imported Water Purchases

Projects implemented in the Imported Water Purchases model run provide water supply by purchasing treated or untreated water from a water wholesaler outside of the region. For the Imported Water Purchases model run, one additional Imported Water Purchases project was modeled in addition to the single Imported Water Purchases Concept project included in the Baseline Portfolio. Simulations were done under central tendency climate and 2050 demands. Table 15 lists the project that was included in this model run in addition to the projects included in the Baseline run, such as MWD purchases (see Table 10 for projects included in the Baseline).

Table 15. Projects included in the Imported Water Purchases model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Imported Water Purchases	
Cadiz additional imported supplies	5,000 AF/y

3.3.1.1.7. Potable Reuse

Projects implemented in the Potable Reuse model run provide water supply by producing advanced treated water from wastewater for direct or indirect (e.g., reservoir or groundwater augmentation) potable use. For the Potable Reuse model run, all projects categorized by the Potable Reuse Concept were simulated under central tendency climate and 2050 demands. Table 16 lists projects that were included in this model run in addition to the projects included in the Baseline run (see Table 10 for projects included in the Baseline).

Table 16. Projects included in the Potable Reuse model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Potable Reuse	
East County Advanced Water Purification Program Phase 1	3,920 AF/y
East County Advanced Water Purification Program Phase 2	7,616 AF/y
East County Advanced Water Purification Program Phase 3	5,824 AF/y
Encina Wastewater Reuse Project	16,802 AF/y
New Local Supply Rincon del Diablo - Hale Avenue Resource Recovery Facility/City of Escondido/WRFs	1,000 AF/y
Potable Reuse/Hale Avenue Resource Recovery Facility	90 AF/y
Pure Water San Diego Phase 1 - North City	33,627 AF/y (30 mgd) production capacity
Pure Water San Diego Phase 2	59,407 AF/y (53 mgd) production capacity
SFID/SDWD/SEJPA Potable Reuse Project	550 AF/y
South WWTP - Indirect Potable Recharge	Not modeled

3.3.1.1.8. Recycled Water

Projects implemented in the Recycled Water model run offset potable water use by providing non-potable recycled water use for landscape irrigation, industrial purposes, or groundwater recharge. For the Recycled Water model run, all projects categorized by the Recycled Water Concept were simulated under central tendency climate and 2050 demands. Table 17 lists projects that were included in this model run in addition to the projects included in the Baseline run (see Table 10 for projects included in the Baseline).

Table 17. Projects included in the Recycled Water model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Recycled Water	
Carlsbad WRF - Landscape, Agriculture 2025	328 AF/y
Carlsbad WRF - Landscape, Agriculture 2050	616 AF/y
Extension 153 Phase I	189 AF/y
Extension 153 Phase II	300 AF/y
Hale Avenue Resource Recovery Facility - Landscape, Agriculture, Industrial, PR	8,130 AF/y
Integrated Water Resource Solutions for the Carlsbad Watershed (San Elijo Joint Powers Authority)	100 AF/y
Integrated Water Resource Solutions for the Carlsbad Watershed (Olivenhain Municipal Water District)	100 AF/y
Joint Recycled Water Transmission Project with SFID and OMWD	400 AF/y
Lilac Hills Ranch WRF	294 AF/y
Lower Moosa Canyon WRF	700 AF/y
Meadowlark WRF	187 AF/y
Meadowood WRF	143 AF/y
North City WRP - Project 1	100 AF/y
North City WRP - Project 2	50 AF/y
North District Recycled System/ RW Chapman WRF	4,400 AF/y

Project	2050 Scenario
Recycled Water	
North San Diego County Regional Recycled Water Project - Phase II	6,790 AF/y
North Village WRF	105 AF/y
North WWTP Landscape Application	Not modeled
Rancho Cielo	100 AF/y
Ray Stoyer WRF - Landscape, Irrigation, Dust Control	1,008 AF/y
Safari Drought Response and Outreach	72 AF/y
Santa Maria WRP	3,000 AF/y
Shadowridge WRP	3,000 AF/y
South WWTP - Injection to Las Flores Basin	Not modeled
South WWTP - Injection to Santa Margarita Basin	Not modeled
TBD - Evaluation Multiple Options/TBD - Supply/Source Treatment Plant/Agency for Recycled Water	50 AF/y
Village Park Recycled Water Expansion Project	127 AF/y
W+157:181RP/Recycled Water Distribution System	1,600 AF/y
Welk WRF	140 AF/y
Woods Valley Ranch WRF Phase 3	168 AF/y

3.3.1.1.9. Seawater Desalination

Projects implemented in the Seawater Desalination model run provide water supply by utilizing or expanding existing facilities or constructing new facilities to treat seawater to potable use standards. For the Seawater Desalination model run, all projects categorized by the Seawater Desalination Concept were simulated under central tendency climate and 2050 demands. Table 18 lists projects that were included in this model run in addition to the projects included in the Baseline run (see Table 10 for projects included in the Baseline).

Table 18. Projects included in the Seawater Desalination model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Seawater Desalination	
Camp Pendleton Desalination Facility	168,133 AF/y (150 mgd) production capacity
Re-rating of Carlsbad Desalination for higher flow	59,407 AF/y (53 mgd) production capacity
Rosarito Beach Desalination	16,800 AF/y production capacity

3.3.1.1.10. Stormwater BMPs

Projects implemented in the Stormwater BMPs model run reduce adverse water quality impacts of stormwater through implementation of stormwater Best Management Practices. For the Stormwater BMPs model run, all projects categorized by the Stormwater BMPs Concept were simulated under central tendency climate and 2050 demands. Table 19 lists projects that were included in this model run in addition to the projects included in the Baseline run (see Table 10).

Table 19. Projects included in the Stormwater BMPs model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Stormwater BMPs	
Alternative Compliance Retrofit Project El Norte Parkway and Rincon, Villa Drive, Escondido	Not modeled
Alternative Compliance Retrofit Project Mountain View Park, Escondido	Not modeled
Bakersfield Street and San Altos Channel Restoration	12 AF/y
Broadway Channel Flood Risk Reduction and Water Quality Improvements	Not modeled
City of Oceanside Loma Alta Slough Restoration Project	Not modeled
Golden Ave Green Street	Not modeled
Las Colinas Channel Improvements	Not modeled
Lemon Grove Avenue Green Streets	Not modeled

Project	2050 Scenario
Stormwater BMPs	
Leucadia Roadside Park Stormwater Capture/Reuse Project	Not modeled
Lincoln St Green Street	Not modeled
Low Impact Development Urban Runoff Control Projects for the Tijuana Estuary	3 AF/y
Madera St Green Street	Not modeled
Main Street Promenade Expansion	23 AF/y
Mapleview Street - Green Infrastructure and Stormwater Quality Improvement Program	Not modeled
Paradise Valley Creek Water Quality and Community Enhancement	Not modeled
Pure Water - Los Penasquitos Creek Urban Dry-Weather Water Harvesting	Not modeled
Safari Park Stormwater Capture and Reuse Project	5 AF/y
Safari Park Water Reuse Sustainability and Watershed Protection Program	19 AF/y
San Marino Drive Green Street and Dry Weather Flow Management Sweetwater	3 AF/y
San Marino Drive Green Street and Dry Weather Flow Management Vallecitos	2 AF/y
San Miguel Green Street	Not modeled
Skyline Dr and Kempt St Green Streets	Not modeled
South Santa Fe Green Street Project	Not modeled
Spruce Street Channel Improvement Project	Not modeled
Stormwater Capture off San Diego River along Alvarado Canyon and Fairmont Canyon to Fish and Wildlife site	Not modeled
Sweetwater Rd Green Street	Not modeled
Sweetwater River Park Bioretention	43 AF/y
Telegraph Canyon Channel Improvement Project	Not modeled

Project	2050 Scenario
Stormwater BMPs	
Woodside Avenue Complete Green Street	Not modeled

3.3.1.1.11. Stormwater Capture

Projects implemented in the Stormwater Capture model run provide water supply by capturing stormwater through both centralized projects and regional decentralized efforts, then treating it for both potable and non-potable uses. For the Stormwater Capture model run, all projects categorized by the Stormwater Capture Concept were simulated under central tendency climate and 2050 demands. Table 20 lists projects that were included in this model run in addition to the projects included in the Baseline run (see Table 10).

Table 20. Projects included in the Stormwater Capture model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Stormwater Capture	
Murray Urban Runoff Diversion System Capture	200 AF/y
Rainwater Harvesting	416 AF/y

3.3.1.1.12. Urban and Agricultural Water Use Efficiency

Projects implemented in the Urban and Agricultural Water Use Efficiency model run increase water use efficiency by encouraging long-term behavioral change and implementing water use efficiency programs. For the Urban and Agricultural Water Use Efficiency model run, all projects categorized by the Urban and Agricultural Water Use Efficiency Concept were simulated under central tendency climate and 2050 demands. Table 21 lists projects that were included in this model run in addition to the projects included in the Baseline run (see Table 10).

Table 21. Projects included in the Urban and Agriculture Water Use Efficiency model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Urban and Agricultural Water Use Efficiency	
Ms. Smarty-Plants Grows Water Wise Schools	6 AF/y
Regional Demand Management Program Expansion	Not modeled
Regional Drought Resilience Program	1,809 AF/y
Rincon Customer-Driven Demand Management Program	400 AF/y
San Diego Water Conservation Program	75 AF/y
San Diego Water Use Reduction Program	381 AF/y
UC San Diego Water Conservation and Watershed Protection	203 AF/y

3.3.1.1.13. Watershed and Ecosystem Management

Projects implemented in the Watershed and Ecosystem Management model run promote sustainable, high quality local water supplies through practices that support healthy ecosystems and improve or restore the condition of landscapes and biological communities. For the Watershed and Ecosystem Management model run, all projects categorized by the Watershed and Ecosystem Management Concept were simulated under central tendency climate and 2050 demands. Table 22 lists projects that were included in this model run in addition to the projects included in the Baseline run (see Table 10).

Table 22. Projects included in the Watershed and Ecosystem Management model run in addition to projects that were implemented in the Baseline.

Project	2050 Scenario
Watershed and Ecosystem Management	
69th St Green Street	Not modeled
Alternative Compliance Retrofit Project Avenida Del Diablo Park, Escondido	Not modeled
Broadway/Federal Blvd Green Street	Not modeled
Canton Dr Green Street	Not modeled
Central Avenue Green Street	Not modeled

Project	2050 Scenario
Federal Blvd Channel	Not modeled
Hodges Water Quality Improvement Program	Uses model logic
Massachusetts Blvd Green Street	Not modeled
Mt. Vernon St Green Street	Not modeled
Nestor Creek Channel Restoration	Not modeled
North Ave and Grove Green Street	Not modeled
Palm St Green Street	Not modeled
Paradise Creek Restoration Phase II	Not modeled
San Diego Healthy Headwaters Restoration	Not modeled
Sustaining Healthy Tributaries to the Upper San Diego River and Protecting Local Water Supplies	Not modeled
Sweetwater Reservoir Wetlands Habitat Recovery	Allows for an additional 7.873 AF of storage in Sweetwater
Sycamore Creek Restoration	Not modeled
Tijuana River Floating Trash Capture System	Not modeled

3.3.1.2 Surveys of Identified Experts and Stakeholders

Information from surveys of identified experts and stakeholders and a workshop of regional economic experts was obtained to help quantify the effects of each Concept on the Evaluation Objectives on a Likert scale (rating scale). Information obtained from individuals with knowledge and expertise of projects and areas potentially affected by projects is a commonly used source for evaluating impacts when empirical data of project performance is lacking. The knowledge of individuals with relevant expertise is very useful when it is not possible to gather relevant empirical data needed to measure the impacts of different projects. In many cases, individual experts or stakeholders may be the only source of information available to evaluate site-specific impacts associated with projects or Concepts. However, the use of data based on information from experts or stakeholders creates unique challenges for project evaluation. The information provided can vary greatly based on differences in experience, area of expertise, and other factors. General consensus can be used to deal with this variation when there is a sufficient number of responses to achieve consensus.

Information from identified experts and stakeholders was gathered through the use of questionnaires that were developed and distributed by the City of San Diego. These experts and stakeholders included individuals with knowledge of specific projects as well as those with a broad knowledge of the general Concepts. Two separate surveys were conducted using two different questionnaires: a general Concept-level questionnaire and a project-specific questionnaire, which enabled a broad range of identified experts and stakeholders to be included in the surveys. Surveys of five attendees at a Regional Economic Impact Workshop were also used to develop scores for the Regional Economic Impact Evaluation Objective.

The Concept-level questionnaires were developed to gather information needed to complete scoring. The Concept-level questionnaire was sent by the City of San Diego to the STAC (26 individuals) and the IRWM Regional Advisory Committee (RAC) members (28 individuals) in March 2018 (some individuals serve on both the STAC and RAC). A copy of the questionnaire is provided in Appendix B: Surveys Used to Gather Data for Task 2.5. There were 16 Concept-level survey responses, representing 16 agencies or organizations (six non-governmental organizations, nine government agencies, and one academic institution), for all Concepts except Enhanced Conservation. There were no responses for the Enhanced Conservation Concept because this Concept was originally included in the Urban and Agricultural Water Use Efficiency Concept, but was split out as a separate Concept after the survey questionnaires were distributed. Therefore, Enhanced Conservation was given a value of NA for all Concept-level questionnaire calculations.

In March 2018, project-level questionnaires were sent to designated project managers or subject matter experts for all but two of the 120 projects included in the trade-off analysis[1]. A copy of the questionnaire is provided in Appendix B: Surveys Used to Gather Data for Task 2.5. For this project-level survey, each recipient was provided with a questionnaire specific to their organization’s projects. Therefore, each project could only receive one response. Of the 37 project-level survey questionnaires that were distributed (representing 118 projects), 21 responses were received representing 87 projects, or about 73% of the total projects. The respondents consisted of 20 government agencies and one academic institution. Although a response was received for the Enhanced Conservation project, this response was not used in the analysis because the Enhanced Conservation Concept was not included in the Concept-level survey. Therefore, Enhanced Conservation was given a value of NA for all project-level questionnaire calculations.

[1] Two projects were excluded from the survey due to errors in survey distribution. Both projects were in the Stormwater BMPs Concept, which contains 29 projects. Responses were received for 20 of the 29 Stormwater BMPs projects. Therefore, although two projects were not included in the survey, the other survey responses provide sufficient data to characterize the effects of Stormwater BMPs projects in the trade-off analysis.

The number of project-level survey responses for each Concept is shown in Table 23. Since only one project-level questionnaire was distributed for each project, the maximum number of responses was equal to the number of projects in the Concept. Four Concepts had responses rates of 100% (Conveyance Improvement, Enhanced Conservation, Imported Water, and Stormwater Capture). All other Concepts had response rates above 50%. Although response rates were relatively high, some respondents did not provide responses for all survey questions. Therefore, some projects had fewer responses on those questions than on the survey as a whole. In cases where there were more than three project-level survey responses, scores were based on the average of the mean project-level score and the mean Concept-level score.

In cases where there were three or fewer project-level survey responses, the Concept-level survey results were combined with the project-level responses and then averaged to calculate a score. In cases where there were no project-level survey results (project-level result of NA), the mean of the Concept-level survey results was used as the basis for the score. In cases where there were no Concept-level survey results (Concept-level survey results were NA), the Concept received a score of NA regardless of whether there were project-level survey results.

Table 23. Project-level survey responses for each Concept.

Concept	Number of Projects	Number of Project Level Survey Responses	Percent of Projects with Responses
Recycled Water	28	18	64
Stormwater BMPs	29	20	69
Watershed and Ecosystem Management	18	14	78
Groundwater	11	9	82
Potable Reuse	12	8	67
Urban and Agricultural Water Use Efficiency	7	5	71
Conveyance Improvement	6	6	100
Seawater Desalination	3	2	67
Gray Water Use	2	1	50
Stormwater Capture	2	2	100

Concept	Number of Projects	Number of Project Level Survey Responses	Percent of Projects with Responses
Imported Water	1	1	100
Enhanced Conservation[1]	1	1	100
Total	120[2]	87	73

[1] A project-level survey was received for Enhanced Conservation, but this Concept was not included in the Concept-level survey, so it was given a score of NA for all Performance Measures using survey responses.
[2] Two projects in the Stormwater BMPs Concept were excluded from the survey due to errors in survey distribution, so only 118 projects were included in the survey.

3.3.1.3 Geospatial Analysis

Geospatial analysis of individual projects was used to quantify values of Performance Measures and/or components of Performance Measures in relation to key factors of interest, such as proximity of projects to areas inhabited by endangered/threatened species, and proximity of projects to fire hazard safety zones, ecologically important habitats, disadvantaged communities, and impaired surface and groundwater water bodies. The project-level results were then aggregated to the Concept-level as described for each Performance Measure. This analysis enabled a quantitative approach to developing scores for Performance Measures for which geospatial data was available and relevant to the performance measure. For example, geospatial data on fire hazard severity were used to score the Performance Measure, Warming and Fire Vulnerability, by determining a project's proximity to moderate, high and very high fire hazard severity zones (as defined by California Department of Forestry and Fire Protection [CAL FIRE]). Each project was mapped using GIS software based on its proposed location in the region, as identified in local and regional planning documents. Then the project locations were analyzed in conjunction with other geospatial data, such as flood hazard zones or disadvantaged communities to calculate the Performance Measure values.

One limitation of the geospatial analysis was its dependence on a single specific project location within the Study Area. Seven projects (Enhanced Conservation, Graywater Pilot Project, Pipeline ¾ Conversion, Rainwater Harvesting, San Diego Water Conservation Program, San Diego Water Use Reduction Program, and Second Crossover Pipeline) could not be mapped because of their distributed nature. Although these projects could potentially have location-specific impacts, it was not possible to assign a single value to their impacts. Therefore, they were assigned scores of NA for all geospatial analysis calculations. All projects except for three were able to be mapped for geospatial analysis. Three projects (Rosarito Desalination Plant, Rincon Customer-Driven Demand Management Program, and Cadiz Additional Imported Supplies) could not be mapped due to their locations outside the Study Area. Analysis of effects outside the Study Area is beyond the scope of the Basin Study. Therefore, these projects were also assigned scores of NA in all geospatial analysis calculations.

Another limitation of the geospatial analysis was that it only analyzed the specific project location and did not account for facilities or areas that the project is dependent on or areas or facilities that are dependent on the project location. Although a project may have shown no impact on a Performance Measure since it is located outside a vulnerable area, the geospatial analysis did not capture the location of facilities that the project is dependent on. For example, if a pump station located in a vulnerable area was damaged in a storm, then a water treatment plant that used that pump station may become inoperative, even though it was not directly exposed to that vulnerability. This type of analysis, however, is outside the scope of this Study and would require additional research.

3.4. Evaluation Objective Scoring Methodology

Each Evaluation Objective was measured by one or more Performance Measures, which were scored using one or more types of input data. Performance Measure scores were then averaged to obtain an Evaluation Objective Unweighted Score. The Unweighted Score was then weighted as described in Section 3.5. A generic example of the scoring process based on the use of specific data sources, performance measures, and methods of combining performance measures is illustrated in Figure 3. Decision trees for each Evaluation Objective and Performance Measure, which provide a visual representation of the scoring methods, are provided below and in Appendix A: Decision Trees for All Evaluation Objectives and Performance Measures.

The Evaluation Objective unweighted scores were calculated at the Concept level. As mentioned above, many sources of information were used to score each Concept, some of which were collected at the project-level. For example, surveys of interested parties were completed at the Concept-level and for specific projects within a Concept. For most Concepts, the mean of the Concept-level survey responses and the mean of the project-level were averaged to derive the final scores. However, due to the small number of projects in some Concepts and/or the response rate to the project-level surveys, some Concepts had very small number of project-level survey responses (see Table 23). For Concepts that had three or fewer survey responses (either due to the low number of projects and/or the low response rate), the Performance Measure score was based on the average of all survey responses at the project-level and Concept-level combined. This essentially treated the project-level survey responses as additional Concept-level responses in order to prevent undue influence of individual survey responses on the final Performance Measure score.

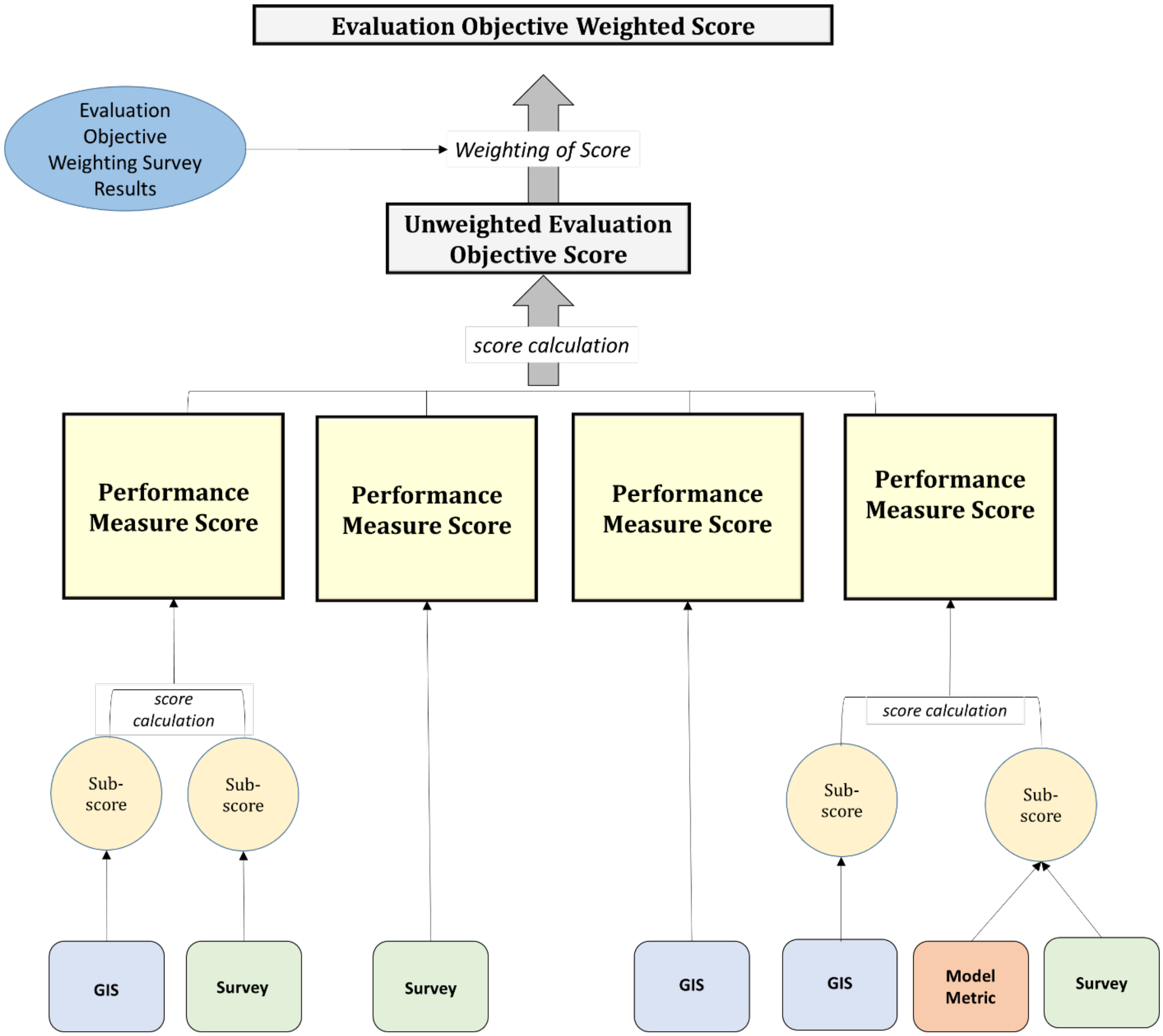


Figure 3. Evaluation Objective scoring.

Due to the small number of projects in some Concepts and/or a low response rate for some project-level surveys, some project-level survey scores were not considered representative for the Concept (see Section 3.3.1.2). The Enhanced Conservation Concept was given a score of NA because it was developed after the surveys were distributed. This Concept was originally included in the Urban and Agricultural Water Use Efficiency Concept, but was split out as a separate Concept after the survey was distributed.

The Performance Measure scores ranged from 1 to 5. The score structure was designed to reflect negative, neutral, and positive characteristics of projects and Concepts. A score of 4 or 5 indicated that the project or Concept had a moderate or strong positive effect, respectively, on the Performance Measure. A score of 3 indicated that that project or Concept had a neutral or unknown effect on the Performance Measure. A score of 1 or 2 indicated that the project or Concept had a strong or moderate negative effect, respectively, on the Performance Measure.

3.4.1. Address Climate Change Through Greenhouse Gas Reduction Evaluation Objective

The Address Climate Change Through Greenhouse Gas Reduction Evaluation Objective contained a single Performance Measure: GHG Mitigation (Figure 4).

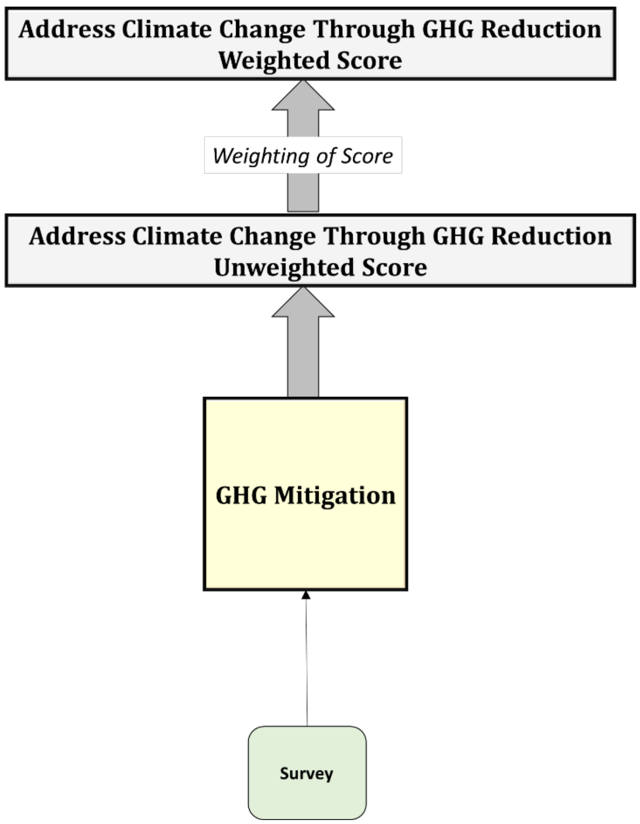


Figure 4. Decision tree for the Address Climate Change Through GHG Reduction Evaluation Objective.

3.4.1.1 GHG Mitigation Performance Measure

The GHG Mitigation Performance Measure was evaluated based on survey responses at both the Concept- and project-level (Figure 5). Both the Concept-level and project-level surveys included a general question about the extent to which projects included in a Concept would mitigate greenhouse gas emissions through carbon storage and sequestration. Scores were on a scale of 1 to 5. A score of 1 indicated greenhouse gas mitigations were eliminated through implementation of projects within a Concept. A score of 2 indicated greenhouse gas mitigations were decreased through the implementation of projects within a Concept. A score of 3 represented no or an unknown amount of greenhouse gas mitigation. A score of 4 indicated a moderate amount of greenhouse gas mitigation was achieved by the implementation of projects within a Concept. For a score of 4, mitigation could not be directly quantified as “carbon credits” or “carbon dioxide equivalents.” Finally, if a substantial amount of greenhouse mitigation was achieved by the implementation of projects within a Concept and mitigation could be quantified as “carbon credits” or “carbon dioxide equivalents,” the Concept received a score of 5. The Performance Measure score was calculated as the average of the means of the project-level and Concept-level survey responses or from the mean of all survey responses, depending on the number of survey responses for a given Concept, as described in Section 3.4. Enhanced Conservation was given a score of NA because it was not included in the surveys.

In addition to the general question regarding extent of GHG mitigation, the project-level survey included two additional questions regarding habitat acreage conserved or restored by the project and the type of habitat. However, there were very few usable responses to those questions, so they were removed from the Performance Measure calculation.

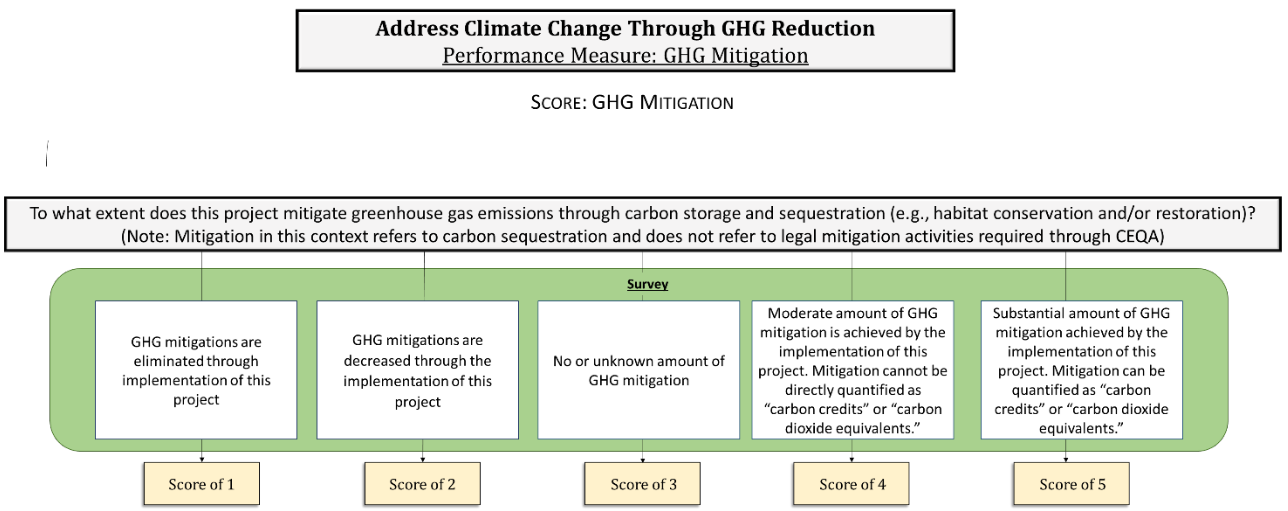


Figure 5. Decision tree for the GHG Mitigation Performance Measure.

3.4.2. Climate Resilience Evaluation Objective

Stakeholders identified climate resilience as an important objective to consider when evaluating projects. However, during development of the Performance Measures associated with climate resilience, it was recognized that data for directly evaluating resilience was not readily available or known for the majority of projects and, thus, an analysis of a project’s ability to increase climate resilience was outside the scope of the Study. Therefore, the Performance Measures within the Climate Resilience Evaluation Objective were focused on evaluating the vulnerability of individual projects to the impacts of climate change (e.g., warming and fire, sea level rise, and flooding), and did not directly evaluate the ability of a project to increase regional resilience to climate change (e.g., by actively reducing the San Diego region's exposure or sensitivity to a particular climate impact). For example, a project may increase regional resilience to fire if it removes invasive species that are known to increase fire risk. This Evaluation Objective did not include an analysis of drought resilience, as this factor was evaluated in the Evaluation Objective Reliability and Robustness.

To evaluate vulnerability, this Evaluation Objective relied on geospatial data to evaluate projects in relation to these climate risk factors. The Climate Resilience Evaluation Objective included three Performance Measures: Sea Level Rise Vulnerability, Flood Risk Management, and Warming and Fire Vulnerability (Figure 6). The Climate Resilience Unweighted Score was equal to the average of Sea Level Rise Resilience and Flood Risk Management Scores multiplied by the Warming and Fire Vulnerability Score. This score was then converted to a 1 to 5 scale for comparison with the other Evaluation Objectives. Multiplication was used to represent the synergistic nature of the interaction between flooding and fire. Flooding in an area that has been recently burned has a disproportionately higher impact relative to an area that has not recently been burned. For example, in December 2017 the San Diego region experienced multiple, fast-moving wildfires were followed by extreme precipitation in the winter (January 2018) causing mudslides on fire-scarred slopes (Syphard, et al., 2018; Cannon & Highland, 2005; United States Geological Survey, 2018).

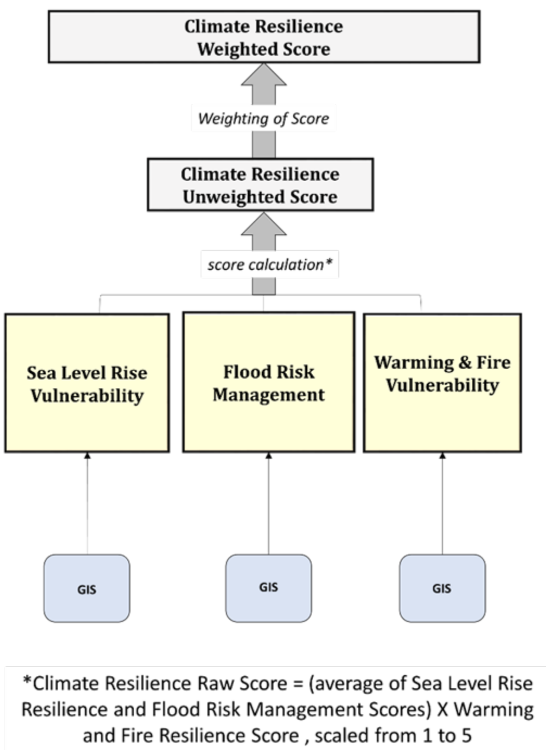


Figure 6. Decision tree for the Climate Resilience Evaluation Objective.

3.4.2.1 Sea Level Rise Vulnerability Performance Measure

The Sea Level Rise Performance Measure (Figure 7) was evaluated using geospatial data from the U.S. Geological Survey Coastal Storm Modeling System (CoSMoS) accessed through the Point Blue Our Coast, Our Future website (U.S. Geological Survey, 2018). Our Coast, Our Future is a collaborative, user-driven project that provides coastal California resource managers and land use planners locally relevant, online maps and tools to help understand, visualize, and anticipate vulnerabilities to sea level rise (SLR) and storms.

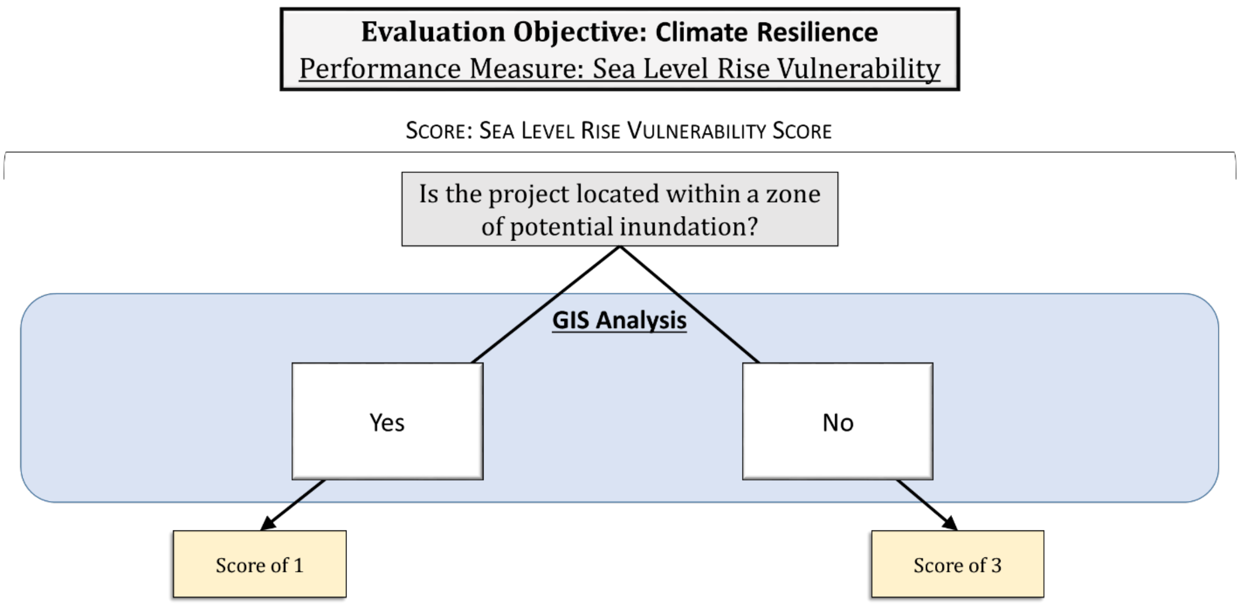


Figure 7. Decision tree for the Sea Level Rise Vulnerability Performance Measure associated with the Climate Resilience Evaluation Objective.

CoSMoS was used to map potential flooding associated with future sea level rise based on projections that account for tidal fluctuations as well as storm events. CoSMoS models the results of the latest Global Climate Models, which are fed into a global wave model to develop wave conditions for the U.S. West Coast through 2100. Those offshore wave conditions, combined with tides and storm surges, are modeled down to the local level using numerical modeling tools to determine coastal water levels which are then projected onto a 2-meter Digital Elevation Model to estimate the extent of flooding. This is performed for a comprehensive number of combinations of anticipated SLR and storm conditions.

The CoSMoS data layer selected for the analysis depicts locations subject to potential flooding by 2.5 feet in SLR during a 100-year storm event. A sea level rise of 2.5 feet represents a likely scenario as identified in the 2018 Ocean Protection Council Sea Level Rise Guidance. Specifically, the 2018 Guidance reports that there is a 66% probability that sea level will rise between 1.3 and 2.5 feet in La Jolla, CA by 2080. Since a 30-year project lifespan is assumed in this analysis (e.g., from 2050-2080), the potential for inundation is evaluated using projections in the year 2080. To provide a more conservative and risk-adverse analysis, a sea level rise of 2.5 feet was selected within CoSMoS and the resulting map was used in the analysis.

The potential for inundation or flooding was determined by using geospatial location of projects in relation to the selected GIS data layer described above, which delineates projected inundation due to a combination of sea level rise, waves, tidal fluctuations, storm surge and storm events.

The Sea Level Rise Performance Measure score was evaluated on a scale of 1 to 3. A project located within a zone of potential inundation received a score of 1 and a project located outside the zone of potential inundation received a score of 3. The project-level scores for each Concept were averaged to derive an overall score for each Concept.

3.4.2.2 Flood Risk Management Performance Measure

The Flood Risk Management Performance Measure (Figure 8 and Figure 9) is evaluated using geospatial data from the U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA) National Flood Hazard Layer Web Map Service (U.S. Department of Homeland Security, Federal Emergency Management Agency, 2018). The flood data incorporates all Flood Insurance Rate Map (FIRM) databases published by FEMA and any Letters of Map Revision that have been issued against those databases since their publication date. The data is updated monthly. The FIRM Database is the digital, geospatial version of the flood hazard information shown on the published paper FIRMs. It depicts flood risk information and supporting data used to develop the risk data. The primary risk classifications used are the 1-percent-annual-chance flood event, the 0.2-percent-annual-chance flood event, and areas of minimal flood risk. The FIRM Database is derived from FEMA Flood Insurance Studies (FISs), previously published FIRMs, flood hazard analyses performed in support of the FISs and FIRMs, and new mapping data, where available. Flood zone designations are described at https://snmapmod.snco.us/fmm/document/fema-flood-zone-definitions.pdf. The Flood Risk Management Performance Measure was based on a 1 to 5 scale.

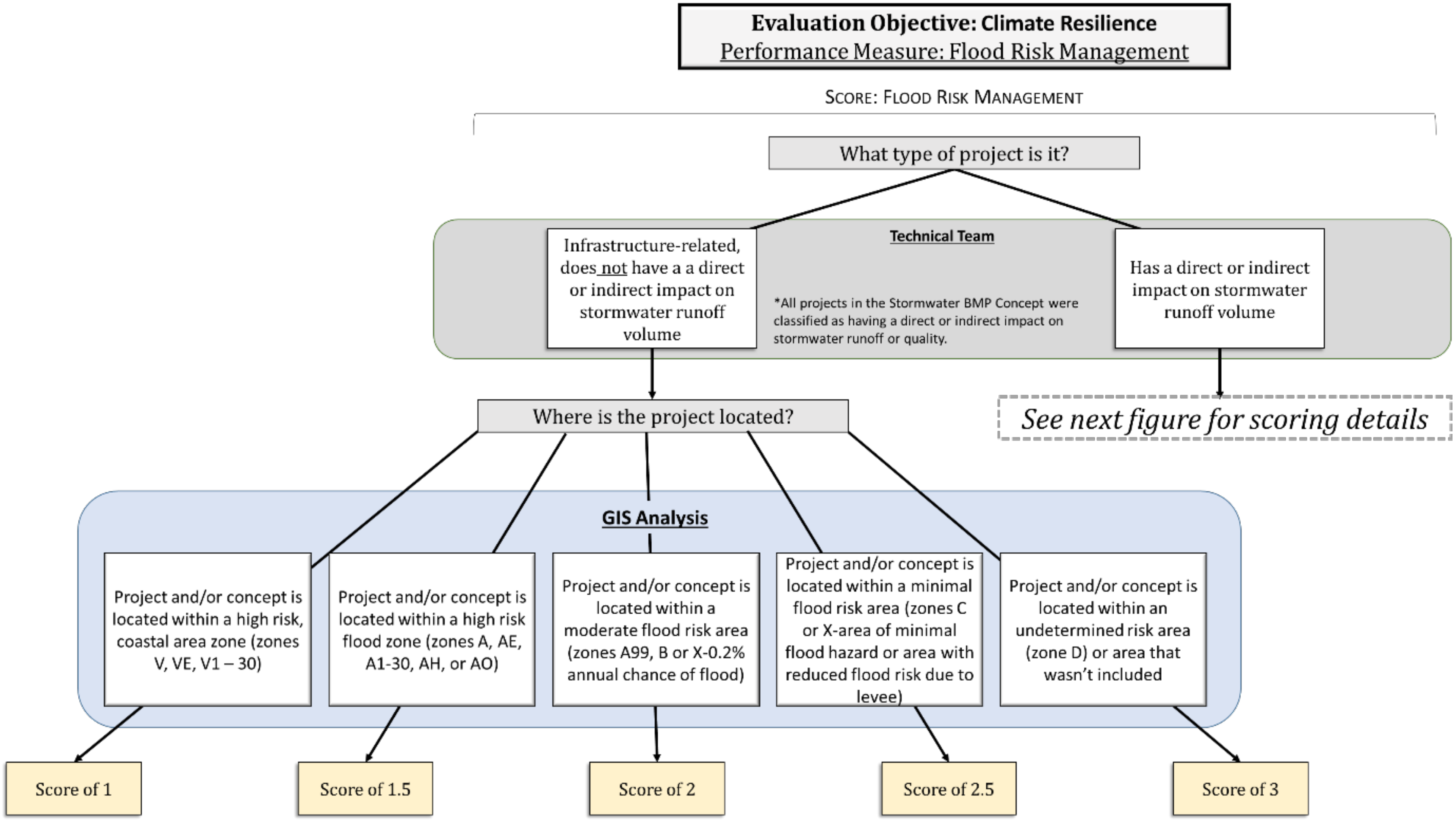


Figure 8. Part 1 of the decision tree for Flood Risk Management Performance Measure associated with the Climate Resilience Evaluation Objective.

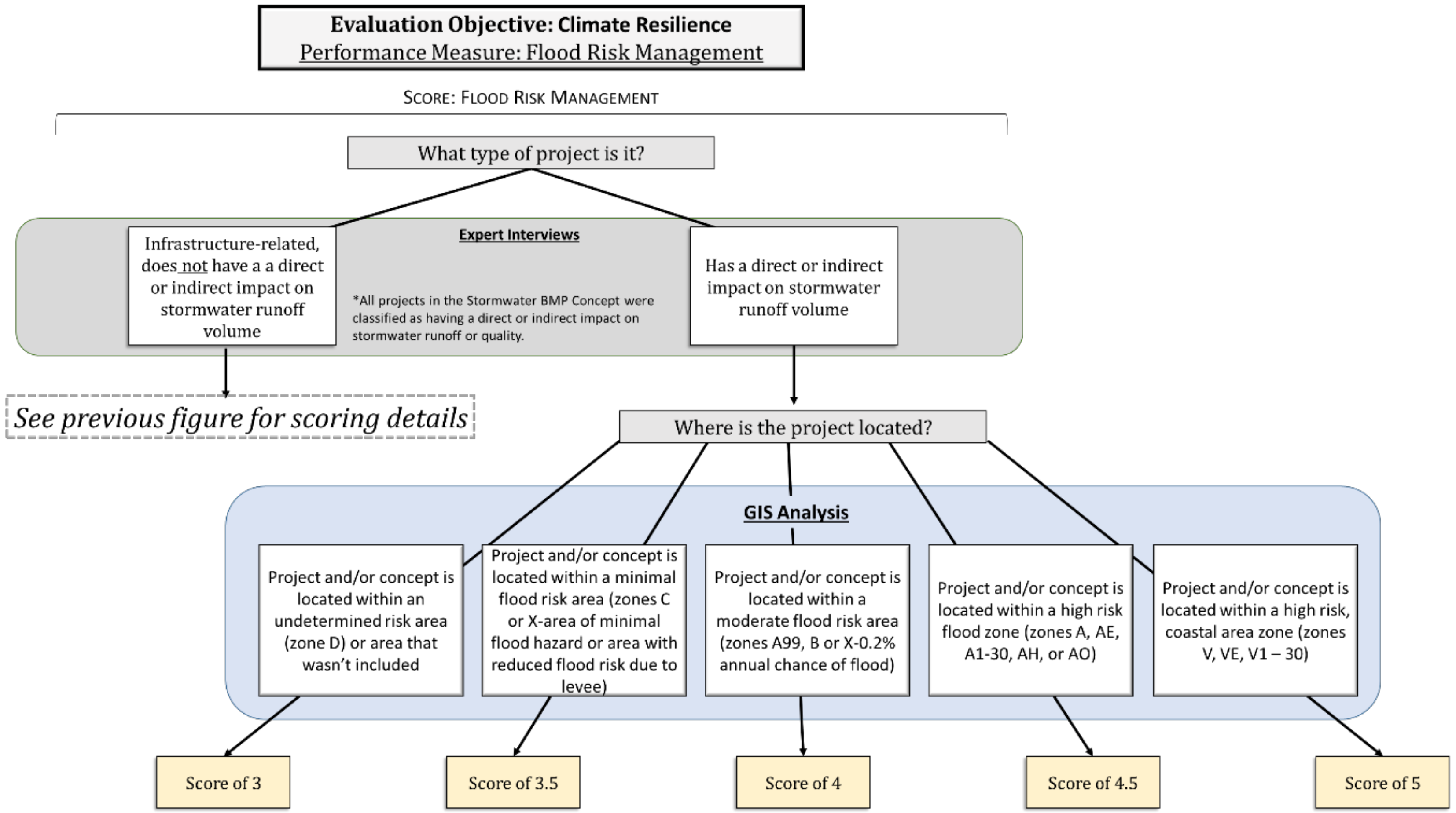


Figure 9. Part 2 of the decision tree for Flood Risk Management Performance Measure associated with the Climate Resilience Evaluation Objective.

Some projects are specifically designed to reduce the volume of stormwater runoff or improve stormwater quality (e.g., projects in the Stormwater BMPs Concept). These projects are typically co-located with flood zones to achieve their intended purpose, and thus, these projects received high scores if located in flood zones. Conversely, infrastructure-related projects that are not designed to have a direct or indirect impact on stormwater runoff received low scores if co-located in flood zones, as flooding is expected to negatively impact these projects.

As such, if an infrastructure-related project and/or Concept did not have a direct or indirect impact on stormwater runoff volume or quality, the following criteria applied: A project and/or Concept located within a high risk coastal area (zones V, VE, or V1-30) received a score of 1. A project and/or Concept located within a non-coastal high-risk area (zones A, AE, A1-30, AH, or AO) received a score of 1.5. A project and/or Concept located within a moderate flood risk area (zones A99, B or X-0.2% annual chance of flood) received a score of 2. A project and/or Concept located within a minimal flood risk area (zones C or X-area of minimal flood hazard or area with reduced flood risk due to a levee) received a score of 2.5. A project and/or Concept located within an undetermined risk area (zone D) or area not included in the flood hazard layer received a score of 3.

For projects and/or Concepts that do have a direct or indirect impact on stormwater runoff volume or quality (e.g., those included in the Stormwater BMP Concept), the following criteria applied: A project and/or Concept located within a high risk coastal area (zones V, VE, or V1-30) received a score of 5. A project and/or Concept located within a non-coastal high-risk area (zones A, AE, A1-30, AH, or AO) received a score of 4.5. A project and/or Concept located within a moderate flood risk area (zones A99, B or X-0.2% annual chance of flood) receives a score of 4. A project and/or Concept located within a minimal flood risk area (zones C or X-area of minimal flood hazard) received a score of 3.5. Finally, a project and/or Concept located within an undetermined risk area (zone D) or area not included in the flood hazard layer received a score of 3. Project-specific scores were averaged within each Concept to give an overall score for each Concept.

3.4.2.3 Warming and Fire Vulnerability Performance Measure

The Warming and Fire Vulnerability Performance Measure was evaluated using geospatial data from CAL FIRE Fire Hazard Severity Zone Maps (San Diego Association of Governments, 2018) (Figure 10). The data shows areas of moderate, high, or very high fire hazard zones based on fuels, terrain, weather, and other relevant factors; these zones are referred to as Fire Hazard Severity Zones. Their scores combine the burn probability with the expected flame sizes predicted by fuels, slope, and expected fire weather. Since it describes potential hazard to buildings, the model characterizes the fuel potential of the area over a 30- to 50-year period and the maximum expected hazard value is used. This specific dataset is used to create the official "Maps of Fire Hazard Severity Zones in the State Responsibility Area (SRA) of California" as required by Public Resources Code 4201-4204 and entitled in the California Code of Regulation, Title 14, Section 1280 Fire Hazard Severity Zones, and as adopted by CAL FIRE on November 7, 2007. Maps of the adopted zones in SRA are available at: http://frap.cdf.ca.gov/projects/hazard/fhz.html.

The Warming and Fire Vulnerability Performance Measure scores were based on a scale of 1 to 3. A project located within a very high fire hazard severity zone received a score of 1, a project located within a high fire hazard severity zone receives a 1.5 score, a project located within a moderate fire hazard severity zone received a score of 2, and a project located outside any fire hazard severity zone received a 3. The project-level scores within each Concept were averaged to derive an overall score for each Concept.

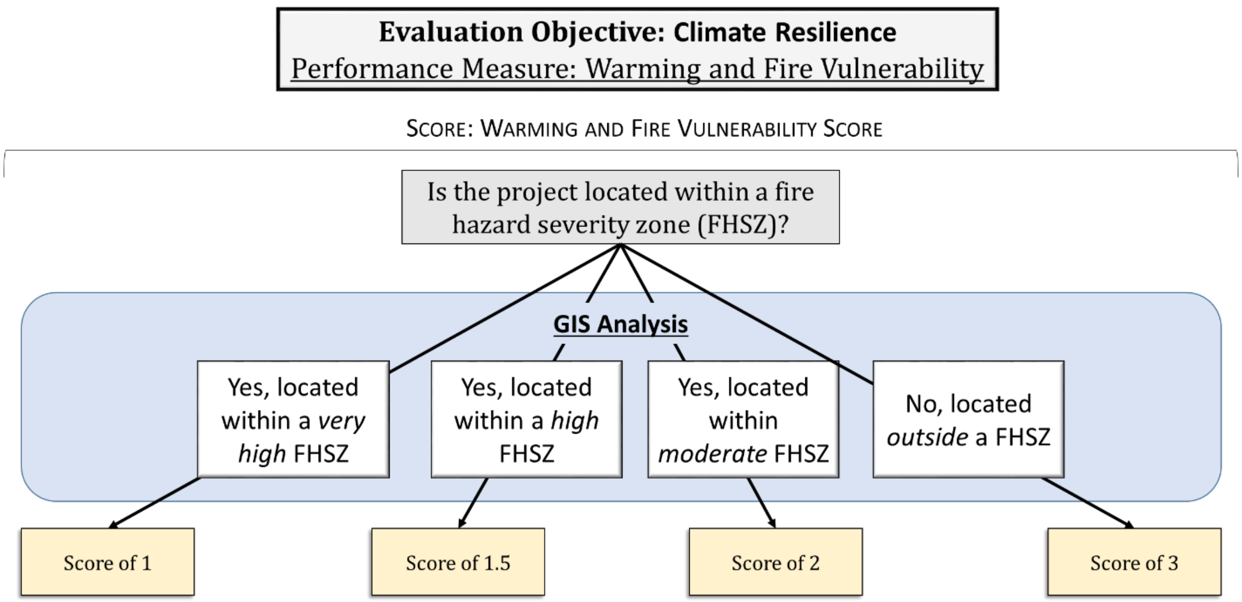


Figure 10. Decision tree for Warming and Fire Vulnerability Performance Measure associated with the Climate Resilience Evaluation Objective.

3.4.3. Cost Effectiveness Evaluation Objective

The Cost Effectiveness Evaluation Objective included three Performance Measures: Capital Costs, O&M Costs, and Potential for External Funding that were averaged together to calculate the Evaluation Objective Unweighted Score (Figure 11).

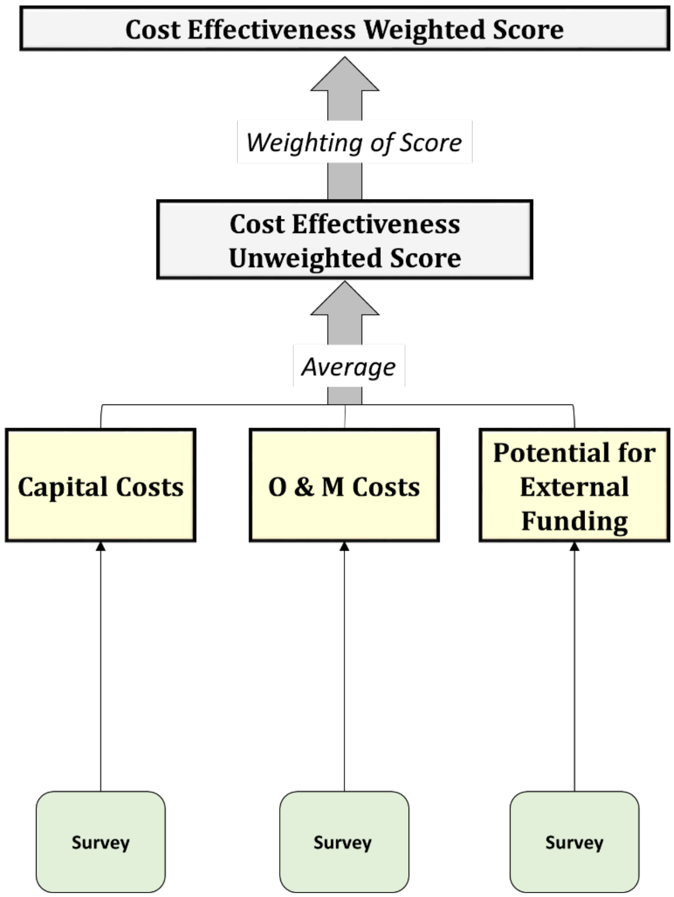


Figure 11. Decision tree for Cost Effectiveness Evaluation Objective.

3.4.3.1 Capital Costs Performance Measure

Capital costs are the total present value of capital costs to a region and customers/developers over the planning period and may include up-front construction/modification costs, planning costs, engineering costs, environmental compliance costs, or other costs required for project completion. The Capital Cost Performance Measure score in this analysis was evaluated through a survey question asking about the capital costs associated with the implementation of projects within a Concept (Figure 12). A very costly/high cost project or Concept received a score of 1, a moderately costly or variable cost project or Concept received a score of 3, and an inexpensive/low cost project or Concept received a score of 5. This question was asked in both the project-level and Concept-level surveys. The Performance Measure Score was calculated as the average of the means of the project-level and Concept-level survey responses or from the mean of all survey responses, depending on the number of survey responses for a given Concept, as described in Section 3.4. Enhanced Conservation was given a score of NA because it was not included in the surveys.

The use of actual capital costs by project was originally considered for evaluating cost effectiveness. However, of the 82 projects that received responses to the question asking for specific capital costs, only 55 (67%) received a single dollar value that could have been used for scoring and the rest received non-standard or text-based responses (e.g. "to be determined"). Therefore, only the general capital cost question responses to the Concept-level and project-level surveys were used to calculate the Cost Effectiveness Evaluation Objective unweighted scores for all Concepts.

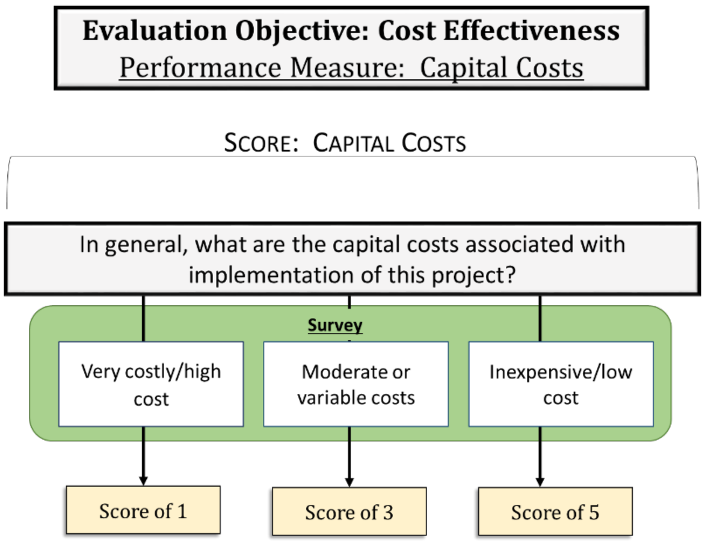


Figure 12. Decision tree for Capital Costs Performance Measure associated with the Cost Effectiveness Evaluation Objective.

3.4.3.2 O&M Costs Performance Measure

O&M costs are the total present value of operation, maintenance, and periodic replacement costs to customers/developers required for continued service of a project. These costs may include materials, labor, energy, and any other recurring costs necessary to support continued project service. The O&M Costs Performance Measure was scored in the same way as the Capital Costs Performance Measure, with a survey question asking about the O&M costs associated with the implementation of projects in within a Concept (Figure 13). A very costly/high cost project or a Concept received a score of 1, a moderately costly or variable cost project or Concept received a score of 3, and an inexpensive/low cost project or Concept received a score of 5. This question was asked in both the project-level and Concept-level surveys. The Performance Measure Score was calculated as the average of the means of the project-level and Concept-level survey responses or from the mean of all survey responses, depending on the number of survey responses for a given Concept, as described in Section 3.4. Enhanced Conservation was given a score of NA because it was not included in the surveys.

The use of actual O&M costs (e.g., dollar amount) by project was originally considered for evaluating cost effectiveness. However, of the 82 projects that received responses to the question asking about specific O&M costs, the majority of the responses to this question were text-based responses (e.g. a range of potential O&M costs) that could not be used for numeric scoring. Therefore, only the general O&M cost question responses to the Concept-level and project-level surveys were used to calculate the Cost Effectiveness Evaluation Objective unweighted scores for all Concepts.

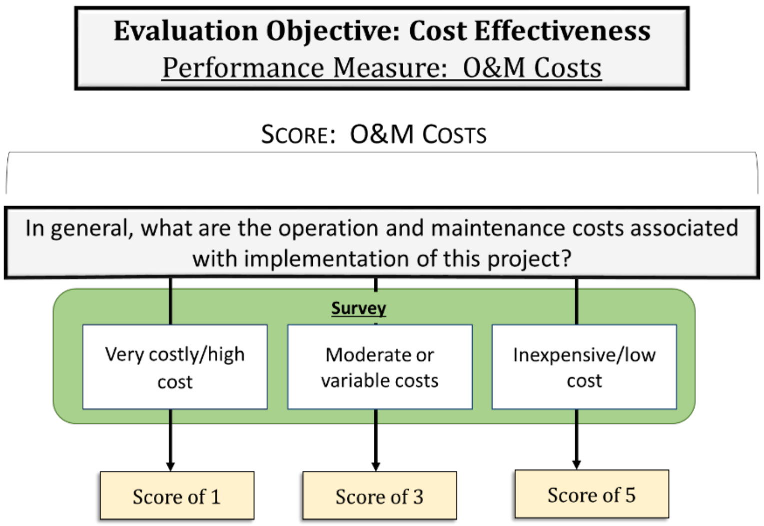


Figure 13. Decision tree for O&M Costs Performance Measure associated with the Cost Effectiveness Evaluation Objective.

3.4.3.3 Potential for External Funding Performance Measure

An additional cost effectiveness question was asked regarding the potential for external funding (Figure 14). The potential for external funding has an impact on the portion of project costs that must be paid by customers/developers within the local region, reducing the financial cost of the project to the region, but it does not have an impact on the actual cost of the project and instead only redistributes project costs. The survey question asked to what extent a project was expected to be funded by external sources. If no external funding was/is expected, a score of 1 was assigned. If the project was/is expected to be partially funded by external sources, a score of 3 was assigned. If the project was/is expected to be fully funded by external sources, a score of 5 was assigned. The external funding question was asked in the project-level surveys only, and therefore, the Performance Measure score for each Concept was the mean of the project-level survey responses for each Concept, regardless of the number of project-level responses.

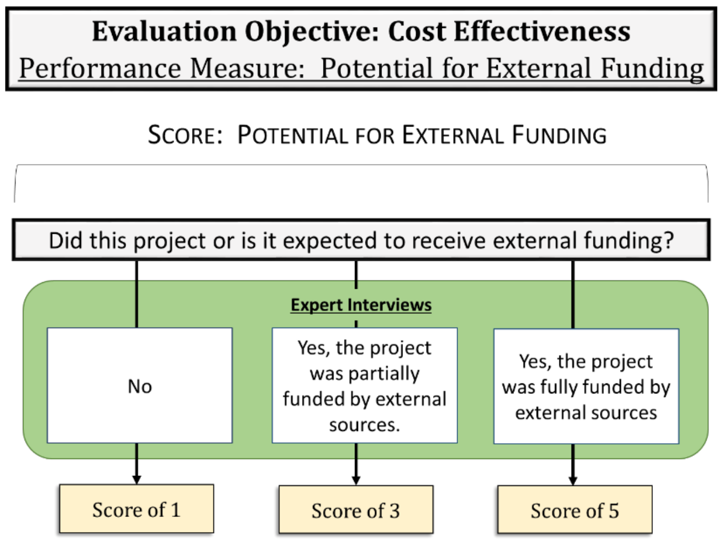


Figure 14. Decision tree for the Potential for External Funding Performance Measure associated with the Cost Effectiveness Evaluation Objective.

3.4.4. Environmental Justice Evaluation Objective

The Environmental Justice Evaluation Objective includes two Performance Measures: Environmental Justice and Disadvantaged Communities (DACs) (Figure 15).

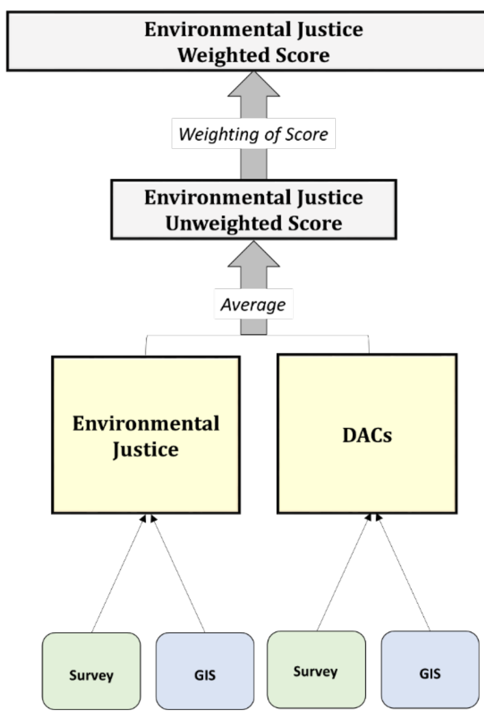


Figure 15. Decision tree for the Environmental Justice Evaluation Objective.

The Environmental Justice Performance Measure addressed the fair treatment of people of all social and economic backgrounds with respect to actions that have potential environmental effects. Fair treatment implies that no group of people should bear a disproportionate share of negative effects of an action. The negative effects of an action can be considered disproportionately distributed if the percentage of negative to total effects imposed on a specific group is greater than the percentage of the total population represented by that group. A group can be defined by race, ethnicity, income, community, or some other grouping. An evaluation of potential environmental justice concerns requires an understanding of where project influences are likely to occur and where potentially affected groups are located.

A separate but closely related Concept is Disadvantaged Communities. This Performance Measure was included in addition to the Environmental Justice Performance Measure because the Integrated Regional Water Management Program has specific funding allocations and program goals for DACs, as defined by the California Department of Water Resources (DWR). DWR defines a DAC as a community that has a median household income of less than 80% of the State's median household income ($51,026 in 2015). A severely disadvantaged community is defined as having a median household income less than 60% of the State's median household income ($38,270 in 2015) (California Department of Water Resources, 2016).

3.4.4.1 Environmental Justice Performance Measure

The Environmental Justice Performance Measure is calculated from two sub-scores: Magnitude of Environmental Impact and Environmental Justice Sensitivity.

3.4.4.1.1. Magnitude of Environmental Impact Sub-Score

The Magnitude of Environmental Impact sub-score was based on two project-level survey questions. The first question asked whether the likely environmental impact of a project would be negative, neutral or unknown, or positive. The second question asked about the likely magnitude of a project's environmental impact, with possible responses including "large impact", "moderately large impact", "average impact", "less than average impact", and "minor impact".

The Magnitude of Environmental Impact Sub-score was determined by combining the likely environmental impact survey responses with the magnitude of environmental impact survey responses for each project. If the response to the likely environmental impact project-level survey question indicated a negative impact, the sub-score value was determined to be either 1 or 2, depending on the response to the likely magnitude of the project's environmental impact. If the response to the magnitude of environmental impact was a "large impact" or "moderately large impact", then the project received a score of 1. If the response to the magnitude of environmental impact question was "average impact", "less than average impact", or "minor impact", then the project received a score of 2. Although it would have been possible to divide the negative impacts into five levels of negative impact magnitude, the responses were grouped into only two scores (score of 1 or score of 2) in recognition that the difference between impact magnitude is somewhat subjective and can vary by survey respondent.

If the response to the likely environmental impact project-level survey question indicated a neutral or unknown impact, then the project received a score of 3 regardless of the magnitude of project's environmental impact result. This is because a neutral impact will not have an effect regardless of magnitude of the project's impact.

If the response to the likely environmental impact project-level survey indicated a positive impact, then the survey response to the likely magnitude of the project's environmental impact, the sub-score value was determined to be either 4 or 5, depending on the response to the magnitude of environmental impact question. If the response to the magnitude of environmental impact question was "large impact" or "moderately large impact", then the project received a score of 5. If the response to the magnitude of environmental impact was "average impact", "less than average impact", or "minor impact", then the project received a score of 4. The Magnitude of Environmental Impact scoring process is shown in Figure 16.

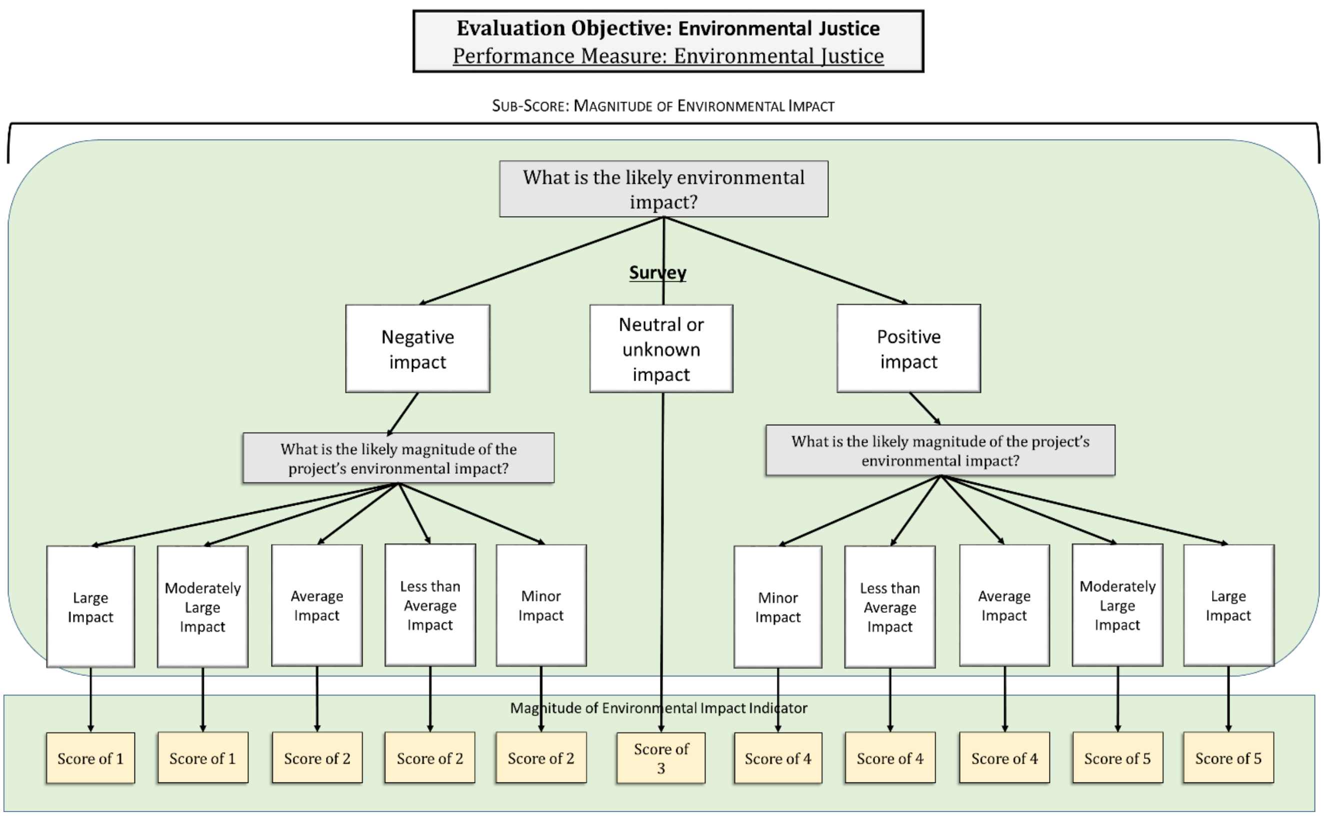


Figure 16. Decision tree for Magnitude of Environmental Impact Sub-score for the Environmental Justice Performance Measure associated with the Environmental Justice Evaluation Objective.

3.4.4.1.2. Environmental Justice Sensitivity Sub-Score

The Environmental Justice Sensitivity sub-score was based on GIS analysis of CalEnviroScreen 3.0 data and was calculated from two indicators: the Population Sensitivity Indicator (based on the CalEnviroScreen Population Characteristic) and the Environmental Sensitivity Indicator (based on the CalEnviroScreen Pollution Burden).

The Population Sensitivity Indicator accounts for sensitive populations and socioeconomic factors in the areas where projects are located. Sensitive populations include people with asthma and cardiovascular disease as well as low birth weight infants. Socioeconomic factors include educational attainment, housing burden, linguistic isolation, poverty, and unemployment. The socioeconomic factors implicitly include low income and minority populations that are considered as part of an environmental justice analysis.

To obtain the Population Sensitivity Indicator, the Census Tract containing each project was identified and the corresponding CalEnviroScreen Population Characteristic value was assigned to the project. Then the CalEnviroScreen Population Characteristic values were converted to a 1 to 5 scale by dividing the scores for all the projects into quintiles and assigning the first quintile a score of 1, the second quintile a score of 2, and so on. The converted value became the Population Sensitivity Indicator. The calculation process for the Population Sensitivity Indicator is shown in Figure 17.

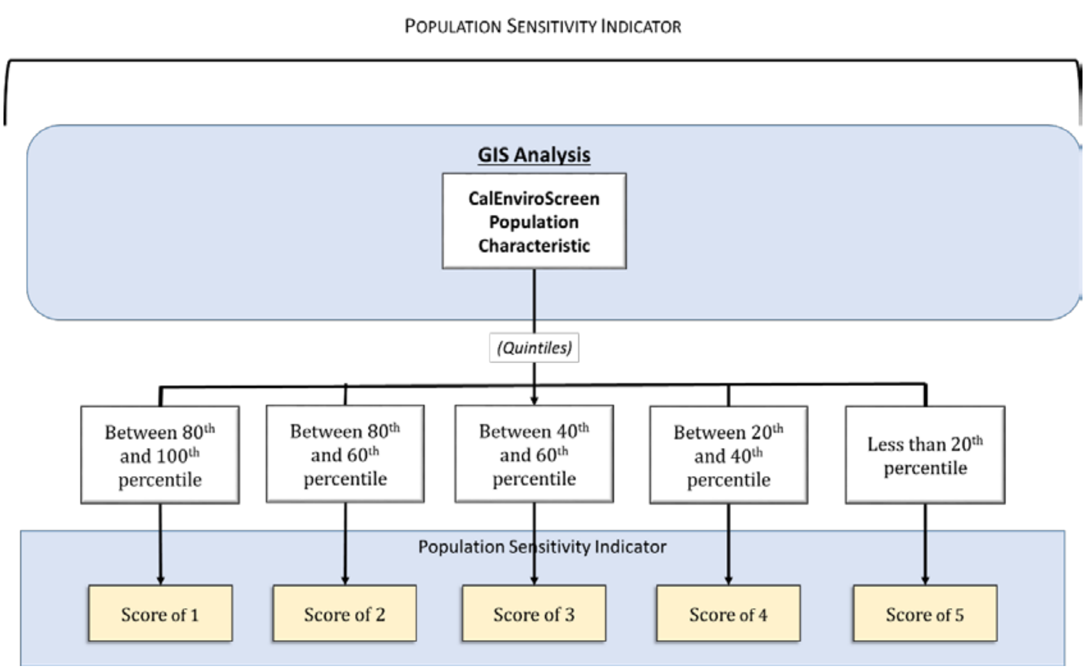


Figure 17. Decision tree for the Population Sensitivity Indicator used to calculate the Environmental Justice Sensitivity Sub-score as part of the Environmental Justice Performance Measure.

The Environmental Sensitivity Indicator accounts for exposures and environmental effects in the areas where projects are located. Examples of exposures include measures of air quality such as ozone and particulate matter, drinking water contaminants, pesticide use, and toxic releases from facilities. Examples of environmental effects include cleanup sites, groundwater threats, hazardous waste generators and facilities, and impaired water bodies.

A slightly different approach was used to obtain the Environmental Sensitivity Indicator. Similar to the Population Sensitivity Indicator, the Census Tract containing each project was identified and the corresponding CalEnviroScreen Pollution Burden was assigned to the project. Also similar to the Population Sensitivity Indicator, the CalEnviroScreen Pollution Burden values were divided into quintiles. However, rather than assigning a score of 1 to 5, a scale of 1 to 3 was used for the Environmental Sensitivity Indicator because areas that are most susceptible to environmental impacts can be either those with environments that are currently very high quality or those with environments that are currently very low quality. In other words, causing an adverse environmental impact on a pristine environment is very undesirable and, equally, making a bad environmental condition worse is also very undesirable. Therefore, the Pollution Burden quintiles were given scores of 1, 2, or 3. A score of 1 was assigned to the first quintile and the fifth quintile, recognizing the relatively large potential environmental impact on high-quality and low-quality environments. A score of 2 was assigned to the second and fourth quintiles, recognizing a reduced effect on somewhat high-quality or somewhat low-quality environments, and a score of 3 was assigned to the third quintile. The calculation process for the Environmental Sensitivity Indicator is shown in Figure 18.

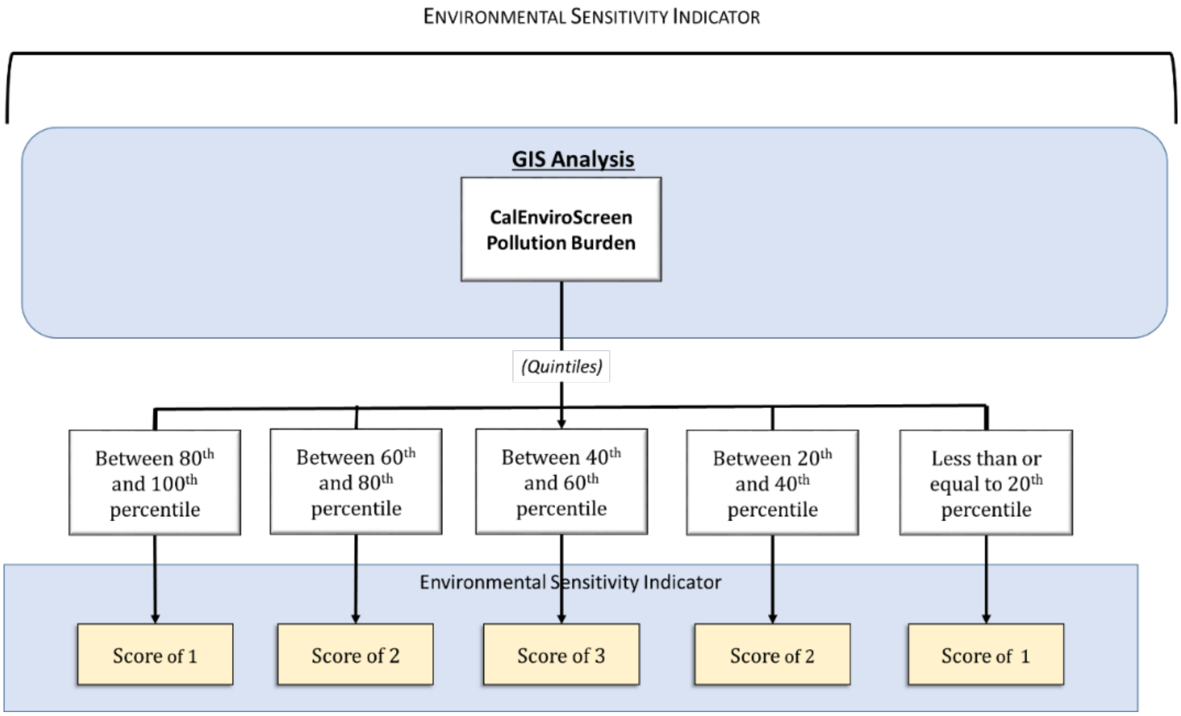


Figure 18. Decision tree for the Environmental Sensitivity Indicator used to calculate the Environmental Justice Sensitivity Sub-score as part of the Environmental Justice Performance Measure.

The Environmental Justice Sensitivity sub-score is the combination of the Population Sensitivity Indicator and the Environmental Sensitivity Indicator, resulting in a scoring range of 1 to 3 in ½ unit increments as shown in Figure 19. For example, a Population Sensitivity Indicator score of 1 combined with an Environmental Sensitivity Indicator score of 1 results in an Environmental Justice Sensitivity Sub-score of 1.0. A Population Sensitivity Indicator score of 3 combined with an Environmental Sensitivity Indicator score of 2 results in an Environmental Justice Sensitivity Sub-score of 2.5. As a final example on the opposite end of the scale, a Population Sensitivity Indicator score of 5 combined with an Environmental Sensitivity Indicator score of 3 results in an Environmental Justice Sensitivity Sub-score of 3.0. The Environmental Justice Sensitivity Sub-score provides a means for taking into account the susceptibility of a project location to environmental justice impacts.

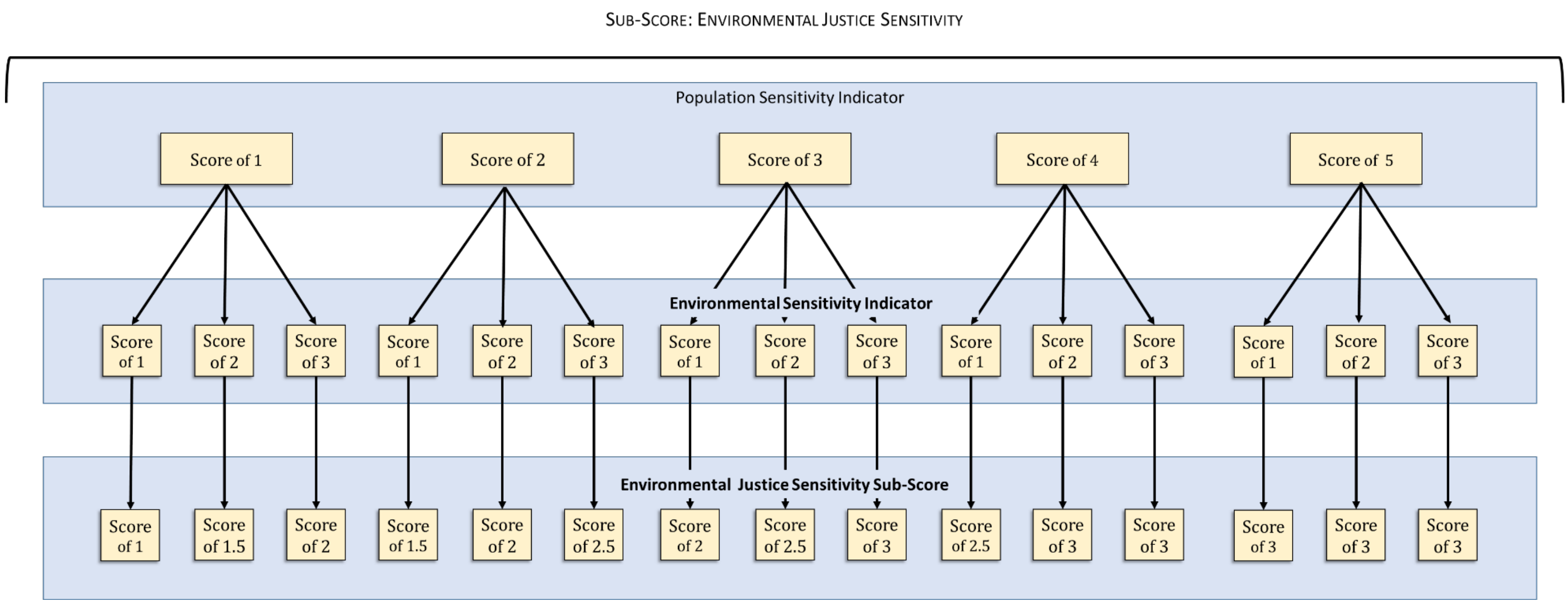


Figure 19. Decision tree for the Environmental Justice Sensitivity Sub-score associated with the Environmental Justice Performance Measure.

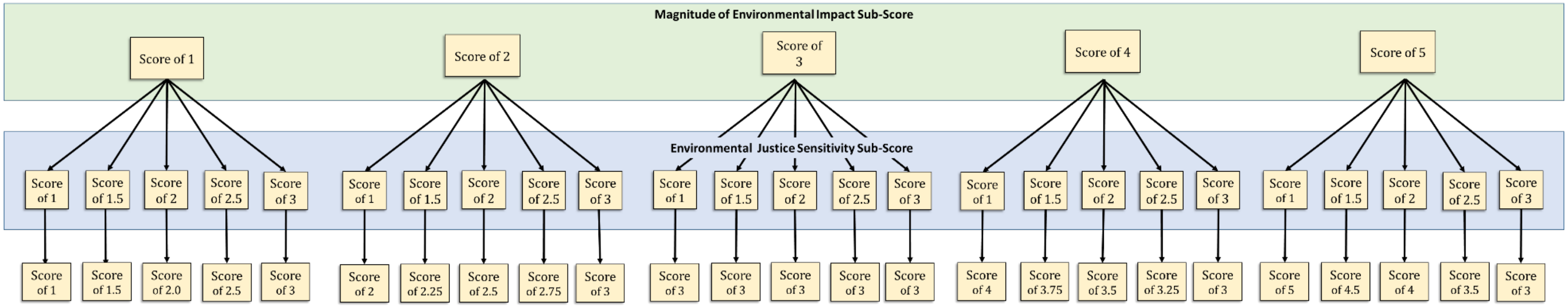


Figure 20. Decision tree for the Environmental Justice Performance Measure associated with the Environmental Justice Evaluation Objective.

3.4.4.1.3. Environmental Justice Performance Measure Scoring

The Environmental Justice Performance Measure is a combination of the Magnitude of Environmental Impact Sub-score, which is measured on a 1 to 5 scale in single unit increments, and the Environmental Justice Sensitivity Sub-score, which is measured on a 1 to 3 scale in ½ unit increments. The combined scores for the Environmental Justice Performance Measure range from 1 to 5, where a score of 1 represents the greatest potential adverse Environmental Justice Performance Measure impact and a score of 5 represents the greatest potential beneficial impact. A score of 3 represents a neutral impact. The Environmental Justice Performance Measure Scoring process is shown in Figure 20.

3.4.4.2 Disadvantaged Communities Performance Measure

The Environmental Justice Evaluation Objective also included a DACs Performance Measure, which was scored based on responses to a project-level survey question about the impact a project may have on DACs (negative impact, neutral or unknown impact, and positive impact) and GIS analysis of project location relative to DACs and severe DACs. The location of DACs and severe DACs was obtained from the California Department of Water Resources Disadvantaged Community Tracts data layer (California Department of Water Resources, n.d.). This layer depicts data from the U.S. Census American Community Survey from 2010-2014 and shows Census Tracts identified as DACs (California Department of Water Resources, 2016).

Scoring for the DACs Performance Measure is shown in Figure 21. If the response to the DACs project-level survey question indicated a negative impact and overlapped a severe DAC, then the project received a score of 1. If the project had a negative impact. and overlapped a DAC, then the project received a score of 2. If the response to the DACs project-level survey question indicated a neutral or unknown impact, then the project received a score of 3 regardless of the GIS analysis based on the fact that a neutral impact will not have an effect on a DAC regardless of project overlap with a DAC. If the response to the DACs project-level survey question indicated a positive impact, and the project overlapped a DAC, then the project received a score of 4. If the project had a positive impact and overlapped a severe DAC, then the project received a score of 5.

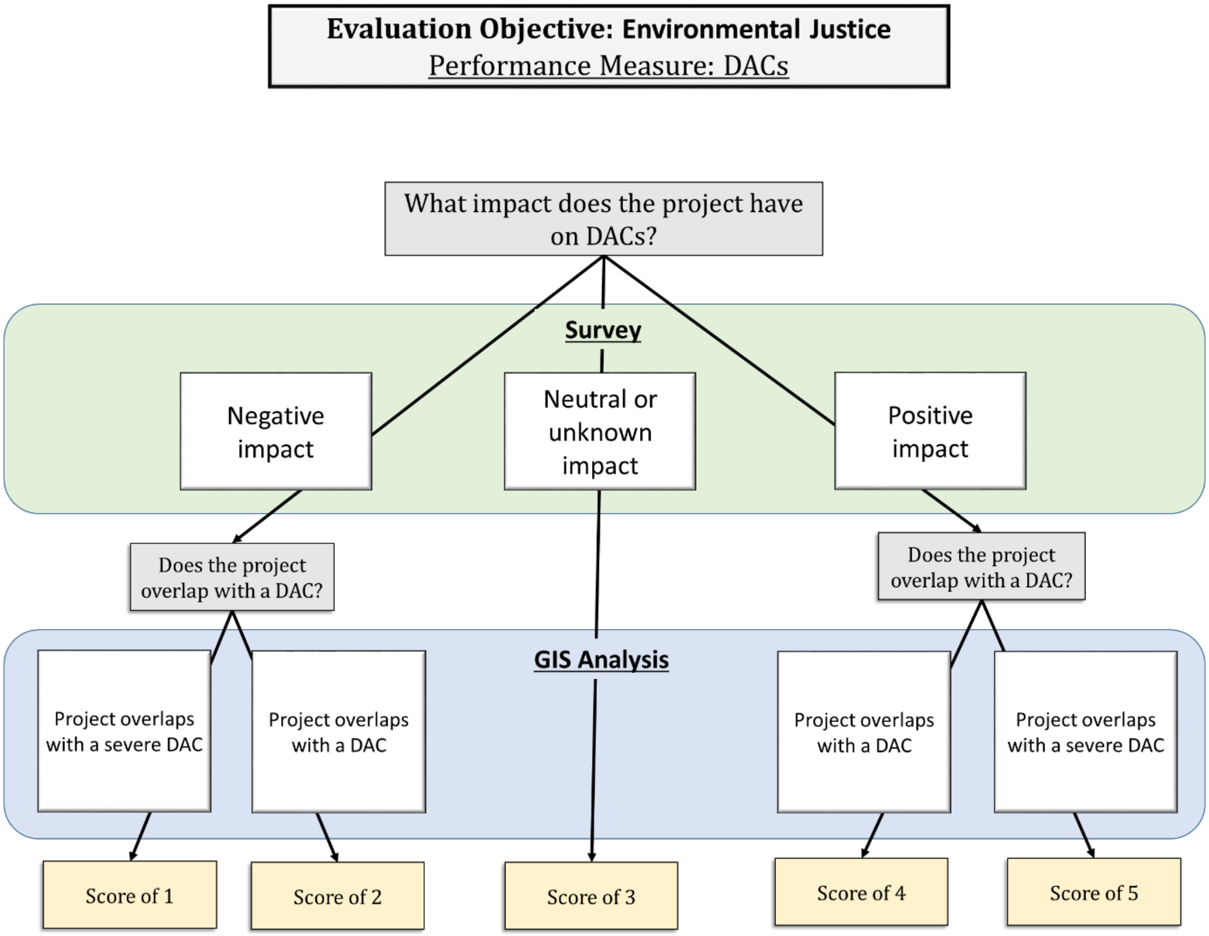


Figure 21. Decision tree for the DACs Performance Measure associated with the Environmental Justice Evaluation Objective.

3.4.5. Optimize Local Supplies Evaluation Objective

The Optimize Local Supplies Evaluation Objective included one Performance Measure, Local Supply (Figure 22).

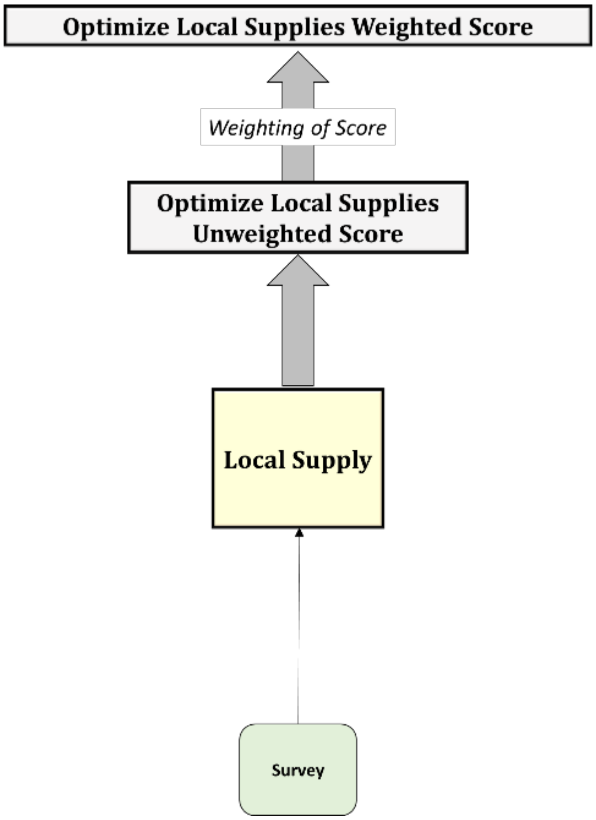


Figure 22. Decision tree for the Optimize Local Supplies Evaluation Objective.

3.4.5.1 Local Supply Performance Measure

The Local Supply Performance Measure score was derived from a single survey question, which asked whether the project increases local water supply (Figure 23). The intent of this question was to evaluate a Concept's or project's ability to provide locally-sourced water supply. A direct or long-term decrease in local water supply resulted in a score of 1, an indirect or temporary decrease in local water supply was a 2, a neutral or unknown impact on local water supply was a 3, an indirect or temporary increase in local water supply was a 4, and a direct or long-term increase in local water supply resulted in a score of 5. The local supply question was asked at both the project-level and Concept-level. Therefore, the Performance Measure score was calculated as the average of the means of the project-level and Concept-level survey responses or from the mean of all survey responses, depending on the number of survey responses for a given Concept, as described in Section 3.4. Enhanced Conservation was given a score of NA because it was not included in the surveys.

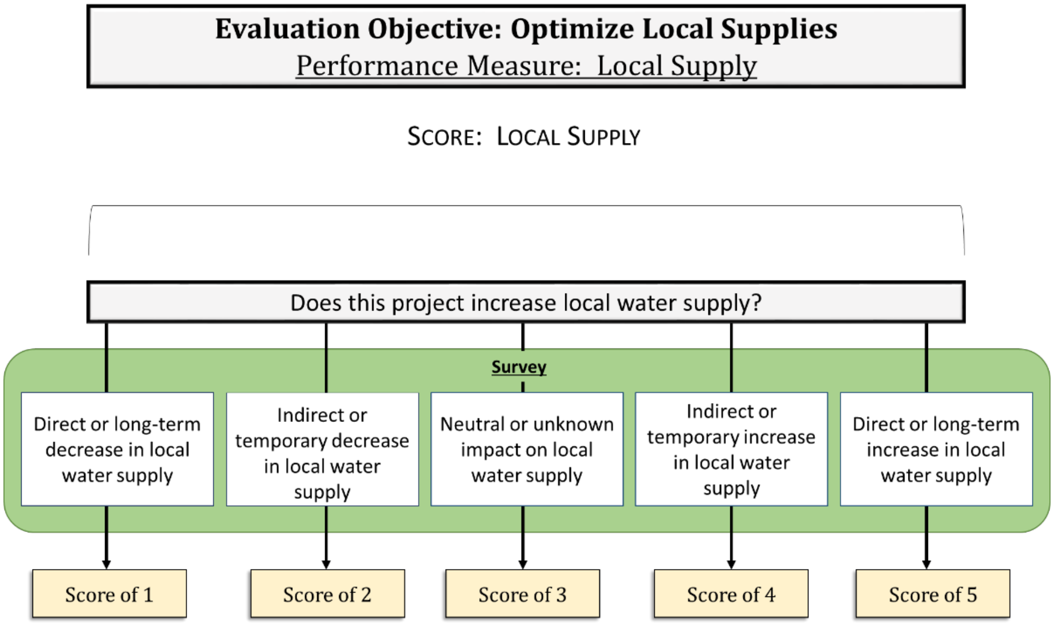


Figure 23. Decision tree for the Local Supply Performance Measure associated with the Optimize Local Supplies Evaluation Objective.

3.4.6. Project Complexity Evaluation Objective

Project Complexity considered regulatory compliance, number of agencies or approvers involved, property ownership, public opinion, acceptance, and practicality of implementation. If significant expertise, experience, and collaboration among multiple partners or collaborators was required for a project to be successfully implemented, complexity increased. Additional considerations included the potential for project delays and potential logistical issues.

The Project Complexity score was based on one Performance Measure: Project Complexity and Feasibility (Figure 24).

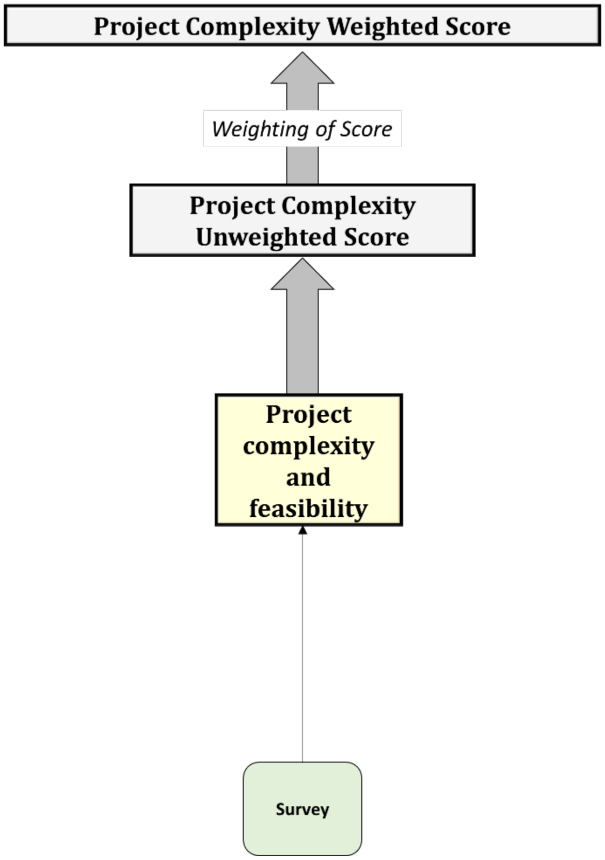


Figure 24. Decision tree for the Project Complexity Evaluation Objective.

3.4.6.1 Project Complexity and Feasibility Performance Measure

The Project Complexity and Feasibility Performance Measure was evaluated by a survey question related to project implementation within a Concept (Figure 25). Considerations included regulatory compliance, number of agencies or approvers involved, property ownership, public opinion, acceptance, and practicality of implementation.

If significant expertise, experience, and collaboration among multiple partners or collaborators is required for a project to be successfully implemented, and projects regularly experience delays and/or must be altered due to project complexity, logistics, and/or competing interests, then the project was considered highly complex and infeasible and received a score of 1. Projects that are moderately complex in terms of project implementation and/or require approval from multiple agencies or organizations to collaborate received a score of 2. Projects that have unknown complexity and/or feasibility received a score of 3. Moderately simple projects within a Concept that are likely to experience a limited number of barriers to implementation, that achieve regulatory compliance as a routine procedure, and that have multiple partners involved who have existing agreements in place to facilitate project approval and implementation received a 4.

Finally, relatively simple projects that are easily and regularly implemented with few barriers, and have easily acquired and achieved regulatory compliance received a score of 5. The project complexity question was asked at both the project-level and Concept-level. Therefore, the Performance Measure score was calculated as the average of the means of the project-level and Concept-level survey responses or from the mean of all survey responses, depending on the number of survey responses for a given Concept, as described in Section 3.4. Enhanced Conservation was given a score of NA because it was not included in the surveys.

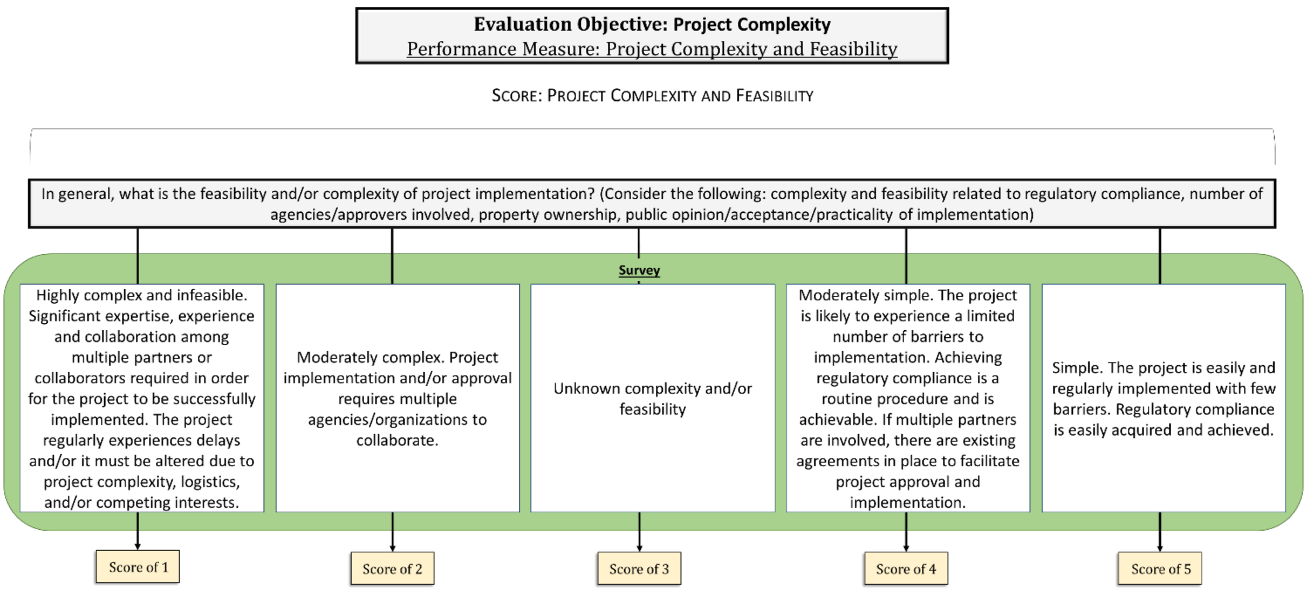


Figure 25. Decision tree for the Project Complexity and Feasibility Performance Measure associated with the Project Complexity Evaluation Objective.

3.4.7. Protect Habitats, Wildlife, and Ecosystems Evaluation Objective

The Evaluation Objective Protect Habitats, Wildlife, and Ecosystems included three Performance Measures: Impacts to Ecosystems, Impacts to Threatened and Endangered Species, and Impacts to Native Species (Figure 26). These Performance Measures were evaluated using geospatial analysis and results from surveys of identified experts and stakeholders.

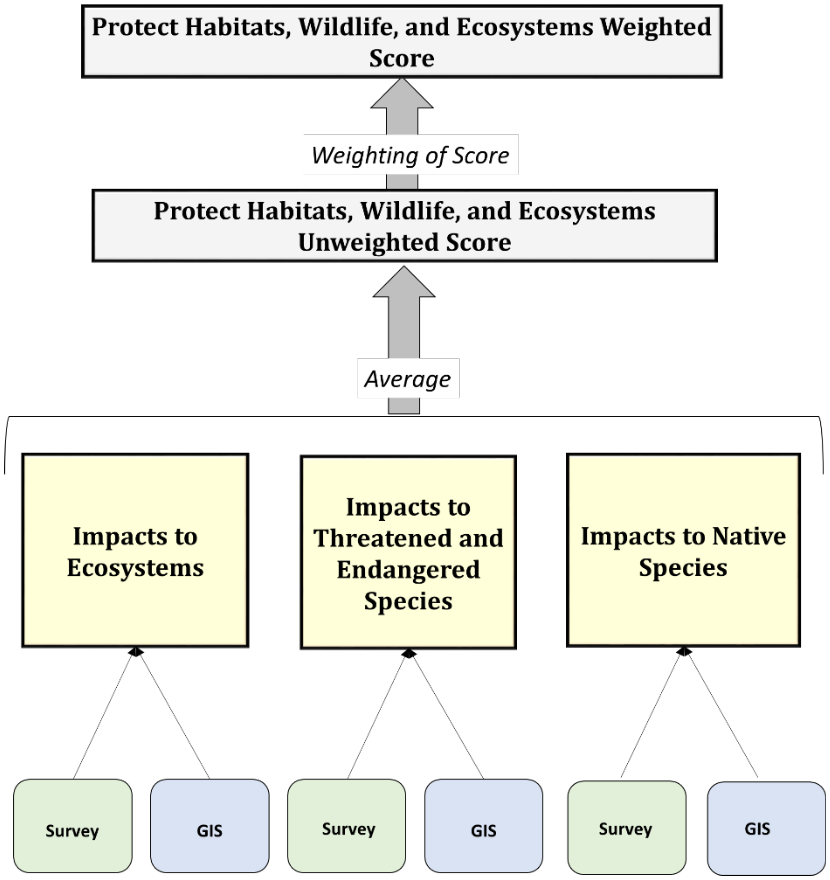


Figure 26. Decision tree for the Protect Habitats, Wildlife, and Ecosystems Evaluation Objective.

3.4.7.1 Impacts to Ecosystems Performance Measure

The Impacts to Ecosystems Performance Measure was based on determination of likely negative, positive, or neutral or unknown impacts of a project on ecosystems through a combination of surveys of identified experts and stakeholders and GIS analysis at the project-level. First, a project-level survey question was asked about the likely impact to ecosystems, with possible responses of negative, neutral, or positive (Figure 27). Then a GIS analysis was performed using geospatial data available from the San Diego Association of Governments (San Diego Association of Governments, 2018a) to determine whether a project would have a direct or indirect impact on ecologically important habitat. Geospatial data layers used to collectively represent "ecologically important habitats" included habitats defined within the Multiple Species Conservation Program (MSCP) and the Multi-Habitat Planning Area (MHPA), the proposed MSCP North and East County Plan Areas, Environmentally Sensitive Areas, and the 100-Year Floodway.

Direct impacts were assumed if a project was located in an ecologically important habitat. Indirect impacts were identified if a project was within a 500-foot buffer around the ecologically important habitats.

Finally, the survey responses were combined with the GIS data to determine the Performance Measure score. If a project had a negative impact on ecosystems and was located within ecologically important habitat, the project received a score of 1. If a project had a negative impact on ecosystems and was located within the 500-foot buffer around ecologically important habitat, the project received a score of 2. If the project had an unknown impact on ecosystems or was located outside of ecologically important habitats or the buffer around ecologically important habitat, then the project received a score of 3. If a project had a positive impact on ecosystems and was located within the 500-foot buffer around ecologically important habitat, the project received a score of 4. If a project had a positive impact on ecosystems and was located within ecologically important habitat, the project received a score of 5. Project-specific scores were averaged within each Concept to give an overall score for each Concept.

Evaluation Objective: Protect Habitats, Wildlife, and Ecosystems
Performance Measure: Impacts to Ecosystems

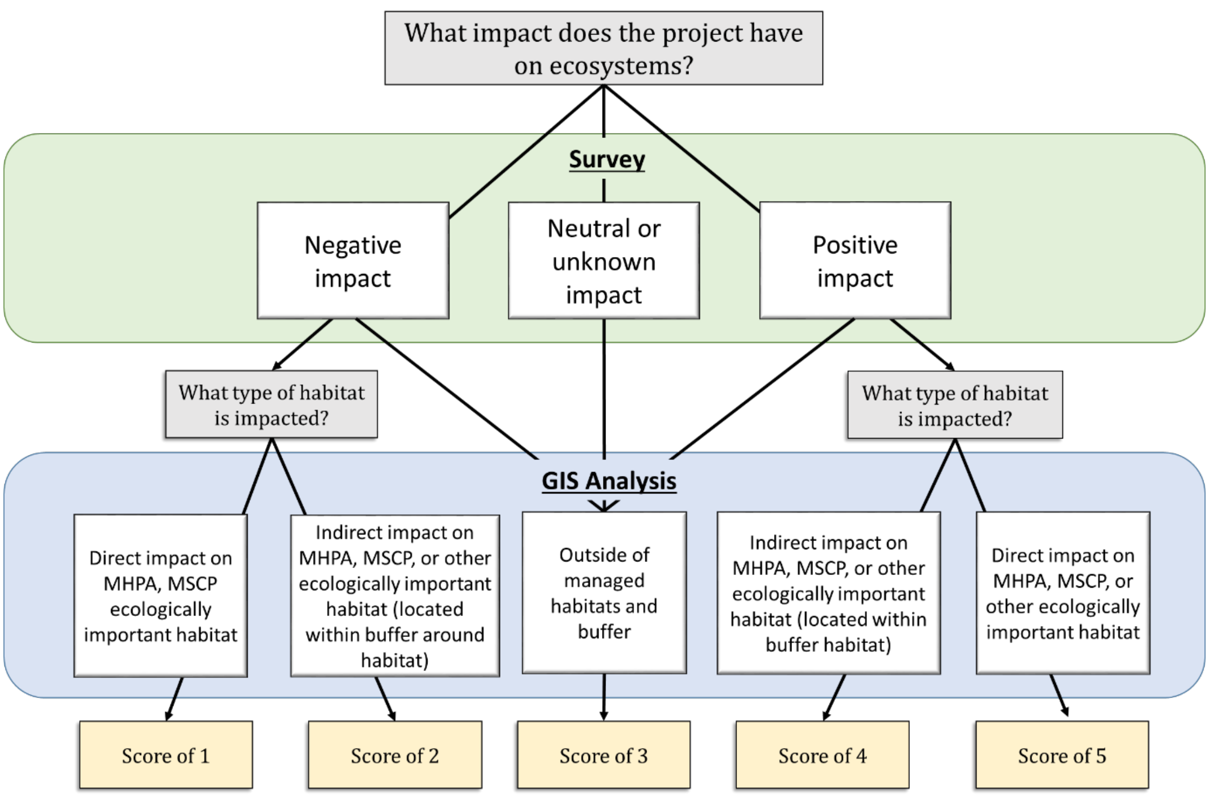


Figure 27. Decision tree for the Impacts to Ecosystems Performance Measure associated with the Protect Habitats, Wildlife and Ecosystem Services Evaluation Objective.

Initially, the Performance Measure was planned to be measured by two sub-scores: a Habitat Restoration/Degradation sub-score and the Ecosystems sub-score that was eventually used as the Performance Measure score. The Habitat Restoration/Degradation sub-score was planned to be calculated based on a determination of whether a project likely restores, conserves, degrades, or has a neutral or unknown impact on a habitat through survey responses. The surface area/extent of the habitat impacted, and determination of mitigation was determined through survey responses and literature review. However, 72 out of 87 habitat restoration or degradation question responses were neutral (about 83% of total responses) and 8 out of 87 (about 9% of the total) were missing responses. For the area of habitat, a total of 36 (about 41%) of the survey responses were missing. Neutral responses to the restoration/degradation question indicated that the project would either have a neutral effect (e.g., by mitigation or design of project) or that most survey respondents did not know enough about the conceptual project to determine whether habitat was degraded or restored. In many cases, projects that were determined to have an impact on ecosystems were designed to include mitigation, and thus, the net impact of the project was neutral. The combination of small variation in response values (mostly neutral) and the relatively large percentage of missing values resulted in unreliable estimates for the Habitat Restoration/Degradation sub-score. As a result, the Habitat Restoration/Degradation sub-score was dropped from the Impacts to Ecosystems Performance Measure, and the Protect Habitats, Wildlife, and Ecosystems Evaluation Objective unweighted score was based on an average of the remaining three sub-scores.

3.4.7.2 Impacts to Threatened and Endangered Species Performance Measure

The Impacts to Threatened and Endangered Species Performance Measure was determined by evaluating project locations in relation to endangered/threatened species using California Natural Diversity Database (CNDDB) and SANBIOS geospatial data combined with the survey response data.

First, survey responses determined the relative impact of a project on endangered or threatened species. The survey question asked the likely impact of a project on endangered/threatened species. A negative impact resulted in a score of 1, a neutral or unknown impact resulted in a score of 2, and a positive impact resulted in a score of 3.

Next, project locations in relation to the CNDDB and SANBIOS data were evaluated by isolating the sensitive and invasive species from the geospatial attribute table data.

Finally, the survey and GIS data were combined to determine the overall score. If a project had a likely positive impact on endangered or threatened species, then it received a score of 5. If a project had a likely positive impact on a candidate/at-risk species, species of concern, or species considered “sensitive,” then it received a score of 4. If a project had a neutral or unknown impact on a species or the project area had no documented threatened or endangered species, then it received a score of 3. If a project had a likely negative impact on a candidate/at-risk species,

species of concern, or species considered “sensitive,” then it received a score of 2. If a project had a likely negative impact on an endangered or threatened species, then it received a score of 1 (Figure 28).

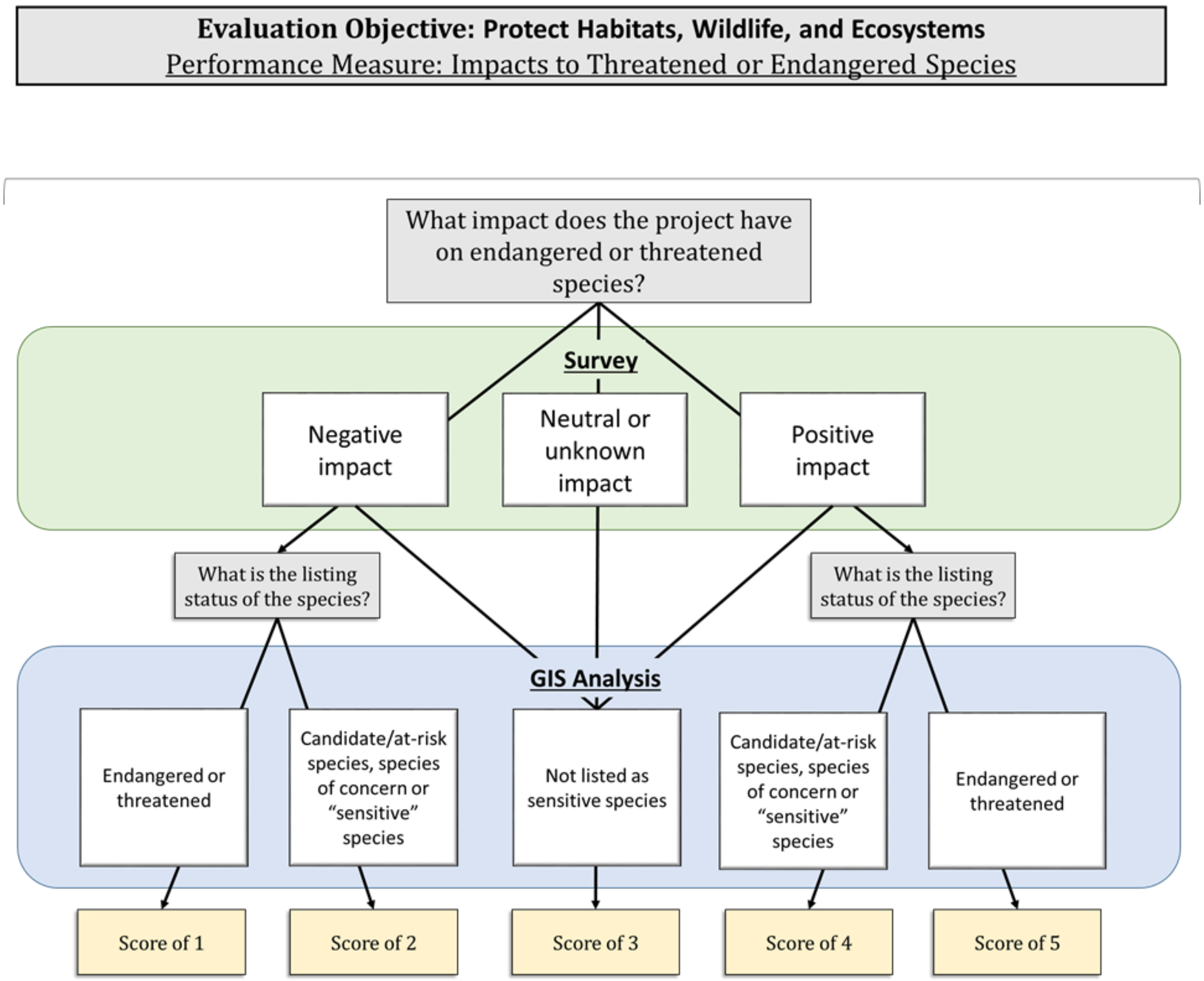


Figure 28. Decision tree for the Impacts to Threatened or Endangered Species Performance Measure associated with the Protect Habitats, Wildlife, and Ecosystems Evaluation Objective.

3.4.7.3 Impacts to Native Species Performance Measure

The Impacts to Native Species Performance Measure was determined by evaluating project locations in relation to native species using the CNDDB and SANBIOS geospatial data combined with the survey response data. The CNDDB, a product of the California Department of Fish and Wildlife’s Biogeographic Data Branch (www.wildlife.ca.gov/Data/CNDDB), is a database of the status and locations of California's rare species and natural community types. The CNDDB includes all federally and state listed plants and animals, all species that are candidates for listing, all species of special concern, and those species that are considered “sensitive” by government agencies and the conservation community. This data features species observed from 1875 to 2017 within 10 miles of San Diego County.

SANBIOS, a product of the County of San Diego, is part of the State of California's Biological Information and Observation System (BIOS) database (bios.dfg.ca.gov/). It is a catalog of species observations recorded by professional biologists from the County of San Diego and various other agencies and firms. The species are classified as either sensitive, invasive, or neither and the date of species observations range from 1856 to 2016. These data serve as a baseline catalog of species records in the MSCP preserve systems in the incorporated areas of San Diego County. It is important to note these observations are an indication of confirmed species presence at the time of the survey but offer no indication of species absence.

First, survey responses determined the relative impact of a project on native species. The survey question asked the likely impact of a project on native species. Possible responses were negative impact, neutral or unknown impact, or positive impact.

Next, project locations in relation to the CNDDB and SANBIOS data were evaluated by determining the relative abundance of native species from the geospatial attribute table data. "Substantial abundance of native species" was defined as greater than three species observed in CNDDDB or SANBIOS. "Minimal abundance of native species" was defined as less than three species observed.

Finally, the survey data was combined with the GIS data to determine the Performance Measure score. If a substantial number of native species was documented for the project's location, and the project had a likely positive impact on species, then the project received a score of 5. If a less than significant number of native species was documented for the project area, and the project had a likely positive impact on native species, then the project received a score of 4. If there were any number of species documented for the project area, and the project had a neutral or unknown impact on native species, or the project area had no documented native species, then the project received a score of 3. If a minimal abundance (i.e., <3) of native species was documented for the project's location, and the project had a likely negative impact on native species, then the project received a score of 2. If a substantial abundance of native species was documented for the project's location, and the project had a likely negative impact on native species, then the project received a score of 1 (Figure 29).

Evaluation Objective: Protect Habitats, Wildlife, and Ecosystems
Performance Measure: Impacts to Native Species

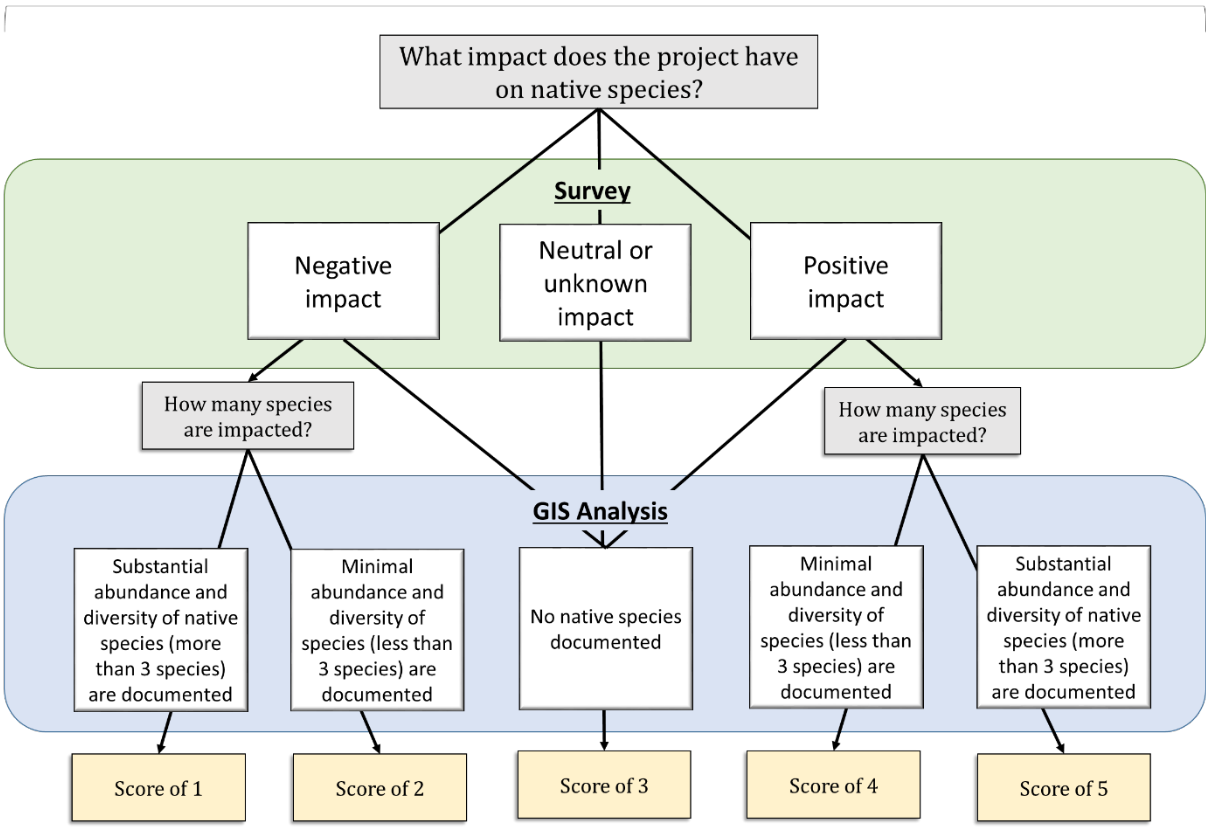


Figure 29. Decision tree for the Impacts to Native Species Performance Measure associated with the Protect Habitats, Wildlife, and Ecosystems Evaluation Objective.

3.4.8. Provide for Scalability of Implementation Evaluation Objective

Provide for Scalability of Implementation considered the possibility for project phasing and expansion. Difficulty in scaling back, phasing, or expansion creates a barrier to accommodating changes in regional needs and planning. The Provide for Scalability of Implementation Evaluation Objective included one Performance Measure: Project Phasing (Figure 30).

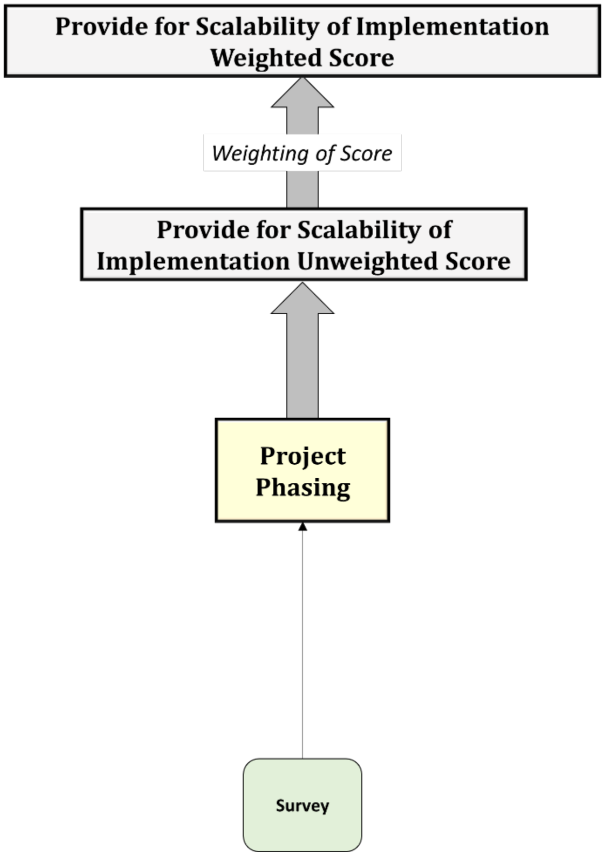


Figure 30. Decision tree for the Provide for Scalability of Implementation Evaluation Objective.

3.4.8.1 Project Phasing Performance Measure

Provide for Scalability of Implementation Performance Measure scores were based on a single survey question regarding the ability for project phasing and expansion (Figure 31). Extreme difficulty in scaling back, phasing, or expansion resulted in a score of 1. A score of 2 indicated moderate difficulty to expand or phase the project. A score of 3 indicated no or unknown difficulty to expand or phase the project. A 4 meant the project could be easily modified to accommodate a subsequent phase or expansion. Last, a score of 5 indicated that the project is planned and designed to accommodate a subsequent phase or expansion. The project phasing question was asked at both the project-level and Concept-level. Therefore, the Performance Measure score was calculated as the average of the means of the project-level and Concept-level survey responses or from the mean of all survey responses, depending on the number of survey responses for a given Concept, as described in Section 3.4. Enhanced Conservation was given a score of NA because it was not included in the surveys.

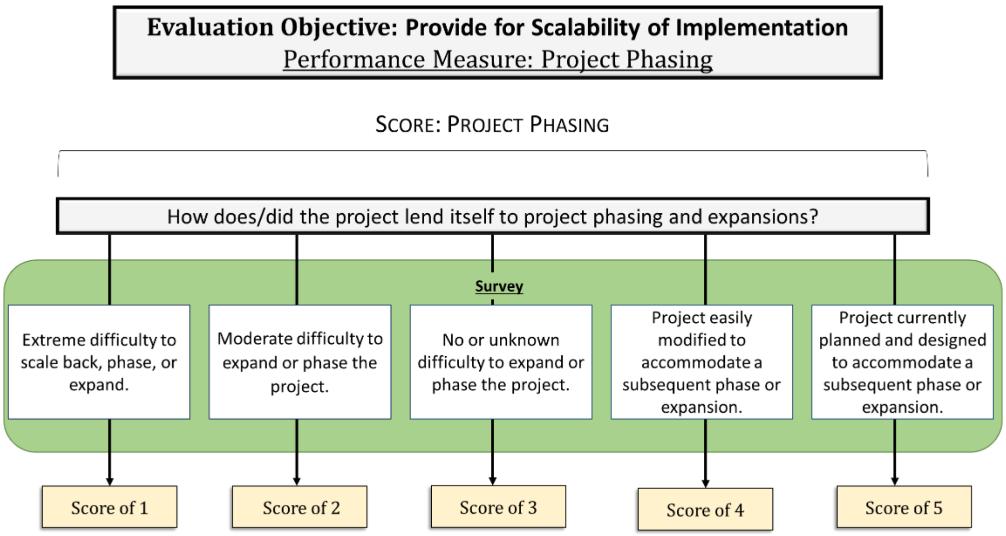


Figure 31. Decision tree for the Project Phasing Performance Measure associated with the Provide for Scalability of Implementation Evaluation Objective.

3.4.9. Quality of Life/Recreation Evaluation Objective

The Quality of Life/Recreation Evaluation Objective was calculated using two Performance Measures: Green Space/Open Space and Recreation Opportunities (Figure 32). The Green Space/Open Space Performance Measure was calculated from two sub-scores: Green Space/Open Space and Quality of Life, both based on the results of surveys of identified experts and stakeholders. The Recreation Opportunities Performance Measure was based on two sub-scores: Recreation Opportunities, based on the results of surveys of identified experts and stakeholders, and Visitation Impact from Changes in Reservoir Elevation, based on recreation visitation modeling at three reservoirs and estimated visitation effects for a fourth reservoir. The two Quality of Life Performance Measures were averaged to derive the Quality of Life/Recreation Evaluation Objective unweighted score.

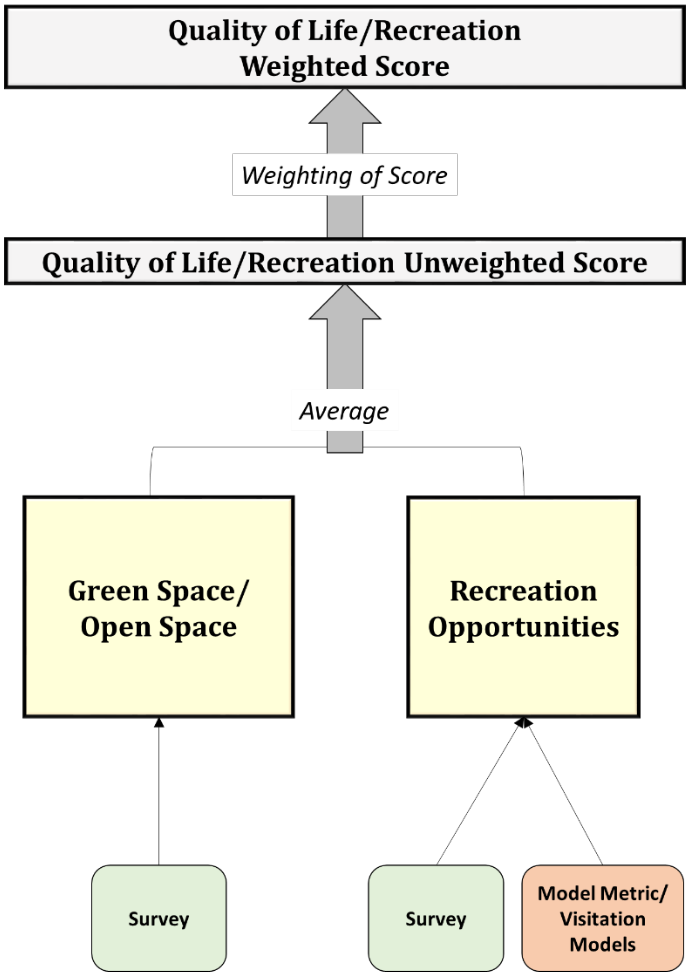


Figure 32. Decision tree for the Quality of Life/Recreation Evaluation Objective.

3.4.9.1 Green Space/Open Space Performance Measure

The Green Space/Open Space Performance Measure was based on two sub-scores corresponding to two survey questions.

3.4.9.1.1. Green Space/Open Space Sub-Score

The first sub-score in the Green Space/Open Space Performance Measure, Green Space/Open Space, addressed the extent to which a Concept increases green space or open space, or increases the quality of existing green space or open space (Figure 33). A direct or long-term reduction in the amount or quality of green or open space received a score of 1, and an indirect, limited or temporary reduction in the amount or quality of green or open space received a score of 2. No impact or an unknown impact on green or open space received a score of 3. An indirect, limited or temporary increase in the amount or quality of green or open space received a 4 score, and a score of 5 was given if there is a direct or long-term increase in the amount or quality of green or open space.

SUB-SCORE 1: GREEN SPACE/OPEN SPACE

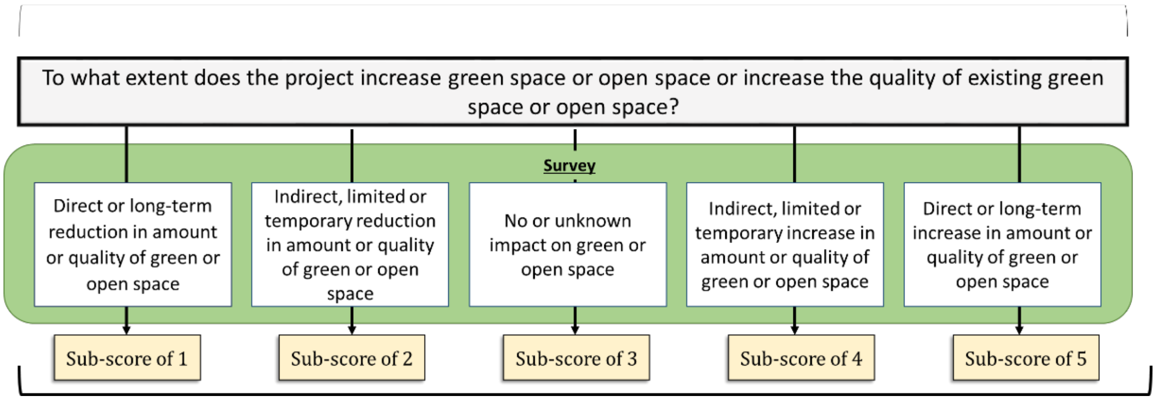


Figure 33. Decision tree for the Green Space/Open Space Sub-Score for the Green Space/Open Space Performance Measure associated with the Quality of Life/Recreation Evaluation Objective.

3.4.9.1.2. Quality of Life Sub-Score

The second sub-score in the Green Space/Open Space Performance Measure, Quality of Life, addressed the extent to which the Concept increases quality of life (Figure 34). This survey question considered impacts such as air pollution, noise/nuisance impacts, increased urbanization, view obstruction or enhancement, and cultural enrichment. A direct or long-term reduction in quality of life received a score of 1, an indirect or limited or temporary reduction in quality of life received a score of 2, no impact or an unknown impact on quality of life received a 3 score, an indirect, limited or temporary increase in quality of life received a 4, and a direct or long-term increase in quality of life received a score of 5.

SUB-SCORE 2: QUALITY OF LIFE

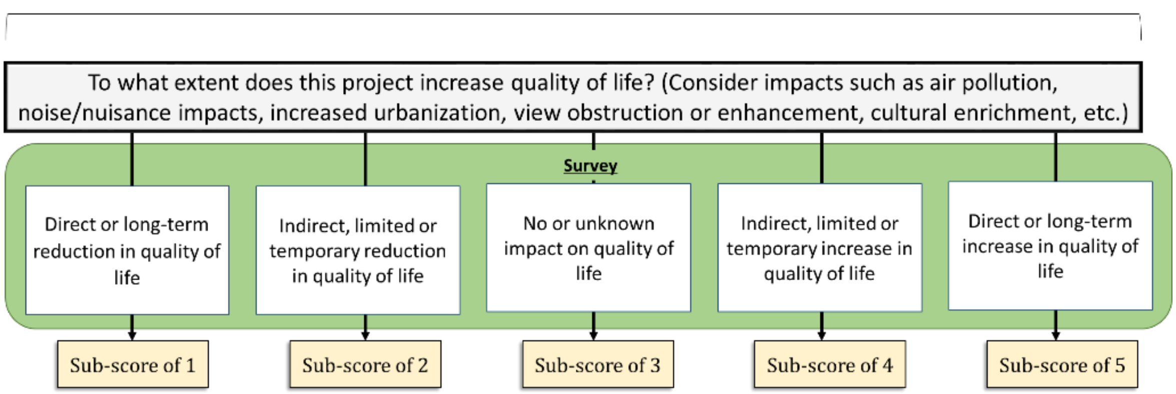


Figure 34. Decision tree for the Quality of Life Sub-Score for the Green Space/Open Space Performance Measure associated with the Quality of Life/Recreation Evaluation Objective.

3.4.9.2 Recreation Opportunities Performance Measure

The Recreation Opportunities Performance Measure considered the potential for a project to create additional areas and opportunities for recreation, such as hiking and biking trails, wildlife viewing, swimming, boating, and fishing as incidental benefits to water supply storage and conveyance. The Recreation Opportunities Performance Measure included two sub-scores: Recreation Opportunities and Visitation Impacts for Changes in Reservoir Elevation.

3.4.9.2.1. Recreation Opportunities Sub-score

The Recreation Opportunities sub-score in the Recreation Opportunities Performance Measure included one survey question. The question asked the extent to which projects within the Concept increase recreational opportunities. Consideration was given to recreation opportunities such as trails/hiking, community gathering space, wildlife watching, swimming, boating, and fishing as incidental benefits to water supply storage and conveyance. A direct or long-term reduction in recreational opportunities received a score of 1, an indirect, temporary or limited reduction in recreational opportunities received a 2, no impact or an unknown impact on recreational opportunities received a score of 3, an indirect, temporary or limited increase in recreational opportunities received a 4, and a direct or long-term increase in recreational opportunities received a score of 5.

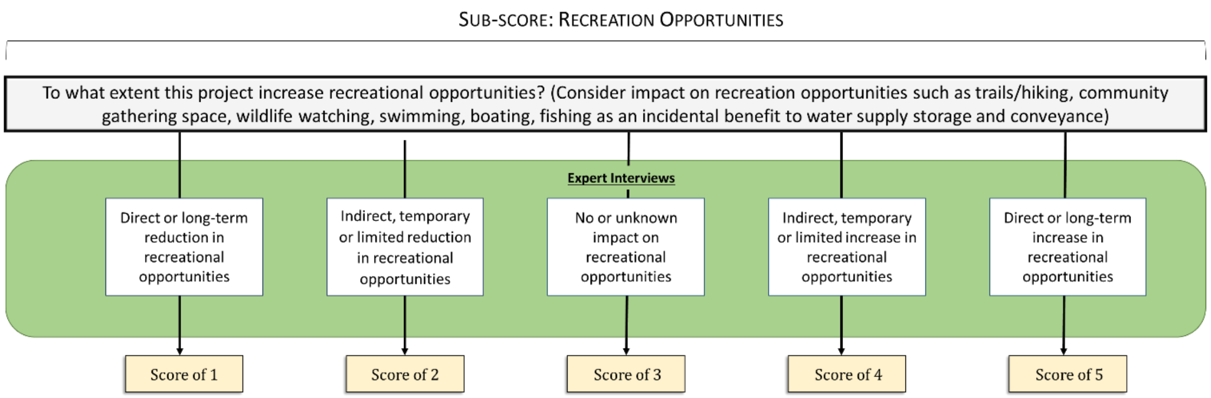


Figure 35. Decision tree for the Recreation Opportunities Sub-Score for the Recreation Opportunities Performance Measure associated with the Quality of Life/Recreation Evaluation Objective.

3.4.9.2.2. Visitation Impacts for Changes in Reservoir Elevation Sub-Score

The Visitation Impacts for Changes in Reservoir Elevation sub-score in the Recreation Opportunities Performance Measure reflected the potential of changes in reservoir elevation to influence the probability of participating in recreation activities and therefore total reservoir recreation visitation. The percentage change in recreation visitation from a change in reservoir elevation was evaluated using recreation visitation models based on historical visitation data.

The modeling results were combined with the change in reservoir elevation estimated for each Concept from the CWASim model to estimate changes in visitation.

The recreation portion of this analysis included four reservoir recreation sites: El Capitan Reservoir, Hodges Reservoir, Lower Otay Reservoir, and San Vicente Reservoir. El Capitan Reservoir has 1,562 surface acres when full, a maximum water depth of 197 feet, and 22 miles of shoreline. Recreational activities at El Capitan Reservoir include fishing, boating, and picnicking. Hodges Reservoir has 1,234 surface acres when full, a maximum water depth of 115 feet, and 27 shoreline miles. Recreation at Hodges Reservoir includes fishing, boating, hiking, hunting, picnicking, and shoreline wading. Lower Otay Reservoir has 1,100 surface acres when full, a maximum water depth of 137.5 feet, and 25 shoreline miles. Recreation at Lower Otay supports fishing, boating, and picnicking, and is the site of the United States Olympic Training center for rowing sports. San Vicente Reservoir has approximately 1,600 surface acres when full, a maximum water depth of 306 feet, and approximately 21 shoreline miles. San Vicente Reservoir recreation activities include fishing, boating, and picnicking. San Vicente Dam was closed to recreation from 2008 to 2016 for construction to raise the dam’s height but reopened to recreation in 2016. None of the reservoirs allow swimming or camping.

A November 26, 2008 City of San Diego Report to the City Council about Reservoir Recreation Business Process Reengineering included estimates of the number of users for eight City of San Diego reservoirs (City of San Diego, 2008). The estimated annual number of users for El Capitan Reservoir was 73,800, the number for Hodges Reservoir was 25,600, and Lower Otay was estimated to be 27,200 users. Data were not provided for San Vicente Reservoir in the Report to the City Council. However, information provided in the Carryover Storage and San Vicente Dam Raise Project Final Environmental Impact Report (San Diego County Water Authority and U.S. Army Corps of Engineers, 2007) indicated that, during the peak season from May through September, the number of people visiting San Vicente Reservoir can range from 40 to 450 per day. Using the mid-point of 245 people per day over the five-month period (153 days), the total number of visits for the reservoir was approximately 37,500 per year.

3.4.9.2.2.1. Recreation Visitation Modeling Background

A recreation visitation model for the San Diego Basin Study was developed and applied to the three San Diego region reservoirs for which recreation permit sales data and Task 2.5 modeling results for reservoir elevation were available. This model was used to estimate changes in recreation visitation associated with each Concept relative to baseline conditions. Recreation visitation models represent the relationship between the factors that influence the level of recreation participation at a site and the number of recreation visits. The estimated model must include the most important variables that influence visitation to provide reliable estimates of the influence of important variables on visitation. If important variables are missing, then the explanatory power of the model will be greatly reduced and the resulting estimates of the influence of reservoir elevation on visitation may be biased. However, it is recognized that every variable influencing recreation cannot be included in a visitation model.

Previous studies provided guidance on potential explanatory variables for the SDBS recreation visitation model. Potential explanatory variables discussed in Platt and Munger (1999) included water level, water quality, climate variables such as temperature and precipitation, whether school is in session (as an indicator of the vacation season), and socio-economic variables such as population and income (Platt & Munger, 1999). A study of the influence of water levels on recreational use at Lakes Mead and Powell (Neher, Duffield, & Patterson, 2013) included monthly reservoir volume, monthly regional gasoline prices, months in which the U.S. economy was officially in a recession, indicators for critical reservoir elevation levels that impact recreation, and dummy month variables representing the non-winter months of March through November. Climate variables were not included in the models estimated by Neher, Duffield, and Patterson (2013). The monthly dummies were included to represent different characteristics during each month, which could include climatic variation.

The Platt and Munger (1999) and Neher, Duffield, and Patterson (2013) studies identified reservoir elevation and climatic variables as very important explanatory variables influencing recreation visitation. Other important variables identified in the two studies included the cost of travel and entrance fees, population of the area from which visitation originates, income, and general economic conditions. Although cost of entrance was identified in the studies, this variable may be less important in California. A document published by the California State Parks Planning Division (California State Parks, 2010) indicated that the costs of participating in California recreation influences park use less strongly than other factors, such as limited leisure time, other interests, a lack of companions, or fears about crime.

San Diego Basin Study Recreation Visitation Model Development

Based on the review of previous studies, the variables of Reservoir Elevation, Temperature, and Leisure Time, and a Wet Month dummy variable were selected for the SDBS recreation visitation model. The theoretical model using these variables is shown below in Equation 1. It was recognized that all the variables that influence recreation could not be included in the estimated model due to the unavailability of some data (e.g., San Vicente monthly permit sales data) and the impracticality of including all possible variables that influence visitation in the models. However, the goal was to capture the most important variables so that a statistically significant model could be estimated which explains a relatively large portion of the variation in visitation. The reservoir elevation explanatory variable was the decision variable of interest which could be influenced through implementation of different Concepts.

Equation 1 - Visitation

Visitation = f (Reservoir Elevation, Temperature, Leisure Time, Wet Month)

Recreation Visitation Model Input Data

Visitation Data

Monthly data for the number of permits sold and permit prices at the four reservoirs operated by the City of San Diego were provided by the City of San Diego City Treasurer for the period from March 2013 to February 2018. The number of permits sold was used as a proxy for visitation to the reservoirs. The City of San Diego also provided historic monthly reservoir elevation data for the four reservoirs. It should be noted that monthly permit data for San Vicente were only available for the period from July 2017 to February 2018 due to the dam raise as a part of the Emergency & Carryover Storage Project. As a result, there are not enough observations to estimate a reliable San Vicente model. The average estimated impact of changes in reservoir elevation derived from the visitation models for the other three reservoirs were used to estimate visitation impacts at San Vicente.

Reservoir Elevation Data

Historic monthly reservoir hydrography for the four reservoirs (El Capitan, Hodges, Lower Otay, and San Vicente) were provided by the City of San Diego Public Utilities. These data included reservoir elevation data for more than 50 years.

Temperature Data

Monthly average temperature data were obtained for the station nearest to the recreation area from the U.S. Department of Commerce, National Oceanic & Atmospheric Administration. In many cases recreation is influenced more by variation from normal temperatures rather than absolute temperature values. However, in the case of recreation in the San Diego area, conditions are mild year-around, and recreation would be expected to be more influenced by absolute temperature values rather than by temperature variation.

Leisure Time Data

Annual estimates of leisure time per day were obtained from the Bureau of Labor Statistics, American Time Use Survey for 2016. Given the lack of monthly variation it was not expected that the leisure time variable would be statistically significant. However, it was a significant variable for one of the models, so it was retained in all the models to avoid introducing potential bias in the modeling results. The modeling results are shown in the tables below.

Wet Month Data

The monthly reservoir elevation data also included monthly rainfall data. Monthly normal precipitation values obtained from the U.S. Department of Commerce, National Oceanic & Atmospheric Administration were compared to the historical rainfall data to create the Wet

Month variable. The Wet Month variable is a dummy variable that takes on a value of 1 if observed rainfall is greater than the monthly normal and 0 if observed rainfall is less than the normal.

Other Variables Considered

A cost of participation variable, which included travel cost and entrance fees, was initially considered for inclusion in the models, but initial model runs indicated this variable was not statistically significant in explaining variation in recreation visitation. Since the modeled reservoirs primarily serve a local population, the fact that the California State Parks Planning Division has indicated cost does not strongly influence visitation, and a lack of variation in fees, it was decided that the cost of participation is not likely to strongly influence variation in visitation and was therefore dropped as an explanatory factor from the models.

Initial runs also included the population of San Diego County and median household income for San Diego County as explanatory variables. Only annual average estimates were available for county population and median household income; therefore, there was little variation in these variables over the five-year period for which data visitation and reservoir elevation data were available. This lack of variation resulted in insignificant influences of population and income on visitation and, as a result, those two variables were dropped from the model.

Finally, initial model runs also included a crime variable as suggested by the 2010 California State Parks Planning Division document. A monthly total crime index was obtained from the Automated Regional Justice Information System for San Diego County (Automated Regional Justice Information System, 2018). The crime variable was not statistically significant in explaining variation in recreation visitation and was therefore not included in the final model.

Final Recreation Visitation Model

The final models used to evaluate recreation visitation at El Capitan, Hodges, and Lower Otay Reservoirs are shown below in Equation 2.

Equation 2 - Recreation

$$\ln Permits = \beta_0 + \beta_1 \ln Elev + \beta_2 \ln Temp + \beta_3 \, Wetmonth + \beta_4 \ln Leisure + \varepsilon_0$$

where:

β_0	= Constant term
lnPermits	= Natural log of monthly permits sold at each reservoir
lnElev	= Natural log of monthly average reservoir elevation
lnTemp	= Natural log of average monthly temperature

Wetmonth	= A dummy variable equal to 1 when precipitation was greater than the monthly average and 0 when less than or equal to the monthly average
lnLeisure	= Natural log of average leisure time in hours
ε_0	= Error term

The constant term can be interpreted as the number of visits that would occur if all the explanatory variables included in the model were equal to zero, which is very unlikely. The error term accounts for the fact that the model will not be able to explain all the variation in visitation.

The dependent variable permits and the explanatory variables representing elevation, temperature, and leisure time were converted into natural logs. This is a common functional form used to estimate recreation visitation models, and using this functional form resulted in the estimated coefficient for reservoir elevation representing the percentage change in visitation for a 1% change in reservoir elevation. Therefore, by using this functional form, the influence of elevation on visitation was constant for all elevations. This assumption may not be accurate for extreme elevations, but is likely to be reasonable for the relevant range of elevations experienced at the recreation areas over the data period.

The regression models were run using Stata Statistics/Data Analysis Version 14 econometric software and the data described above. The modeling results for each reservoir are shown in Table 24, Table 25, and Table 26.

Table 24. El Capitan Reservoir Recreation Participation regression results.

Explanatory Variable	Coefficient	t-statistic
Constant	-64.7439	-
ln Elevation	2.7235	2.29**
ln Temp	6.1455	4.99*
Wet Month	0.0220	0.09
ln Leisure Time	18.9322	2.21**
Adjusted R – Squared = 0.428	F – Statistic = 5.10*	
Durbin – Watson Statistic = 2.065	Number of observations = 42	

* significant at the 1% level
** significant at the 5% level

Table 25. Hodges Reservoir Recreation Participation regression results.

Explanatory Variable	Coefficient	t-statistic
Constant	-54.3785	-
ln Elevation	5.6808	1.88***
ln Temp	3.2596	2.94*
Wet Month	-0.2206	-1.00
ln Leisure Time	12.8312	1.30
Adjusted R – Squared = 0.155 Durbin – Watson Statistic = 1.845	F – Statistic = 2.92* Number of observations = 43	

* significant at the 1% level
*** significant at the 10% level

Table 26. Lower Otay Reservoir Recreation Participation regression results.

Explanatory Variable	Coefficient	t-statistic
Constant	-33.4317	-
ln Elevation	5.5625	2.34*
ln Temp	1.7205	3.27*
Wet Month	-0.1399	-1.25
ln Leisure Time	3.6532	0.63
Adjusted R – Squared = 0.250 Durbin – Watson Statistic = 1.096	F – Statistic = 5.65* Number of observations = 57	

* significant at the 1% level

The t-statistics indicate the level of statistical significance for each of the explanatory variables. A 1% level of significance indicates the greatest level of confidence that the estimated coefficient is different from zero. Those coefficients that are not significant at the 10% level or better are not significantly different from zero. The F-statistic indicates significance for the estimated model. The Adjusted R – Squared indicates the percentage of visitation variation that is explained by the model. As described above, there are many factors that influence visitation and not all factors can be included in a visitation model. However, the statistical significance of the elevation variable in each of the models indicated that reservoir elevation is a consistent and important factor in recreation visitation.

The natural log of the elevation coefficient in each of the three models represented the percentage change in visitation from a 1% change in elevation. The estimated change in visitation for each of the four reservoir sites based on the modeling results is shown in Table 27. The percentage change in visitation used for San Vicente was the average for the other three reservoirs.

Table 27. Estimated change in reservoir visitation from a 1% change in elevation.

Reservoir	Estimated % change In visitation from a 1% change in elevation	Estimated annual visitation	Estimated change in visitation from a 1% change in elevation
El Capitan	2.7235%	73,800	2,010
Hodges	5.6808%	25,600	1,450
Lower Otay	5.5625%	27,200	1,510
San Vicente[1]	4.6556%	37,500	1,750

[1]The percentage change in visitation used for San Vicente is the average for the other three reservoirs.

To derive the Recreation Visitation Impacts Sub-scores (Figure 36), the percentage changes in recreation visitation resulting from a change in reservoir elevation (predicted by the recreation visitation models) were combined with the changes in reservoir elevation estimated for each Concept from the CWASim single Concept modeling results. First, the percentage change in monthly reservoir elevation relative to Baseline was calculated for each Concept for each of the four reservoirs from the CWASim model results. Then the estimated monthly visitation was calculated from the estimated annual visitation using the data for number of permits sold by month. Then the percentage change in visitation from a 1% change in elevation was multiplied by the percent change in monthly elevation and the estimated monthly visitation to obtain the estimated change in monthly visitation for each Concept and reservoir. Then the results were summed to obtain the total annual change in visitation relative to Baseline for all four reservoirs. This value was then divided by the estimated annual visitation across all reservoirs to obtain the percent change in visitation for each Concept. This value was then converted to a 1 to 5 score by assigning the largest positive change in recreation visitation a score of 5, assigning zero change in recreation visitation a score of 3, and linearly interpolating to obtain scores for other percentage changes in recreation visitation.

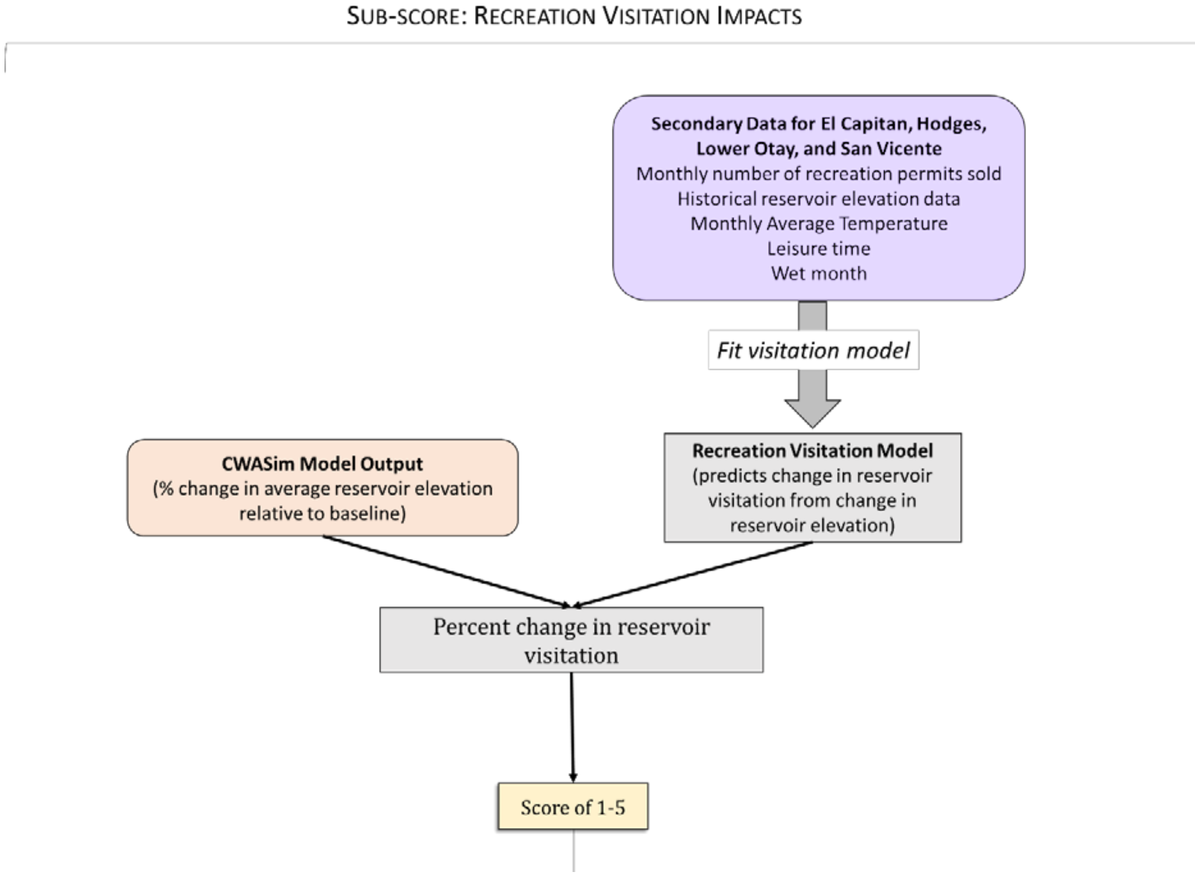


Figure 36. Decision tree for the Recreation Visitation Impacts Sub-Score for the Recreation Opportunities Performance Measure associated with the Quality of Life/Recreation Evaluation Objective.

3.4.10. Regional Economic Impact Evaluation Objective

The Regional Economic Impact Evaluation Objective included one Performance Measure: Regional Economic Impact (Figure 37). This Evaluation Objective quantified the effect of a project or group of projects on income, employment, and the value of output produced in the region where a project is located as well as the potential impact of the project(s) on water rates. Regional impacts could potentially include short-term impacts from construction expenditures; long-term impacts from operation, maintenance, and replacement expenditures; and long-term impacts from changes in population and businesses supported by a project or Concept. The total regional impacts associated with the location of an industry in a region are the sum of direct, indirect, and induced effects. Direct effects represent impacts on the industry that is immediately affected. Indirect effects account for inter-industry transactions. Induced effects measure the effects of the changes in household income on demand for goods and services such as housing, restaurants, and retail sales. The regional impacts associated with changes in water rates are the result of changes in income or revenues of water users.

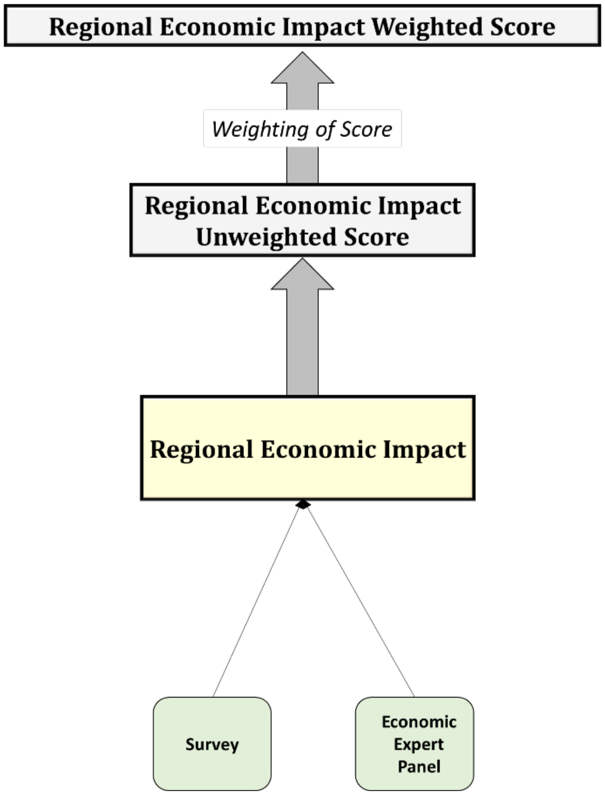


Figure 37. Decision tree for the Regional Economic Impact Evaluation Objective.

3.4.10.1 Regional Economic Impact Performance Measure

The Regional Economic Impact Performance Measure was calculated based on two sub-scores: the Project-level Regional Economic Impact Sub-score (Figure 38), based on project-level survey response, and the Expert Panel Regional Economic Impact Sub-score, based on responses from a panel of regional economic experts. For those Concepts (Figure 39) that had more than three project-level survey responses, the mean scores from project-level survey responses and the responses from the panel of regional economic experts were averaged together to produce the General Regional Economic Impact sub-score for each Concept. For those Concepts that had three or fewer project-level scores, the average of the combined expert panel and project-level survey responses was used. This approach ensured that a disproportionate weight was not given to a small number of project-level responses which could misrepresent Concept performance.

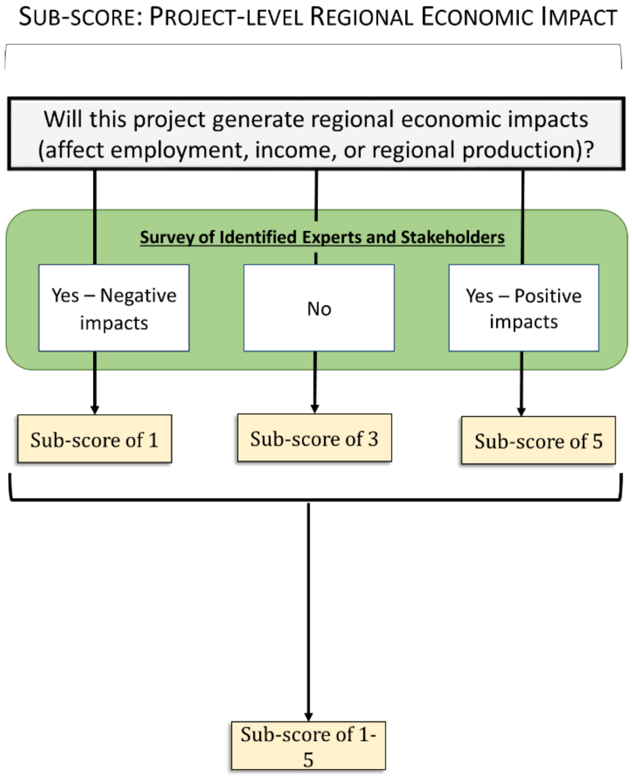


Figure 38. Decision tree for project-level survey responses for the Regional Economic Impact Performance Measure associated with the Regional Economic Impact Evaluation Objective.

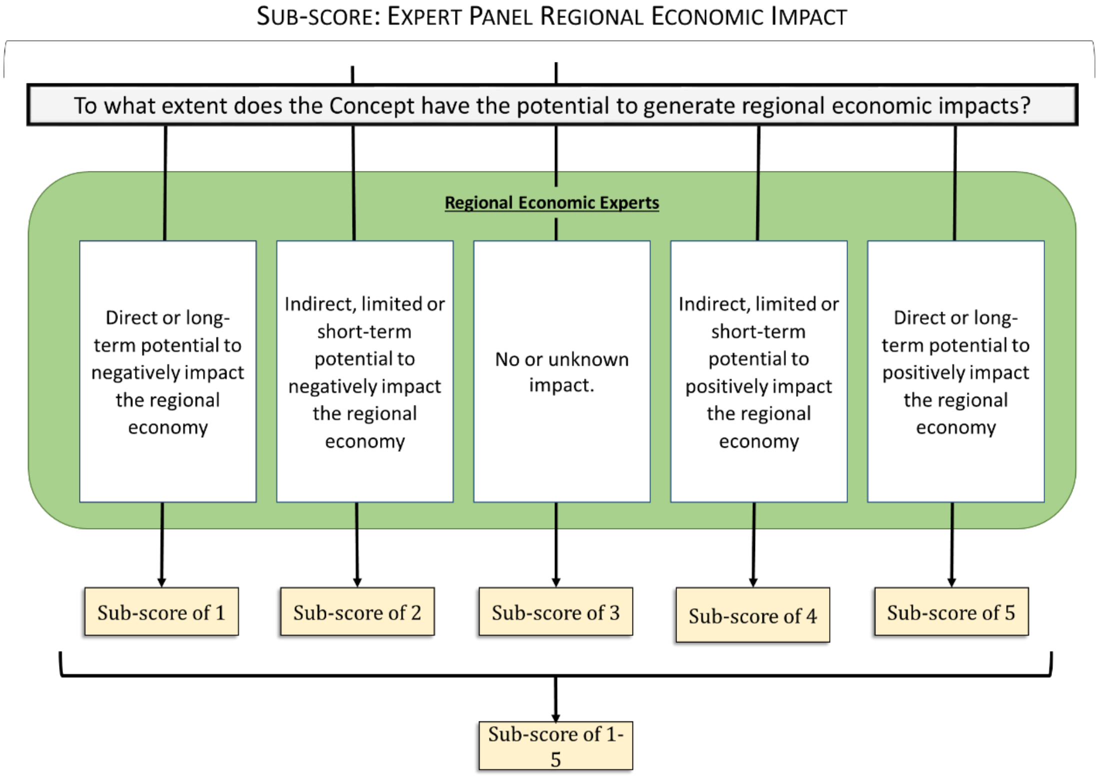


Figure 39. Decision tree for expert panel responses for the Regional Economic Impact Performance Measure associated with the Regional Economic Impact Evaluation Objective.

The project-level surveys included four questions related to regional economic impacts: (1) whether the project would generate general regional economic impacts (affect employment, income, or regional production); (2) the potential of a project to generate regional economic impacts beyond capital and operation and maintenance expenditures; (3) the extent of impacts if they occur; and (4) the extent to which the project has the potential to increase or decrease water rates. The original intent was to use all four project-level questions to score the Concepts, but Questions 2, 3, and 4 had large numbers of missing responses and there was no corresponding Concept-level question to provide additional data, so these questions could not be included in the analysis. Therefore, the Regional Economic Impact Evaluation Objective was based only on Question 1 from the project-level survey along with supplemental data from an expert panel.

In March 2018, the City of San Diego Public Utilities Department convened a group of experts at a Regional Economic Impact Workshop. The goal of the workshop was to develop scores for the Regional Economic Impact Evaluation Objective for each Concept. In attendance were five participants with expertise in economics, California and San Diego water issues and policy, and/or knowledge of the San Diego business community and industrial sector. At the workshop, participants were presented with scoring criteria and information about projects included in each

Concept. Each participant then provided a Regional Economic Impact score, ranging from 1 to 5, for each Concept. Participants were not required to reach consensus as a group, though the group deliberated and discussed preliminary scores before finalizing their individual scores.

3.4.11. Regional Integration and Coordination Evaluation Objective

The Regional Integration and Coordination score was based on two Performance Measures: Coordination, and Education and Outreach (Figure 40). Regional Integration and Coordination evaluated three considerations. Both Performance Measures were scored based on data from surveys of identified experts and stakeholders.

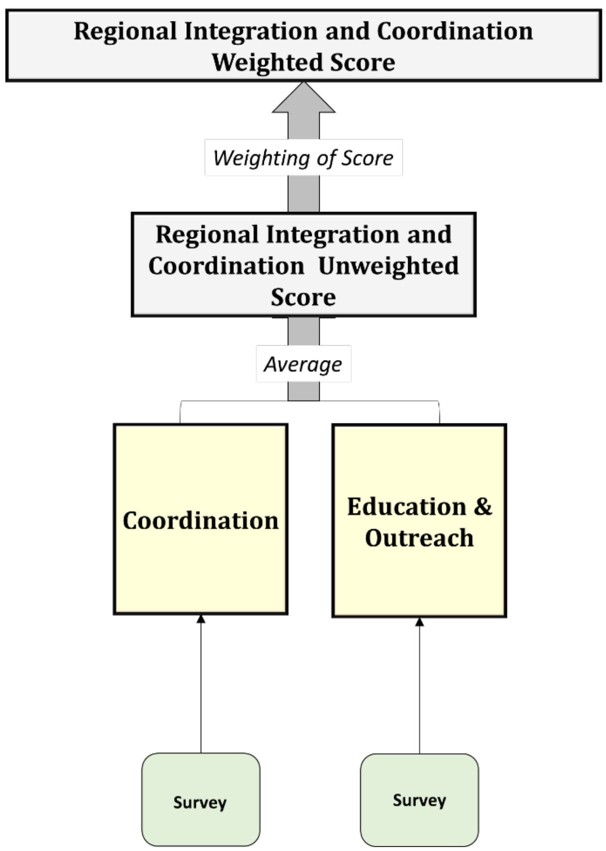


Figure 40. Decision tree for the Regional Integration and Coordination Evaluation Objective.

3.4.11.1 Coordination Performance Measure

For the Performance Measure Coordination, two[2] survey questions generated two sub-scores, Integration and Leveraging. The Integration question (Figure 41) related to the level of integration or coordination that is required for projects/entities to implement a project within a Concept. No required integration or coordination received a score of 1, limited integration or coordination received a score of 2, moderate integration or coordination received a 3 score, substantial integration or coordination received a score of 4, and a very high level of integration or coordination was a 5.

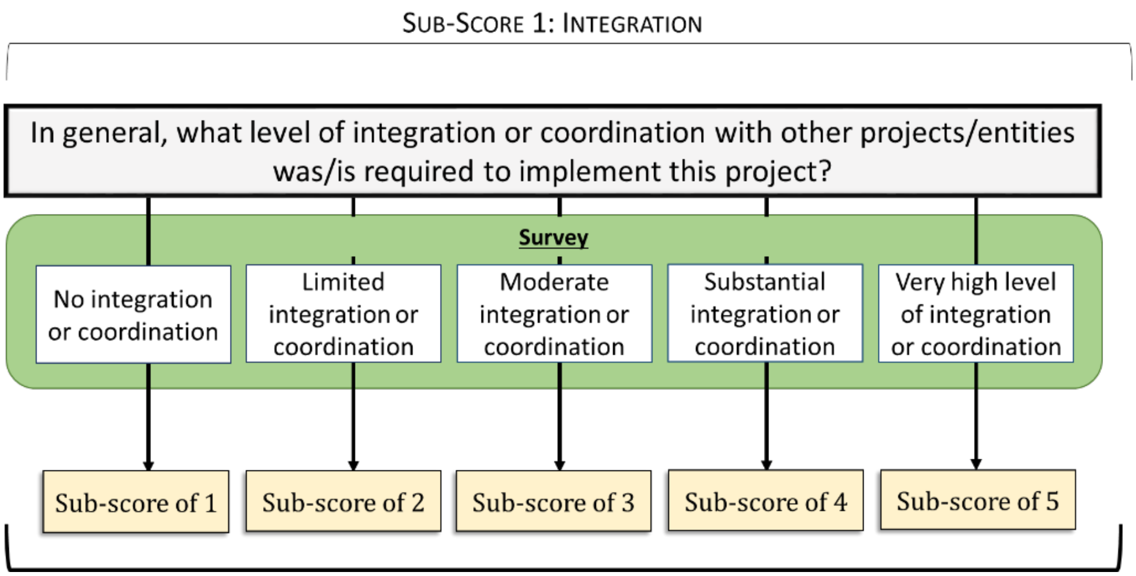


Figure 41. Decision tree for the Integration Sub-score within the Coordination Performance Measure associated with the Regional Integration and Coordination Evaluation Objective.

The Leveraging question (Figure 42) asked if leveraging existing assets or bolstering existing projects was required to implement a project within a Concept. A no was a score of 1, unknown was a score of 3, and if project implementation would require leveraging assets or building off of existing projects at times, then the project would receive a score of 4. Finally, if leveraging assets or building off of existing projects was typically required by the project, the project received a score of 5.

[2] A third question regarding removal of regulatory barriers was included in the project- and Concept-level questionnaires, but survey respondents expressed confusion over the question, so it was dropped from the analysis.

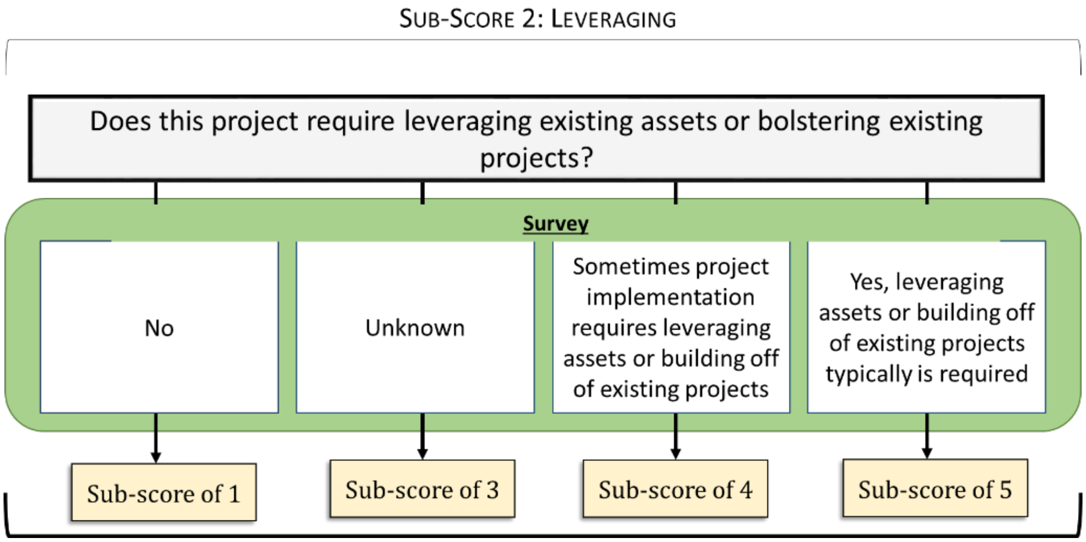


Figure 42. Decision tree for the Leveraging Sub-score within the Coordination Performance Measure associated with the Regional Integration and Coordination Evaluation Objective.

The values of the sub-scores were then averaged together to calculate the Performance Measure score. The coordination questions were asked at both the project-level and Concept-level. Therefore, the Performance Measure score was calculated as the average of the means of the project-level and Concept-level survey responses or from the mean of all survey responses, depending on the number of survey responses for a given Concept, as described in Section 3.4. Enhanced Conservation was given a score of NA because it was not included in the surveys.

3.4.11.2 Education and Outreach Performance Measure

For the Performance Measure Education and Outreach, survey responses to one question were used to develop the Performance Measure score (Figure 43). The Education and Outreach question asked what level of education and outreach would be achieved by projects within a Concept. Opportunities or plans for outreach events, educational or promotional materials, K-12 education, workshops and trainings, and creating space for community gatherings were considered. No education and outreach resulted in a score of 1, very limited education and outreach resulted in a score of 2, limited education and outreach resulted in a score of 3, moderate education and outreach had a score of 4, and significant education and outreach had a score of 5. The education and outreach question was asked at both the project-level and Concept-level. Therefore, the Performance Measure score was calculated as the average of the means of the project-level and Concept-level survey responses or from the mean of all survey responses, depending on the number of survey responses for a given Concept, as described in Section 3.4. Enhanced Conservation was given a score of NA because it was not included in the surveys.

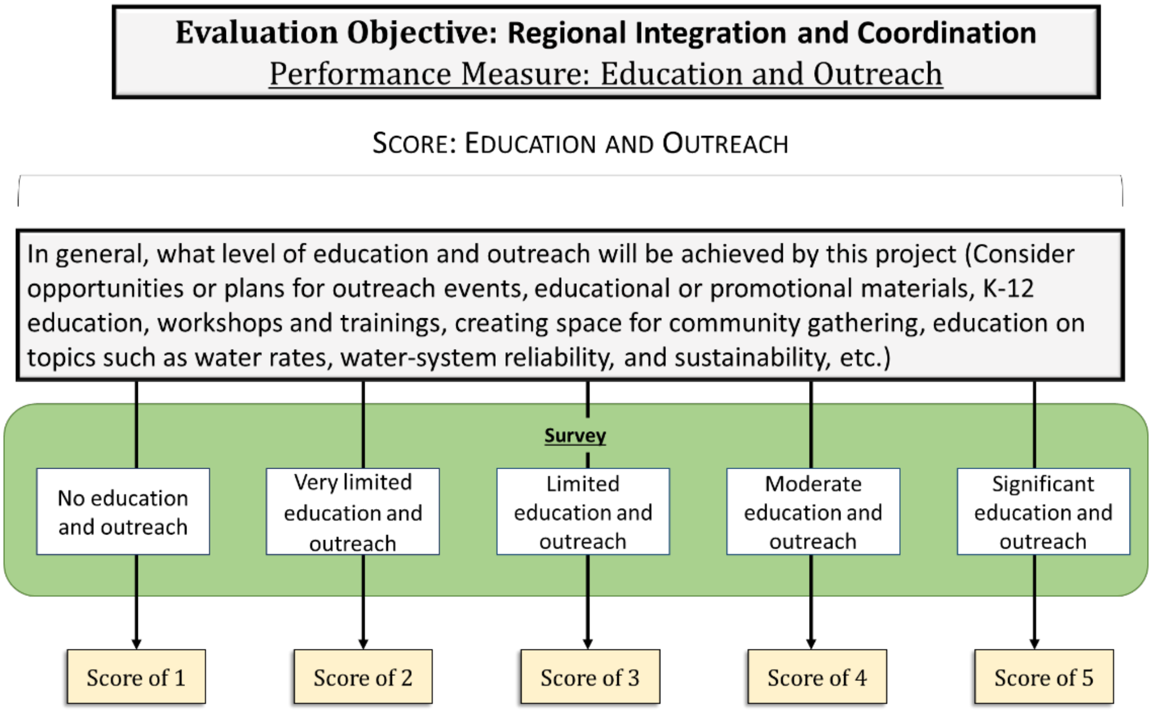


Figure 43. Decision tree for the Education and Outreach Performance Measure associated with the Regional Integration and Coordination Evaluation Objective.

3.4.12. Reliability and Robustness Evaluation Objective

The Reliability and Robustness Evaluation Objective included three Performance Measures: Water Shortage Volume, Vulnerability of Water Supply Facilities and Infrastructure, and Carryover Storage & Reservoir Augmentation (Figure 44). Water Shortage Volume was based on the results of Task 2.5 model runs. Vulnerability of Water Supply Facilities and Infrastructure was scored based on responses to a survey question regarding the ability of a project or Concept to increase the diversity of water supply. Carryover Storage & Reservoir Augmentation was scored based on responses to a survey question regarding the impact of a project or Concept on the ability to use the reservoir storage capacity.

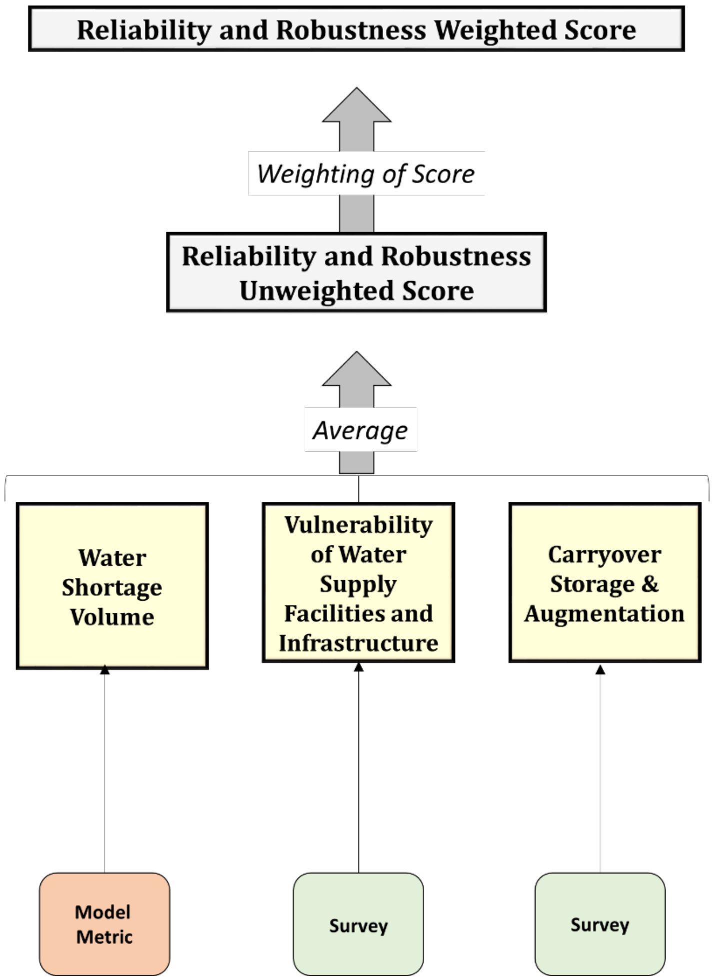


Figure 44. Decision tree for the Reliability and Robustness Evaluation Objective.

3.4.12.1 Water Shortage Volume Performance Measure

The Water Shortage Volume Performance Measure quantified reliability in terms of average annual shortage volumes as modeled in the CWASim model described in Section 3.3.1.1 (Figure 45). Total water supply volume by Concept was originally considered as the model metric for reliability. However, reliability is better quantified by shortage than total water supply. Shortages indicate that demands cannot be met by the available supplies due to an imbalance between water supply and demand, or limits of the conveyance system. The Shortage Volume metric measured the magnitude of regional demand that is unable to be met by the available supplies and/or limited by conveyance system capacity. Non-zero shortage volume indicated that supplies are insufficient to meet demands or that conveyance system capacity limits deliveries. Larger values indicated larger supply-demand imbalances or capacity limitations.

In order to use the model output for comparison of Concepts, the reduced shortage volume relative to the Baseline was calculated by subtracting the Baseline average annual shortage volume from the average annual shortage volume for each of the Concept-specific model runs. Negative values indicated that shortages were larger for a given Concept than in the Baseline run. Positive values indicated that shortages were smaller for a given Concept than in the Baseline run. A value of zero indicated that average annual shortage volume was the same between the Concept and the Baseline. Next, the relative shortage volumes were rescaled on a 1 to 5 scale, with 1 assigned to the largest relative shortage volume, 3 assigned to a relative shortage volume of zero, 5 assigned to the largest reduction in relative shortage volume, and other values linearly interpolated between 1 and 3 or 3 and 5.

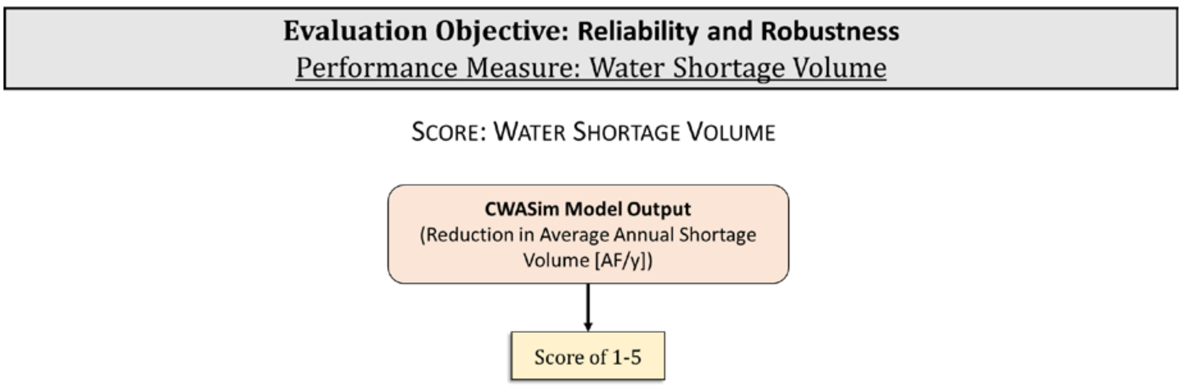


Figure 45. Decision tree for the Water Shortage Volume Performance Measure associated with the Reliability and Robustness Evaluation Objective.

3.4.12.2 Vulnerability of Water Supply Facilities and Infrastructure Performance Measure

The Vulnerability of Water Supply Facilities and Infrastructure Performance Measure was based on four sub-scores that were based on the results of surveys of identified experts and stakeholders. The first sub-score related to the ability of a Concept to increase the diversity of water supply (Figure 46). If a Concept increased reliance on imported water, it received a score of 1. No projects received a score of 2, as all projects that increase reliance on imported water (either directly or indirectly) were given a score of 1. If there was no effect or an unknown effect on diversity of supplies, the Concept received a score of 3. If the Concept indirectly supports other systems/project/infrastructure that may have an impact on the diversity of water supplies, then it received a score of 4. A score of 5 was assigned if the Concept increased diversity of supplies.

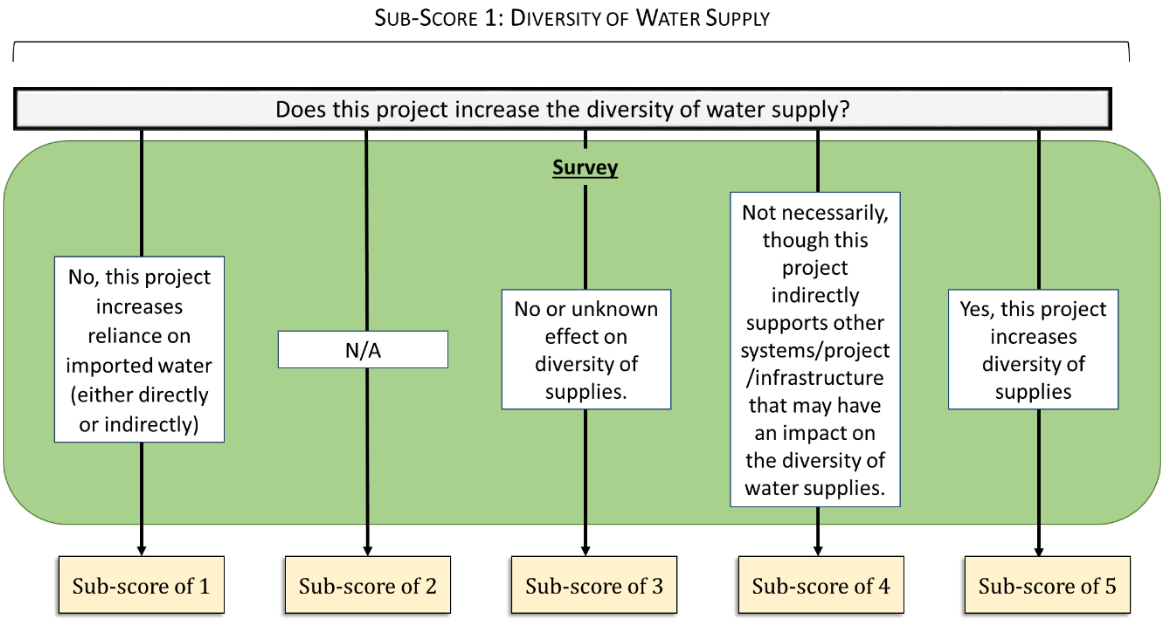


Figure 46. Decision tree for the Diversity of Water Supply sub-score for the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure associated with the Reliability and Robustness Evaluation Objective.

The second sub-score evaluated the extent to which the Concept increases the resilience of the conveyance system such as an ability to withstand or recover from impacts such as pipeline failures (Figure 47). A score of 1 indicated the project reduces resilience of the conveyance system, a score of 2 indicated the question is not applicable, and a 3 reflected neutral or unknown impact on the resilience of the conveyance system. A score of 4 indicated the Concept indirectly supports other systems/project/infrastructure that may have an impact on the resilience of the conveyance system, and a 5 indicated that the Concept increases resilience.

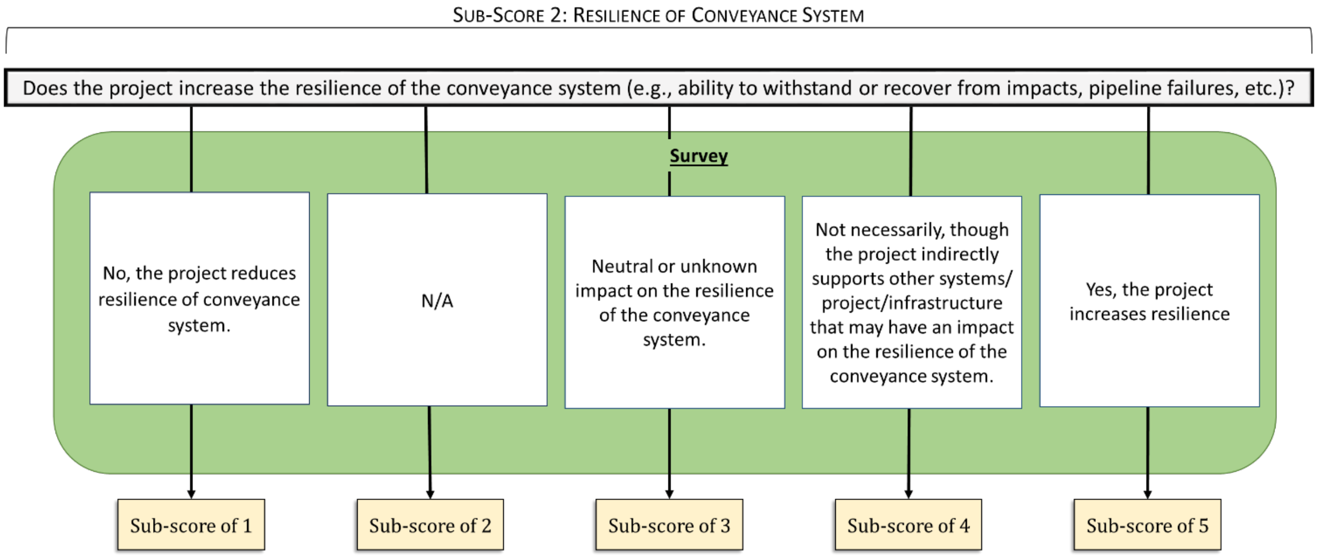


Figure 47. Decision tree for the Resilience of Conveyance System sub-score for the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure associated with the Reliability and Robustness Evaluation Objective.

The third sub-score evaluated the impact of the Concept on aging infrastructure (Figure 48). A score of 1 indicated a significant negative impact, a 2 was a moderate negative impact on infrastructure, a 3 was a neutral or unknown impact, a 4 indicated a moderate positive impact on infrastructure, and a 5 indicated a significant positive impact on infrastructure.

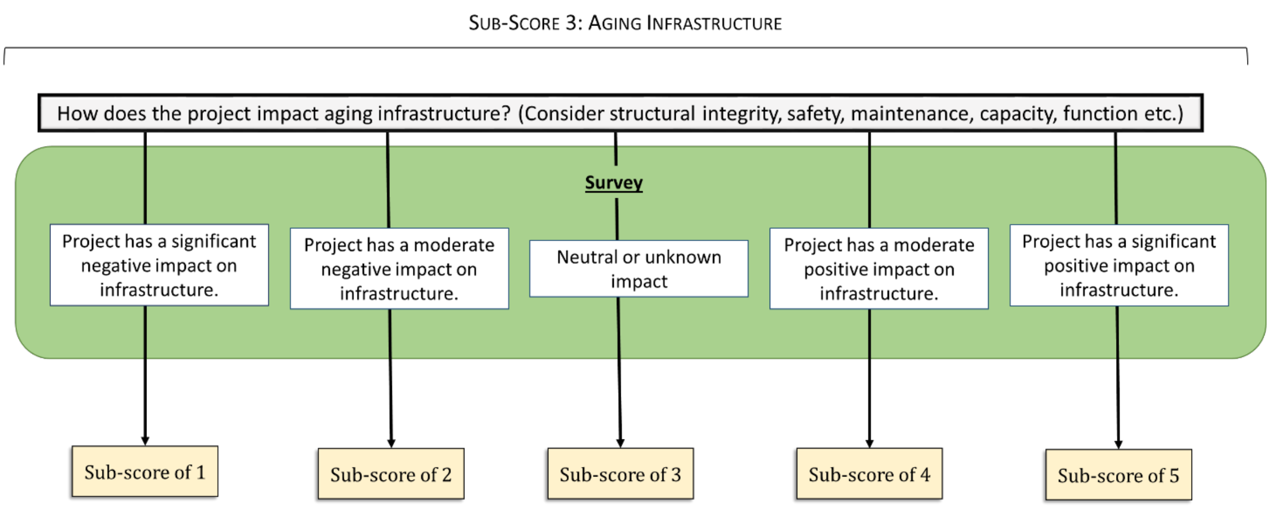


Figure 48. Decision tree for the Aging Infrastructure sub-score for the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure associated with the Reliability and Robustness Evaluation Objective.

The fourth sub-score used to evaluate Concepts for Vulnerability of Water Supply Facilities and Infrastructure addressed the effect of a Concept on problems associated with insufficient wastewater flows to move solid waste (Figure 49). Examples of these types of problems include increased odor production, rate of corrosion, settling and blockages, and number of O&M work orders for the wastewater conveyance system. A score of 1 indicated a strong negative impact, a score of 2 indicated a negative impact, a score of 3 indicated a neutral or unknown impact, a score of 4 indicated positive impacts, and a score of 5 indicated a strong, positive impact.

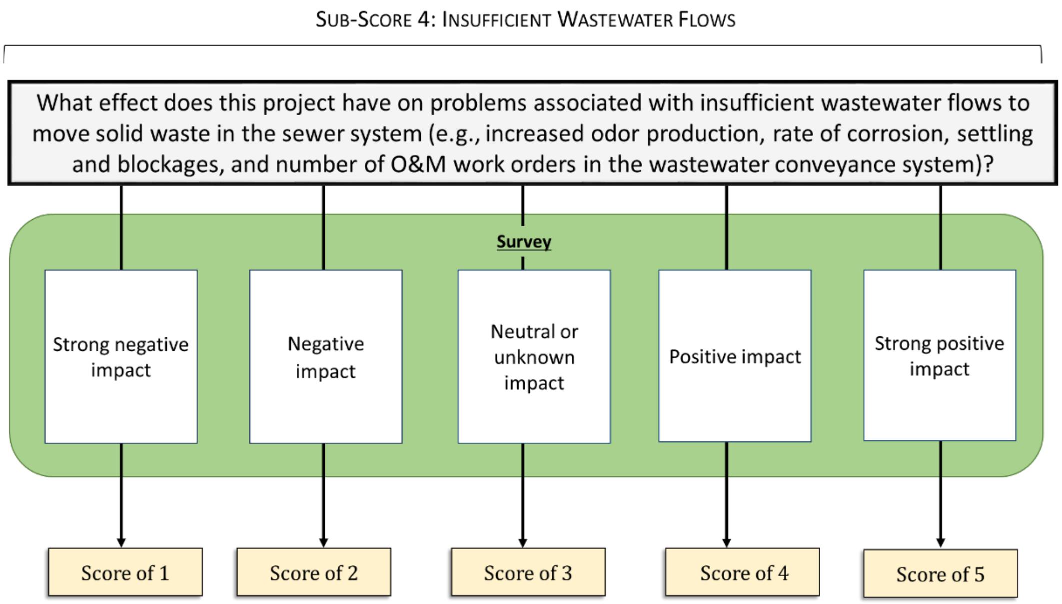


Figure 49. Decision tree for the Insufficient Wastewater Flows sub-score for the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure associated with the Reliability and Robustness Evaluation Objective.

The Vulnerability of Water Supply Facilities and Infrastructure score was the average score from four questions. Because the questions were asked at both the project-level and Concept-level, the Performance Measure score was calculated as the average of the means of the project-level and Concept-level survey responses or from the mean of all survey responses, depending on the number of survey responses for a given Concept, as described in Section 3.4. Enhanced Conservation was given a score of NA because it was not included in the surveys.

3.4.12.3 Carryover Storage and Reservoir Augmentation Performance Measure

The Carryover Storage and Reservoir Augmentation Performance Measure was derived from a single survey question (Figure 50). The question related to the effect of a Concept on the ability to use storage capacity of a reservoir. A direct or long-term negative impact on ability to use storage capacity of reservoirs resulted in a score of 1. An indirect or temporary negative impact on ability to use storage capacity of reservoirs was a score of 2. A score of 3 resulted from a neutral or unknown impact. A 4 reflected an indirect or temporary positive impact on ability to use storage capacity of reservoirs, and a 5 indicated a direct or long-term positive impact on ability to use storage capacity of reservoirs. The carryover storage and reservoir augmentation question was asked at both the project-level and Concept-level. Therefore, the Performance Measure score was calculated as the average of the means of the project-level and Concept-level survey responses or from the mean of all survey responses, depending on the number of survey responses for a given Concept, as described in Section 3.4. Enhanced Conservation was given a score of NA because it was not included in the surveys.

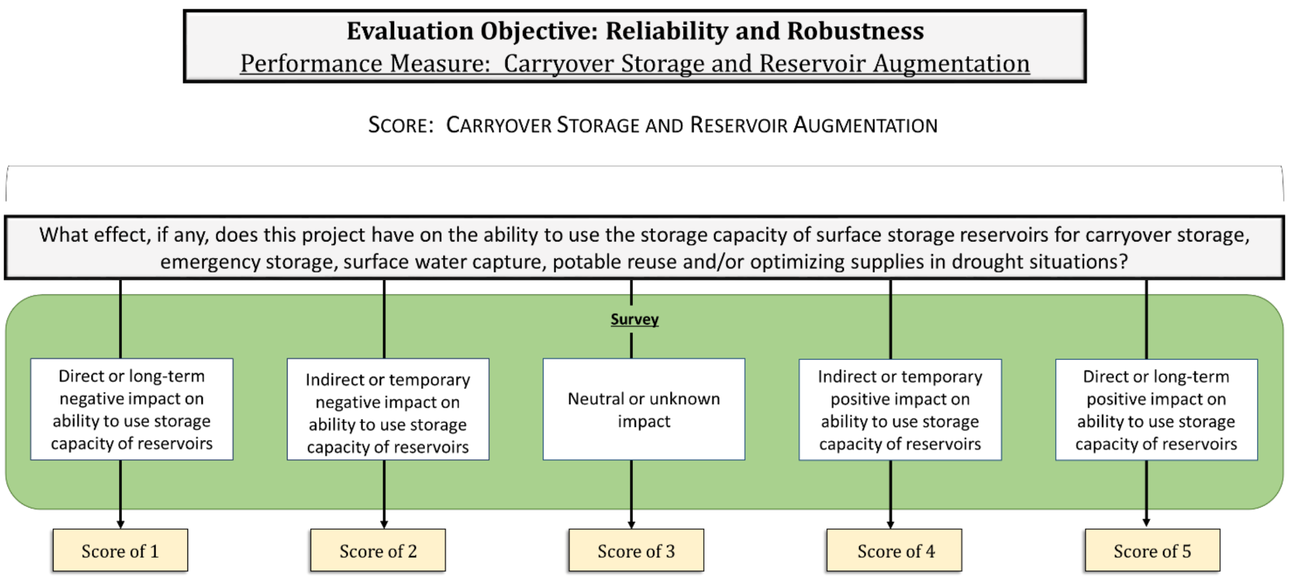


Figure 50. Decision tree for the Carryover Storage and Reservoir Augmentation Performance Measure associated with the Reliability and Robustness Evaluation Objective.

3.4.13. Water Quality and Watersheds Evaluation Objective

The Water Quality and Watersheds Evaluation Objective was based on three Performance Measures: Stormwater and Wastewater Discharges, Surface Water Quality, and Groundwater Quality (Figure 51).

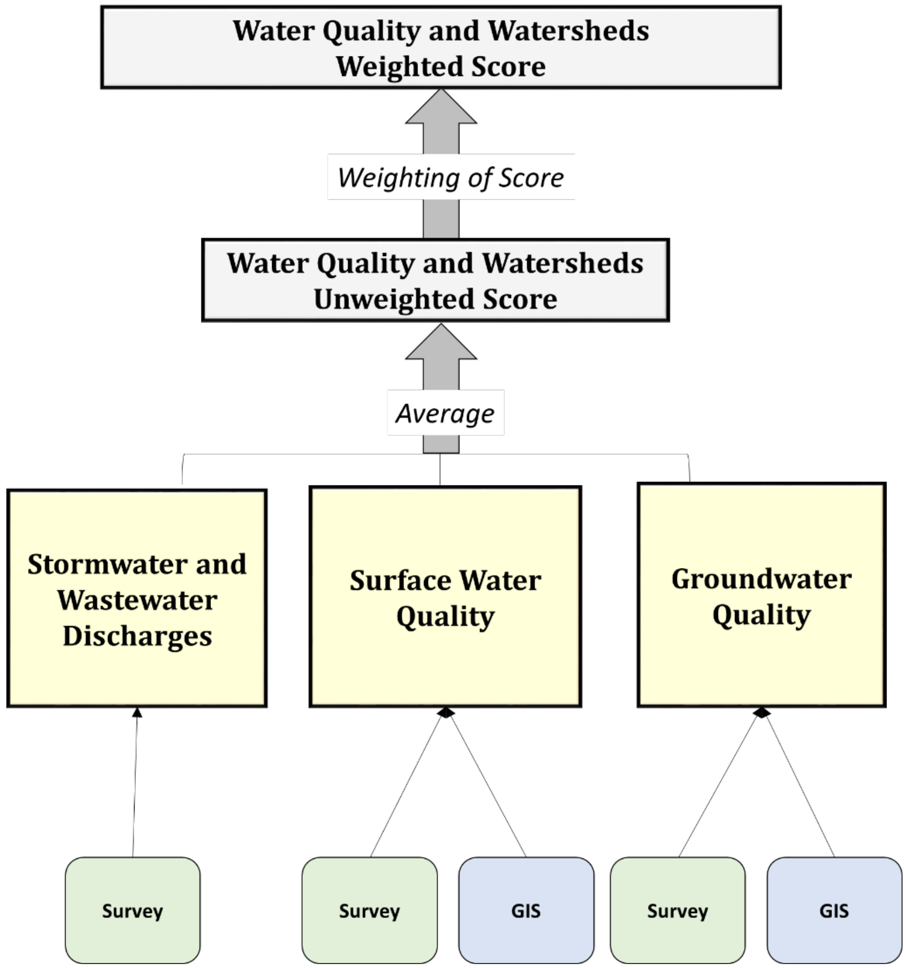


Figure 51. Decision tree for the Water Quality and Watersheds Evaluation Objective.

3.4.13.1 Stormwater and Wastewater Discharges Performance Measure

The Stormwater and Wastewater Discharges Performance Measure was calculated based on two sub-scores: discharges to freshwater or estuarine bodies and discharges to marine water bodies (Figure 52 and Figure 53). Impacts to freshwater and estuarine water bodies were distinguished from marine water bodies, given the distinct nature of projects that impact the volume or quality of wastewater discharged via ocean outfalls versus projects discharging to non-marine water bodies. The sub-scores were based on a direct or long-term increase or decrease in the volume of or resilience to stormwater or wastewater discharged to receiving waters, a limited or temporary change in discharge, or no or an unknown effect that results in a neutral effect.

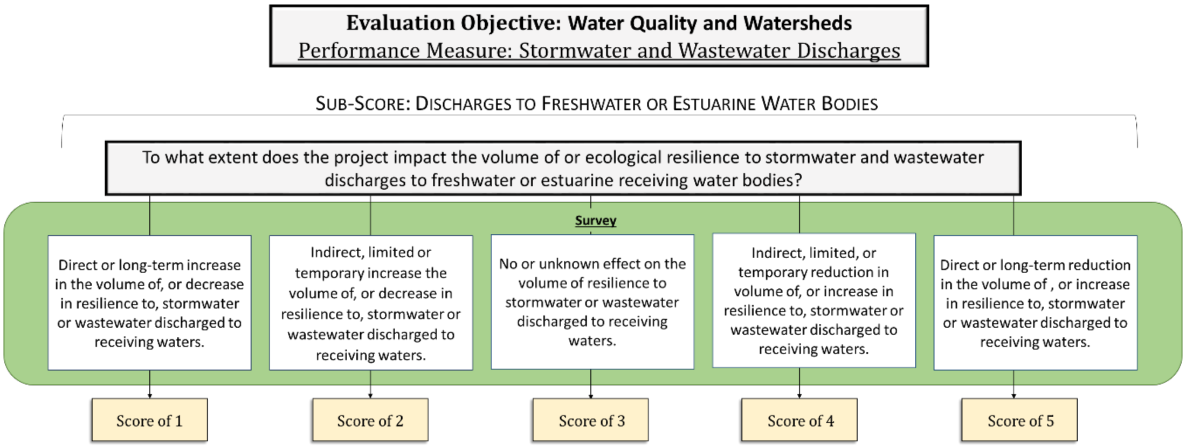


Figure 52. Decision tree for the Discharges to Freshwater or Estuarine Water Bodies Sub-Score for the Stormwater and Wastewater Discharges Performance Measure associated with the Water Quality and Watersheds Evaluation Objective.

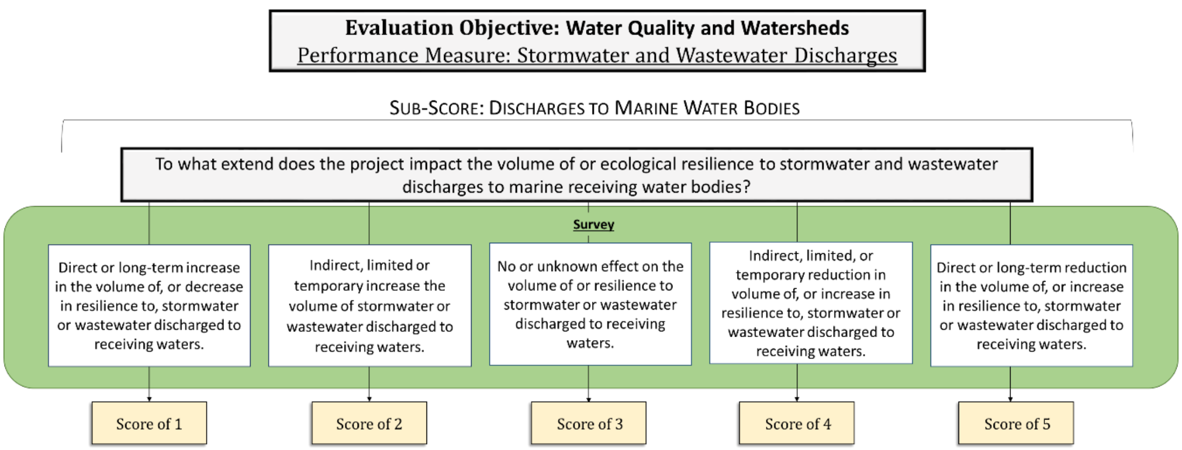


Figure 53. Decision tree for the Discharges to Marine Water Bodies Sub-Score for the Stormwater and Wastewater Discharges Performance Measure associated with the Water Quality and Watersheds Evaluation Objective.

3.4.13.2 Surface Water Quality Performance Measure

The Surface Water Quality score was also calculated using environmental geospatial data from the CalEnviroScreen Tool available on the OEHHA website (California Office of Environmental Health Hazard Assessment, 2018) (Figure 54).

The Surface Water Quality Impact Score was calculated using the “Impaired Water Bodies” CalEnviroScreen indicator, which represents the number of pollutants listed in waterbodies and the proximity of those waterbodies to each Census Tract (obtained from the 303(d) List of Impaired Water Bodies, State Water Resources Control Board). Under Section 303(d) of the

Clean Water Act, states, territories and authorized tribes are required to develop a list of water quality limited segments. Waters on the list do not meet water quality standards, even after point sources of pollution have installed the minimum required levels of pollution control technology. The Clean Water Act requires that these jurisdictions establish priority rankings for water on the lists and develop action plans, based on Total Maximum Daily Loads (TMDL), to improve water quality.

The Impaired Waterbodies indicator was identified for the Census Tract where the project and/or Concept is located. If the Impaired Waterbodies score was within the 70 – 100 percentile range and the project was likely to have negative impact on the surface water quality, then the project received a score of 1. The Impaired Waterbodies score was based on the number of pollutants in a water body that is designated as impaired in a Census Tract. A higher percentile score represented greater impairment. If the Impaired Waterbodies score was within the ≤ 70 percentile range and the project had a likely negative impact on surface water quality, then the project and/or Concept received a score of 2. If the project had no or unknown impact on surface water quality, then the project received a score of 3. If the Impaired Waterbodies score was ≤ 70 percentile range, and the project was likely to have a positive impact on surface water quality, then the project received a score of 4. If the Impaired Waterbodies score was within the 70 – 100 percentile range, and the project had a likely positive impact on surface water quality, then the project received a score of 5.

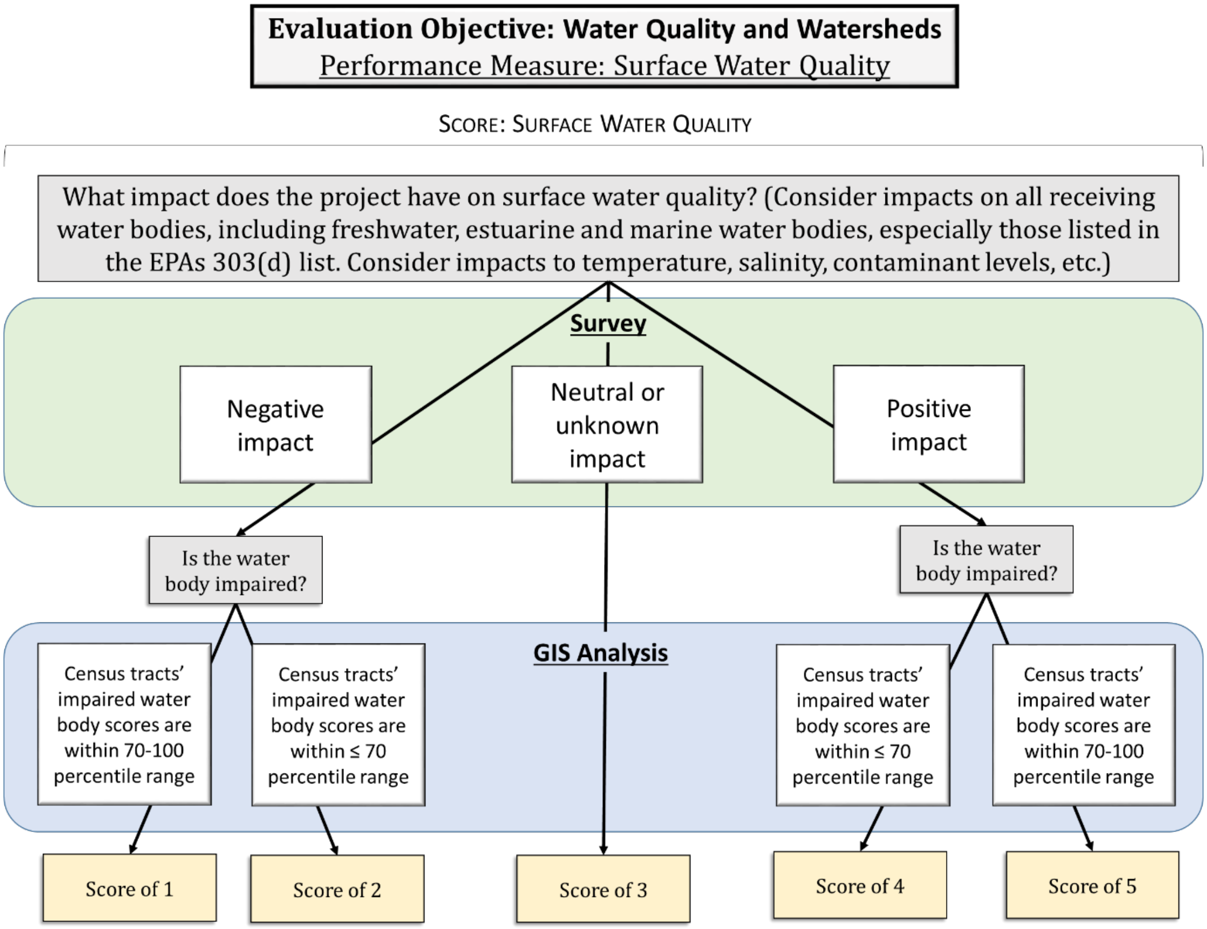


Figure 54. Decision tree for the Surface Water Quality Performance Measure associated with the Water Quality and Watersheds Evaluation Objective.

3.4.13.3 Groundwater Quality Performance Measure

A combination of survey results and the CalEnviroScreen tool was used to develop scores for the Groundwater Quality Impacts Performance Score (Figure 55). The survey of identified experts and stakeholders included a question to determine the likely impact a project has on groundwater quality (negative impact, no/unknown impact, positive impact). Once the likely impact was determined, projects were evaluated using the CalEnviroScreen tools results to measure the impact on impaired water bodies.

The Groundwater Quality Performance Measure score was calculated using environmental geospatial data from the CalEnviroScreen Tool developed by OEHHA, and available through the California Environmental Protection Agency. These data were obtained from the OEHHA website at https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30.

CalEnviroScreen used the Groundwater Threats indicator, which was scored based on each Census Tract's proximity to groundwater contamination sites (obtained from the GeoTracker database - https://geotracker.waterboards.ca.gov/). The original data were obtained from various groundwater monitoring databases from the California Department of Public Health, the State Water Resources Control Board, the U.S. Geological Survey, and the U.S. Environmental Protection Agency.

A Groundwater Threats score for the Census Tract where the project is located was calculated. The Groundwater Threats score represented potential impacts of pollution sources to groundwater quality and was based on information about the type of site that poses a threat and how close it is to neighborhoods where people live. A higher percentile score represented a greater threat. If the score was within the 70 – 100 percentile range and the project was likely to have a negative impact on the groundwater quality, then the project received a score of 1. If the score was within the ≤ 70 percentile range and the project was likely to have negative impacts on groundwater quality, then the project received a score of 2. If the project had no or unknown impact on water quality, then the project received a score of 3. If the score was within the ≤ 70 percentile range and the project had a likely positive impact on groundwater quality, then the project received a score of 4. If the score was within the 70 – 100 percentile range and had a likely positive impact on groundwater quality, then the project and/or Concept received a score of 5.

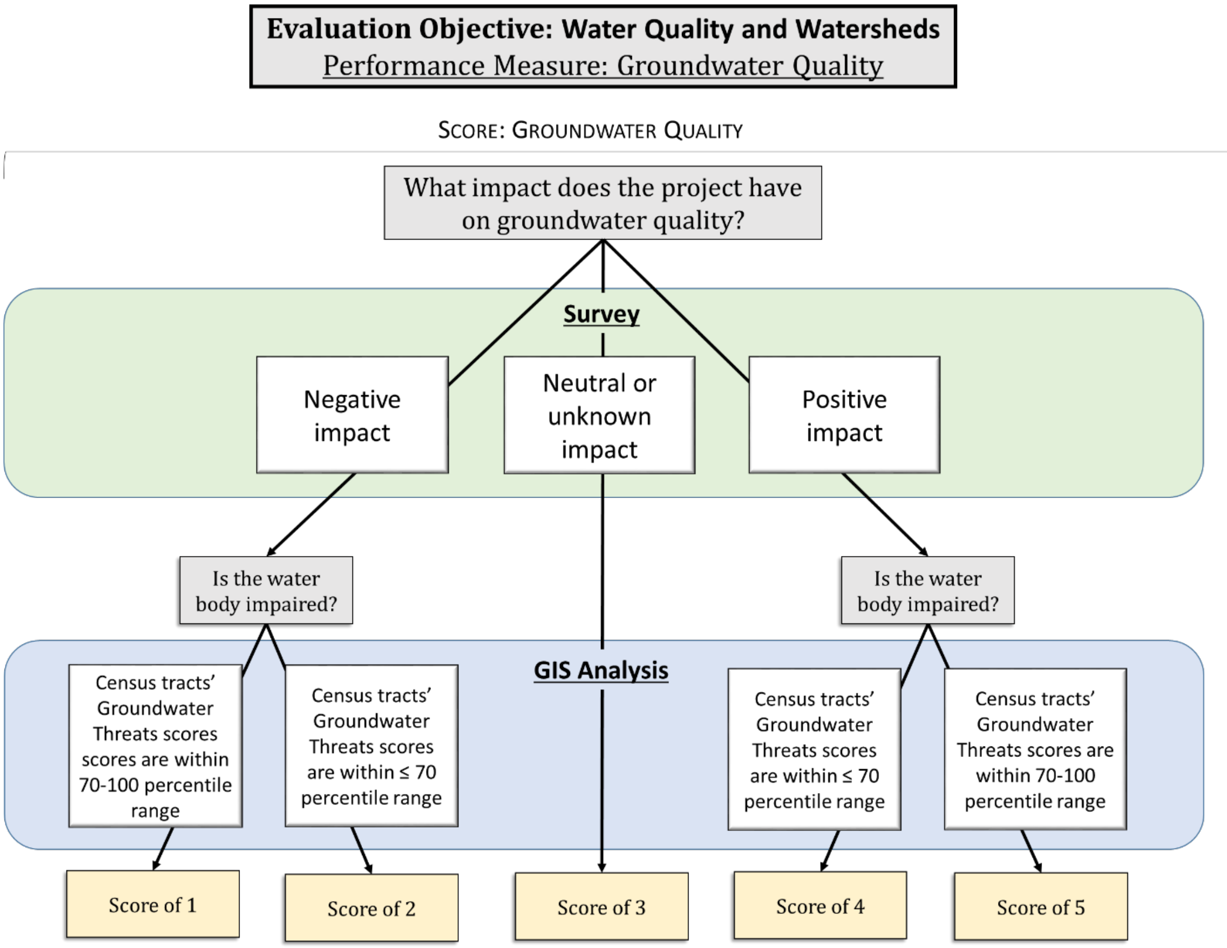


Figure 55. Decision tree for the Groundwater Quality Performance Measure associated with the Water Quality and Watersheds Evaluation Objective.

3.5. Evaluate and Combine Evaluation Objective Scores for Each Concept

The final step of the trade-off analysis was to aggregate the individual Performance Measures scores associated with each Concept for the Evaluation Objectives and combine the scores with the relative importance weights of the Evaluation Objectives to estimate a total score for the Concept across all Evaluation Objectives.

First, the Performance Measures scores were calculated for each Concept using the scoring methodology described in Section 3.4. Then the scores for all Performance Measures associated with an Evaluation Objective were aggregated for each Concept as described in Section 3.4. Next the Evaluation Objective weights described in Section 3.2.2 were multiplied by the individual Evaluation Objective scores and divided by 10 (the highest possible importance weight) to derive the weighted score that accounts for the importance of each Evaluation Objective.

The number of Evaluation Objectives included in the trade-off analysis can be changed to evaluate the sensitivity of alternative preferences to the types of objectives that are considered important by decision-makers and the public. The decision-making tool developed as part of this report and discussed in Section 7.5 can aid in evaluating variations in combinations of Evaluation Objectives and weights of importance.

4. Trade-Off Analysis Results by Evaluation Objective

The Evaluation Objective performance measures and scoring methods described above were applied to each San Diego Basin Study Concept. The specific changes in methods are described in the individual Evaluation Objective sections. In three cases, sufficient expert survey data were not available to complete the performance measure scoring evaluation as originally envisioned. The scoring results by Evaluation Objective for each Concept are summarized below. The last section combines the individual Evaluation Objective results with the weights of importance for each Evaluation Objective to estimate weighted total performance measures for each Concept. These results can then be used to provide information directly relevant to water managers in the region who are making decisions about potential future investments.

It must be emphasized that the results of the trade-off analysis are only as reliable as the data used to measure the performance of projects and Concepts that are under consideration. The measurement of performance for the various Concepts relied on correctly identifying the most relevant performance measures and obtaining accurate data for each performance measure. There are likely to be errors associated with the identification and measurement of performance measures, and as a result, the trade-off analysis results should be interpreted in terms of categories of results (low, medium, and high) rather than for use in precise scores and ranking of Concepts.

4.1. Trade-Off Analysis Results by Evaluation Objective

The following sections provide Concept-level trade-off analysis results for each Evaluation Objective. The results can be used to compare the performance of individual Concepts for a specific Evaluation Objective. The results show a wide variation in the effectiveness of different Concepts in addressing specific Evaluation Objectives. For example, Seawater Desalination ranks very high in terms of achieving Climate Resilience and Optimizing Local Supplies objectives, but ranks low in terms of Project Complexity and Cost Effectiveness. On the other hand, the Urban and Agricultural Water Use Efficiency Concept ranks high in terms of Optimizing Local Supplies, Project Complexity, Cost Effectiveness, and Address Climate

Change Through Greenhouse Gas Reduction as well as Environmental Justice/Disadvantaged Communities, and Scalability. However, the Urban and Agricultural Water Use Efficiency Concept ranks low for Reliability and Robustness.

4.1.1. Address Climate Change Through Greenhouse Gas Reduction

The Address Climate Change Through Greenhouse Gas Reduction Evaluation Objective included a single Performance Measure: GHG Mitigation. The source of Performance Measure data is Concept-level and project-level survey data.

4.1.1.1 GHG Mitigation Performance Measure Results

The GHG Mitigation Performance Measure was derived from survey responses at both the project-level and Concept-level. Scores were on a scale of 1 to 5, with a score above 3 indicating that a Concept or project achieves GHG mitigation and a score below 3 indicating that a Concept or project reduces or eliminates mitigation that was in place. Out of 87 total project-level responses, there were six missing responses for the GHG mitigation question. Enhanced Conservation was given a score of NA because it was not included in the surveys.

The highest scoring Concepts were Urban and Agricultural Water Use Efficiency, with a score of 3.75, and Watershed and Ecosystem Management, with a score of 3.63. The lowest scoring Concepts were Seawater Desalination, with a score of 2.35 and Imported Water Purchases, with a score of 2.38. No Concept scored above 4.0 or below 2.0. The low scores for Imported Water Purchases and Seawater Desalination were due to very low Concept-level survey scores (2.33 for Imported Water and 2.20 for Seawater Desalination). The high Urban and Agricultural Water Use Efficiency score is due to a high project-level survey score (4.50).

Because the GHG Mitigation Performance Measure score was based on survey responses, the overall Performance Measure value is a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The difference in project-level and Concept-level scoring for the GHG Mitigation Performance Measure was very large for Watershed and Ecosystem Management (difference of 1.68 points) and Seawater Desalination (difference of 1.30 points) in Table 28. Responses from the Concept-level survey indicated a higher level of GHG mitigation may be achieved through projects within the Watershed and Ecosystem Management Concept, which may be attributable to a conceptual understanding of GHG mitigation through habitat restoration that is typical of watershed and ecosystem management projects. Project-level responses, however, reflected the practical and specific GHG mitigation planned though the projects included in the Concept, which indicated a more modest level of GHG mitigation may be achieved by this Concept. The opposite was found for Seawater Desalination where the project-level survey score was higher that the Concept-level score, but with a smaller resulting difference in project- and Concept-level scores. The difference between project- and Concept-level scores for Urban and Agricultural Water Use Efficiency was 0.86 points. The discrepancy in scores for these Concepts was reflective of the different perspectives of Concept-level and project-level survey respondents and the differences in their knowledge of these Concepts, generally, and associated projects, specifically. These differences indicated high variability in scoring between project and Concept-level surveys and may suggest that using medians instead of means for comparison would better capture significant differences (see Section 5.1.1).

Table 28. GHG Performance Measure scores and differences between GHG Mitigation project-level and Concept-level survey results.

Concept	Concept-level Survey Scores for GHG Mitigation	Project-level Survey Scores for GHG Mitigation	Difference Between project-level and Concept-level Survey Results for GHG Mitigation	GHG Mitigation Performance Measure Scores
Conveyance Improvement	3.38	3.00	0.38	3.19
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.27	3.00	0.27	3.25
Groundwater	2.93	3.13	0.19	3.03
Imported Water Purchases	2.33	3.00	0.67	2.38
Potable Reuse	3.38	3.00	0.38	3.19
Recycled Water	3.53	3.50	0.03	3.52
Seawater Desalination	2.20	3.50	1.30	2.35
Stormwater BMPs	3.60	3.10	0.50	3.35
Stormwater Capture	3.20	3.00	0.20	3.18
Urban and Ag. Water Use Eff.	3.64	4.50	0.86	3.75
Watershed and Ecosystem Mgmt.	4.47	2.79	1.68	3.63

4.1.1.2 Overall Evaluation Objective Results for Address Climate Change Through Greenhouse Gas Reduction

The overall results for the Address Climate Change through GHG Reduction Evaluation Objective are the same as the results for the GHG Mitigation Performance Measure because it is the only Performance Measure that makes up the Evaluation Objective Score. The Address Climate Change through GHG Reduction Evaluation Objective scoring results are shown in Table 29 and Figure 56.

Table 29. Address Climate Change through GHG Reduction Evaluation Objective unweighted scores.

Concept	Address Climate Change through GHG Reduction Evaluation Objective Unweighted Scores
Conveyance Improvement	3.19
Enhanced Conservation	NA
Gray Water Use	3.25
Groundwater	3.03
Imported Water Purchases	2.38
Potable Reuse	3.19
Recycled Water	3.52
Seawater Desalination	2.35
Stormwater BMPs	3.35
Stormwater Capture	3.18
Urban and Ag. Water Use Eff.	3.75
Watershed and Ecosystem Mgmt.	3.63

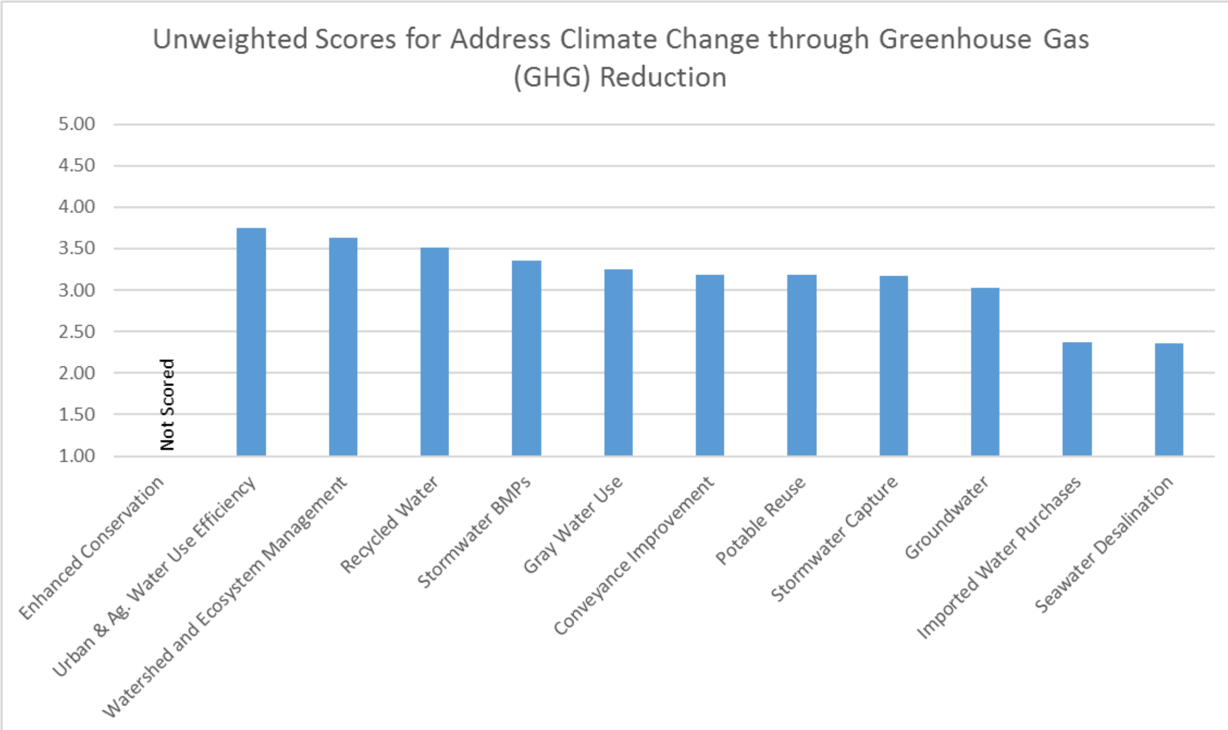


Figure 56. Address Climate Change through Greenhouse Gas Reduction Evaluation Objective unweighted scores.

4.1.2. Climate Resilience

The Climate Resilience Evaluation Objective included three Performance Measures: Sea Level Rise Vulnerability, Flood Risk Management, and Warming and Fire Vulnerability. The location of projects in vulnerable areas was the sole basis for the project and Concept scores, except for Flood Risk Management which also included a survey response component.

4.1.2.1 Sea Level Rise Vulnerability Performance Measure Results

The Sea Level Rise Vulnerability Performance Measure was based solely on GIS analysis. The performance measure results were within a very narrow band, with scores ranging from 2.82 to 3.00, which is expected as the vast majority of projects are located outside the zone of potential inundation due to projected sea level rise, and thus received a neutral score of 3. Enhanced Conservation and Imported Water were given scores of NA because they were not able to be mapped for geospatial analysis.

4.1.2.2 Flood Risk Management Performance Measure Results

The Flood Risk Management Performance Measure was based solely on GIS analysis. Flood Risk Management Performance Measure Scores were also within a fairly narrow range, with a low score of 2.18 and a high score of 2.54. However, it was a wider range than for Sea Level Rise Vulnerability. Enhanced Conservation and Imported Water Purchases were given scores of NA because they were not able to be mapped for geospatial analysis.

4.1.2.3 Warming and Fire Vulnerability Performance Measure Results

The Warming and Fire Vulnerability Performance Measure was based solely on GIS analysis. These performance measure scores showed the widest variability of the three Climate Resilience Evaluation Objectives, ranging from 1.60 to 3.00. Enhanced Conservation and Imported Water Purchases were given scores of NA because they were not able to be mapped for geospatial analysis.

4.1.2.4 Overall Evaluation Objective Results for Climate Resilience

The overall Climate Resilience scores are presented in Table 30 and Figure 57. The Climate Resilience scores ranged from a low of 2.57 for Conveyance Improvement to 5.00 for Gray Water Use, Seawater Desalination, and Stormwater Capture. The average score across all Concepts for which scores were calculated was 3.88.

Table 30. Climate Resilience Evaluation Objective Scores and associated Performance Measure scores.

Concept	Warming and Fire Vulnerability Performance Measure Score	Flood Risk Management Performance Measure Score	Sea Level Rise Vulnerability Performance Measure Score	Calculated Climate Resilience Evaluation Objective Score[1]	Climate Resilience Evaluation Objective Raw Score[2]
Conveyance Improvement	1.60	2.30	3.00	4.24	2.57
Enhanced Conservation	NA	NA	NA	NA	NA
Gray Water Use	3.00	2.50	3.00	8.25	5.00
Groundwater	2.45	2.18	2.82	6.14	3.72
Imported Water	NA	NA	NA	NA	NA
Potable Reuse	1.63	2.54	2.83	4.37	2.65
Recycled Water	1.80	2.29	2.86	4.64	2.81
Seawater Desalination	3.00	2.50	3.00	8.25	5.00
Stormwater BMPs	2.74	2.22	3.00	7.16	4.34
Stormwater Capture	3.00	2.50	3.00	8.25	5.00
Urban & Agricultural Water Use Efficiency	2.25	2.50	3.00	6.19	3.75
Watershed & Ecosystem Management	2.47	2.31	3.00	6.56	3.97

[1] Climate Resilience Calculated Score = (average of Sea Level Rise Vulnerability and Flood Risk Management Scores) × Warming and Fire Vulnerability Score
[2] Score scaled from 1 to 5

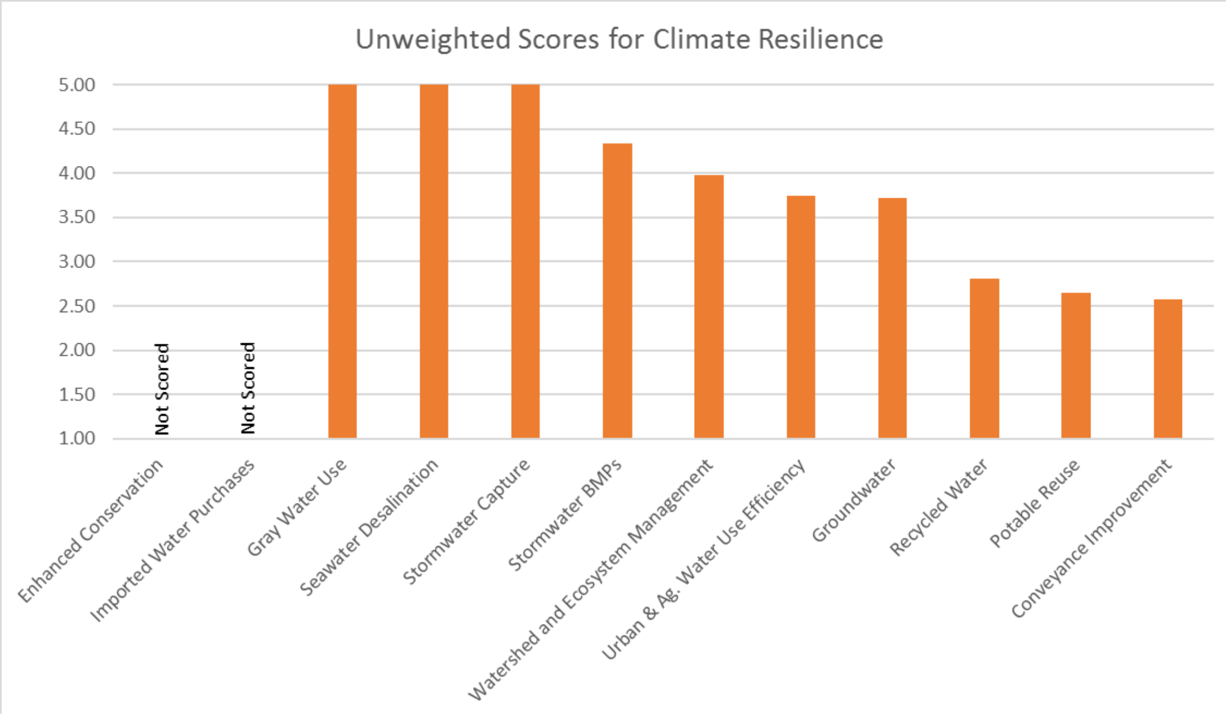


Figure 57. Climate Resilience Evaluation Objective unweighted scores.

The Gray Water Use, Seawater Desalination, and Stormwater Capture Concepts all had the highest scores, which indicated that projects within these Concepts are located in areas that are resilient to the impacts of climate change. The Conveyance Improvement, Potable Reuse, and Recycled Water Concepts were the lowest scored Concepts, which indicated that projects within these Concepts are located in areas that are particularly vulnerable to the impacts of climate change.

4.1.3. Cost Effectiveness

There were three Performance Measures included in the Cost Effectiveness Evaluation Objective: Capital Costs, O&M Costs, and Potential for External Funding.

4.1.3.1 Capital Costs Performance Measure Results

The Capital Costs Performance Measure was based on Concept-level and project-level survey responses, with a score of 1 indicating a very costly/high cost project or Concept, a score of 3 indicating a moderate or variable cost project or Concept, and a score of 5 representing an inexpensive or low cost project or Concept. There was much variability in the Capital Cost Performance Measure scores, ranging from a low of 1.19 to a high of 4.16. This was an expected result given that different types of projects have a wide range of capital costs, depending in part on the construction component and size of the project.

Because the Capital Costs Performance Measure was based on survey responses, the Performance Measure values were a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The differences in Cost Effectiveness project and Concept scoring shown in Table 31 are very high for Stormwater Capture, Gray Water Use, Stormwater BMPs, and Watershed and Ecosystem Management. These scoring differences may be due to uncertainty associated with estimating these costs.

Table 31. Capital Costs Performance Measure scores and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Capital Costs	Concept-level Survey Results for Capital Costs	Difference between project-level and Concept-level Survey Results for Capital Costs	Capital Costs Performance Measure Scores
Conveyance Improvement	2.33	1.63	0.71	1.98
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	5.00	3.75	1.25	3.82
Groundwater	1.50	2.00	0.50	1.75
Imported Water	3.00	3.00	0.00	3.00
Potable Reuse	1.00	1.38	0.38	1.19
Recycled Water	2.38	1.88	0.50	2.13
Seawater Desalination	2.00	1.25	0.75	1.33
Stormwater BMPs	2.20	3.38	1.18	2.79
Stormwater Capture	4.00	2.00	2.00	2.22
Urban & Agricultural Water Use Efficiency	4.20	4.13	0.08	4.16
Watershed & Ecosystem Management	2.29	3.38	1.09	2.83

4.1.3.2 O&M Costs Performance Measure Results

The O&M Costs Performance Measure was based on Concept-level and project-level survey responses, with a score of 1 indicating a very costly/high cost project or Concept, a score of 3 indicating a moderate or variable cost project or Concept, and a score of 5 representing an inexpensive or low cost project or Concept. Variation in the O&M Performance Measure results was relatively large, ranging from a low of 1.56 to a high of 4.35. This variability indicates that O&M costs may not be well understood for many Concepts. Enhanced Conservation was given a score of NA because it was not included in the surveys.

Because the O&M Costs Performance Measure was based on survey responses, the Performance Measure values were a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicate more similar perspectives related to the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The differences in Cost Effectiveness project and Concept scoring shown in Table 32 are very high for Stormwater Capture, Watershed and Ecosystem Management, Seawater Desalination, Recycled Water, and Stormwater BMPs. These scoring differences may be due to uncertainty associated with estimating these costs.

Table 32. O&M Costs Performance Measure scores and difference between project-level and Concept-level scoring.

Concept	Project-level Survey Results for O&M Costs	Concept-level Survey Results for O&M Costs	Difference between project-level and Concept-level Survey Results for O&M Costs	O&M Costs Performance Measure Scores
Conveyance Improvement	3.80	2.87	0.93	3.33
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	5.00	4.13	0.88	4.18
Groundwater	1.86	2.00	0.14	1.93
Imported Water	3.00	3.25	0.25	3.24
Potable Reuse	2.25	1.88	0.53	2.14
Recycled Water	3.67	2.25	1.50	3.00
Seawater Desalination	3.00	1.38	1.63	1.56
Stormwater BMPs	2.40	3.88	1.48	3.14
Stormwater Capture	5.00	2.50	2.50	2.78
Urban & Agricultural Water Use Efficiency	4.20	4.50	0.30	4.35
Watershed & Ecosystem Management	1.71	3.75	2.16	2.79

4.1.3.3 Potential for External Funding Performance Measure Results

The Potential for External Funding Performance Measure scores (Table 33) were based entirely on project-level survey responses, with a score of 1 indicating no external funding, a 3 indicating the project was/is expected to be partially funded by external sources, and a 5 indicating the project was/is expected to be fully funded by external funding. These scores ranged from a low of 1.33 to a high of 3.80. Enhanced Conservation was given a score of NA because it was not included in the surveys.

Table 33. Potential for External Funding Performance Measure scores in project-level scoring.

Concept	Project-level Survey Results for Potential for External Funding and Potential for External Funding Performance Measure Score
Conveyance Improvement	1.33
Enhanced Conservation	NA
Gray Water Use	3.00
Groundwater	2.75
Imported Water	3.00
Potable Reuse	2.40
Recycled Water	2.38
Seawater Desalination	2.00
Stormwater BMPs	2.68
Stormwater Capture	3.00
Urban & Agricultural Water Use Efficiency	3.80
Watershed & Ecosystem Management	3.14

4.1.3.4 Overall Evaluation Objective Results for Cost Effectiveness

The Cost Effectiveness Evaluation Objective Performance Measure scores and Evaluation Objective scores by Concept are shown in Table 34 and Figure 58. It should be noted that higher scores represent lower (more desirable) costs.

Table 34. Cost Effectiveness Evaluation Objective scores and associated Performance Measure scores by Concept.

Concept	Capital Costs Performance Measure Scores	O&M Costs Performance Measure Scores	External Funding Performance Measure Scores	Cost Effectiveness Evaluation Objective Unweighted Scores
Conveyance Improvement	1.98	3.33	1.33	2.22
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.82	4.18	3.00	3.67
Groundwater	1.75	1.93	2.75	2.14
Imported Water	3.00	3.24	3.00	3.08
Potable Reuse	1.19	2.14	2.40	1.91
Recycled Water	2.13	3.00	2.38	2.50
Seawater Desalination	1.33	1.56	2.00	1.63
Stormwater BMPs	2.79	3.14	2.68	2.87
Stormwater Capture	2.22	2.78	3.00	2.67
Urban & Agricultural Water Use Efficiency	4.16	4.35	3.80	4.10
Watershed & Ecosystem Management	2.83	2.79	3.14	2.92

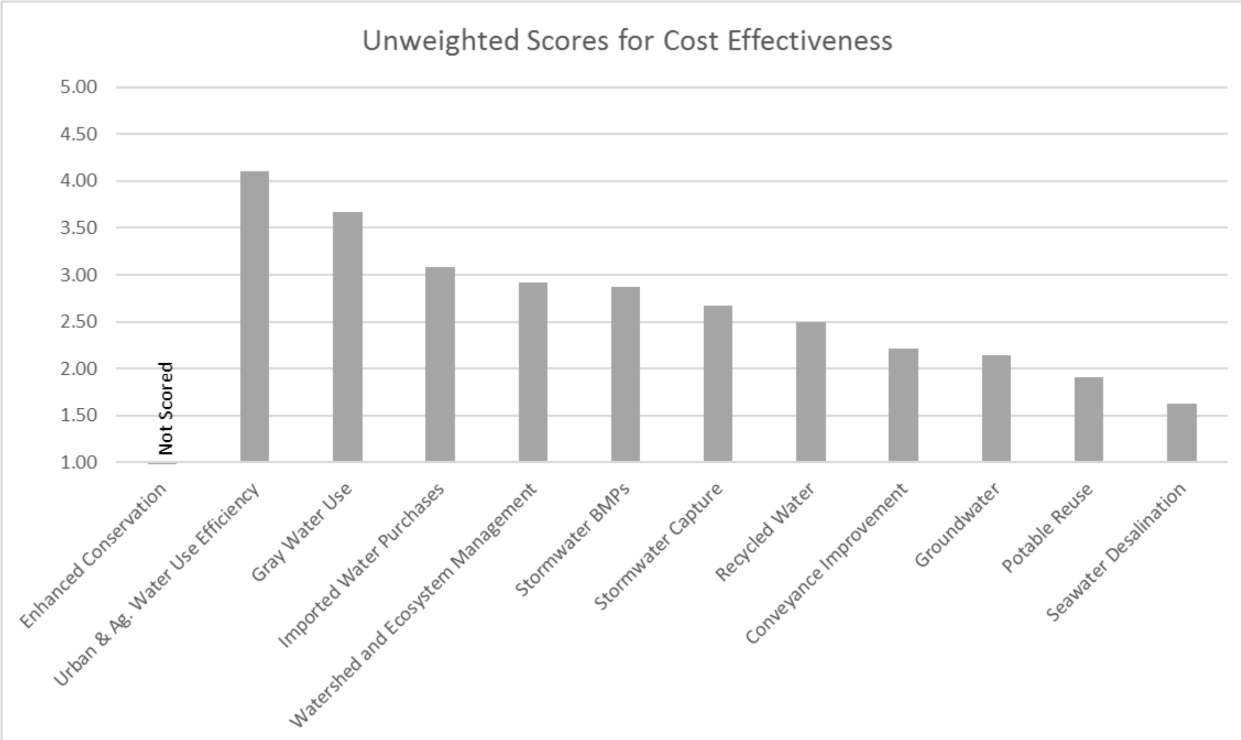


Figure 58. Cost Effectiveness Evaluation Objective unweighted scores.

Urban and Agricultural Water Use Efficiency had the highest score, with a score of 4.10. Gray Water Use and Imported Water Purchases also scored relatively high, with scores of 3.67 and 3.08, respectively. For the Capital Costs and O&M Costs Performance Measures, a score of 3 indicated moderate or variable costs while a score of 1 indicated high costs and a score of 5 indicated low costs. Therefore, the final results indicated that Urban and Agricultural Water Use Efficiency was judged to have the lowest costs overall, followed by Gray Water Use and Imported Water Purchases. Each of the other Concepts had a score between 1.91 and 2.92, indicating that survey respondents judged them to have moderate or variable to high costs. Seawater Desalination and Potable Reuse were rated as least cost effective. The cost effectiveness scores were based entirely on project-level survey responses and were therefore based on limited data in some cases, as described in Section 3.4. Generally, the Cost Effectiveness scores were quite low, indicating that most of the Concepts were viewed as being expensive or that there is limited funding for them. This may be a relative comparison to past projects that tended to be lower cost and perhaps easier to implement.

4.1.4. Environmental Justice

The Environmental Justice Evaluation Objective included two Performance Measures: Environmental Justice and Disadvantaged Communities (DACs).

4.1.4.1 Environmental Justice Performance Measure Results

The Environmental Justice Performance Measure score incorporated GIS analysis and survey questions as described in Section 3.4.4.1. GIS analysis was completed for project location relative to Census Tracts with a relatively high proportion of minority or low income populations and survey responses were used to determine if project impacts were likely to be positive or negative and the likely magnitude of impact. For the positive or negative impact category, a 1 indicated a negative impact, a 3 indicated a neutral impact, and a 5 indicated a positive impact. For the magnitude of impact category, a 1 indicated a minor impact, a 3 indicated a neutral impact, and a 5 indicated a large impact

The Environmental Justice Performance Measure scores combining the analysis of project location and impacts are presented in Table 35. The highest scoring Concept was Watershed and Ecosystem Management with a score of 3.58 followed by Stormwater BMPs with a score of 3.41. The lowest scoring Concepts were Conveyance Improvement, Stormwater Capture, and Urban and Agricultural Water Use Efficiency, which all received scores of 3.00. Enhanced Conservation was given a score of NA because it did not have a specific location for geospatial analysis and was not included in the surveys. Imported Water was given a score of NA because it did not have a specific location for geospatial analysis. Gray Water Use received a score of NA because, of the two Gray Water Use projects included in the analysis, one did not receive a survey response and could not be scored and the other was not able to be mapped so it could not be scored. Seawater Desalination received a score of NA because, of the three Seawater Desalination projects analyzed, one could not be mapped for geospatial analysis, one did not receive a survey response, and one had a missing survey response to one of the survey questions.

Table 35. Environmental Justice Performance Measure scores.

Concept	Environmental Justice Performance Measure Scores
Conveyance Improvement	3.00
Enhanced Conservation	NA
Gray Water Use	NA
Groundwater	3.17
Imported Water	NA
Potable Reuse	3.25
Recycled Water	3.09
Seawater Desalination	NA
Stormwater BMPs	3.41

Concept	Environmental Justice Performance Measure Scores
Stormwater Capture	3.00
Urban & Agricultural Water Use Efficiency	3.00
Watershed & Ecosystem Management	3.58

4.1.4.2 DACs Performance Measure Results

The DACs Performance Measure scores were based on a combination of project-level survey responses and GIS-based scores. The survey responses indicated if a project had negative, neutral or unknown, or positive impacts. A negative or unknown response resulted in a score of 3 for that specific project. The GIS analysis was used to determine if a project overlapped with a DAC. The DACs scores are presented in Table 36. Enhanced Conservation was given a score of NA because it did not have a specific location for geospatial analysis and was not included in the surveys. Imported Water was given a score of NA because it did not have a specific location for geospatial analysis. Gray Water Use received a score of NA because, of the two Gray Water Use projects included in the analysis, one did not receive a survey response and could not be scored and the other was not able to be mapped so it could not be scored.

Table 36. DACs Performance Measure scores.

Concept	DACs Performance Measure Scores
Conveyance Improvement	3.00
Enhanced Conservation	NA
Gray Water Use	NA
Groundwater	3.00
Imported Water	NA
Potable Reuse	3.00
Recycled Water	3.00
Seawater Desalination	3.00
Stormwater BMPs	3.14
Stormwater Capture	3.00
Urban & Agricultural Water Use Efficiency	4.00
Watershed & Ecosystem Management	4.00

4.1.4.3 Overall Evaluation Objective Results for Environmental Justice

The Environmental Justice Evaluation Objective scores are presented in Table 37 and Figure 59. The highest scoring Concept was Watershed and Ecosystem Management, with a score of 3.79. The lowest scoring Concepts were Conveyance Improvement and Stormwater Capture, with scores of 3.0. Enhanced Conservation, Imported Water, Gray Water Use, and Seawater Desalination did not receive scores because they received scores of NA for one or both Performance Measures. All the Concepts that received Environmental Justice scores were expected to have a neutral or positive impact on Environmental Justice and Disadvantaged Communities (i.e., they scored 3.0 or above). This indicated the projects under consideration within the Concepts considered in this analysis may generally lead to improved conditions that support Environmental Justice and Disadvantaged Communities.

Table 37. Environmental Justice Evaluation Objective and associated Performance Measure scores.

Concept	Environmental Justice Performance Measure Scores	DACs Performance Measure Scores	Environmental Justice Evaluation Objective Unweighted Scores
Conveyance Improvement	3.00	3.00	3.00
Enhanced Conservation	NA	NA	NA
Gray Water Use	NA	NA	NA
Groundwater	3.17	3.00	3.08
Imported Water	NA	NA	NA
Potable Reuse	3.25	3.00	3.13
Recycled Water	3.09	3.00	3.05
Seawater Desalination	NA	3.00	NA
Stormwater BMPs	3.41	3.14	3.28
Stormwater Capture	3.00	3.00	3.00
Urban & Agricultural Water Use Efficiency	3.00	4.00	3.50
Watershed & Ecosystem Management	3.58	4.00	3.79

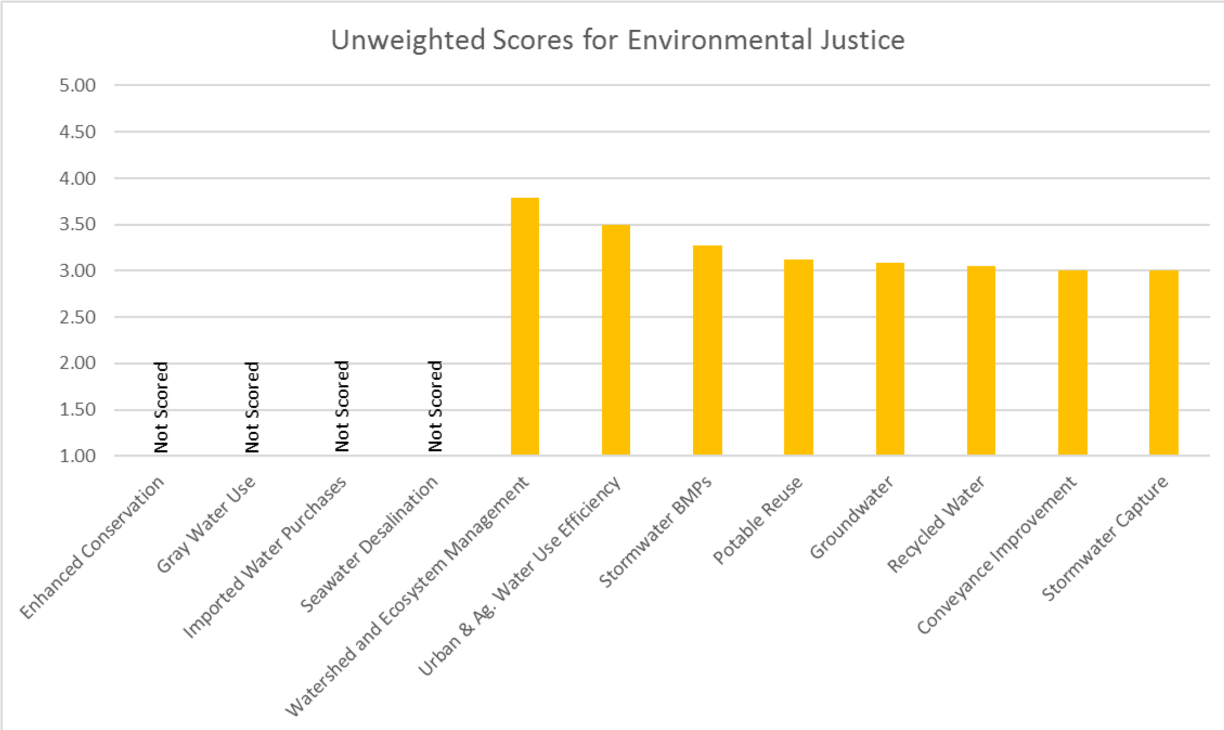


Figure 59. Environmental Justice Evaluation Objective unweighted scores.

4.1.5. Optimize Local Supplies

The Optimize Local Supplies Evaluation Objective included one Performance Measure, Local Supplies.

4.1.5.1 Local Supply Performance Measure Results

The Local Supply Performance Measure score was derived from a single survey question, which asked whether the project or Concept increases or decreases local water supply. This question was asked at both the project-level and Concept-level. The Local Supply Performance Measure scores were calculated as the averages of responses to both the project-level and Concept-level expert surveys to the local supply question. There was a total of 72 project-level survey responses for the local supply question out of 87 survey responses and 16 Concept-level survey responses. Enhanced Conservation was given a score of NA because it was not included in the surveys. Imported Water was initially given a score of 5, indicating a direct or long-term increase in local water supply, based on the project-level survey response for the single project (Cadiz Additional Imported Supplies) in that Concept. However, the score was changed to NA after review by the technical team. As defined in Section 3.3.1.1.6, Imported Water Purchases did not represent a water supply that is sourced locally, and would therefore be expected to score low. The survey response may have been due to a misinterpretation of the question, or the respondent may have interpreted the response to mean that that importing water would make more supply available locally. Because of the possible misinterpretation of the question, the survey response was removed from the analysis and the project-level survey score for the Concept was given a score of NA.

Because the Local Supply Performance Measure was based on survey responses, the Performance Measure values were a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The difference in Optimize Local Supplies project and Concept scoring shown in Table 38 is highest for Gray Water Use. The differences in project-level and Concept-level scoring for the other Concepts were very small. The difference in Gray Water Use may be due to different perspectives on the effectiveness of this Concept in providing additional local supplies while there is more general agreement on the effectiveness of the other Concepts.

The highest scoring Concept for the Local Supply Performance Measure was Seawater Desalination with a score of 5.00, closely followed by Groundwater, Recycled Water, Potable Reuse, and Stormwater Capture. These five Concepts were all within 0.22 point of each other, ranging from 4.78 to 5.00 points. These Concepts would be expected to score high for this Evaluation Objective given that they are focused on local sources. The lowest score (2.81) was for Imported Water Purchases. The average score for Optimize Local Supplies was 4.27.

4.1.5.2 Overall Evaluation Objective Results for Optimize Local Supplies

The overall results for the Optimize Local Supplies Evaluation Objective are the same as the results for the Local Supplies Performance Measure because it is the only Performance Measure that makes up the Evaluation Objective Score. The results are presented in Table 38 and Figure 60. Similar to the Environmental Justice and DACs Evaluation Objective, all the Concepts, except for Imported Water Purchases, had a positive effect in terms of Optimizing Local Supplies. The highest scoring Concepts for Optimize Local Supplies were Seawater Desalination, Groundwater, Recycled Water, Potable Reuse, and Stormwater Capture.

Table 38. Optimize Local Supplies Evaluation Objective scores and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Optimize Local Supplies	Concept-level Survey Results for Optimize Local Supplies	Difference between Project- and Concept-level Survey Results for Optimize Local Supplies	Optimize Local Supplies Evaluation Objective Unweighted Score
Conveyance Improvement	3.67	3.94	0.27	3.80
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	5.00	4.19	0.81	4.24
Groundwater	5.00	4.94	0.06	4.97
Imported Water	NA	2.81	NA	2.81
Potable Reuse	4.80	4.88	0.08	4.84
Recycled Water	4.88	4.94	0.06	4.91
Seawater Desalination	5.00	5.00	0.00	5.00
Stormwater BMPs	3.62	3.44	0.18	3.53
Stormwater Capture	5.00	4.75	0.25	4.78
Urban & Agricultural Water Use Efficiency	4.20	4.31	0.11	4.26
Watershed & Ecosystem Management	3.83	3.88	0.04	3.85

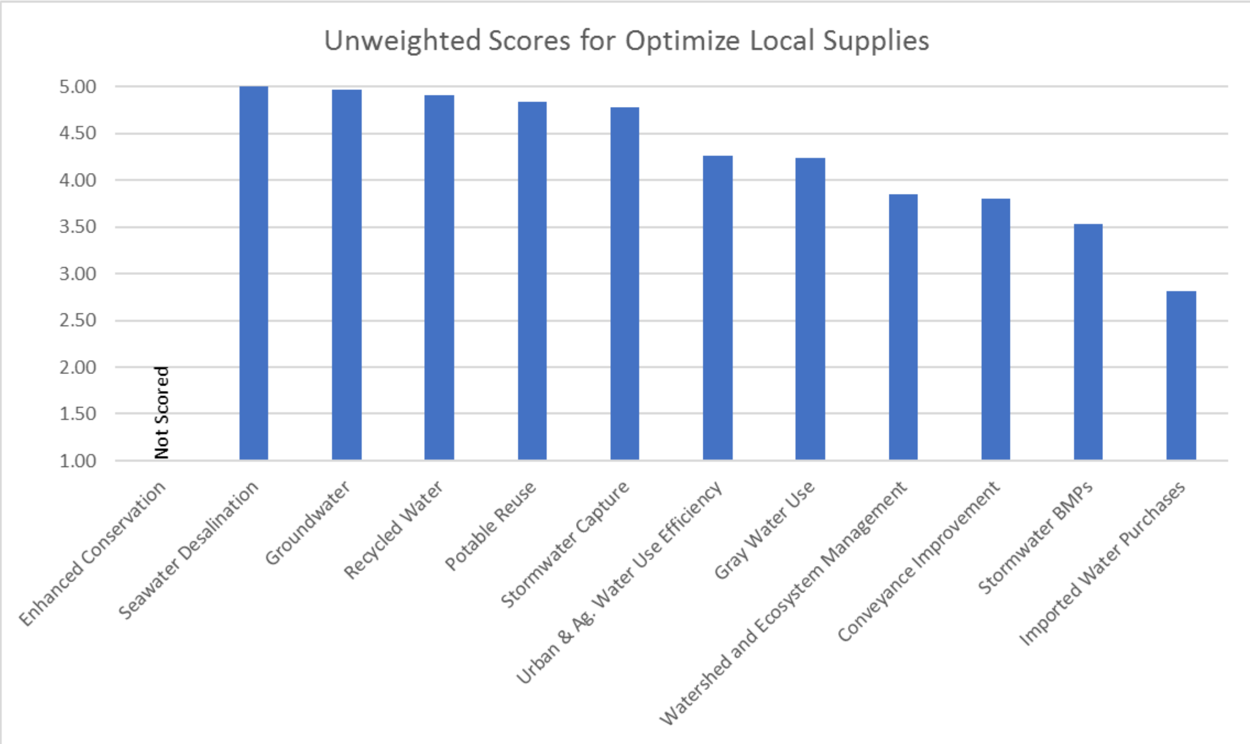


Figure 60. Optimize Local Supplies Evaluation Objective unweighted scores.

4.1.6. Project Complexity

The Project Complexity Evaluation Objective was based on one Performance Measure, Project Complexity and Feasibility.

4.1.6.1 Project Complexity and Feasibility Performance Measure Results

The Project Complexity and Feasibility Performance Measure was quantified using responses to a survey question about feasibility and complexity at both the project- and Concept-levels. Scores ranged from 1 for highly complex projects or Concepts to 5 for Concepts that would be relatively simple to implement. Enhanced Conservation was given a score of NA because there were no Enhanced Conservation Concept projects included in the project-level survey and it was not included as a Concept in the Concept-level survey.

Because the Project Complexity Performance Measure was based on survey responses, the Performance Measure values were a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The greatest difference in project- and Concept-level scoring was for Stormwater Capture followed by Gray Water Use. This discrepancy between project-level and Concept-level scores may indicate that there is a knowledge barrier that does not exist at the project-level (e.g., projects are perceived as less complex by those more familiar with the implementation of these types of projects.) The project- and Concept-level scores were very similar for the Potable Reuse and Urban and Agricultural Water Use Efficiency Concepts.

The highest scoring Concepts for the Project Complexity and Feasibility Performance Measure were Urban and Agricultural Water Use Efficiency with a score of 4.13 and Imported Water Purchases with a 3.26. The lowest scoring Concepts were Seawater Desalination with a score of 1.47 and Potable Reuse with a score of 1.75. The average score for all Concepts was a score of 2.74. A score of NA was assigned to Enhanced Conservation since survey information was not available.

4.1.6.2 Overall Evaluation Objective Results for Project Complexity

The overall results for the Project Complexity Evaluation Objective are the same as the results for the Project Complexity and Feasibility Performance Measure because it is the only Performance Measure that makes up the Evaluation Objective Score. Complete Project Complexity results are presented in Table 39 and Figure 61.

Table 39. Project Complexity Evaluation Objective unweighted scores and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Project Complexity	Concept-level Survey Results for Project Complexity	Difference between project-level and Concept-level Results for Project Complexity	Project Complexity Performance Measure and Evaluation Objective Unweighted Scores
Conveyance Improvement	2.83	3.06	0.23	2.95
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	4.00	3.00	1.00	3.06
Groundwater	1.89	2.13	0.24	2.01
Imported Water	4.00	3.21	0.79	3.26
Potable Reuse	1.70	1.80	0.10	1.75
Recycled Water	3.25	3.00	0.25	3.13
Seawater Desalination	2.00	1.40	0.60	1.47
Stormwater BMPs	2.75	3.47	0.72	3.11
Stormwater Capture	3.50	2.33	1.17	2.46

Concept	Project-level Survey Results for Project Complexity	Concept-level Survey Results for Project Complexity	Difference between project-level and Concept-level Results for Project Complexity	Project Complexity Performance Measure and Evaluation Objective Unweighted Scores
Urban & Agricultural Water Use Efficiency	4.20	4.07	0.13	4.13
Watershed & Ecosystem Management	2.60	3.07	0.47	2.83

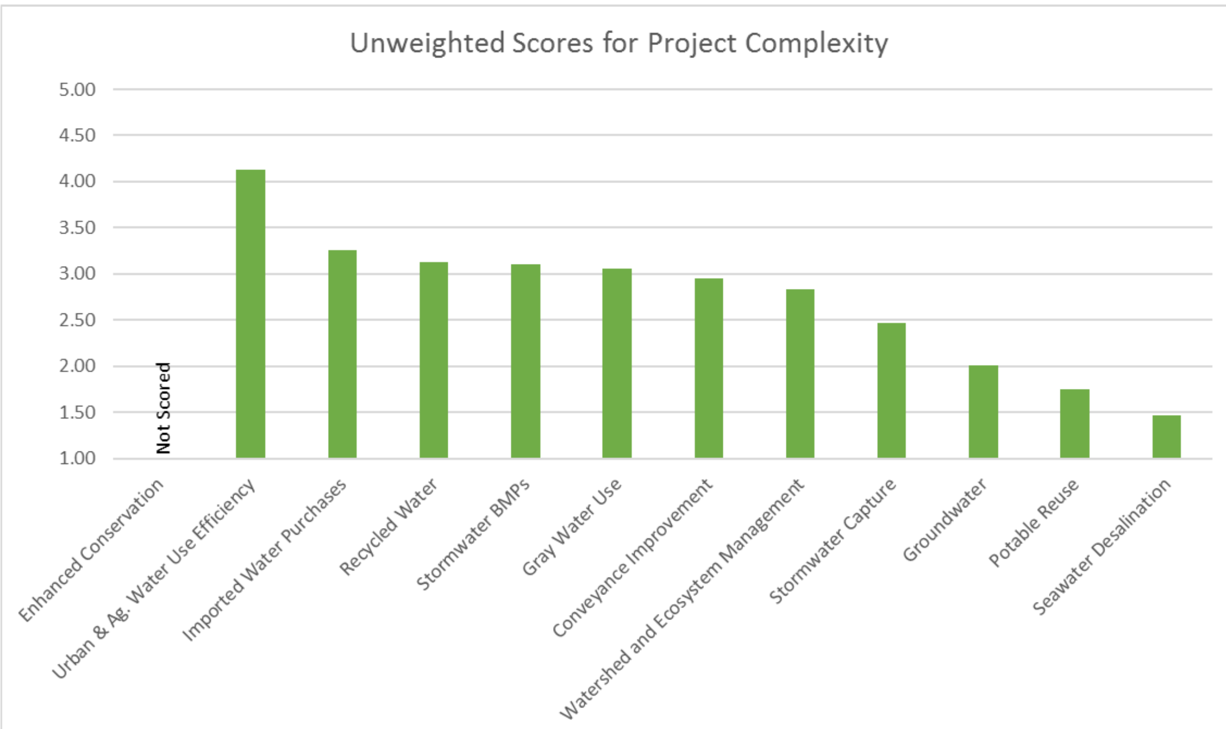


Figure 61. Project Complexity Evaluation Objective unweighted scores.

4.1.7. Protect Habitats, Wildlife, and Ecosystems

The Evaluation Objective Protect Habitats, Wildlife, and Ecosystems included consideration of three Performance Measures: Impacts to Ecosystems, Impacts to Native Species, and Impacts to Threatened and Endangered Species.

4.1.7.1 Impacts to Ecosystems Performance Measure Results

The Impacts to Ecosystems Performance Measure score was based on a combination of project-level survey data and GIS data. First, the survey data for each individual project identified whether the project has a positive impact, a negative impact, or a neutral or unknown impact on ecosystems.

Next, GIS analysis was used to determine whether projects have direct, indirect (within a 500-foot buffer around ecologically important habitat), or no impacts on ecologically important habitat in the Study Area.

Finally, the project-level survey data was combined with the project-level GIS data for individual projects as described in Section 3.4.7.1. If a project has a negative impact on ecosystems and is located within ecologically important habitat, the project received a score of 1. If a project has a negative impact on ecosystems and is located within the 500-foot buffer around ecologically important habitat, the project received a score of 2. If the project has an unknown impact on ecosystems or is located outside of ecologically important habitats or the buffer around ecologically important habitat, then the project received a score of 3. If a project has a positive impact on ecosystems and is located within the 500-foot buffer around ecologically important habitat, the project received a score of 4. If a project has a positive impact on ecosystems and is located within ecologically important habitat, the project received a score of 5. Project-specific scores were averaged within each Concept to give an overall score for each Concept.

The Impacts to Ecosystems Performance Measure results are shown in Table 40. Eleven of the 12 Concepts received scores in the project-level survey. Enhanced Conservation was not included in the survey. Of the 11 Concepts included in the survey, six received only responses indicating a neutral or unknown impact to ecosystems. Only one Concept, Potable Reuse, had any projects with a negative impact on ecosystems; the rest had positive impacts. Ten of the 12 Concepts received scores from the GIS analysis. Enhanced Conservation and Imported Water Purchases had no projects that could be mapped, so they were excluded from the GIS analysis. Of the 10 Concepts that were analyzed with GIS data, four only contained projects that were outside of managed habitats and buffers. Six Concepts had some projects with direct impacts on managed habitats and two Concepts had some projects with indirect impacts on managed habitats.

All the Impacts to Ecosystems Performance Measure Scores were 3.0 except for Stormwater BMPs and Watershed and Ecosystem Management, which received scores of 3.23 and 3.36, respectively. These generally neutral scores for all Concepts are likely due to the Concepts being focused on water supply rather than habitat improvement. Although the trade-off analysis results do not indicate adverse effects of the Concepts on ecosystems, the general lack of positive ecosystem benefit for any of the Concepts provides room to improve all Concepts with respect to impacts to habitats, wildlife, and ecosystems. Additionally, and perhaps more importantly, there appears to be no adverse effects from the Concepts on ecosystems. The highest Impacts to Ecosystems Performance Measure score was a score of 3.36 for Watershed and Ecosystem Management. Enhanced Conservation received a score of NA because it was not included in the project-level survey and was not able to be mapped for GIS analysis. Imported Water Purchases received a score of NA because it was not able to be mapped for GIS analysis

4.1.7.2 Impacts to Threatened and Endangered Species Performance Measure Results

The Impacts to Threatened and Endangered Species Performance Measure score was based on a combination of project-level survey data and GIS data. The project-level survey data identified projects that have a positive impact, a negative impact, or a neutral or unknown impact on threatened and endangered species.

Next, GIS data determined whether projects are located in areas with substantial or minimal documented abundance and diversity of native species in the Study Area.

Finally, the survey and GIS data were combined to determine the overall score. If a project has a likely positive impact on endangered or threatened species, then it received a score of 5. If a project has a likely positive impact on a candidate/at-risk species, species of concern, or species considered “sensitive,” then it received a score of 4. If a project has a neutral or unknown impact on a species, or the project area does not have any documented threatened or endangered species, then it received a score of 3. If a project has a likely negative impact on a candidate/at-risk species, species of concern, or species considered “sensitive,” then it received a score of 2. If a project has a likely negative impact on an endangered or threatened species, then it received a score of 1.

The Impacts to Threatened and Endangered Species Performance Measure results are shown in Table 41 below. All the Threatened and Endangered Species scores were within a very narrow range of 3.0 to 3.08. Two Concepts had Threatened and Endangered Species Performance Measure scores greater than 3.0, Watershed and Ecosystem Management and Stormwater BMPs. There appeared to be no adverse effects from the Concepts on threatened and endangered species.

Eleven of the 12 Concepts received scores in the project-level survey. Enhanced Conservation was not included in the survey. Of the 11 Concepts included in the survey, seven received only responses indicating a neutral or unknown impact to threatened or endangered species. Only one Concept, Potable Reuse, had any projects with a negative impact on threatened or endangered species; the rest had positive impacts. Ten of the 12 Concepts received scores from the GIS analysis. Enhanced Conservation and Imported Water Purchases had no projects that could be mapped, so they were excluded from the GIS analysis. Of the 10 Concepts that were analyzed with GIS data, only six contained projects that were located where no sensitive species are present. Three Concepts had some projects located in areas where threatened or endangered species are present, and two Concepts had some projects located in areas where “At Risk” species are present.

Table 40. Impacts to Ecosystems Performance Measure scores, percentages of projects with direct, indirect, or no impact on habitat based on GIS analysis, and percentages of positive, negative, and neutral impact from project-level surveys.

Concept	Percentage of projects with direct, indirect, or no impact on habitat, as indicated by GIS analysis			Percentage of projects with neutral/uknown, negative, or positive ecosystem impacts, as indicated by project-level survey			Impacts to Ecosystems Performance Measure Scores
	Direct Impact	Indirect Impact	No Impact (outside managed habitat areas)	Neutral/Unknown Impact	Positive Impact	Negative Impact	
Conveyance Improvement	40%	0%	60%	100%	0%	0%	3.00
Enhanced Conservation	NA	NA	NA	NA	NA	NA	NA
Gray Water Use	0%	0%	100%	100%	0%	0%	3.00
Groundwater	9%	0%	91%	78%	22%	0%	3.00
Imported Water	NA	NA	NA	100%	0%	0%	3.00
Potable Reuse	0%	0%	100%	78%	11%	11%	3.00
Recycled Water	4%	0%	96%	100%	0%	0%	3.00
Seawater Desalination	0%	0%	100%	100%	0%	0%	3.00
Stormwater BMPs	31%	10%	59%	68%	32%	0%	3.23
Stormwater Capture	0%	0%	100%	100%	0%	0%	3.00
Urban & Agricultural Water Use Efficiency	25%	0%	75%	33%	67%	0%	3.00
Watershed & Ecosystem Management	33%	6%	61%	62%	38%	0%	3.36

Table 41. Impacts to Threatened and Endangered Species Performance Measure Scores, percentages of projects located in areas with endangered or threatened species, candidate/at-risk species of concern or "sensitive" species, or outside these areas based on GIS analysis, and percentages of positive, negative, and neutral/unknown impact from project-level surveys.

Concept	Percentage of projects in areas with endangered or threatened species, candidate/at-risk/sensitive species, and outside these areas based on GIS analysis			Percentage of projects that would have neutral or unknown, positive, or negative impacts on endangered or threatened species as indicated by project-level surveys			Impacts to Threatened or Endangered Species Performance Measure Scores
	Areas with Endangered or Threatened Species	Areas with Candidate/At-Risk Species of Concern or "Sensitive" Species	Outside	Neutral/Unknown	Positive	Negative	
Conveyance Improvement	20%	0%	80%	100%	0%	0%	3.00
Enhanced Conservation	NA	NA	NA	NA	NA	NA	NA
Gray Water Use	0%	0%	100%	100%	0%	0%	3.00
Groundwater	0%	0%	100%	75%	25%	0%	3.00
Imported Water	NA	NA	NA	100%	0%	0%	3.00
Potable Reuse	0%	0%	100%	80%	10%	10%	3.00
Recycled Water	0%	4%	96%	100%	0%	0%	3.00
Seawater Desalination	0%	0%	100%	100%	0%	0%	3.00
Stormwater BMPs	17%	0%	83%	74%	26%	0%	3.08
Stormwater Capture	0%	0%	100%	100%	0%	0%	3.00
Urban & Agricultural Water Use Efficiency	0%	0%	100%	100%	0%	0%	3.00
Watershed & Ecosystem Management	6%	6%	89%	64%	36%	0%	3.06

4.1.7.3 Impacts to Native Species Performance Measure Results

The Impacts to Native Species Performance Measure score was based on a combination of project-level survey data and GIS data. First, the project-level survey data identified individual projects that have a positive impact, a negative impact, or a neutral or unknown impact on native species.

Next, GIS data was used to determine whether projects are located in areas that have substantial, minimal, or no documented abundance and diversity of native species in the Study Area.

Finally, the survey data was combined with the GIS data to determine the Performance Measure score. If a substantial number of native species is documented for the project's location, and the project has a likely positive impact on species, then the project received a score of 5. If a less than significant number of native species is documented for the project area, and the project has a likely positive impact on native species, then the project received a score of 4. If there are any number of species documented for the project area, and the project has a neutral or unknown impact on native species or the project area does not have any documented native species, then the project received a score of 3. If a minimal abundance of native species is documented for the project's location, and the project has a likely negative impact on native species, then the project received a score of 2. If a substantial abundance of native species is documented for the project's location, and the project has a likely negative impact on native species, then the project received a score of 1.

Impacts to Native Species Performance Measure results are shown in Table 42. Similar to the Impacts to Ecosystems Performance Measure Scores, all the Native Species scores were 3.0 or slightly higher. Only four Concepts had Impacts to Native Species Performance Measure scores greater than 3.0 (Groundwater, Stormwater BMPs, Urban and Agricultural Water Use Efficiency, and Watershed and Ecosystem Management) and those Concept scores were only marginally greater than 3.0. The highest score was 3.64 for Watershed and Ecosystem Management. There appeared to be no adverse effects from the Concepts on native species.

Eleven of the 12 Concepts received scores in the project-level survey. Enhanced Conservation was not included in the survey. Of the 11 Concepts included in the survey, four received only responses indicating a neutral or unknown impact to native species. No Concepts had any projects with a negative impact on native species; the rest had positive impacts. Ten of the 12 Concepts received scores from the GIS analysis. Enhanced Conservation and Imported Water Purchases had no projects that could be mapped, so they were excluded from the GIS analysis. Of the 10 Concepts that were analyzed with GIS data, only three contained projects that were located where no species are present. Six Concepts had some projects located in areas of substantial abundance of native species and two Concepts had some projects located in areas of minimal abundance of native species.

Table 42. Impacts to Native Species Performance Measure scores, percentages of projects located in areas with substantial abundance of native species, minimal abundance of native species, or outside these areas based on GIS analysis, and percentages of positive, negative, and neutral/unknown impact from project-level surveys.

Concept	Percentage of projects located in an area with substantial or minimal documented abundance and diversity of native species or located outside of these areas, based on GIS analysis			Percentage of projects that would have neutral or unknown, positive, or negative impacts on native species as indicated by project-level surveys			Impacts to Native Species Performance Measure Scores
	In Areas of Substantial Abundance	In Areas of Minimal Abundance	Outside	Neutral/Unknown	Positive	Negative	
Conveyance Improvement	20%	40%	40%	100%	0%	0%	3.00
Enhanced Conservation	NA	NA	NA	NA	NA	NA	NA
Gray Water Use	100%	0%	0%	100%	0%	0%	3.00
Groundwater	9%	18%	73%	64%	18%	0%	3.18
Imported Water	NA	NA	NA	100%	0%	0%	3.00
Potable Reuse	0%	0%	100%	58%	17%	8%	3.00
Recycled Water	0%	4%	96%	59%	0%	0%	3.00
Seawater Desalination	0%	0%	100%	67%	0%	0%	3.00
Stormwater BMPs	24%	76%	0%	74%	26%	0%	3.26
Stormwater Capture	0%	0%	100%	100%	0%	0%	3.00
Urban & Agricultural Water Use Efficiency	25%	25%	50%	25%	100%	0%	3.25
Watershed & Ecosystem Management	22%	72%	6%	57%	43%	0%	3.64

4.1.7.4 Overall Evaluation Objective Results for Protect Habitats, Wildlife, and Ecosystems

The resulting Protect Habitats, Wildlife, and Ecosystems Performance Measure scores and overall Evaluation Objective scores are shown in Table 43 and Figure 62. Seven of the 12 Concepts had neutral 3.0 Evaluation Objective scores. One Concept, Enhanced Conservation, did not receive a score due to a lack of survey and GIS data. Four Concepts received scores greater than 3.0: Watershed and Ecosystem Management with a score of 3.35, Stormwater BMPs with a score of 3.19, Urban and Agricultural Water Use Efficiency with a score of 3.08, and Groundwater with a score of 3.06.

Table 43. Protect Habitats, Wildlife, and Ecosystems Evaluation Objective scores.

Concept	Impacts to Ecosystems Performance Measure Scores	Impacts on Threatened and Endangered Species Performance Measure Scores	Impacts on Native Species Performance Measure Scores	Protect Habitats, Wildlife, and Ecosystems Performance Measure and Evaluation Objective Unweighted Scores
Conveyance Improvement	3.00	3.00	3.00	3.00
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.00	3.00	3.00	3.00
Groundwater	3.00	3.00	3.18	3.06
Imported Water	3.00	3.00	3.00	3.00
Potable Reuse	3.00	3.00	3.00	3.00
Recycled Water	3.00	3.00	3.00	3.00
Seawater Desalination	3.00	3.00	3.00	3.00
Stormwater BMPs	3.23	3.08	3.26	3.19
Stormwater Capture	3.00	3.00	3.00	3.00
Urban & Agricultural Water Use Efficiency	3.00	3.00	3.25	3.08
Watershed & Ecosystem Management	3.36	3.06	3.64	3.35

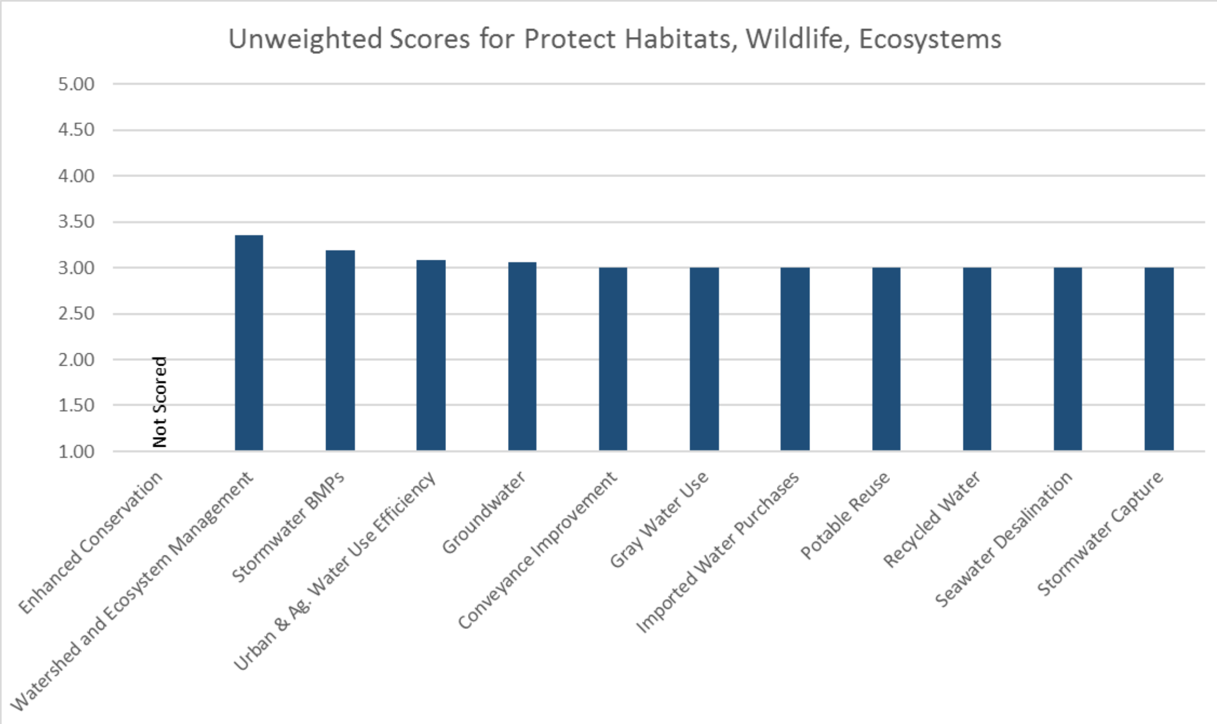


Figure 62. Protect Habitats, Wildlife, and Ecosystems Evaluation Objective unweighted scores.

The scores of 3.0 for Conveyance Improvement, Gray Water Use, Imported Water Purchases, Recycled Water, Seawater Desalination, and Stormwater Capture were the direct result of the project-level survey responses indicating neutral or no impact for projects within that Concept. The score of 3.0 for Potable Reuse was due to all projects being located outside of managed habitats and in areas where there are no threatened, endangered, or native species as indicated by the GIS analysis. Four Concepts (Groundwater, Stormwater BMPs, Urban and Agricultural Water Use Efficiency, and Watershed and Ecosystem Management) had non-neutral Protect Habitats, Wildlife, and Ecosystems Evaluation Objective Scores due to either non-neutral survey responses or locations that have impacts on managed habitats, threatened, endangered, or at-risk species, or native species.

4.1.8. Provide for Scalability of Implementation

The Scalability of Implementation Evaluation Objective scores were based on one Performance Measure, Project Phasing.

4.1.8.1 Project Phasing Performance Measure Results

The Project Phasing Performance Measure was based on survey responses at the project- and Concept-levels to a question about project phasing and expansion.

The Project Phasing Performance Measure scores are presented in Table 44. The average Project Phasing score was 3.37. The highest score was 4.07 for Urban and Agricultural Water Use Efficiency. Several projects within this Concept included water conservation rebate programs that are either designed to be phased or can be easily expanded. The lowest score was 2.53 for Seawater Desalination. Nine of the 11 scored Concepts had a score above a neutral 3.0 value. Enhanced Conservation was given a score of NA because it was not included in the surveys.

Because the Project Phasing Performance Measure was based on survey responses, the Performance Measure values were a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. There was a difference of nearly two points on a five-point scale between the project-level and Concept-level scores for Provide for Scalability of Implementation for Imported Water Purchases (1.93 points) and Seawater Desalination (1.12 points). For Imported Water Purchases, this difference may be due to the fact that there is a single project within this Concept, Cadiz, and the survey response reflected an extreme difficulty to phase or expand this particular project. Similarly, Seawater Desalination only has three projects, so the difference between project-level and Concept-level responses may be due to specific difficulty in phasing those projects compared to a general understanding of the ability to phase desalination projects. The other Concepts all had relatively similar project-level and Concept-level scores.

4.1.8.2 Overall Evaluation Objective Results for Provide Scalability of Implementation

The overall results for the Project Complexity Evaluation Objective are the same as the results for the Project Complexity and Feasibility Performance Measure because it is the only Performance Measure that makes up the Evaluation Objective Score. The Provide for Scalability of Implementation Evaluation Objective scores are presented in Table 44 and Figure 63.

Table 44. Project Phasing Performance Measure and Provide for Scalability of Implementation Evaluation Objective scores and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Project Phasing	Concept-level Survey Results for Project Phasing	Difference between project-level and Concept-level Survey Results for Project Phasing	Project Phasing Performance Measure Scores and Scalability of Implementation Evaluation Objective Unweighted Scores
Conveyance Improvement	3.00	3.53	0.53	3.27
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	4.00	3.57	0.43	3.60

Concept	Project-level Survey Results for Project Phasing	Concept-level Survey Results for Project Phasing	Difference between project-level and Concept-level Survey Results for Project Phasing	Project Phasing Performance Measure Scores and Scalability of Implementation Evaluation Objective Unweighted Scores
Groundwater	2.78	3.36	0.58	3.07
Imported Water	1.00	2.93	1.93	2.80
Potable Reuse	3.70	3.86	0.16	3.78
Recycled Water	4.13	3.57	0.55	3.85
Seawater Desalination	3.50	2.38	1.12	2.53
Stormwater BMPs	3.15	3.29	0.14	3.22
Stormwater Capture	4.00	3.29	0.71	3.38
Urban & Agricultural Water Use Efficiency	4.00	4.14	0.14	4.07
Watershed & Ecosystem Management	3.14	3.86	0.71	3.50

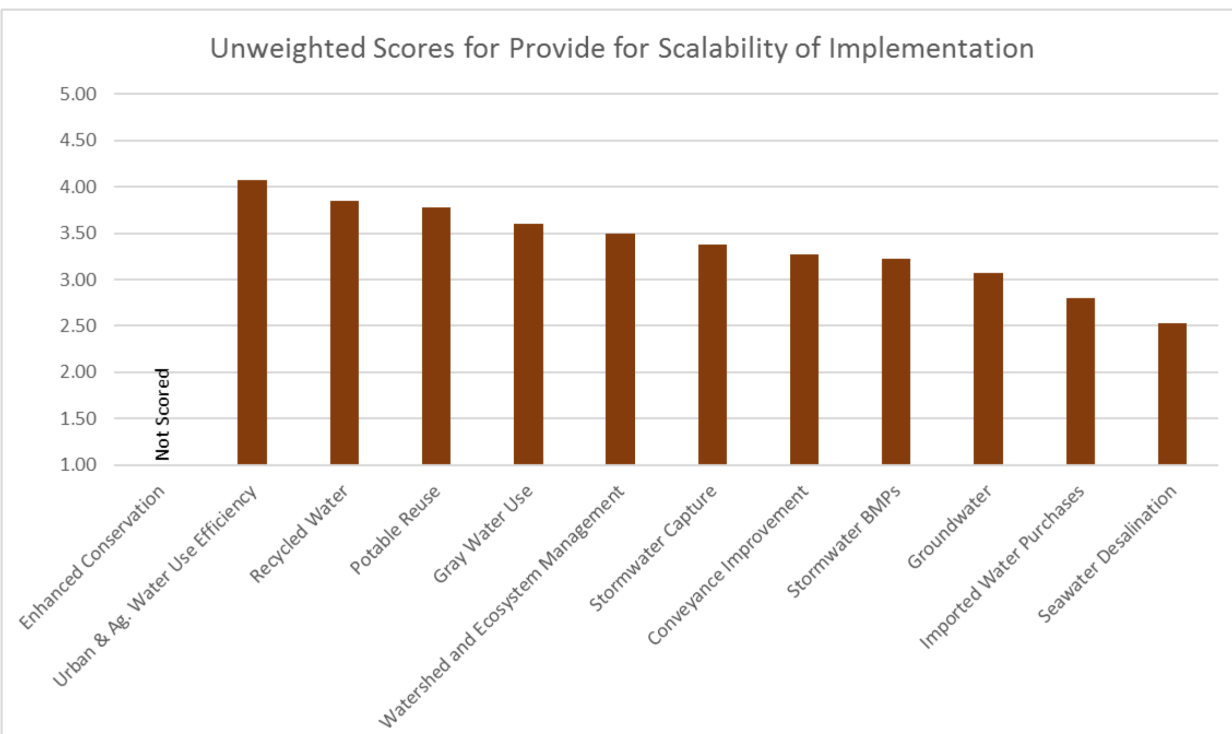


Figure 63. Scalability of Implementation Evaluation Objective unweighted scores.

4.1.9. Quality of Life/Recreation

The Quality of Life/Recreation Evaluation Objective included two Performance Measures, Green Space/Open Space and Recreation Opportunities. The Green Space/Open Space Performance Measure was the average of two sub-scores: Green Space/Open Space and Quality of Life. The Recreation Opportunities Performance Measure was the average of two sub-scores: Recreation Opportunities and Visitation Impacts for Changes in Reservoir Elevation. All the sub-scores except Visitation Impacts for Changes in Reservoir Elevation were derived directly from the average of project- and Concept-level survey question responses. The Visitation Impacts for Changes in Reservoir Elevation sub-score was derived from recreation visitation modeling results based on modeled changes in reservoir elevation at four reservoirs.

4.1.9.1 Green Space/Open Space Performance Measure Results

The Green Space/Open Space sub-score results are shown in Table 45. The sub-scores ranged from 2.85 to 4.73 with an average of 3.52. The highest scoring Concept was Watershed and Ecosystem Management and the lowest scoring Concept was Conveyance Improvement. Enhanced Conservation was given a score of NA because it was not included in the surveys. Because the Green Space/Open Space sub-score was based on survey responses, the overall Performance Measure value was a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project’s effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The scoring differences for Urban and Agricultural Water Use Efficiency are greater than one point, and the scoring differences for Gray Water and Recycled Water are greater than 0.5 points, but all other differences are relatively small.

Table 45. Green Space/Open Space sub-scores.

Concept	Project-level Survey Results for Green Space/Open Space	Concept-level Survey Results for Green Space/Open Space	Difference between project-Level and Concept-level Survey Results for Green Space/Open Space	Green Space/Open Space Sub-scores
Conveyance Improvement	2.83	2.87	0.03	2.85
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	4.00	3.27	0.73	3.31
Groundwater	3.11	3.07	0.04	3.09
Imported Water	3.00	3.07	0.07	3.06
Potable Reuse	3.00	3.13	0.13	3.07

Concept	Project-level Survey Results for Green Space/Open Space	Concept-level Survey Results for Green Space/Open Space	Difference between project-Level and Concept-level Survey Results for Green Space/Open Space	Green Space/Open Space Sub-scores
Recycled Water	4.38	3.80	0.58	4.09
Seawater Desalination	3.00	2.93	0.07	2.94
Stormwater BMPs	4.45	4.13	0.32	4.29
Stormwater Capture	3.50	3.27	0.23	3.29
Urban & Agricultural Water Use Efficiency	4.60	3.47	1.13	4.03
Watershed & Ecosystem Management	4.86	4.60	0.26	4.73

4.1.9.2 Recreation Opportunities Performance Measure Results

The Quality of Life sub-score results are presented in Table 46. The sub-scores ranged from 3.06 to 4.55 with an average of 3.78. The highest scoring Concept was Watershed and Ecosystem Management. Because the Quality of Life sub-score was based on survey responses, the overall Performance Measure value was a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The scoring differences for Gray Water Use and Urban and Agricultural Water Use Efficiency were one point or greater, and the differences for Seawater Desalination, Recycled Water, and Conveyance Improvement were greater than 0.5 points, but all other differences were relatively small.

Table 46. Quality of Life sub-scores.

Concept	Project-level Survey Results for Quality of Life	Concept-level Survey Results for Quality of Life	Difference between project-Level and Concept-level Survey Results for Quality of Life	Quality of Life Sub-scores
Conveyance Improvement	4.00	3.47	0.53	3.73
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	5.00	3.27	1.73	3.38
Groundwater	3.22	3.00	0.22	3.11

Concept	Project-level Survey Results for Quality of Life	Concept-level Survey Results for Quality of Life	Difference between project-Level and Concept-level Survey Results for Quality of Life	Quality of Life Sub-scores
Imported Water	3.00	3.07	0.07	3.06
Potable Reuse	3.80	3.60	0.20	3.70
Recycled Water	4.38	3.73	0.64	4.05
Seawater Desalination	4.00	3.27	0.73	3.35
Stormwater BMPs	4.60	4.47	0.13	4.53
Stormwater Capture	4.00	3.53	0.47	3.59
Urban & Agricultural Water Use Efficiency	5.00	4.00	1.00	4.50
Watershed & Ecosystem Management	4.57	4.53	0.04	4.55

The Green Space/Open Space Performance Measure results are shown in Table 47. The Performance Measure scores ranged from 3.06 to 4.64 with an average of 3.65. The highest scoring Concept was Watershed and Ecosystem Management and the lowest scoring Concept was Imported Water Purchases. Enhanced Conservation was given a score of NA because it was not included in the surveys.

Table 47. Green Space/Open Space Performance Measure results and associated sub-scores.

\Concept	Green Space/Open Space Sub-scores	Quality of Life Sub-scores	Green Space/Open Space Performance Measure Scores
Conveyance Improvement	2.85	3.73	3.29
Enhanced Conservation	NA	NA	NA
Gray Water Use	3.31	3.38	3.34
Groundwater	3.09	3.11	3.10
Imported Water	3.06	3.06	3.06
Potable Reuse	3.07	3.70	3.38
Recycled Water	4.09	4.05	4.07
Seawater Desalination	2.94	3.35	3.15

\Concept	Green Space/Open Space Sub-scores	Quality of Life Sub-scores	Green Space/Open Space Performance Measure Scores
Stormwater BMPs	4.29	4.53	4.41
Stormwater Capture	3.29	3.59	3.44
Urban & Agricultural Water Use Efficiency	4.03	4.50	4.27
Watershed & Ecosystem Management	4.73	4.55	4.64

4.1.9.3 Recreation Opportunities Performance Measure Results

The Recreation Opportunities Performance Measure is the average of two sub-scores, Recreation Opportunities and Visitation Impacts for Changes in Reservoir Elevation. The Recreation Opportunities sub-scores used in the calculation of the Recreation Opportunities Performance Measure scores are shown in Table 48. The Recreation Opportunities sub-scores ranged from 2.76 to 4.45 with an average of 3.30. The highest scoring Concept was Watershed and Ecosystem Management and the lowest scoring Concept was Seawater Desalination. Because the Recreation Opportunities sub-score was based on survey responses, the overall Performance Measure value was a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The scoring differences for Urban and Agricultural Water Use Efficiency, Stormwater BMPs, Recycled Water, and Stormwater Capture were greater than 0.5 points, but all other differences were relatively small.

Table 48. Recreation Opportunities sub-scores and difference between project-level and Concept-level results.

Concept	Project-level Survey Results for Recreation Opportunities	Concept-level Survey Results for Recreation Opportunities	Difference between project-Level and Concept-level Survey Results for Recreation Opportunities	Recreation Opportunities Sub-scores
Conveyance Improvement	2.83	3.07	0.24	2.95
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.00	3.00	0.00	3.00
Groundwater	2.89	2.87	0.02	2.88

Concept	Project-level Survey Results for Recreation Opportunities	Concept-level Survey Results for Recreation Opportunities	Difference between project-Level and Concept-level Survey Results for Recreation Opportunities	Recreation Opportunities Sub-scores
Imported Water	3.00	2.93	0.07	2.94
Potable Reuse	3.10	3.00	0.10	3.05
Recycled Water	4.13	3.47	0.66	3.80
Seawater Desalination	3.00	2.73	0.27	2.76
Stormwater BMPs	4.32	3.50	0.82	3.91
Stormwater Capture	2.50	3.13	0.63	3.06
Urban & Agricultural Water Use Efficiency	4.00	3.07	0.93	3.53
Watershed & Ecosystem Management	4.50	4.40	0.10	4.45

The Visitation Impacts sub-score quantifies the change in recreation visitation for each Concept relative to baseline conditions based on changes in reservoir elevation at El Capitan, Hodges, Lower Otay, and San Vicente Reservoirs. The Task 2.5 model metric used to evaluate recreation was the average monthly elevation for each reservoir. The estimated annual change in visitation for each Concept relative to baseline and the percentage change in Visitation relative to baseline are presented in Table 49. The Conveyance Improvement Concept had the greatest positive impact on recreation visitation, followed by Potable Reuse and Enhanced Conservation. The Watershed and Ecosystem Management Concept had the greatest negative impact on visitation relative to Baseline conditions. All other Concepts had very small impacts on recreation visitation, resulting in scores very close to 3.0.

Table 49. Estimated change in recreation visitation based on visitation modeling and Task 2.5 model metrics.

Concept	Estimated Annual Change in Recreation Visitation from Visitation Model	Estimated Percentage Change in Annual Visitation	Visitation Impacts Sub-scores (Visitation Modeling converted to 1-5 scale)
Conveyance Improvement	13,358	8.14%	5.00
Enhanced Conservation	2,910	1.77%	3.44
Gray Water Use	47	0.03%	3.01

Concept	Estimated Annual Change in Recreation Visitation from Visitation Model	Estimated Percentage Change in Annual Visitation	Visitation Impacts Sub-scores (Visitation Modeling converted to 1-5 scale)
Groundwater	129	0.08%	3.02
Imported Water	-3	0.00%	3.00
Potable Reuse	6,833	4.16%	4.02
Recycled Water	85	0.05%	3.01
Seawater Desalination	17	0.01%	3.00
Stormwater BMPs	6	0.00%	3.00
Stormwater Capture	13	0.01%	3.00
Urban & Agricultural Water Use Efficiency	17	0.01%	3.00
Watershed & Ecosystem Management	-3,464	-2.11%	2.48

The Recreation Opportunities Performance Measure scores are shown in Table 50. The Recreational Opportunities Performance Measure scores ranged from 2.88 for Seawater Desalination to 3.98 for Conveyance Improvement, with an average of 3.27. Enhanced Conservation received a score of NA because it could not be scored for the Recreation Opportunities sub-score because it was not included in the surveys.

Table 50. Recreation Opportunities Performance Measure results and associated sub-scores.

Concept	Recreation Opportunities Sub-scores	Visitation Impacts Sub-scores	Recreation Opportunities Performance Measure Scores
Conveyance Improvement	2.95	5.00	3.98
Enhanced Conservation	NA	3.44	NA
Gray Water Use	3.00	3.01	3.00
Groundwater	2.88	3.02	2.95
Imported Water	2.94	3.00	2.97
Potable Reuse	3.05	4.02	3.54
Recycled Water	3.80	3.01	3.40

Concept	Recreation Opportunities Sub-scores	Visitation Impacts Sub-scores	Recreation Opportunities Performance Measure Scores
Seawater Desalination	2.76	3.00	2.88
Stormwater BMPs	3.91	3.00	3.45
Stormwater Capture	3.06	3.00	3.03
Urban & Agricultural Water Use Efficiency	3.53	3.00	3.27
Watershed & Ecosystem Management	4.45	2.48	3.47

4.1.9.4 Overall Evaluation Objective Results for Quality of Life/Recreation

Final Quality of Life/Recreation scores are presented in Table 51 and Figure 64. The Overall Quality of Life/Recreation scores ranged from 3.02 to 4.05 with an average score of 3.46. The highest score was for Watershed and Ecosystem Management and the lowest score was for Seawater Desalination, Groundwater, and Imported Water.

The Quality of Life Scores/Recreation scores were all neutral or greater, indicating that no Concepts have an overall negative impact on Quality of Life or Recreation.

Table 51. Quality of Life/Recreation Evaluation Objective scores.

Concept	Green Space/Open Space Performance Measure Scores	Recreation Opportunities Performance Measure Scores	Quality of Life/Recreation Evaluation Objective Unweighted Scores
Conveyance Improvement	3.29	3.98	3.63
Enhanced Conservation	NA	NA	NA
Gray Water Use	3.34	3.00	3.17
Groundwater	3.10	2.95	3.02
Imported Water	3.06	2.97	3.02
Potable Reuse	3.38	3.54	3.46
Recycled Water	4.07	3.40	3.74
Seawater Desalination	3.15	2.88	3.02
Stormwater BMPs	4.41	3.45	3.93

Concept	Green Space/Open Space Performance Measure Scores	Recreation Opportunities Performance Measure Scores	Quality of Life/Recreation Evaluation Objective Unweighted Scores
Stormwater Capture	3.44	3.03	3.24
Urban & Agricultural Water Use Efficiency	4.27	3.27	3.77
Watershed & Ecosystem Management	4.64	3.47	4.05

Figure 64. Quality of Life/Recreation Evaluation Objective unweighted scores.

4.1.10. Regional Economic Impact

The Regional Economic Impact Evaluation Objective included one Performance Measure, Regional Economic Impact.

4.1.10.1 Regional Economic Impact Performance Measure Results

The Regional Economic Impact Performance Measure was calculated from a combination of project-level survey responses and responses from a panel of regional economic experts.

Enhanced Conservation was given a score of NA for the project-level surveys because it was not included in the surveys. However, it was included in the questionnaire for regional economic experts, so it was scored at the Concept-level.

Because the Regional Economic Impact Performance Measure was based on survey responses, the overall Performance Measure value was a combination of project-level survey responses and responses from an expert panel. Larger differences between project-level and expert panel scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the understanding of the experts regarding the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The difference between project-level and expert panel survey scores was notable for Gray Water Use, Urban and Agricultural Water Use Efficiency, and Stormwater Capture (Table 52). Similar to the other differences discussed, the source of variation was likely a result of specific local project perspective and experience, and a more general understanding of categories of impact.

It should be noted that project-level costs were not explicitly defined for those responding to the Concept-level survey and participating in the Regional Economic Impact Workshop. For assessments of Regional Economic Impact to be more informative, it would be beneficial to have certain factors clearly defined before scoring, such as project costs or estimates of employment during project implementation and operations.

4.1.10.2 Overall Evaluation Objective Results for Regional Economic Impact

The overall results for the Regional Economic Impact Evaluation Objective are the same as the results for the Project Complexity and Feasibility Performance Measure because it is the only Performance Measure that makes up the Evaluation Objective Score. The Overall Regional Economic Impact scores ranged from 2.60 to 4.80 with an average of 3.79. The highest score was for Potable Reuse and the lowest score was for Enhanced Conservation.

The Regional Economic Impact results are summarized in Table 52 and Figure 65.

Table 52. Regional Economic Impact Performance Measure and Evaluation Objective Scores and difference between project-level and Concept-level survey results.

Concept	Project- level Survey Results for Regional Economic Impact	Expert Panel Results for General Economic Impact	Difference between project-level and Expert Panel Results for Regional Economic Impact	Regional Economic Impact Performance Measure and Evaluation Objective Unweighted Scores
Conveyance Improvement	4.33	3.70	0.63	4.05
Enhanced Conservation	NA	2.60	NA	2.60
Gray Water Use	5.00	3.20	1.80	3.50

Concept	Project- level Survey Results for Regional Economic Impact	Expert Panel Results for General Economic Impact	Difference between project-level and Expert Panel Results for Regional Economic Impact	Regional Economic Impact Performance Measure and Evaluation Objective Unweighted Scores
Groundwater	4.11	4.60	0.49	4.36
Imported Water	3.00	2.80	0.20	2.83
Potable Reuse	4.60	5.00	0.40	4.80
Recycled Water	4.50	4.80	0.30	4.65
Seawater Desalination	4.00	3.50	0.50	3.64
Stormwater BMPs	3.40	3.10	0.30	3.25
Stormwater Capture	5.00	3.60	1.40	4.00
Urban & Agricultural Water Use Efficiency	5.00	3.40	1.60	4.20
Watershed & Ecosystem Management	3.43	3.80	0.37	3.61

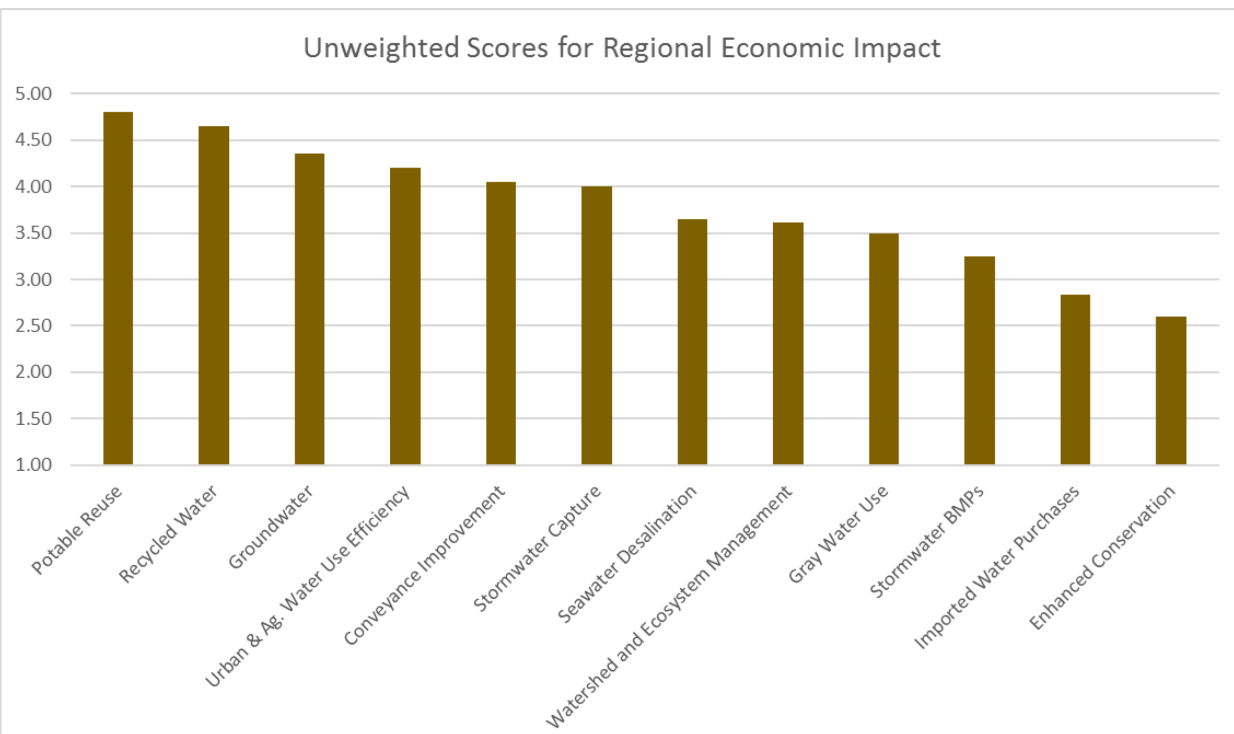


Figure 65. Regional Economic Impact Evaluation Objective unweighted scores.

4.1.11. Regional Integration and Coordination

The Regional Integration and Coordination score was based on two Performance Measures: Coordination, and Education and Outreach, which are both based entirely on project-level and Concept-level survey responses. The Evaluation Objective unweighted score was an average of the two Performance Measures.

4.1.11.1 Coordination Performance Measure Results

The Coordination Performance Measure had two sub-scores. The first sub-score, Integration, quantified the level of integration or coordination with other projects or entities that is required to implement a project within a Concept. The second sub-score, Leveraging, quantified the need for leveraging assets or building off existing projects. The scores for the Integration sub-score are presented in Table 53 and the scores for the Leveraging sub-score are presented in Table 54. The scores for the Coordination Performance Measure are presented in Table 55.

The combined Integration sub-scores ranged from 2.45 to 4.22 with an average of 3.10. The highest Integration sub-score was for Seawater Desalination and the lowest was for Stormwater BMPs. Because the Integration sub-score was based on survey responses, the overall Performance Measure value was a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The differences between project-level and Concept-level survey scores used to calculate the Integration sub-score were substantial for several Concepts in that four Concepts had a difference between project-level and Concept-level scores of one point or more.

Table 53. Integration sub-scores and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Integration	Concept-level Survey Results for Integration	Difference between project- and Concept-level Survey Results for Integration	Integration Sub-scores
Conveyance Improvement	2.17	2.81	0.65	2.49
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	2.00	2.56	0.56	2.53
Groundwater	3.78	3.56	0.22	3.67
Imported Water	3.00	3.19	0.19	3.18
Potable Reuse	4.30	3.75	0.55	4.03

Concept	Project-level Survey Results for Integration	Concept-level Survey Results for Integration	Difference between project- and Concept-level Survey Results for Integration	Integration Sub-scores
Recycled Water	2.63	3.13	0.50	2.88
Seawater Desalination	3.00	4.38	1.38	4.22
Stormwater BMPs	2.40	2.50	0.10	2.45
Stormwater Capture	1.50	3.38	1.88	3.17
Urban & Agricultural Water Use Efficiency	3.40	2.38	1.03	2.89
Watershed & Ecosystem Management	2.00	3.13	1.13	2.56

The combined Leveraging sub-scores ranged from 1.79 to 4.37, as shown in Table 54, with an average score of 3.19. The highest leveraging sub-score was for Recycled Water and the lowest sub-score was for Gray Water Use. Enhanced Conservation was again given a score of NA due to the lack of survey responses. Because the Leveraging sub-scores were based on survey responses, the overall Performance Measure value was a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The differences between project-level and Concept-level survey scores used to calculate the Leveraging sub-score were substantial for several Concepts, with six Concepts that had a mean scoring difference of one point or more.

Table 54. Leveraging sub-scores and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Leveraging	Concept-level Survey Results for Leveraging	Difference between project- and Concept-level Survey Results for Leveraging	Leveraging Sub-scores
Conveyance Improvement	4.50	3.25	1.25	3.88
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.00	1.69	1.31	1.79
Groundwater	4.00	3.67	0.33	3.83

Concept	Project-level Survey Results for Leveraging	Concept-level Survey Results for Leveraging	Difference between project- and Concept-level Survey Results for Leveraging	Leveraging Sub-scores
Imported Water	5.00	2.89	2.11	3.10
Potable Reuse	5.00	3.00	2.00	4.00
Recycled Water	4.88	3.86	1.02	4.37
Seawater Desalination	3.00	3.50	0.50	3.25
Stormwater BMPs	2.58	2.86	0.28	2.72
Stormwater Capture	4.00	3.14	0.86	3.33
Urban & Agricultural Water Use Efficiency	3.40	1.80	1.60	2.60
Watershed & Ecosystem Management	1.92	2.50	0.58	2.21

Table 55. Coordination Performance Measure results and associated sub-scores.

Concept	Integration Sub-scores	Leveraging Sub-scores	Coordination Performance Measure Scores
Conveyance Improvement	2.49	3.88	3.18
Enhanced Conservation	NA	NA	NA
Gray Water Use	2.53	1.79	2.16
Groundwater	3.67	3.83	3.75
Imported Water	3.18	3.10	3.14
Potable Reuse	4.03	4.00	4.01
Recycled Water	2.88	4.37	3.62
Seawater Desalination	4.22	3.25	3.74
Stormwater BMPs	2.45	2.72	2.58
Stormwater Capture	3.17	3.33	3.25
Urban & Agricultural Water Use Efficiency	2.89	2.60	2.74
Watershed & Ecosystem Management	2.56	2.21	2.39

4.1.11.2 Education and Outreach Performance Measure Results

The Education and Outreach Performance Measure was based on project-level and Concept-level survey responses. The scores for the Education and Outreach Performance Measure are presented in Table 56. The Education and Outreach Performance Measure scores ranged from 1.93 to 4.71 with an average score of 3.63. The highest score was for Urban and Agricultural Water Use Efficiency and the lowest was for Imported Water Purchases. Enhanced Conservation was given a score of NA because it was not included in the surveys. Because the Education and Outreach Performance Measure was based on survey responses, the overall Performance Measure value was a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The differences between project-level and Concept-level survey scores used to calculate the Education and Outreach Performance Measure were relatively small, but Imported Water Purchases and Watershed and Ecosystem Management had mean scoring differences between the project-level survey and the Concept-level survey of more than one point.

Table 56. Education and Outreach Performance Measure scores and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Education and Outreach	Concept-level Survey Results for Education and Outreach	Difference between project- and Concept-level Survey Results for Education and Outreach	Education and Outreach Performance Measure Scores
Conveyance Improvement	2.33	2.53	0.20	2.43
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	5.00	4.14	0.86	4.20
Groundwater	3.33	3.36	0.02	3.35
Imported Water	3.00	1.86	1.14	1.93
Potable Reuse	4.20	4.57	0.37	4.39
Recycled Water	3.44	3.86	0.42	3.65
Seawater Desalination	3.00	4.00	1.00	3.88
Stormwater BMPs	3.15	4.00	0.85	3.58
Stormwater Capture	3.50	4.07	0.57	4.00
Urban & Agricultural Water Use Efficiency	5.00	4.43	0.57	4.71

Concept	Project-level Survey Results for Education and Outreach	Concept-level Survey Results for Education and Outreach	Difference between project- and Concept-level Survey Results for Education and Outreach	Education and Outreach Performance Measure Scores
Watershed & Ecosystem Management	3.29	4.36	1.07	3.82

4.1.11.3 Overall Regional Integration and Coordination Evaluation Objective Results

The Regional Integration and Coordination Evaluation Objective unweighted scores are presented in Table 57 and Figure 66. The Overall Regional Integration scores ranged from 2.54 to 4.20 with an average of 3.39. The highest score was for Potable Reuse and the lowest score was for Imported Water Purchases. All but two Concepts scored above 3.0, and only one scored above 4.0, indicating that most Concepts require moderate integration or coordination, sometimes require leveraging, and provide limited education and outreach opportunities. Enhanced Conservation was given a score of NA because it could not be scored for either of the two Performance Measures that make up the Evaluation Objective.

Table 57. Regional Integration and Coordination Evaluation Objective unweighted scores and associated Performance Measures.

Concept	Coordination Performance Measure Scores	Education and Outreach Performance Measure Scores	Regional Integration and Coordination Evaluation Objective Unweighted Scores
Conveyance Improvement	3.18	2.43	2.81
Enhanced Conservation	NA	NA	NA
Gray Water Use	2.16	4.20	3.18
Groundwater	3.75	3.35	3.55
Imported Water	3.14	1.93	2.54
Potable Reuse	4.01	4.39	4.20
Recycled Water	3.62	3.65	3.63
Seawater Desalination	3.74	3.88	3.81
Stormwater BMPs	2.58	3.58	3.08
Stormwater Capture	3.25	4.00	3.63
Urban & Agricultural Water Use Efficiency	2.74	4.71	3.73

Concept	Coordination Performance Measure Scores	Education and Outreach Performance Measure Scores	Regional Integration and Coordination Evaluation Objective Unweighted Scores
Watershed & Ecosystem Management	2.39	3.82	3.10

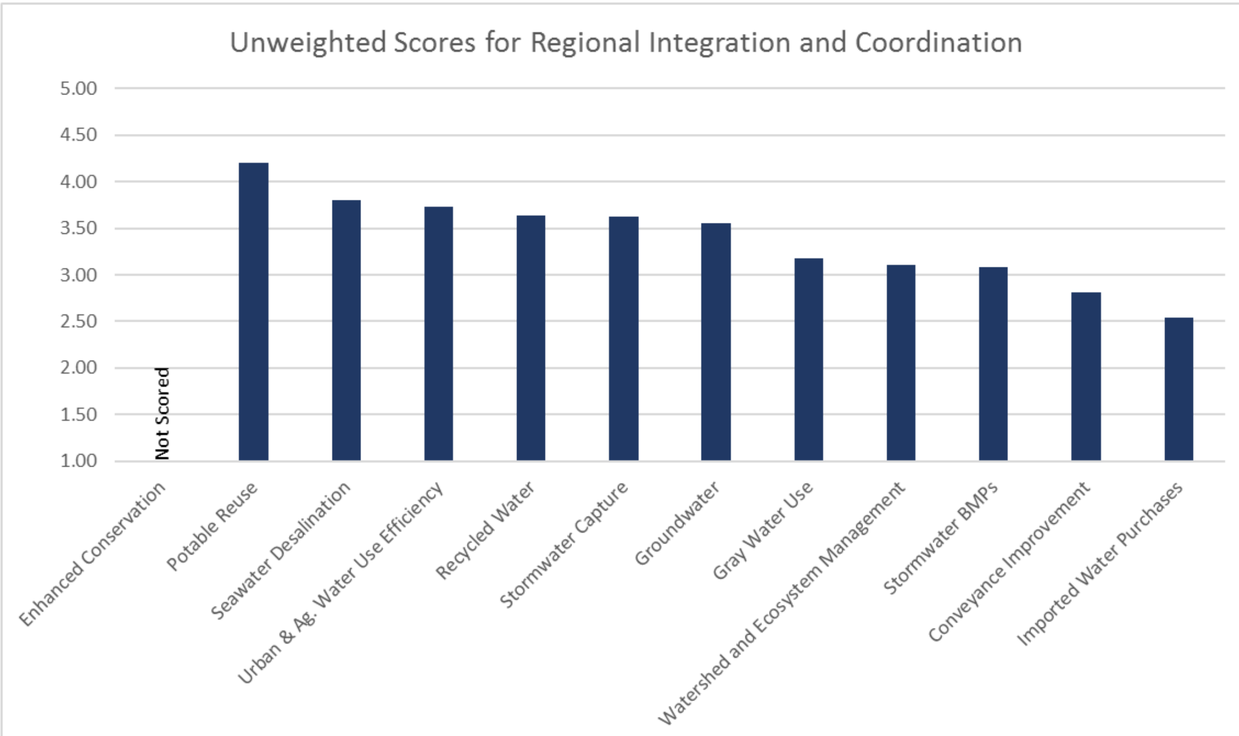


Figure 66. Regional Integration and Coordination Evaluation Objective unweighted scores.

4.1.12. Reliability and Robustness

The Reliability and Robustness Evaluation Objective included three Performance Measures: Water Shortage Volume, Vulnerability of Water Supply Facilities and Infrastructure, and Carryover Storage & Reservoir Augmentation. The Water Shortage Volume Performance Measure was based on modeling results for water shortage volume. The Vulnerability of Water Supply Facilities and Infrastructure and Carryover Storage & Reservoir Augmentation Performance Measures were based on survey responses at the project- and Concept-level.

4.1.12.1 Water Shortage Volume Performance Measure Results

The average annual shortage in acre-feet was used to compare Concepts with the baseline condition. The results of the model metric for water shortage volume are shown in Table 58. The conversion of shortage volume to a 1 to 5 scale assumed the highest positive volume was a 5, a volume of 0 was a 3, and the greatest deficit was a 1, with linear interpolation between 1 and 3 and 3 and 5. No Concept resulted in increased shortage volumes compared to the baseline. Therefore, all the scores were a 3 or above. The average score was 3.58 and the highest scoring Concepts were Enhanced Conservation and Potable Reuse. The lowest scoring were Stormwater BMPs and Stormwater Capture.

Table 58. Reduction in Shortage Volumes by Concept relative to Baseline and resulting Water Shortage Volume Performance Measure scores.

Concept	Reduction in Average Annual Water Shortage (AF/y)	Water Shortage Volume Performance Measure Score (Shortage Reduction on a 1 to 5 scale)
Conveyance Improvement	246	3.10
Enhanced Conservation	4,734	5.00
Gray Water Use	400	3.17
Groundwater	1,914	3.81
Imported Water	348	3.15
Potable Reuse	3,204	4.35
Recycled Water	2,082	3.88
Seawater Desalination	2,762	4.17
Stormwater BMPs	12	3.01
Stormwater Capture	100	3.04
Urban & Agricultural Water Use Efficiency	338	3.14
Watershed & Ecosystem Management	287	3.12

4.1.12.2 Vulnerability of Water Supply Facilities and Infrastructure Performance Measure Results

The Vulnerability of Water Supply Facilities and Infrastructure Performance Measure was based on the results of surveys of identified experts and stakeholders. Four survey questions corresponding to four sub-scores were used to evaluate Concepts for Vulnerability of Water Supply Facilities and Infrastructure. The first sub-score, Diversity of Water Supply, evaluated the ability of a Concept to increase the diversity of water supply. The second sub-score, Resilience of Conveyance System, evaluated the extent to which the Concept increases the resilience of the conveyance system such as an ability to withstand or recover from impacts such as pipeline failures. The third sub-score, Aging Infrastructure, evaluated the impact of the

Concept on aging infrastructure. The fourth sub-score, Insufficient Wastewater Flows, evaluated the effect of a Concept on problems associated with insufficient wastewater flows to move solid waste, such as increased odor production, rate of corrosion, settling and blockages, and number of O&M work orders for the wastewater conveyance system.

Because the Vulnerability of Water Supplies and Infrastructure Performance Measure was based on survey responses, the Performance Measure values were a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective.

Diversity of Water Supplies sub-scores ranged from 2.59 to 4.97, as shown in Table 59. Enhanced Conservation received a score of NA because it was not included in the survey. Imported Water showed a very large difference between project-level and Concept-level scores.

Table 59. Diversity of Water Supply Sub-score within the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Diversity of Water Supply	Concept-level Survey Results for Diversity of Water Supply	Difference between project- and Concept-level Survey Results for Diversity of Water Supply	Diversity of Water Supply Sub-Scores
Conveyance Improvement	3.83	4.00	0.17	3.92
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	5.00	4.69	0.31	4.71
Groundwater	5.00	4.81	0.19	4.91
Imported Water	5.00	2.44	2.56	2.59
Potable Reuse	4.60	5.00	0.40	4.80
Recycled Water	5.00	4.94	0.06	4.97
Seawater Desalination	5.00	4.94	0.06	4.94
Stormwater BMPs	3.25	3.13	0.13	3.19
Stormwater Capture	5.00	4.75	0.25	4.78
Urban & Agricultural Water Use Efficiency	3.80	3.88	0.08	3.84
Watershed & Ecosystem Management	3.29	3.38	0.09	3.33

Resilience of Conveyance System sub-scores ranged from 2.81 to 4.64, as shown in Table 60. Enhanced Conservation received a score of NA because it was not included in the survey. Project-level and Concept-level scores differed by one point or more for Seawater Desalination, Watershed and Ecosystem Management, and Urban and Agricultural Water Use Efficiency.

Table 60. Resilience of Conveyance System Sub-score within the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Resilience of Conveyance System	Concept-level Survey Results Resilience of Conveyance System	Difference between project- and Concept-level Survey Results for Resilience of Conveyance System	Resilience of Conveyance System Sub-Scores
Conveyance Improvement	4.33	4.94	0.60	4.64
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.00	3.50	0.50	3.47
Groundwater	3.56	3.56	0.01	3.56
Imported Water	NA	2.81	NA	2.81
Potable Reuse	4.10	3.56	0.54	3.83
Recycled Water	4.19	3.50	0.69	3.84
Seawater Desalination	5.00	3.69	1.31	3.83
Stormwater BMPs	3.75	3.25	0.50	3.50
Stormwater Capture	3.50	3.63	0.13	3.61
Urban & Agricultural Water Use Efficiency	2.40	3.44	1.04	2.92
Watershed & Ecosystem Management	4.21	3.13	1.09	3.67

Aging Infrastructure sub-scores ranged from 2.69 to 4.81, as shown in Table 61. Enhanced Conservation received a score of NA because it was not included in the survey. Five additional Concepts did not receive project-level scores for the Aging Infrastructure question, so these subs-scores are only based on Concept-level survey responses. For the Concepts that had both project-level and Concept-level scores, the difference is greater than 1.0 point for all Concepts that received both scores except for Conveyance Improvement.

Table 61. Aging Infrastructure Sub-score within the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Aging Infrastructure	Concept-level Survey Results for Aging Infrastructure	Difference between project- and Concept-level Survey Results for Aging Infrastructure	Aging Infrastructure Sub-Scores
Conveyance Improvement	5.00	4.63	0.38	4.81
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	NA	3.25	NA	3.25
Groundwater	NA	3.13	NA	3.13
Imported Water	NA	2.69	NA	2.69
Potable Reuse	4.80	2.94	1.86	3.87
Recycled Water	4.67	3.19	1.48	3.93
Seawater Desalination	NA	2.93	NA	2.93
Stormwater BMPs	5.00	3.38	1.63	4.19
Stormwater Capture	4.00	2.88	1.13	2.94
Urban & Agricultural Water Use Efficiency	NA	3.50	NA	3.50
Watershed & Ecosystem Management	5.00	3.06	1.94	4.03

Insufficient Wastewater Flows sub-scores ranged from 2.12 to 3.61, as shown in Table 62. Enhanced Conservation received a score of NA because it was not included in the survey. The difference between project-level and Concept-level survey scores is less than 1.0 point for all Concepts. The two Concepts with the greatest differences were Conveyance Improvement and Stormwater Capture.

Table 62. Insufficient Wastewater Flows Sub-score within the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Insufficient Wastewater Flows	Concept-level Survey Results for Insufficient Wastewater Flows	Difference between Project- and Concept-level Survey Results for Insufficient Wastewater Flows	Insufficient Wastewater Flows Sub-Scores
Conveyance Improvement	3.00	3.69	0.69	3.34
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	2.00	2.13	0.13	2.12
Groundwater	3.00	3.25	0.25	3.13
Imported Water	3.00	3.44	0.44	3.41
Potable Reuse	3.50	3.19	0.31	3.34
Recycled Water	3.00	3.19	0.19	3.09
Seawater Desalination	3.00	3.44	0.44	3.39
Stormwater BMPs	3.20	3.06	0.14	3.13
Stormwater Capture	3.00	3.69	0.69	3.61
Urban & Agricultural Water Use Efficiency	2.80	2.38	0.43	2.59
Watershed & Ecosystem Management	3.00	3.06	0.06	3.03

The Vulnerability of Water Supplies and Infrastructure Performance Measure is the average of the four sub-scores: Diversity of Water Supply, Resilience of Conveyance System, Aging Infrastructure, and Insufficient Wastewater Flows. The sub-scores used in the calculation of the Performance Measure scores are shown in Table 63. The Vulnerability of Water Supplies and Infrastructure scores ranged from 2.88 to 4.18 with an average of 3.62. The highest scoring Concept was Conveyance Improvement and the lowest scoring Concept was Imported Water Purchases.

Table 63. Vulnerability of Water Supplies and Infrastructure Performance Measure results and associated sub-scores.

Concept	Diversity of Water Supply Sub-Scores	Resilience of Conveyance System Sub-Scores	Aging Infrastructure Sub-Scores	Insufficient Wastewater Flows Sub-Scores	Vulnerability of Water Supplies and Infrastructure Performance Measure Scores
Conveyance Improvement	3.92	4.64	4.81	3.34	4.18
Enhanced Conservation	NA	NA	NA	NA	NA
Gray Water Use	4.71	3.47	3.25	2.12	3.39
Groundwater	4.91	3.56	3.13	3.13	3.68
Imported Water	2.59	2.81	2.69	3.41	2.88
Potable Reuse	4.80	3.83	3.87	3.34	3.96
Recycled Water	4.97	3.84	3.93	3.09	3.96
Seawater Desalination	4.94	3.83	2.93	3.39	3.78
Stormwater BMPs	3.19	3.50	4.19	3.13	3.50
Stormwater Capture	4.78	3.61	2.94	3.61	3.74
Urban & Agricultural Water Use Efficiency	3.84	2.92	3.50	2.59	3.21
Watershed & Ecosystem Management	3.33	3.67	4.03	3.03	3.52

4.1.12.3 Carryover Storage and Reservoir Augmentation Performance Measure Results

The Carryover Storage and Reservoir Augmentation Performance Measure score was based on Concept-level and project-level survey responses to a single question. Carryover Storage scores ranged from 3.06 to 4.26 with an average of 3.73. These scores reflected an understanding that all Concepts would have a positive impact on the ability to use the storage capacity of reservoirs for carryover storage. The highest scoring Concept was Potable Reuse and the lowest scoring Concept was Gray Water Use. Enhanced Conservation was given a score of NA because it was not included in the surveys.

The survey-based scoring results for the Carryover Storage Performance Measure and differences between the project- and Concept-level scoring are shown in Table 64. Because the Vulnerability of Water Supplies and Infrastructure Performance Measure is based on survey responses, the Performance Measure values were a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. There were also some differences for the Carryover Storage Performance Measure, but the differences were small.

Table 64. Carryover Storage Performance Measure scores and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Carryover Storage	Concept-level Survey Results for Carryover Storage	Difference between project- and Concept-level Survey Results for Carryover Storage	Carryover Storage Performance Measure Scores
Conveyance Improvement	3.83	4.27	0.43	4.05
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.00	3.06	0.06	3.06
Groundwater	4.00	3.69	0.31	3.84
Imported Water	4.00	3.56	0.44	3.59
Potable Reuse	4.20	4.31	0.11	4.26
Recycled Water	4.13	3.63	0.50	3.88
Seawater Desalination	4.00	3.75	0.25	3.78
Stormwater BMPs	3.17	3.56	0.40	3.36
Stormwater Capture	4.50	4.06	0.44	4.11
Urban & Agricultural Water Use Efficiency	3.00	3.50	0.50	3.25
Watershed & Ecosystem Management	3.83	3.81	0.02	3.82

4.1.12.4 Overall Evaluation Objective Results for Reliability and Robustness

The Reliability and Robustness Evaluation Objective scores, as well as the three sub-scores used to calculate the final overall scores, are shown in Table 65 and Figure 67. All the Reliability and Robustness scores were above a neutral score of 3.0, indicating that none of the Concepts was anticipated to reduce Reliability and Robustness. The average score was 3.60 and the highest-scoring Concept was Potable Reuse, which may be attributed to this Concept having the highest Water Shortage Volume Performance Measure score, in addition to high scores for the other Performance Measures. The lowest-scoring Concepts were Gray Water Use, Imported Water

Purchases, and Urban and Agricultural Water Use Efficiency. Enhanced Conservation received a score of NA because it could only be scored on one of the three Performance Measures. However, it should be noted that Enhanced Conservation had the highest Water Shortage Volume Performance Measure score, implying that if the other Performance Measure scores for Reliability and Robustness had been available for this Concept, it would have received a high overall score. The major driving Performance Measure for the Reliability and Robustness Evaluation Objective was the Water Shortage Volume measure. The Stormwater BMPs, Stormwater Capture, Conveyance Improvement, and Watershed and Ecosystem Management Concepts all had approximately neutral (3.0) shortage volume scores which resulted in the lower overall scores compared to the other Concepts.

Table 65. Reliability and Robustness Evaluation Objective unweighted scores and associated Performance Measures results.

Concept	Water Shortage Volume Performance Measure Scores	Vulnerability of Water Supply Facilities and Infrastructure Performance Measure Scores	Carryover Storage Performance Measure Scores	Reliability and Robustness Evaluation Objective Unweighted Scores
Conveyance Improvement	3.10	4.18	4.05	3.78
Enhanced Conservation	5.00	NA	NA	NA
Gray Water Use	3.17	3.39	3.06	3.20
Groundwater	3.81	3.68	3.84	3.78
Imported Water	3.15	2.88	3.59	3.20
Potable Reuse	4.35	3.96	4.26	4.19
Recycled Water	3.88	3.96	3.88	3.90
Seawater Desalination	4.17	3.78	3.78	3.91
Stormwater BMPs	3.01	3.50	3.36	3.29
Stormwater Capture	3.04	3.74	4.11	3.63
Urban & Agricultural Water Use Efficiency	3.14	3.21	3.25	3.20
Watershed & Ecosystem Management	3.12	3.52	3.82	3.49

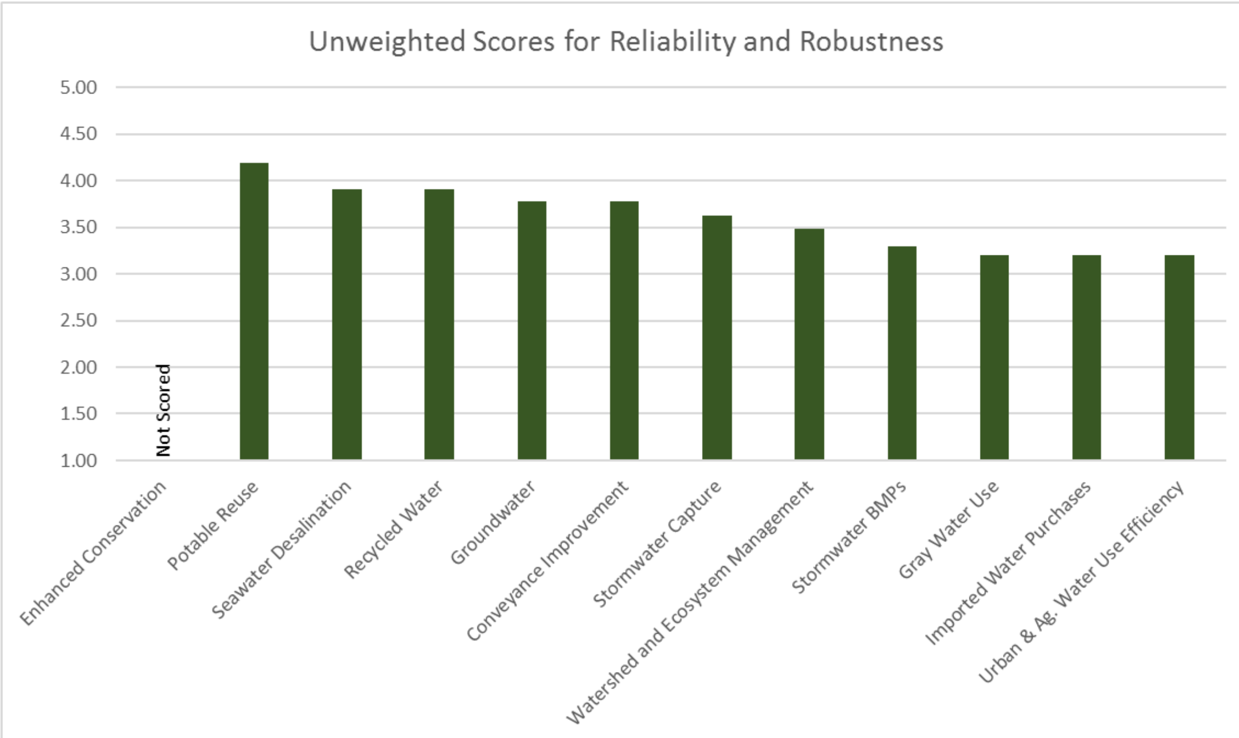


Figure 67. Reliability and Robustness Evaluation Objective unweighted scores.

4.1.13. Water Quality and Watersheds

The Water Quality and Watersheds Evaluation Objective was based on three Performance Measures, Stormwater and Wastewater Discharges, Surface Water Quality, and Groundwater Quality.

4.1.13.1 Stormwater and Wastewater Discharges Performance Measure Results

The Stormwater and Wastewater Discharges Performance Measure was calculated based on two sub-scores: Discharges to Freshwater or Estuarine Water Bodies and Discharges to Marine Water Bodies. The average of the two sub-scores was used as the Stormwater and Wastewater Discharges Performance Measure Score.

The Discharges to Freshwater or Estuarine Water Bodies scores ranged from 2.65 for Seawater Desalination to 4.59 for Stormwater Capture, as shown in Table 66, with an average of 3.53. Because the Discharges to Freshwater or Estuarine Water Bodies sub-score was based on survey responses, the overall sub-score value was a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an

Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The difference between the project- and Concept-level scores for the Discharges to Freshwater or Estuarine Water Bodies sub-scores was less than one point for all the Concepts. This indicated general agreement and stability of the scoring estimates for this Evaluation Objective and confidence in the scoring results.

Table 66. Discharges to Freshwater or Estuarine Water Bodies sub-scores within the Stormwater and Wastewater Discharges Performance Measure and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Freshwater / Estuarine Discharges	Concept-level Survey Results for Freshwater/ Estuarine Discharges	Difference between project- and Concept-level Survey Results for Freshwater/ Estuarine Discharges	Freshwater/ Estuarine Discharges Sub-Scores
Conveyance Improvement	3.17	3.20	0.03	3.18
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.00	3.53	0.53	3.50
Groundwater	3.14	3.40	0.26	3.27
Imported Water	3.00	2.73	0.27	2.75
Potable Reuse	3.00	3.60	0.60	3.30
Recycled Water	3.50	3.93	0.43	3.72
Seawater Desalination	3.00	2.60	0.40	2.65
Stormwater BMPs	3.90	4.47	0.57	4.18
Stormwater Capture	5.00	4.53	0.47	4.59
Urban & Agricultural Water Use Efficiency	3.80	4.20	0.40	4.00
Watershed & Ecosystem Management	3.21	4.14	0.93	3.68

The Discharges to Marine Water Bodies scores ranged from 2.35 for Seawater Desalination to 4.53 for Stormwater Capture, as shown in Table 67, with an average of 3.66. Because the Discharges to Marine Water Bodies sub-score was based on survey responses, the overall sub-score value was a combination of project-level and Concept-level survey results. Larger differences between project-level and Concept-level scores indicated that survey respondents had somewhat different perspectives on a specific project's effects on an Evaluation Objective compared to the generalized Concept. Smaller differences indicated more similar perspectives of the effects of a specific project compared to the generalized Concept on an Evaluation Objective. The difference between the project- and Concept-level scores for the Discharges to Freshwater or Estuarine Water Bodies sub-scores was less than one point for all the Concepts. This indicated general agreement and stability of the scoring estimates for this Evaluation Objective and confidence in the scoring results.

Table 67. Discharges to Marine Water Bodies sub-scores within the Stormwater and Wastewater Discharges Performance Measure and difference between project-level and Concept-level survey results.

Concept	Project-level Survey Results for Marine Discharges	Concept-level Survey Results for Marine Discharges	Difference between project- and Concept-level Survey Results for Marine Discharges	Marine Discharges Sub-Scores
Conveyance Improvement	3.17	3.33	0.17	3.25
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.00	3.67	0.67	3.63
Groundwater	3.29	3.40	0.11	3.34
Imported Water	3.00	2.80	0.20	2.81
Potable Reuse	3.60	4.07	0.47	3.83
Recycled Water	3.75	3.93	0.18	3.84
Seawater Desalination	3.00	2.27	0.73	2.35
Stormwater BMPs	4.40	4.33	0.07	4.37
Stormwater Capture	4.50	4.53	0.03	4.53
Urban & Agricultural Water Use Efficiency	4.20	4.13	0.07	4.17
Watershed & Ecosystem Management	4.43	3.87	0.56	4.15

As shown in Table 68, the highest scoring Concept for the Stormwater and Wastewater Discharges Performance Measure was Stormwater Capture with a score of 4.56 followed by Stormwater BMPs and Urban and Agricultural Water Use Efficiency, which also scored over 4.00 points. The lowest scoring Concept was Seawater Desalination with a score of 2.50. Imported Water Purchases also scored under 3.00 points. The average Stormwater and Wastewater Discharge Performance Measure score was 3.59. Enhanced Conservation was given a score of NA because it was not included in the surveys.

Table 68. Stormwater and Wastewater Discharges Performance Measure results and associated sub-scores.

Concept	Freshwater/ Estuarine Discharge Sub-scores	Marine Discharges Sub-scores	Stormwater and Wastewater Discharges Performance Measure Scores
Conveyance Improvement	3.18	3.25	3.22
Enhanced Conservation	NA	NA	NA
Gray Water Use	3.50	3.63	3.56
Groundwater	3.27	3.34	3.31
Imported Water	2.75	2.81	2.78
Potable Reuse	3.30	3.83	3.57
Recycled Water	3.72	3.84	3.78
Seawater Desalination	2.65	2.35	2.50
Stormwater BMPs	4.18	4.37	4.28
Stormwater Capture	4.59	4.53	4.56
Urban & Agricultural Water Use Efficiency	4.00	4.17	4.08
Watershed & Ecosystem Management	3.68	4.15	3.91

4.1.13.2 Surface Water Quality Performance Measure Results

The Surface Water Quality Performance Measure score was based on a combination of project-level survey data and GIS data. First, the survey data for each individual project identified whether the project has a positive impact, a negative impact, or a neutral or unknown impact on surface water quality.

Next, GIS analysis was used to determine whether projects are located where there are impaired water body scores in the 70-100th percentile range or below the 70th percentile.

Finally, the project-level survey data was combined with the project-level GIS data for individual projects as described in Section 3.4.13.2. If a project has a negative impact on surface water and is located where there are impaired water body scores in the 70-100th percentile range, the project received a score of 1. If a project has a negative impact on surface water and is located where there are impaired water body scores below the 70th percentile, the project received a score of 2. If the project has an unknown impact on surface water, then the project received a score of 3. If a project has a positive impact on surface water and is located where there are impaired water body scores below the 70th percentile, the project received a score of 4. If a project has a positive impact on surface water and is located where there are impaired water body scores in the 70-100th percentile range, the project received a score of 5. Project-specific scores were averaged within each Concept to give an overall score for each Concept.

As shown in Table 69, no projects were anticipated to have negative impacts on surface water quality. Seven Concepts only contain projects that are anticipated to have a neutral or unknown impact on surface water quality, and four Concepts are anticipated to have some or all projects with positive impacts on surface water quality. Six Concepts contained some projects located in areas where the impaired water body score is in the 70 to 100th percentile range, and four Concepts contained only projects located in areas where the impaired water body score is below the 70th percentile. These values result in Surface Water Quality Performance Measure scores that are predominantly neutral. Four Concepts received scores above 3.00, and no projects score below 3.00. The highest scoring Concept was Potable Reuse (score of 4.25), followed by Stormwater BMPs (score of 4.11), Watershed and Ecosystem Management (score of 4.07), and Urban and Agricultural Water Use Efficiency (score of 3.50). The remaining Concepts all scored 3.00. Enhanced Conservation received a score of NA because it did not have a specific location for geospatial analysis and was not included in the surveys. Imported Water Purchases received a score of NA because it did not have a specific location for geospatial analysis.

Table 69. Surface Water Quality Performance Measure scores, percentages of projects with Impaired Water Bodies Score in 70-100th Percentile Range or below 70th Percentile based on GIS analysis, and percentages of positive, negative, and neutral impact from project-level surveys.

Concept	Percentage of Projects with Impaired Water Bodies Score in 70-100th Percentile Range or below 70th Percentile, as indicated by GIS Analysis		Percentage of Projects with Neutral/Unknown, Negative, or Positive Surface Water Quality Impacts, as indicated by project-level Surveys			Surface Water Quality Performance Measure Scores
	70-100th Percentile	Below 70th Percentile	Neutral/Unknown Impact	Positive Impact	Negative Impact	
Conveyance Improvement	40%	60%	100%	0%	0%	3.00
Enhanced Conservation	NA	NA	NA	NA	NA	NA
Gray Water Use	0%	100%	100%	0%	0%	3.00
Groundwater	45%	45%	100%	0%	0%	3.00
Imported Water	NA	NA	100%	0%	0%	NA
Potable Reuse	42%	58%	13%	88%	0%	4.25
Recycled Water	36%	64%	100%	0%	0%	3.00
Seawater Desalination	0%	100%	100%	0%	0%	3.00
Stormwater BMPs	28%	72%	0%	100%	0%	4.11
Stormwater Capture	0%	100%	100%	0%	0%	3.00
Urban & Agricultural Water Use Efficiency	0%	100%	33%	67%	0%	3.50
Watershed & Ecosystem Management	22%	78%	7%	93%	0%	4.07

4.1.13.3 Groundwater Quality Performance Measure Results

The Groundwater Quality Performance Measure score was based on a combination of project-level survey data and GIS data. First, the survey data for each individual project identified whether the project has a positive impact, a negative impact, or a neutral or unknown impact on groundwater quality.

Next, GIS analysis was used to determine whether projects are located where there are impaired water body scores in the 70-100th percentile range or below the 70th percentile.

Finally, the project-level survey data was combined with the project-level GIS data for individual projects as described in Section 3.4.13.3. If a project has a negative impact on groundwater and is located where there are impaired water body scores in the 70-100th percentile range, the project received a score of 1. If a project has a negative impact on groundwater and is located where there are impaired water body scores below the 70th percentile, the project received a score of 2. If the project has an unknown impact on groundwater, then the project received a score of 3. If a project has a positive impact on groundwater and is located where there are impaired water body scores below the 70th percentile, the project received a score of 4. If a project has a positive impact on groundwater and is located where there are impaired water body scores in the 70-100th percentile range, the project received a score of 5. Project-specific scores were averaged within each Concept to give an overall score for each Concept.

As shown in Table 70, no projects were anticipated to have negative impacts on groundwater quality. Five Concepts only contain projects that are anticipated to have a neutral or unknown impact on surface water quality, and six Concepts are anticipated to have some projects with positive impacts on surface water quality. Nine Concepts contained some projects located in areas where the impaired water body score is in the 70 to 100th percentile range, and one Concept (Stormwater Capture) contained only projects located in areas where the impaired water body score is below the 70th percentile. These values result in Groundwater Quality Performance Measure scores that are all neutral or positive. Five Concepts received scores above 3.00, and no projects scored below 3.00. The highest scoring Concept was Potable Reuse (score of 4.13), followed by Groundwater (score of 3.78), Conveyance Improvement (score of 3.50), and Stormwater BMPs and Watershed and Ecosystem Management (scores of 3.21). The remaining Concepts all scored 3.00. Enhanced Conservation received a score of NA because it was not included in the surveys and did not have a specific location for geospatial analysis. Imported Water received a score of NA because it did not have a specific location for geospatial analysis.

Table 70. Groundwater Quality Performance Measure Scores, percentages of projects with Impaired Water Bodies Score in 70-100th Percentile Range or below 70th Percentile based on GIS analysis, and percentages of positive, negative, and neutral impact from project-level surveys.

Concept	Percentage of Projects with Impaired Water Bodies Score in 70-100th Percentile Range or below 70th Percentile, as indicated by GIS Analysis		Percentage of Projects with Neutral/Unknown, Negative, or Positive Groundwater Quality Impacts, as indicated by project-level Surveys			Groundwater Quality Performance Measure Scores
	70-100th Percentile	Below 70th Percentile	Neutral/Unknown Impact	Positive Impact	Negative Impact	
Conveyance Improvement	20%	80%	50%	50%	0%	3.50
Enhanced Conservation	NA	NA	NA	NA	NA	NA
Gray Water Use	100%	0%	100%	0%	0%	3.00
Groundwater	27%	64%	33%	67%	0%	3.78
Imported Water	NA	NA	100%	0%	0%	NA
Potable Reuse	58%	42%	25%	75%	0%	4.13
Recycled Water	25%	75%	100%	0%	0%	3.00
Seawater Desalination	100%	0%	100%	0%	0%	3.00
Stormwater BMPs	41%	59%	84%	16%	0%	3.21
Stormwater Capture	0%	100%	100%	0%	0%	3.00
Urban & Agricultural Water Use Efficiency	25%	75%	67%	33%	0%	3.00
Watershed & Ecosystem Management	61%	39%	86%	14%	0%	3.21

4.1.13.4 Overall Evaluation Objective Results for Water Quality and Watersheds

The scores for each of the three Performance Measures were averaged to derive the Water Quality and Watersheds Evaluation Objective unweighted scores. The scores are summarized in

Table 71 and Figure 68 below. The average Water Quality and Watersheds Evaluation Objective unweighted score was 3.45. The highest scoring Concepts were Potable Reuse with a score of 3.98 and Stormwater BMPs with a score of 3.86. The lowest scoring Concept was Seawater Desalination with a score of 2.83. Enhanced Conservation and Imported Water Purchases received scores of NA because they could not be scored for some or all Performance Measures.

Table 71. Water Quality and Watersheds Evaluation Objective scores and associated Performance Measures results.

Concept	Stormwater and Wastewater Discharges Performance Measure Scores	Surface Water Quality Performance Measure Scores	Groundwater Quality Performance Measure Scores	Water Quality and Watersheds Evaluation Objective Unweighted Scores
Conveyance Improvement	3.22	3.00	3.50	3.24
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.56	3.00	3.00	3.19
Groundwater	3.31	3.00	3.78	3.36
Imported Water	2.78	NA	NA	NA
Potable Reuse	3.57	4.25	4.13	3.98
Recycled Water	3.78	3.00	3.00	3.26
Seawater Desalination	2.50	3.00	3.00	2.83
Stormwater BMPs	4.28	4.11	3.21	3.86
Stormwater Capture	4.56	3.00	3.00	3.52
Urban & Agricultural Water Use Efficiency	4.08	3.50	3.00	3.53
Watershed & Ecosystem Management	3.91	4.07	3.21	3.73

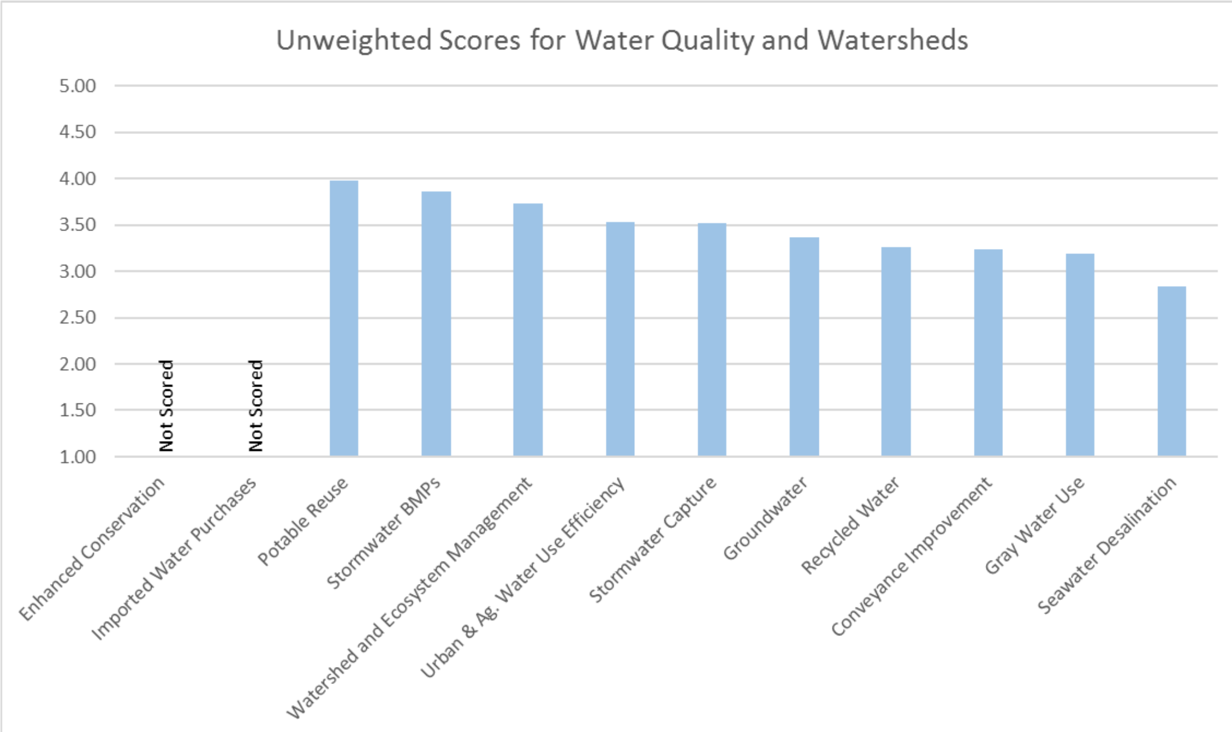


Figure 68. Water Quality and Watersheds Evaluation Objective unweighted scores.

5. Overall Trade-Off Analysis Results

5.1. Trade-Off Analysis Scores Including All Evaluation Objectives and Weighted for Importance

The individual Evaluation Objective analysis results presented in Chapter 4 can be used to compare Concepts withina single Evaluation Objective, but the individual results do not provide a comprehensive comparison across all Evaluation Objectives. Multiple Evaluation Objectives can be considered in a trade-off analysis by combining individual scores into a single multi-criterion total score. The total score provides a unit-less comparison of effects summed across Evaluation Objective categories.

An evaluation of multiple Evaluation Objective trade-offs requires the calculated Evaluation Objective unweighted scores to be combined with the Evaluation Objective weights described in Section 3.2.2. These weights are multiplied by the individual Evaluation Objective unweighted scores and divided by 10 (the highest possible importance weight) to derive a final weighted score that accounts for the importance of each Evaluation Objective (Table 72). The Evaluation Objective weights used in this analysis are from Study Area survey data. However, other weights could be used if additional information were found for a project or area of interest as project planning progresses or the public becomes more aware of and interested in projects under consideration. If it had been determined that each Evaluation Objective has the same level of importance, then weighting could have been skipped.

Table 72. Weighted Evaluation Objective Scores based on mean survey results by Concept.

Concept	Address Climate Change through Greenhouse Gas (GHG) Reduction	Climate Resilience	Cost Effectiveness	Environmental Justice	Optimize Local Supplies	Project Complexity	Protect Habitats, Wildlife, and Ecosystems	Provide for Scalability of Implementation	Quality of Life/Recreation	Regional Economic Impact	Regional Integration and Coordination	Reliability and Robustness	Water Quality and Watersheds
Conveyance Improvement	2.61	2.47	1.88	2.61	3.57	2.15	2.76	2.52	2.69	3.16	2.39	3.78	3.24
Enhanced Conservation	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.03	NA	NA	NA
Gray Water Use	2.67	4.80	3.12	NA	3.98	2.23	2.76	2.77	2.35	2.73	2.70	3.20	3.19
Groundwater	2.48	3.57	1.82	2.68	4.67	1.47	2.82	2.36	2.24	3.40	3.02	3.78	3.36
Imported Water Purchases	1.95	NA	2.62	NA	2.64	2.38	2.76	2.16	2.23	2.21	2.16	3.20	NA
Potable Reuse	2.61	2.54	1.62	2.72	4.55	1.28	2.76	2.91	2.56	3.74	3.57	4.19	3.98
Recycled Water	2.88	2.70	2.13	2.65	4.61	2.28	2.76	2.96	2.77	3.63	3.09	3.90	3.26
Seawater Desalination	1.93	4.80	1.39	NA	4.70	1.07	2.76	1.95	2.23	2.84	3.23	3.91	2.83
Stormwater BMPs	2.75	4.17	2.44	2.85	3.31	2.27	2.94	2.48	2.91	2.54	2.62	3.29	3.86
Stormwater Capture	2.60	4.80	2.27	2.61	4.49	1.80	2.76	2.60	2.39	3.12	3.08	3.63	3.52
Urban & Ag. Water Use Efficiency	3.08	3.60	3.49	3.05	4.00	3.02	2.84	3.14	2.79	3.28	3.17	3.20	3.53
Watershed and Ecosystem Management	2.97	3.82	2.48	3.30	3.62	2.07	3.08	2.70	3.00	2.82	2.64	3.49	3.73

The trade-off analysis results for all the Evaluation Objectives (see Sections 4.1.1 to 4.1.13) using the Evaluation Objective weights (see Section 3.2) are presented in Table 73 and Figure 69. Only eight of the 12 Concepts can be directly compared with the trade-off analysis because some Concepts were not scored for all Evaluation Objectives, so the total possible points differs for those Concepts. In addition to the total weighted scores, the scores are converted to a relative point scale where a 100 corresponds to the Concept with the highest point total, and the percent difference from the highest-scoring Concepts is also tabulated. The purpose of this information is to provide a more intuitive indicator of the relative position of each Concept.

Of those Concepts that could be directly compared, the highest-scoring Concept was Urban and Agricultural Water Use Efficiency, with a score of 42.16 points out of a possible 56.15 points. This Concept scored more than two points higher than any other Concepts, and was the only Concept that scored above 40 points. All Concepts that could be directly compared scored within 15% of the highest-scoring Concept. No Concepts scored within 5% of the highest-scoring Concept. Five Concepts scored within 10% of the highest-scoring Concept: Watershed and Ecosystem Management, Stormwater Capture, Recycled Water, Potable Reuse, and Stormwater BMPs. The other two directly comparable Concepts, Groundwater and Conveyance Improvement, scored within 15% of the highest-scoring Concept.

Enhanced Conservation was scored for only one of the 13 Evaluation Objectives (Regional Economic Impact). Imported Water Purchases was not scored for three Evaluation Objectives (Climate Resilience; Environmental Justice; and Water Quality and Watersheds). Seawater Desalination and Gray Water Use were not scored for Environmental Justice.

Table 73. Total and relative points by Concept including all Evaluation Objectives and using mean survey scores.

Concept	Rank	Total Scores Weighted by Importance	Total Possible Weighted Points	Relative Points on a 1 to 100 scale	Percent Difference from Highest Score
Concepts Scored for ALL Evaluation Objectives					
Urban & Ag. Water Use Efficiency	1	42.16	56.15	100.00	0%
Watershed and Ecosystem Management	2	39.72	56.15	94.21	6%
Stormwater Capture	3	39.67	56.15	94.10	6%
Recycled Water	4	39.62	56.15	93.97	6%
Potable Reuse	5	39.03	56.15	92.58	7%
Stormwater BMPs	6	38.42	56.15	91.12	9%

Concept	Rank	Total Scores Weighted by Importance	Total Possible Weighted Points	Relative Points on a 1 to 100 scale	Percent Difference from Highest Score
Concepts Scored for ALL Evaluation Objectives					
Groundwater	7	37.66	56.15	89.34	11%
Conveyance Improvement	8	35.82	56.15	84.96	15%
Concepts NOT Scored for All Evaluation Objectives					
Gray Water Use[a]	NA	36.50	51.80	NA	NA
Seawater Desalination[b]	NA	33.64	51.80	NA	NA
Imported Water Purchases[c]	NA	24.30	42.00	NA	NA
Enhanced Conservation[d]	NA	2.03	3.90	NA	NA

[a] Not Scored for Environmental Justice (maximum weighted score 51.80 points)
[b] Not Scored for Environmental Justice (maximum weighted score 51.80 points)
[c] Not scored for Climate Resilience, Environmental Justice, and Water Quality and Watersheds (maximum weighted score 42.00 points)
[d] Scored only on Regional Economic Impact (maximum weighted score 3.90 points)

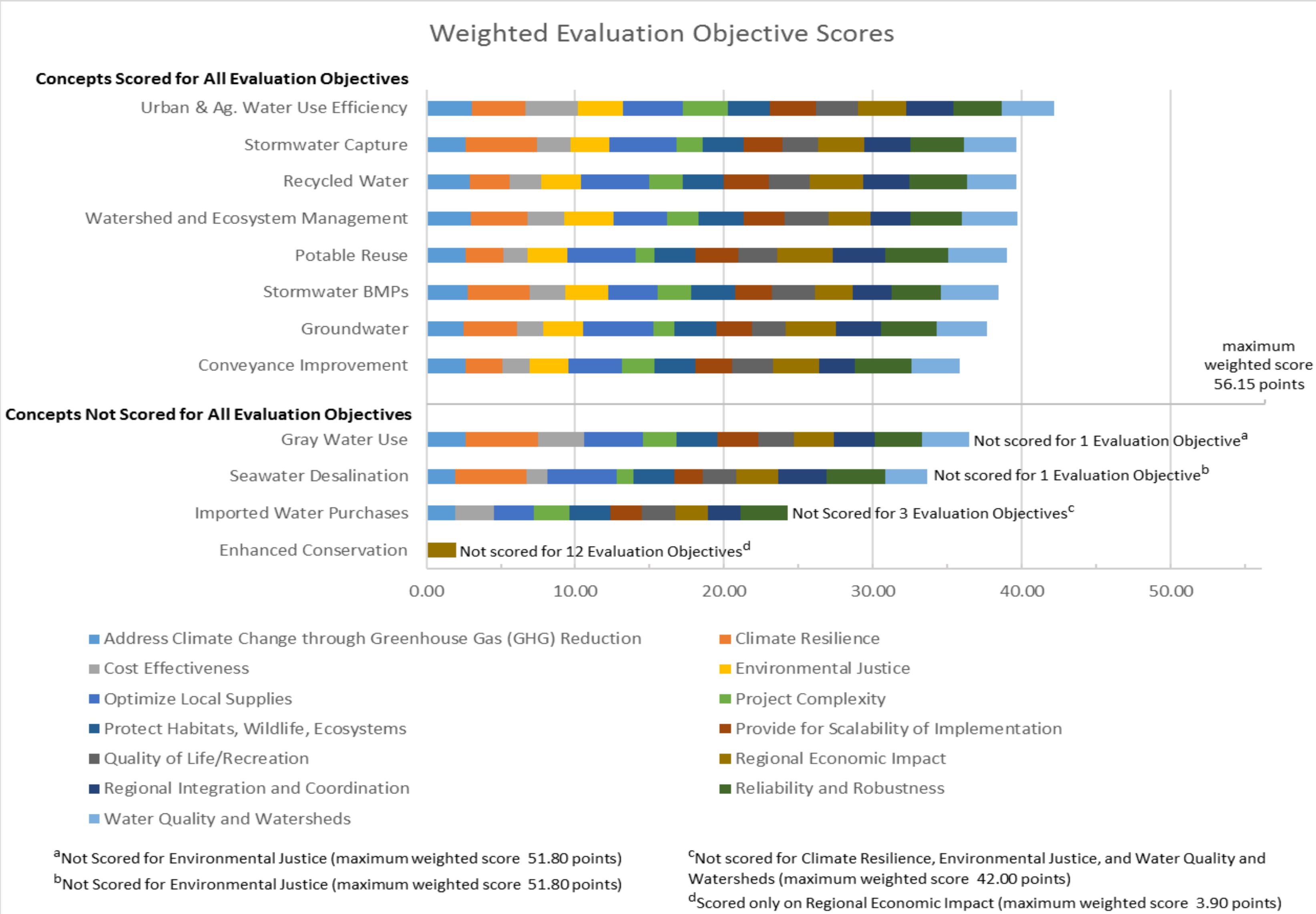


Figure 69. Trade-off analysis results for each Concept by Evaluation Objective, excluding Imported Water Purchases and Enhanced Conservation.

5.1.1. Analysis of the Statistical Difference in Unweighted Evaluation Objective Scores between Concepts

The scores reported in the previous section were based in part on mean (average) scores from responses provided through project- and Concept-level surveys (scoring inputs were also obtained from GIS and modeling data). Mean scores were used to represent the central tendency of individual survey responses for use in estimating various performance measures. The mean value is an appropriate representative measure when the data set does not have outlying values that would skew the mean. If there are outliers, then the median (middle) value may be a better representation of central tendency. However, the survey responses did not exhibit a large number of outliers, so the use of mean values was appropriate.

Although use of the mean was appropriate based on lack of outliers, another potential issue related to the use of mean values to estimate performance measure and Evaluation Objective scores is the statistical significance of the differences in means between Concepts. The accuracy of trade-off analysis results is contingent upon accurate measurement of differences in the performance of various Concepts. In some cases, differences in mean values may not accurately represent differences in the central tendency of the value of those variables. This would primarily be the case if the median is a better representation of central tendency compared to the mean. Therefore, it was important to determine the significance of differences in the mean survey question responses.

The mean scores for each of the project- and Concept-level survey questions for the individual Concepts were compared to determine if there was a significant difference between the mean scores for each Concept. Significance is based on the application of a pooled t-test, which uses the variation of values around the means of two different groups to test for a significant difference between those means. The mean of a specific variable for two groups may be different, but depending on variability in the survey responses, the difference in means may not be statistically significant.

As an example, the Concept-level survey included a question that asked about the extent to which a Concept would increase the diversity of the water supply. The mean value for the Groundwater Concept was 4.8125 and the mean value for the Recycled Water Concept responses was 4.9375. A pooled t-test was used to determine if there was a significant difference in the mean value of responses to the diversity of water supply question. The calculated pooled t-test p-value was 0.41 compared to a statistically significant critical p-value of 0.05 (the 5% level of significance is the standard level used for determining significance). Since the p-value for the comparison of Groundwater to Recycled Water (0.41) was higher than the critical p-value value (0.05), the mean diversity of water supply scores for the Groundwater Concept and the Recycled Water Concept was determined to not be significantly different (e.g., they increase the diversity of water supply equally). This approach was applied to all the project-level and Concept-level questions used to calculate Performance Measure Values. Pooled t- statistic p-values were only calculated for Concepts and survey questions that had more than five responses. For the project-level survey, pooled t-statistic p-values were calculated for Conveyance Improvement, Groundwater, Potable Reuse, Recycled Water, Stormwater BMPs, Urban and Agricultural Water Use Efficiency, and Watershed and Ecosystem Management for questions that received five or more responses, representing 27% of the total possible questions and Concepts that could have been compared. For the Concept-level survey, t-statistic p-values were calculated for all Concepts except for Enhanced Conservation, representing 71% of the Concepts and questions that could have been compared. Concept-level survey data were not available for the Enhanced Conservation Concept.

The results of the pooled t-statistic tests for each of the Concept-level and project-level survey questions are shown in Appendix C: Pooled t-test Results for Project-Level and Concept-Level Survey Questions. The results are presented in a simplified format rather than reporting actual p-values due to the large number of survey questions and Concepts compared. A “SIG” indicates that there was a significant difference in the mean values based on the pooled t-tests at the 5% level of significance between the two Concepts that were compared, and an “ns” indicates the mean values were not statistically different. A “NA” indicates a comparison of the Concept to itself. A “--” indicates that a t-statistic p-value could not be computed for the comparison because there were no responses or because the number of responses was too small (less than or equal to five). This simplified format is useful for identifying potential biases from using mean survey responses values to evaluate trade-offs. Bias could occur as a result of the use of mean values for calculating Performance Measure and Evaluation Objective scores. This may lead to the calculation of different Performance Measure and Evaluation Objective scores for Concepts when there is not actually a statistically significant difference in the survey data used to estimate the scores.

A large number of “SIG” indicators for a particular survey question within a Concept is an indicator that mean survey values actually differed between Concepts and that there is a reduced potential for bias. Conversely, a small number of “SIG” indicators is an indicator that there is a higher potential for bias. For example, as shown in Appendix C: Pooled t-test Results for Project-Level and Concept-Level Survey Questions, the evaluation of significant differences between Conveyance Improvement and other Concepts on Concept-level survey questions for both RR-V-2 (Concept increases resilience of the conveyance system?) resulted in 10 “SIG” indicators for the 10 possible comparisons to other Concepts. This indicates that there was a significant difference in mean values for Conveyance Improvement compared to all 10 of the other Concepts, and suggests that there was a low potential for bias for Conveyance Improvement when using mean scores for comparison. It also indicates that the magnitude of bias may be less for Conveyance Improvement than for other Concepts that have fewer yes indicators. In contrast, Gray Water Use had two of nine “SIG” indicators for RR-V-2 along with an additional “SIG” indicator for the comparison of Gray Water Use to Conveyance Improvement, indicating that there were only some cases where there was a significant difference in means between Gray Water Use and other Concepts, and that there is a higher potential that using mean values will lead to biased scores and a higher possible magnitude of bias. This comparison of significant differences between means scores is a heuristic measure of possible bias.

It needs to be stressed that a non-significant difference between the mean scores for a specific survey question for two Concepts does not signify that the survey responses are inaccurate, but instead, that the performance of the two Concepts for the specific measure represented by the question is essentially the same. Use of different calculated mean scores for each Concept when the difference is not significantly different could lead to biased relative scores. The amount of bias is likely to be small if the mean scores for two Concepts are very close, but it is important to understand the potential for bias and the possible magnitude of bias.

Across the Concepts and survey questions that could be compared, approximately 76% of the pooled t-test results for the project-level survey responses indicated the mean values were significantly different between Concepts and 79% of the Concept-level survey means were significantly different between Concepts. This is a relatively high percentage, indicating that the potential for bias from using mean scores is relatively low.

5.1.2. Comparison of Trade-Off Analysis Scores Using Mean and Median Values

Although the potential for bias is relatively low, as discussed in Section 5.1.1, some survey mean values for responses used to calculate performance measures and Evaluation Objectives were found to not be significantly different across Concepts. An alternative to using mean scores for comparing the results of survey questions is to use median scores. Median scores can be used to represent the central tendency for survey questions that have similar, though different, means because median values are closer together than the means and therefore better reflect a lack of significant difference in survey responses. For example, the mean value for the Concept-level survey question asking if the Concept has an effect on aging infrastructure was 3.125 for the Groundwater Concept and 3.1875 for the Recycled Water Concept, but the p-value for the comparison indicated that this difference was not significant. The median value for both Concepts was a value of 3.0. Thus, using the median value better represents the lack of a significant difference between the two Concepts than using the mean value.

The approach of using medians instead of means for the survey results was used as a sensitivity analysis to demonstrate the potential bias associated with using mean values in the trade-off analysis. All the Evaluation Objectives that used survey data were recalculated using median values for project-level and Concept-level survey responses (Table 74) and the Evaluation Objective scores using mean and median values were then be compared as a heuristic measure of potential bias.

The cumulative scores using median values are shown in Table 75 and differences in scoring and ranking of Concepts using mean survey scores and median survey scores are presented in Table 76. There was very little difference between the mean and median point totals for the 10 Concepts for which all the Evaluation Objectives were scored. Five of the Concepts changed ranking using median values, but four of the five changed by only one place and they all changed very little in terms of percentage change in point totals. The small difference in the results using mean and median values supports the conclusion that the use of mean values did not introduce bias into the trade-off analysis results.

Table 74. Weighted Evaluation Objective Scores based on median survey results by Concept.

Concept	Address Climate Change through Greenhouse Gas (GHG) Reduction	Climate Resilience	Cost Effectiveness	Environmental Justice	Optimize Local Supplies	Project Complexity	Protect Habitats, Wildlife, and Ecosystems	Provide for Scalability of Implementation	Quality of Life/Recreation	Regional Economic Impact	Regional Integration and Coordination	Reliability and Robustness	Water Quality and Watersheds
Conveyance Improvement	2.46	2.47	1.42	2.61	3.29	2.01	2.76	2.70	2.59	3.12	2.55	3.78	3.17
Enhanced Conservation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gray Water Use	2.46	4.80	3.68	NA	4.23	2.56	2.76	3.08	2.22	3.12	2.34	3.14	3.25
Groundwater	2.46	3.57	1.42	2.68	4.70	1.46	2.82	2.50	2.22	3.12	2.98	3.77	3.26
Imported Water Purchases	2.46	NA	2.55	NA	2.82	2.56	2.76	1.54	2.22	2.34	1.91	2.88	NA
Potable Reuse	2.46	2.54	1.70	2.72	4.70	1.10	2.76	3.08	2.41	3.51	4.04	4.37	3.96
Recycled Water	2.46	2.70	2.55	2.65	4.70	2.56	2.76	3.08	2.73	3.90	3.40	3.71	3.33
Seawater Desalination	2.46	4.80	1.13	NA	4.70	1.10	2.76	2.12	2.22	3.12	3.40	3.64	3.00
Stormwater BMPs	2.46	4.17	2.55	2.85	2.82	2.19	2.94	2.70	3.15	2.34	2.76	3.00	4.11
Stormwater Capture	2.46	4.80	2.55	2.61	4.70	2.01	2.76	3.08	2.17	3.12	3.19	3.76	3.67
Urban & Ag. Water Use Efficiency	3.28	3.60	3.68	3.05	4.00	2.92	2.84	3.08	2.68	3.12	2.76	3.13	3.58
Watershed and Ecosystem Management	3.28	3.82	2.55	3.30	3.53	1.83	3.08	2.70	3.23	2.34	2.55	3.21	3.76

Table 75. Total scores and relative points by Concept including all Evaluation Objectives and using median survey scores.

Concept	Rank	Total Scores Weighted by Importance	Total Possible Weighted Points	Relative Points on a 1 to 100 scale
Concepts Scored for ALL Evaluation Objectives				
Urban and Agricultural Water Use Efficiency	1	41.72	56.15	100.00
Stormwater Capture	2	40.88	56.15	97.99
Recycled Water	3	40.53	56.15	97.14
Potable Reuse	4	39.34	56.15	94.29
Watershed and Ecosystem Management	5	39.17	56.15	93.88
Stormwater BMPs	6	38.02	56.15	91.14
Groundwater	7	36.96	56.15	88.58
Conveyance Improvement	8	34.92	56.15	83.69
Concepts NOT Scored for All Evaluation Objectives				
Gray Water Use[a]	NA	37.64	51.80	NA
Seawater Desalination[b]	NA	34.45	51.80	NA
Imported Water Purchases[c]	NA	24.04	42.00	NA
Enhanced Conservation[d]	NA	1.56	3.90	NA

[a] Not Scored for Environmental Justice (maximum weighted score 51.80 points)
[b] Not Scored for Environmental Justice (maximum weighted score 51.80 points)
[c] Not scored for Climate Resilience, Environmental Justice, and Water Quality and Watersheds (maximum weighted score 42.00 points)
[d] Scored only on Regional Economic Impact (maximum weighted score 3.90 points)

Table 76. Comparison of Concept scores and ranks based on mean and median survey values.

Concept	Total Score Based on Mean Values	Mean Value Rank	Total Score Based on Median Values	Median Value Rank	Difference in Rank Using Mean and Median	Percentage Difference in Scores Between Mean and Median
Urban & Ag. Water Use Efficiency	42.16	1	42.50	1	SAME	-1%
Watershed and Ecosystem Management	39.72	2	39.17	5	-3	1%
Stormwater Capture	39.67	3	41.66	2	+1	-5%

Concept	Total Score Based on Mean Values	Mean Value Rank	Total Score Based on Median Values	Median Value Rank	Difference in Rank Using Mean and Median	Percentage Difference in Scores Between Mean and Median
Recycled Water	39.62	4	40.53	3	+1	-2%
Potable Reuse	39.03	5	39.73	4	+1	-2%
Stormwater BMPs	38.42	6	38.02	6	SAME	1%
Groundwater	37.66	7	37.74	7	SAME	0%
Conveyance Improvement	35.82	8	35.70	8	SAME	0%

5.2. Scores for Subsets of Evaluation Objectives

The trade-off analysis results presented above in Section 5.1 include all Evaluation Objectives. Trade-off analyses with subsets of Evaluation Objectives can also be completed to evaluate specific Evaluation Objectives of interest. As examples, two additional trade-off analyses were completed using two subsets of Evaluation Objectives. The first example subset includes Evaluation Objectives that evaluate cost and feasibility: Cost Effectiveness, Project Complexity, Provide for Scalability of Implementation, and Regional Integration and Coordination. The second example subset includes Evaluation Objectives that evaluate environmentally-related factors: Address Climate Change through GHG Reduction; Climate Resilience; Environmental Justice; Protect Habitats, Wildlife, and Ecosystems; and Water Quality and Watersheds. The results of these two example subset trade-off analyses are presented in Table 77 and Table 78 and in Figure 70 and Figure 71. A comparison of results for the three different groups of Evaluation Objectives is shown in Table 79. For the cost and feasibility subset, 11 of the 12 Concepts had scores for all Evaluation Objectives included in the subset, but Enhanced Conservation did not receive scores for any of the Evaluation Objectives included in the subset. For the environmentally-related subset, eight of the 12 Concepts had scores for all Evaluation Objectives included in the Subset, but Enhanced Conservation was not scored for any of the Evaluation Objectives, Imported Water Purchases was only scored for two of the five Evaluation Objectives, and Seawater Desalination and Gray Water Use were only scored for four of the five Evaluation Objectives included in the subset. The Concepts that were not scored on all Evaluation Objectives included in the subset are not directly comparable to the other Concepts.

Table 77. Total scores and relative points by Concept including cost and feasibility related Evaluation Objectives.

Concept	Rank	Total Scores	Maximum Possible Weighted Score	Relative Points on a 1 to 100 scale
Concepts Scored for ALL Evaluation Objectives				
Urban & Ag. Water Use Efficiency	1	12.81	16.00	100.00
Gray Water Use	2	10.82	16.00	84.49
Recycled Water	3	10.46	16.00	81.64
Watershed and Ecosystem Management	4	9.89	16.00	77.17
Stormwater BMPs	5	9.80	16.00	76.53
Stormwater Capture	6	9.74	16.00	76.07
Potable Reuse	7	9.38	16.00	73.21
Imported Water Purchases	8	9.31	16.00	72.66
Conveyance Improvement	9	8.94	16.00	69.76
Groundwater	10	8.67	16.00	67.66
Seawater Desalination	11	7.64	16.00	59.65
Concepts NOT Scored for All Evaluation Objectives				
Enhanced Conservation	NA	0.00	0.00	NA

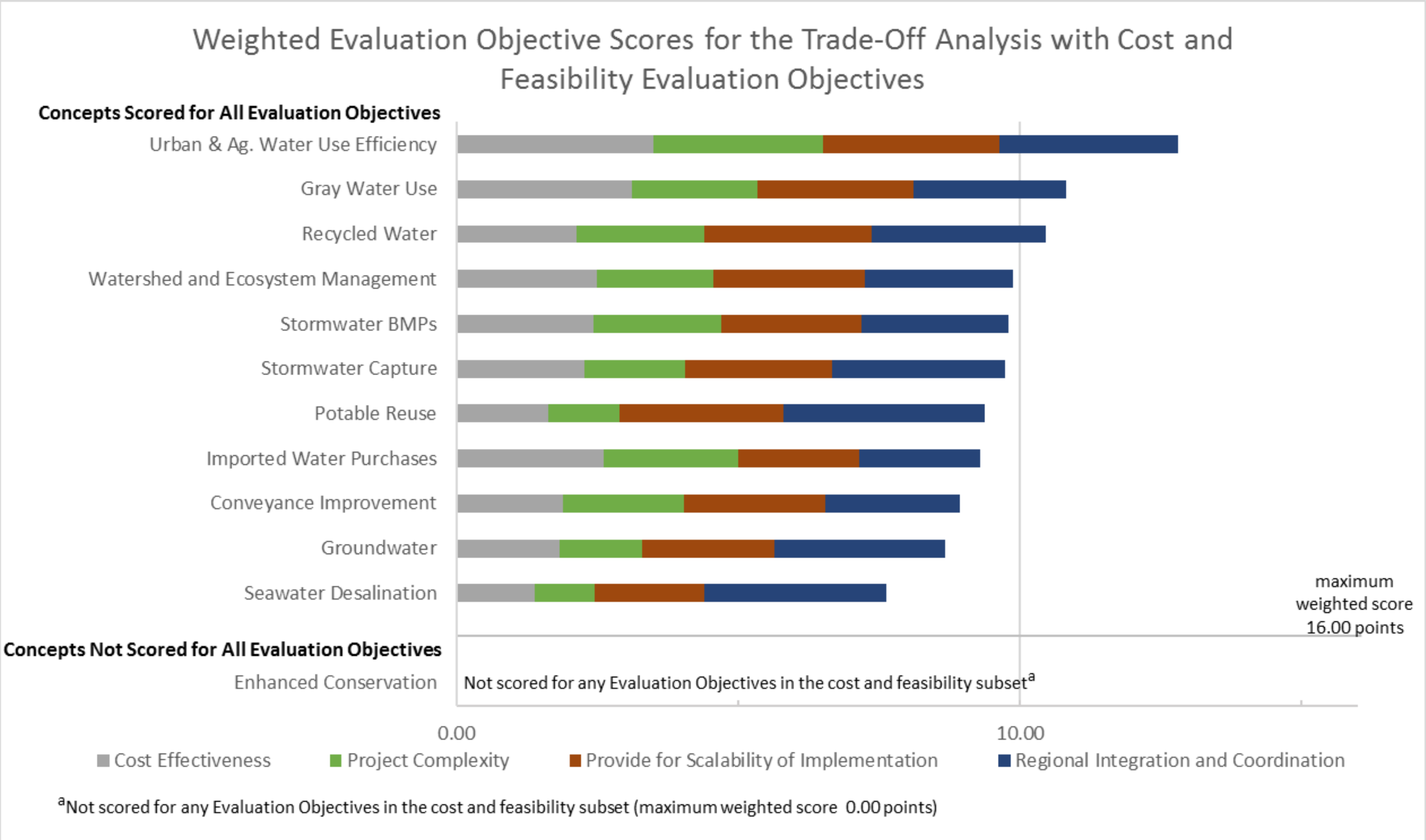


Figure 70. Trade-off analysis results using a subset of cost- and feasibility-related Evaluation Objectives.

Table 78. Total scores and relative points by Concept including environmentally-related Evaluation Objectives.

Concept	Rank	Total Scores	Maximum Possible Weighted Score	Relative Points on a 1 to 100 scale
Concepts Scored for ALL Evaluation Objectives in the Subset				
Watershed and Ecosystem Management	1	16.91	22.85	100.00
Stormwater BMPs	2	16.56	22.85	97.98
Stormwater Capture	3	16.29	22.85	96.38
Urban & Ag. Water Use Efficiency	4	16.08	22.85	95.14
Groundwater	5	14.91	22.85	88.22
Potable Reuse	6	14.61	22.85	86.44
Recycled Water	7	14.25	22.85	84.31
Conveyance Improvement	8	13.69	22.85	80.98
Concepts NOT Scored for All Evaluation Objective in the Subset				
Gray Water Use	NA	13.41	18.50	NA
Seawater Desalination	NA	12.32	18.50	NA
Imported Water Purchases	NA	4.71	8.70	NA
Enhanced Conservation	NA	0.00	0.00	NA

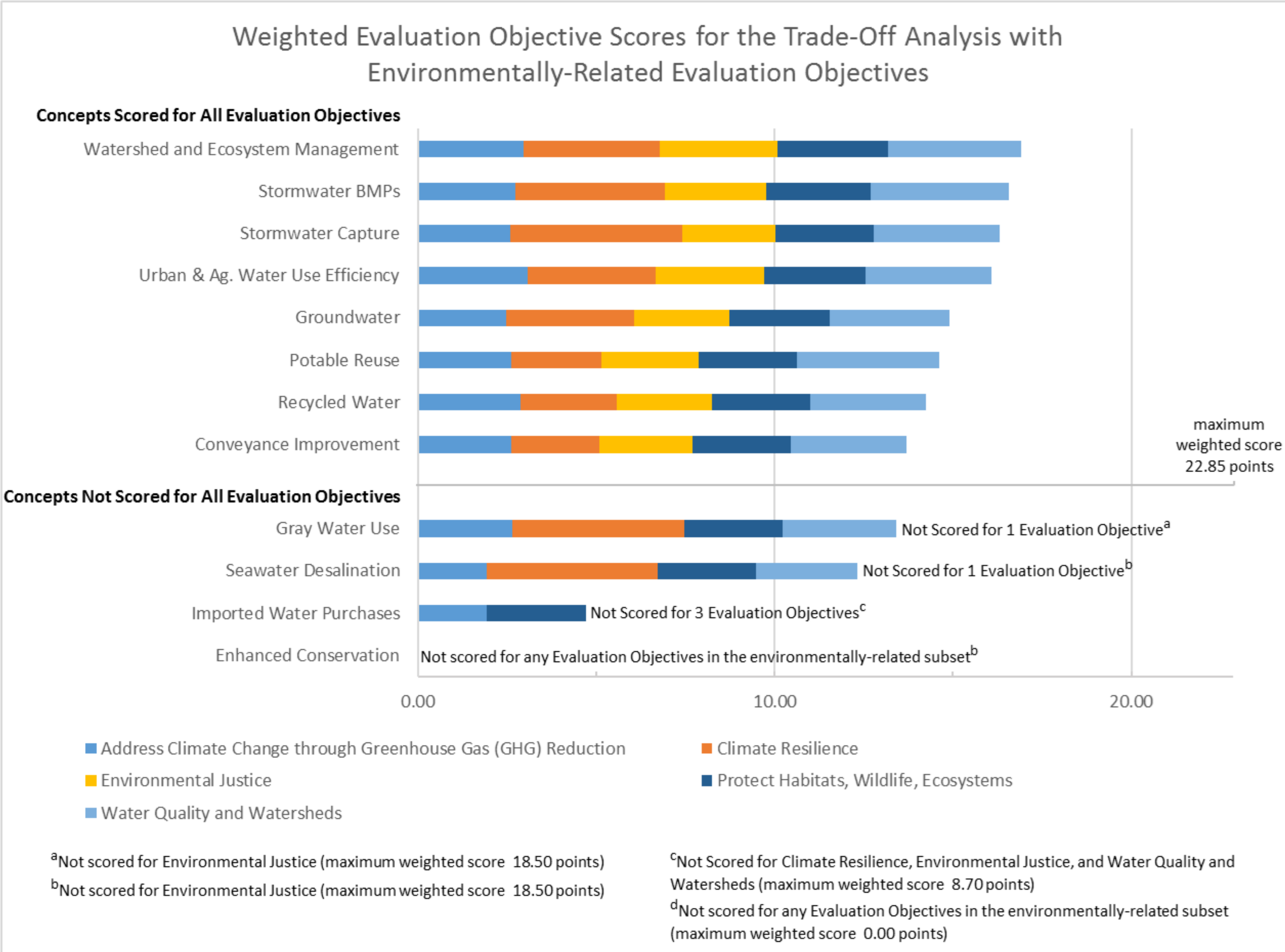


Figure 71. Trade-off analysis results for a subset of environmentally-related Evaluation Objectives.

Table 79. Trade-off analysis rankings based on all Evaluation Objectives, environmentally-related Evaluation Objectives, and cost/feasibility Evaluation Objectives for Concepts that received scores for all Evaluation Objectives.

Concept	Rank Based on All Evaluation Objectives	Rank for Cost and Feasibility Evaluation Objectives Subset	Rank for Environmentally-Related Evaluation Objectives Subset
Urban & Ag. Water Use Efficiency	1	1	4
Watershed and Ecosystem Management	2	4	1
Stormwater Capture	3	6	3
Recycled Water	4	3	7
Potable Reuse	5	7	6
Stormwater BMPs	6	5	2
Groundwater	7	10	5
Conveyance Improvement	8	9	8
Gray Water Use	NA	2	NA
Seawater Desalination	NA	11	NA
Imported Water Purchases	NA	8	NA
Enhanced Conservation	NA	NA	NA

Including only a subset of Evaluation Objectives clearly changed the ranking of the Concepts in the trade-off analysis results from the ranking using all Evaluation Objectives. For both the trade-off analysis including all Evaluation Objectives and the trade-off analysis using the cost/feasibility subset of Evaluation Objectives, the Urban and Agricultural Water Use Efficiency Concept had the greatest number of points, while the analysis including environmentally-related Evaluation Objectives dropped the Urban and Agricultural Water Use Efficiency Concept to fourth highest. Watershed and Ecosystem Management was raised to the highest ranking in the subset including environmentally-related Evaluation Objectives, from the second-ranked Concept including all Evaluation Objectives and fourth-ranked Concept using cost/feasibility related Evaluation Objectives. This demonstrates the potentially large influence that different perspectives on regional objectives, as reflected through the use of different subsets of Evaluation Objectives, can have on the trade-off analysis results.

Sections 5.1 and 5.2 describe three combinations of Evaluation Objective groups that could be analyzed. However, there are many combinations of Evaluation Objectives that could be evaluated to reflect effects that are considered most important. In order to facilitate evaluation of different combinations of Evaluation Objectives, a customized trade-off analysis tool has been developed and is included as Appendix D: Customized Trade-Off Analysis. This tool allows the user to choose the Evaluation Objectives included in the trade-off analysis, to choose the Concepts considered, and to modify the weights indicating the importance of different Evaluation Objectives.

5.3. Summary of Evaluation Objective Results by Concept

In order to evaluate the relative strength of each Concept in achieving specific Evaluation Objectives, the scoring results within each Concept must be compared. In this way, high-scoring Evaluation Objectives within each Concept can be identified and used to evaluate what each Concept does well or does not do well. These comparisons are described below for each Concept. The Evaluation Objective scores used to compare Concepts were unweighted scores. The use of unweighted scores was appropriate because the purpose of this section is not to calculate a total score accounting for all Evaluation Objectives, but to understand the strength or weakness of a Concept in accomplishing an Evaluation Objective. This comparison could be used to identify projects that could be added to a Concept to potentially improve performance.

5.3.1. Conveyance Improvement

The highest-scoring unweighted Evaluation Objectives for the Conveyance Improvement Concept were Regional Economic Impact, Optimize Local Supplies, and Reliability and Robustness. The lowest unweighted scores were for Cost Effectiveness and Climate Resilience. Six of the unweighted Evaluation Objective scores for Conveyance Improvement had scores less than or equal to a neutral 3.0 value. Individual Evaluation Objective scores for Conveyance Improvement are shown below in Figure 72.

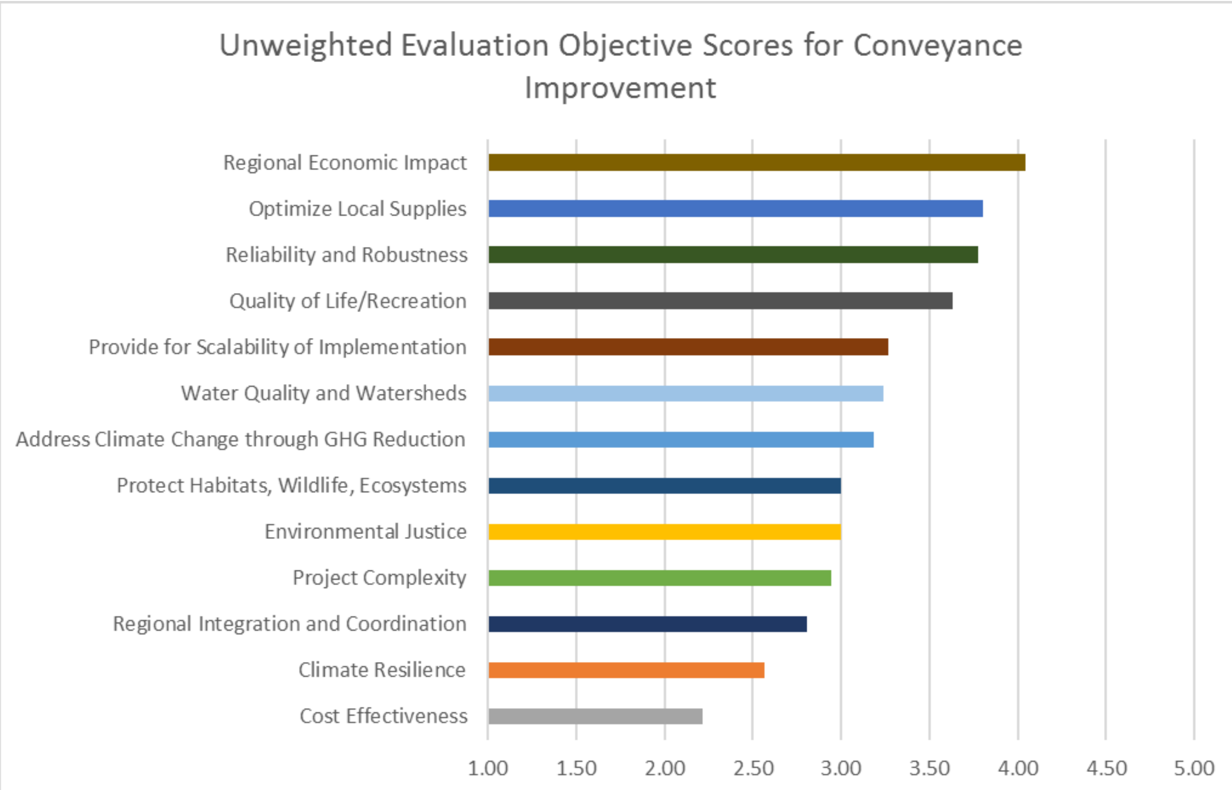


Figure 72. Unweighted Evaluation Scores for Conveyance Improvement.

5.3.2. Enhanced Conservation

Trade-off analysis results for Enhanced Conservation were available for only one Evaluation Objective, Regional Economic Impact. As a result, there was not enough data available to fully assess the relative strength of specific Evaluation Objectives within the Enhanced Conservation Concept. The one available Evaluation Objective score for Enhanced Conservation is shown in Figure 73.

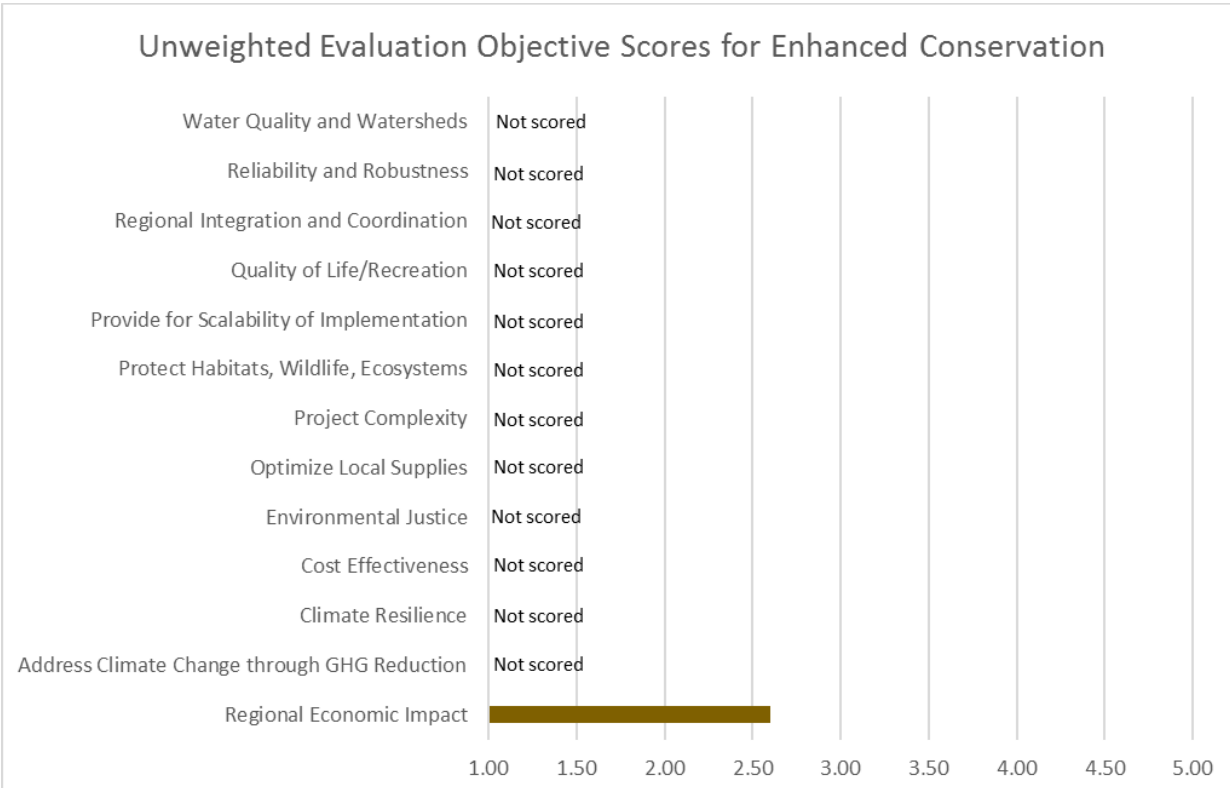


Figure 73. Unweighted Evaluation Objective scores for Enhanced Conservation.

5.3.3. Gray Water Use

The highest-scoring unweighted Evaluation Objectives for the Gray Water Use Concept were for Climate Resilience, Optimize Local Supplies, and Cost Effectiveness. The lowest unweighted scores were for Protect Habitats, Wildlife, and Ecosystems; Project Complexity; and Quality of Life/Recreation. Gray Water Use was not scored for Environmental Justice. All the unweighted Evaluation Objective scores for Gray Water Use had scores of 3.0 or higher. Individual Evaluation Objective scores for Gray Water Use are shown in Figure 74.

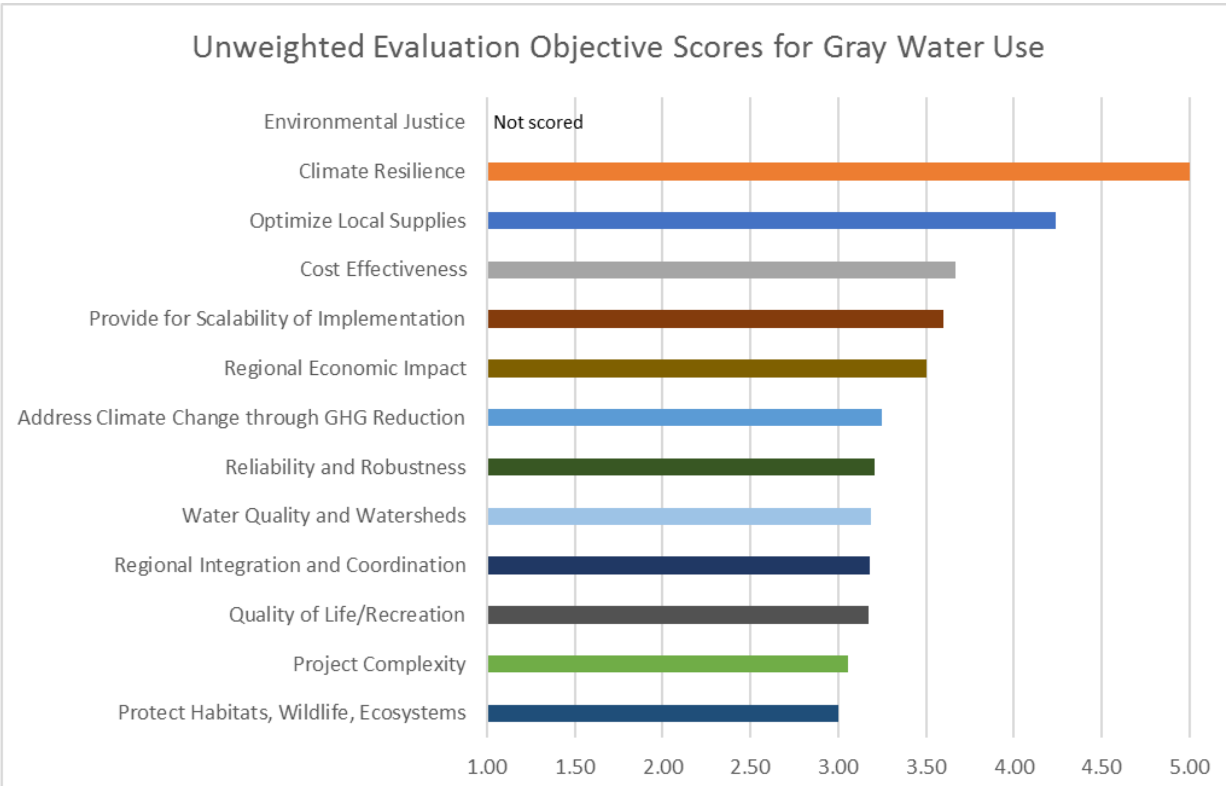


Figure 74. Unweighted Evaluation Objective scores for Gray Water Use.

5.3.4. Groundwater

The highest-scoring unweighted Evaluation Objectives for the Groundwater Concept were for Optimize Local Supplies, Regional Economic Impact, and Reliability and Robustness. Climate Resilience had a very similar score to Reliability and Robustness (scores of 3.72 and 3.78, respectively). The lowest unweighted scores were for Project Complexity and Cost Effectiveness. Only two of the unweighted Evaluation Objective scores for Groundwater had scores lower than a neutral 3.0 score. Individual Evaluation Objective scores for Groundwater are shown in Figure 75.

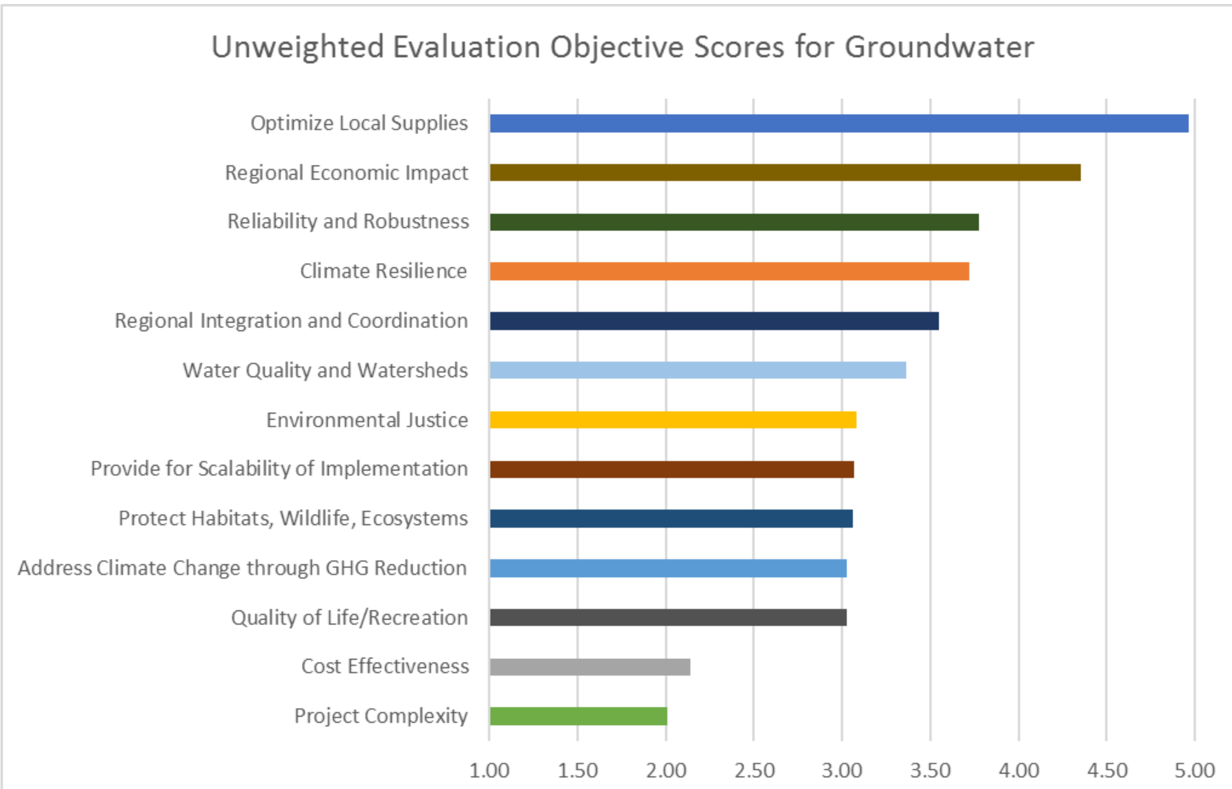


Figure 75. Unweighted Evaluation Objective scores for Groundwater.

5.3.5. Imported Water Purchases

The highest-scoring unweighted Evaluation Objectives for the Imported Water Purchases Concept were Project Complexity, Reliability and Robustness, and Cost Effectiveness. The lowest unweighted scores were for Address Climate Change through GHG Mitigation and Regional Integration and Coordination. Imported Water Purchases was not scored for three Concepts (Climate Resilience, Environmental Justice, and Water Quality and Watershed). Five unweighted Evaluation Objective scores for Imported Water Purchases had scores lower than a neutral 3.0 score. Individual Evaluation Objective scores for Imported Water Purchases are shown in Figure 76.

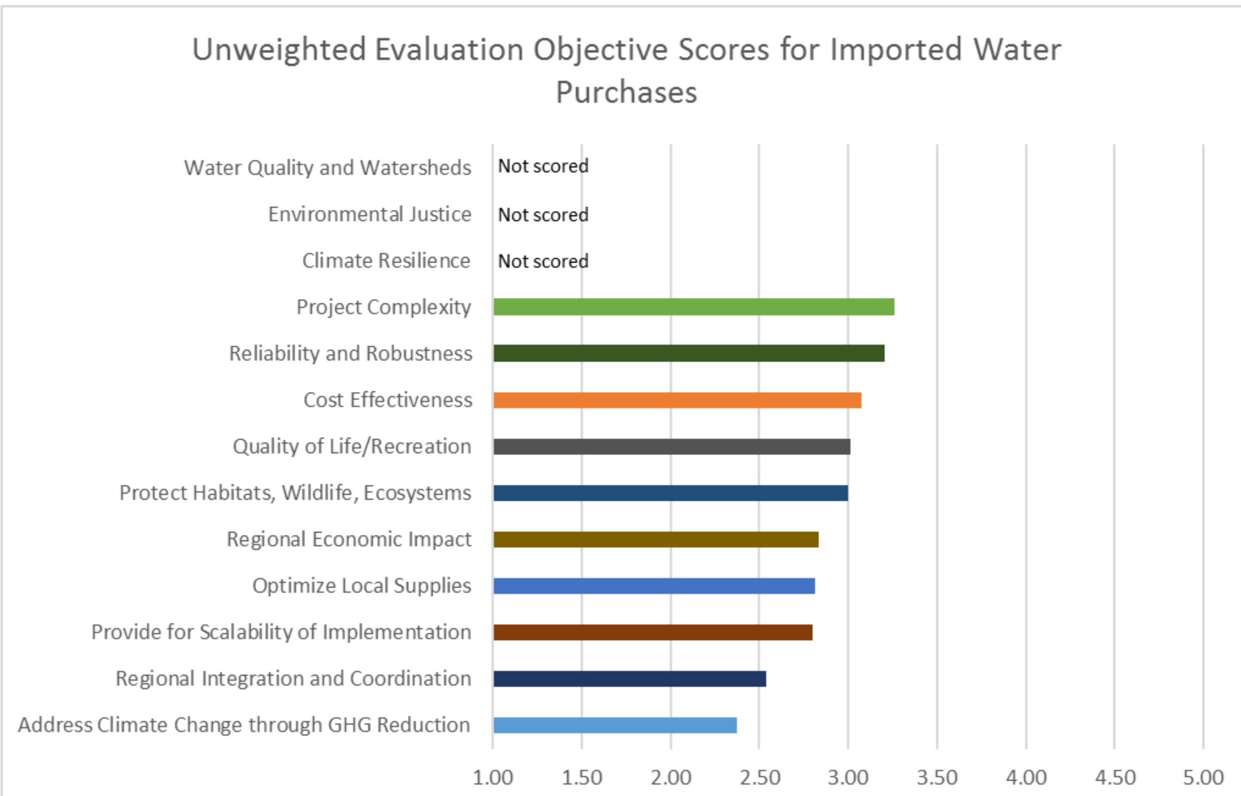


Figure 76. Unweighted Evaluation Objective scores for Imported Water Purchases.

5.3.6. Potable Reuse

The highest-scoring unweighted Evaluation Objectives for Potable Reuse were Optimize Local Supplies, Regional Economic Impact, and Regional Integration and Coordination. Reliability and Robustness had a very similar score to Regional Integration and Coordination (scores of 4.19 and 4.20, respectively). The lowest unweighted scores were for Project Complexity and Cost Effectiveness. Three unweighted Evaluation Objective scores for Potable Reuse were lower than a neutral 3.0 score. Individual Evaluation Objective scores for Potable Reuse are shown in Figure 77.

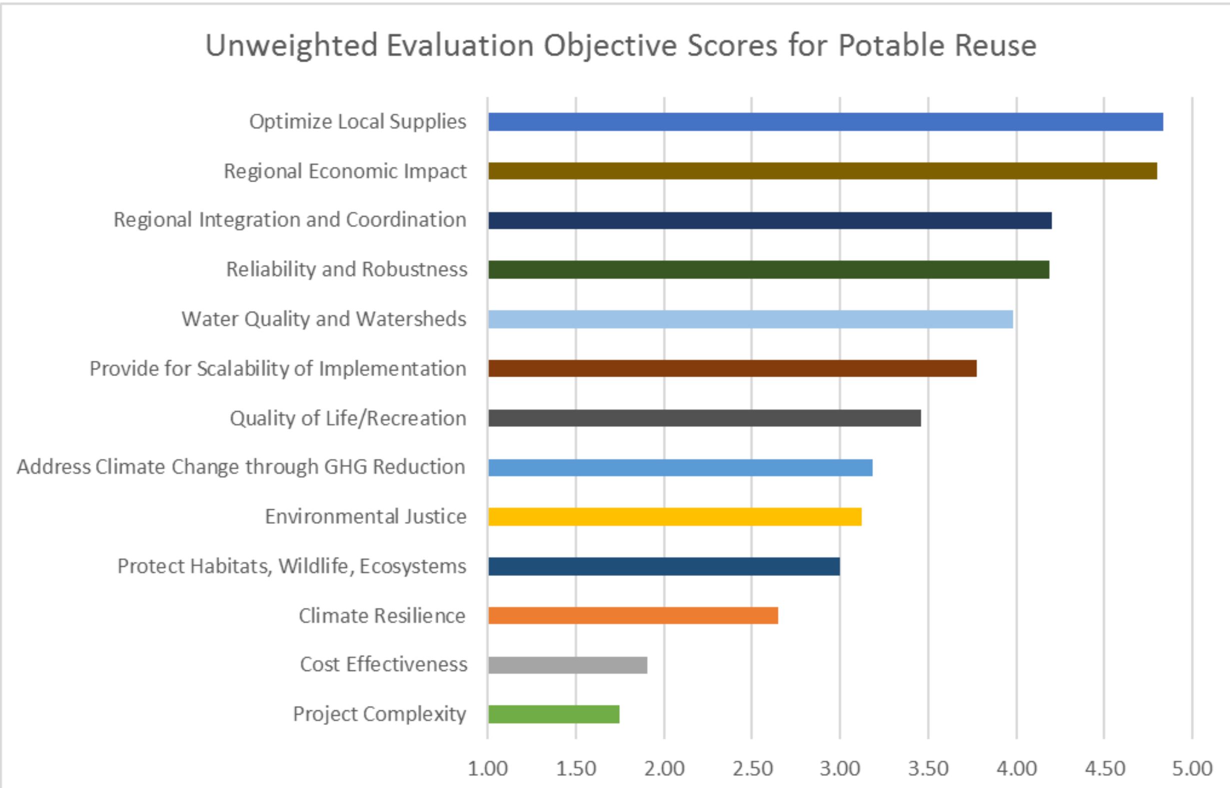


Figure 77. Unweighted Evaluation Objective scores for Potable Reuse.

5.3.7. Recycled Water

The highest-scoring unweighted Evaluation Objectives for Recycled Water were Optimize Local Supplies and Regional Economic Impact. Scores for these two Evaluation Objectives were more than half a point higher than the third highest score (Reliability and Robustness). This indicates that the Recycled Water Concept is particularly good at providing positive regional economic impacts based on the use of local supplies. The lowest unweighted scores were for Cost Effectiveness and Climate Resilience, both of which had scores lower than a neutral 3.0 score. Individual Evaluation Objective scores for Recycled Water Use are shown in Figure 78.

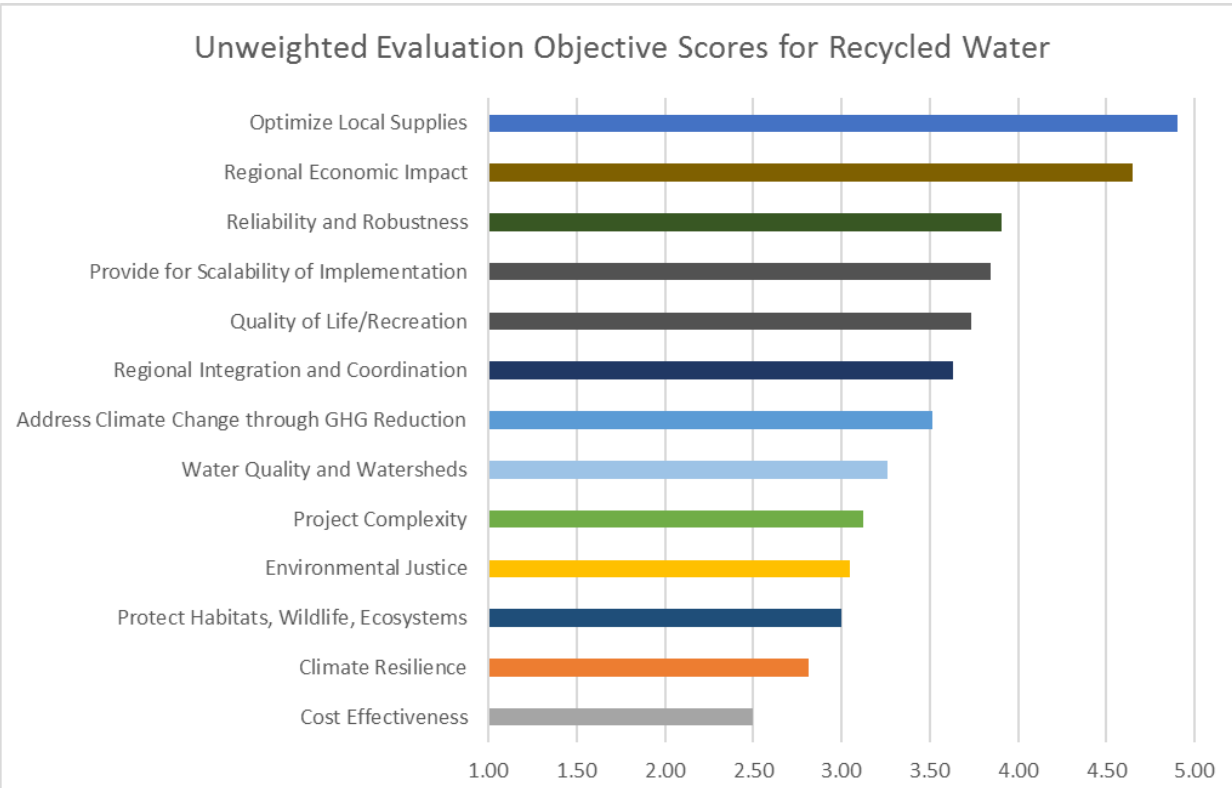


Figure 78. Unweighted Evaluation Objective scores for Recycled Water.

5.3.8. Seawater Desalination

The highest-scoring unweighted Evaluation Objectives for Seawater Desalination were Optimize Local Supplies and Climate Resilience, with unweighted scores of 5.00 for both. Scores for these two Evaluation Objectives were more than one point higher than the third highest scoring Evaluation Objective (Reliability and Robustness). Similar to Recycled Water, this indicates that the Seawater Desalination Concept is particularly good at providing positive regional economic impacts based on the use of local supplies. The lowest unweighted scores were for Project Complexity and Cost Effectiveness, which both scored below a 2.0. Five unweighted Evaluation Objective scores for Seawater Desalination were lower than a neutral score of 3.0. Seawater Desalination had a high degree of variability for Evaluation Objective performance. Individual Evaluation Objective scores for Seawater Desalination are shown in Figure 79.

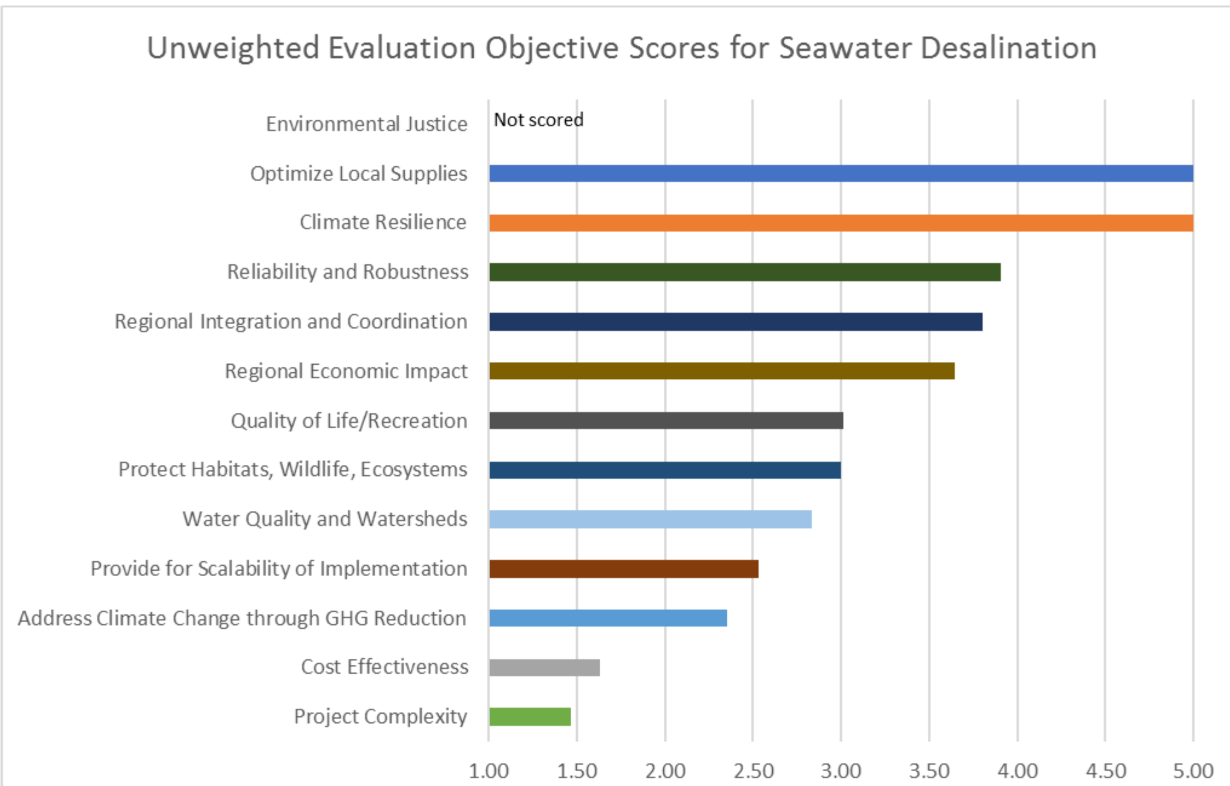


Figure 79. Unweighted Evaluation Objective scores for Seawater Desalination.

5.3.9. Stormwater BMPs

The highest-scoring unweighted Evaluation Objectives for Stormwater BMPs were for Climate Resilience, Quality of Life/Recreation, and Water Quality and Watersheds. The lowest unweighted scores were for Cost Effectiveness, and Regional Integration and Coordination. Cost Effectiveness was the only Evaluation Objective for the Stormwater BMPs Concept that received an unweighted score below a neutral 3.0 score. Individual Evaluation Objective scores for Stormwater BMPs are shown in Figure 80.

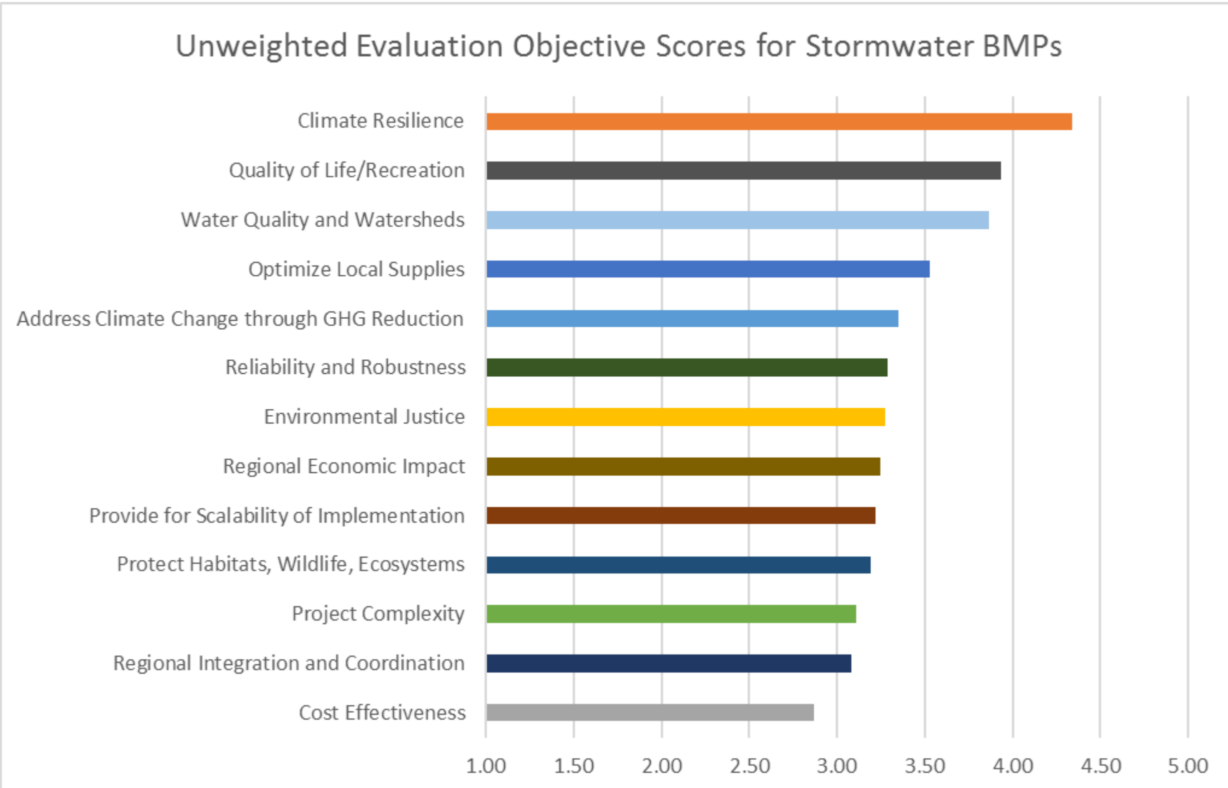


Figure 80. Unweighted Evaluation Objective scores for Stormwater BMPs.

5.3.10. Stormwater Capture

The highest-scoring unweighted Evaluation Objectives for Stormwater Capture were for Climate Resilience and Optimize Local Supplies, both of which had scores that were more than half a point higher than the other 11 Evaluation Objectives. After the top two scores, three Evaluation Objectives had scores near a value of 3.5. The lowest unweighted scores were for Project Complexity and Cost Effectiveness, which were both lower than a neutral 3.0 score. Individual Evaluation Objective scores for Stormwater Capture are shown in Figure 81.

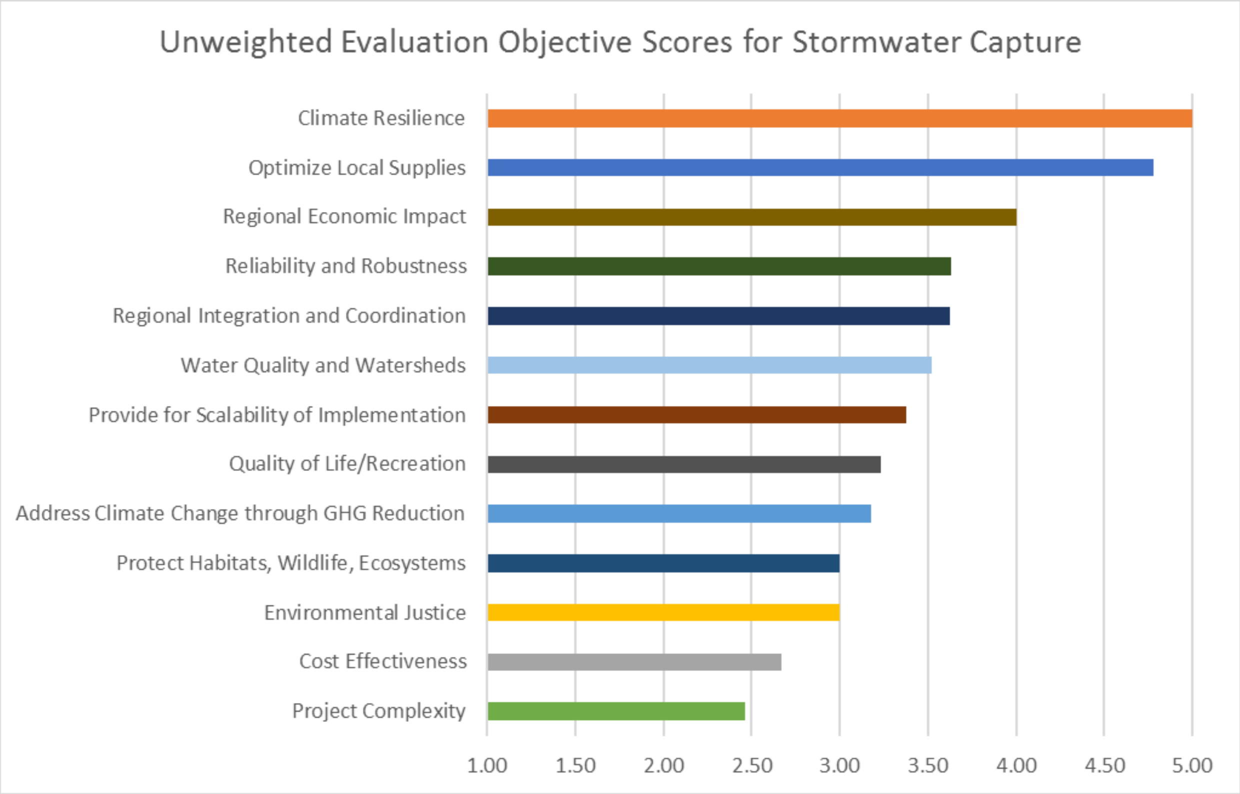


Figure 81. Unweighted Evaluation Objective scores for Stormwater Capture.

5.3.11. Urban and Agricultural Water Use Efficiency

The highest-scoring unweighted Evaluation Objectives for Urban and Agricultural Water Use Efficiency were Optimize Local Supplies, Regional Economic Impact, and Project Complexity, closely followed by Cost Effectiveness and Provide for Scalability of Implementation. All five of these Evaluation Objectives had scores higher than 4.00. The lowest scoring Evaluation Objectives were Protect Habitats, Wildlife, and Ecosystems, and Reliability and Robustness. None of the unweighted Evaluation Objective scores was lower than a neutral 3.0 score, with the lowest unweighted score being a 3.08 for Protect Habitats, Wildlife, and Ecosystems. Urban and Agricultural Water Use Efficiency and Gray Water Use were the only Concepts that did not receive an unweighted score below a 3.0 for any Evaluation Objective. The combination of no below 3.0 scores and six 4.0 or greater scores is why Urban and Agricultural Water Use Efficiency had the highest overall total score when considering all the Evaluation Objectives among all Concepts. Individual Evaluation Objective scores for Urban and Agricultural Water Use Efficiency are shown in Figure 82.

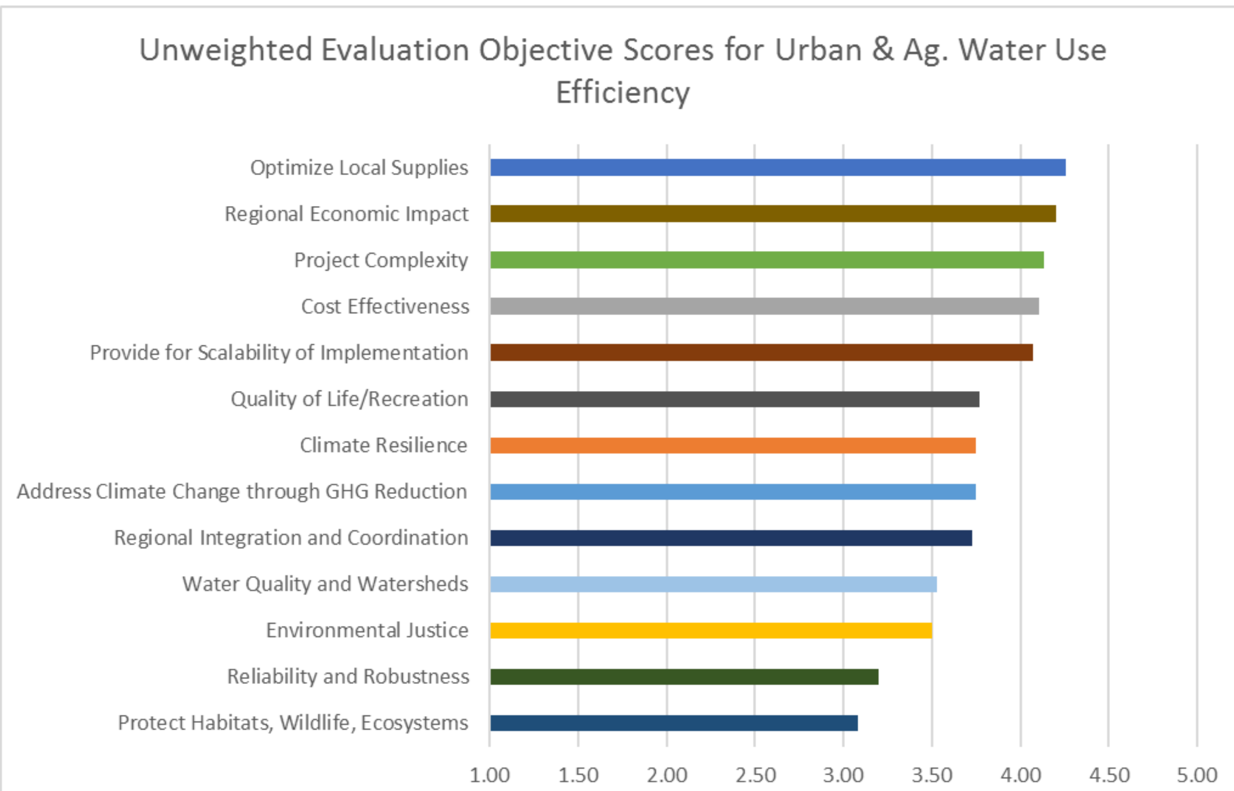


Figure 82. Unweighted Evaluation Objective scores for Urban and Agricultural Water Use Efficiency.

5.3.12. Watershed and Ecosystem Management

The highest-scoring unweighted Evaluation Objectives for Watershed and Ecosystem Management were Quality of Life/Recreation, Climate Resilience, and Optimize Local Supplies. The lowest unweighted scores were for Project Complexity and Cost Effectiveness, both of which scored below a neutral 3.0. The Quality of Life/Recreation Evaluation Objective score was above 4.0. Individual Evaluation Objective scores for Watershed and Ecosystem Management are shown in Figure 83.

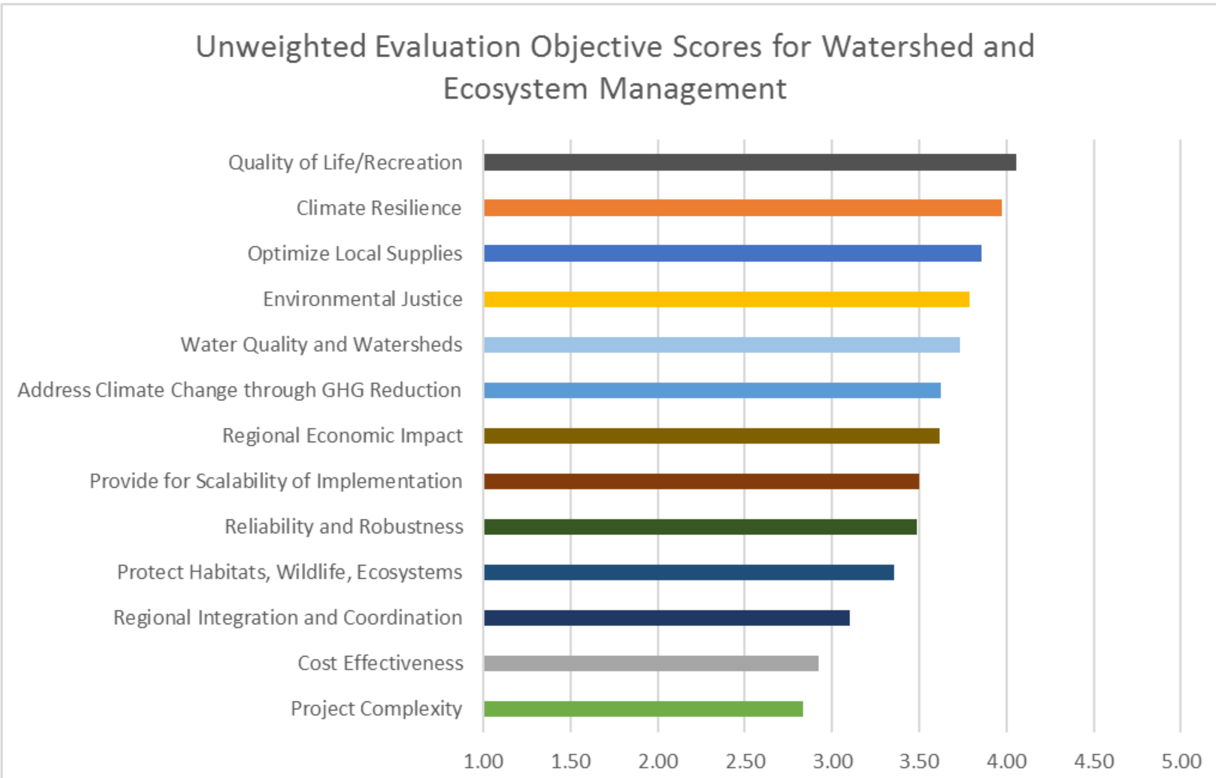


Figure 83. Unweighted Evaluation Objective scores for Watershed and Ecosystem Management.

6. Supplemental Economic Assessment

Although the primary mechanism for accomplishing the Task 2.5 goal of comparing Concepts is to complete a trade-off analysis, estimation of quantifiable, monetized benefits provides additional information which can better help to inform decision-makers. It should also be noted that there is some crossover between an economic assessment and a trade-off analysis. For example, the economic benefits from additional water supplies can be estimated as the volume in acre-feet multiplied by the value per acre-foot. A trade-off analysis can account for differences in water supply volumes by comparing differences in volumes for different Concepts. This supplemental economic assessment includes consideration of the economic benefits of water supply reliability (reduced shortages), recreation, and energy usage.

6.1. Methods Used to Estimate Economic Benefits and Costs

Calculation of the economic benefits associated with water supply reliability, recreation, and energy usage relied on comparisons of model outputs for each single Concept model run relative to the Baseline model run (see Section 3.3.1.1) and data obtained from the literature as described below.

6.1.1. Municipal and Industrial Water Supply Reliability Benefits

The economic value of water supply reliability was calculated from the relative change in water supply shortages for each Concept and the value of avoided shortages compared to the Baseline. Relatively few studies are available that provide estimates of the economic benefits of water supply reliability (reduced shortages), due to difficulties in data gathering and establishing reliability criteria. Four California studies, one Colorado study, and one Texas study were found that provide estimates of the value of water supply reliability (Barakat & Chamberlin, Inc., 1994; Carson & Mitchell, 1987; Griffin & Mjelde, 2000; Koss & Khawaja, 2001; Howe & Smith, 1994; Jenkins, Lund, & Howitt, 2003). The Koss and Khawaja study is geographically the most applicable to the San Diego Basin Study because its study area included ten southern California water districts and it provides consistent reliability values for a variety of water shortage conditions. Therefore, the Koss and Khawaja study was used as the basis for the best estimate of the value of reduced water supply shortages. The lower bound estimate of the Koss and Khawaja study represents the willingness to pay of water users to avoid a 1 event in 10 year occurrence of a 10% shortage and was judged to be the most representative of potential water reliability benefits in the San Diego region and therefore was used as the basis for the avoided water shortage (reliability) benefits in this economic assessment. The avoided 1 in 10 year 10% shortage value is approximately $12 per household per month.

In order to estimate the water reliability benefits associated with each Concept, benefits were converted into a value per acre-foot. First, the average domestic water use per household was obtained from the literature. Domestic water use in California was estimated by the U.S. Geological Survey to be 108 gallons per capita per day (U.S. Geological Survey, 2014). Average household size for California was estimated to be 2.90 persons per household (U.S. Census Bureau, 2012). Based on these values, average annual water use was estimated to be 114,318 gallons per household (0.351 acre-feet per household) for California. Water reliability benefits were translated into a value per acre-foot by multiplying the average monthly water reliability values by 12 months, indexing the values to 2016 dollars using the Consumer Price Index for all urban consumers, and dividing the result by the estimated average annual water use in acre-feet. Performing this calculation resulted in a water reliability benefit (value of avoided water supply shortage) of $682 per acre-foot annually.

The value of reduced shortages on a per acre-foot basis tends to be quite high due to increased willingness to pay for goods and services in short supply. However, these values are highly dependent on the severity and duration of shortage. The value of $682 per acre-foot per year was used to value water shortages for this economic assessment, recognizing that a constant average value is not likely to apply to either small, short-term shortages or large, long-term shortages. This value was used to represent the potential magnitude of economic value associated with a shortage. There are conditions that could occur that are not average and average values may not be representative of all conditions.

Annual total water supply shortage volumes from the Task 2.5 single Concept model runs (Section 3.3.1.1) were used to evaluate the impact of different Concepts on water shortages relative to the Baseline model run. It should be recognized that using average annual shortages for different year types and central tendencies does not account for specific shortage events. However, average shortage quantities can provide a general basis for comparing Concepts. The average annual shortage volume for the Baseline was about 4,735 acre-feet. All Concepts resulted in lower shortage volumes than the Baseline. Negative values for shortage volumes compared to the Baseline in Table 80 indicate reduced shortages associated with the Concepts.

Table 80. Estimated shortage volume and value of shortage.

Concept	Shortage Volume Compared to Baseline (acre-feet)	Annual Value of a Change in Water Shortages Compared to Baseline
Conveyance Improvement	-246	$167,800
Enhanced Conservation	-4,734	$3,228,600
Gray Water Use	-400	$272,800
Groundwater	-1,914	$1,305,300
Imported Water	-348	$237,300
Potable Reuse	-3,204	$2,185,100
Recycled Water	-2,082	$1,419,900
Seawater Desalination	-2,762	$1,883,700
Stormwater BMPs	-12	$8,200
Stormwater Capture	-100	$68,200

Concept	Shortage Volume Compared to Baseline (acre-feet)	Annual Value of a Change in Water Shortages Compared to Baseline
Urban & Agricultural Water Use Efficiency	-338	$230,500
Watershed & Ecosystem Management	-287	$195,700

6.1.2. The Economic Value of Recreation

The economic value of recreation was calculated from the relative change in reservoir visitation for each Concept and the value of recreation at reservoirs compared to the Baseline. A recreation value of $23.90 per day was used to evaluate recreation benefits for the San Diego Basin Study. This value was based on a California outdoor recreation economic study prepared for the California State Parks Department (BBC Research and Consulting, undated). The study provided estimates of the contribution of recreation expenditures to the California economy and the economic benefits from participating in outdoor recreation. The estimates of economic contribution and benefits were provided for different regions of the state and for different types of parks and facilities, including State Park System facilities, regional parks, and county and local parks. Benefit estimates were provided for several specific activities, with a focus on water-related recreation activities.

Primary recreation activities at Hodges, El Capitan, Lower Otay, and San Vicente reservoirs are fishing, boating, hiking, and picnicking. The California State Parks Department study estimated recreation values of $23 per day for fishing, $29 per day for boating, $16 per day for hiking, $20 per day for picnicking, and $19 per day for sightseeing. The average for all recreation activities is $21.40 per day in 2008 dollars. Indexing the 2008 value to 2016 dollars using the Consumer Price Index results in a value of $23.90 per day.

Average monthly reservoir elevations from the Task 2.5 single Concept model runs (Section 3.3.1.1) were input into the recreation visitation model (see Section 3.4.9.2.2). Although using average monthly elevations ignores the effects of any wide fluctuations in reservoir elevation during the month that could affect recreation, it provides a useful basis for establishing relative differences between Concepts. The recreation visitation modeling coefficients were used to estimate differences in visitation at the four recreation sites evaluated in the model. The changes in visitation based on average monthly reservoir elevations from each of the single Concept model runs relative to the Baseline model run and the value of those changes are presented in Table 81. Total recreation visits to all four reservoirs were estimated to be 164,100 annually, and a value of $23.90 per visitor day was used to estimate the value of changes in recreation benefits.

Table 81. Estimated change in recreation visitation based on visitation model.

Concept	Estimated Annual Change in Recreation Visitation	Percentage Change in Annual Visitation	Annual Change in the Value of Recreation Activities
Conveyance Improvement	13,358	8.14%	$319,300
Enhanced Conservation	2,910	1.77%	$69,549
Gray Water Use	47	0.03%	$1,123
Groundwater	129	0.08%	$3,083
Imported Water	-3	0.00%	-$72
Potable Reuse	6,833	4.16%	$163,309
Recycled Water	85	0.05%	$2,032
Seawater Desalination	17	0.01%	$406
Stormwater BMPs	6	0.00%	$143
Stormwater Capture	13	0.01%	$311
Urban & Agricultural Water Use Efficiency	17	0.01%	$406
Watershed & Ecosystem Management	-3,464	-2.11%	-$82,790

6.1.3. Energy Usage Values

The economic value of energy usage was calculated from the relative change in annual net energy for each Concept and the avoided cost of power generation compared to the Baseline. Model metrics from the Task 2.5 single Concept model runs (Section 3.3.1.1) were used as the basis for estimating the change in annual net energy. The value of energy is based on the avoided cost of power generation, which assumes that the value of energy is equal to the cost of generating an extra unit of power for the Study Area. The avoided cost of power generation was calculated from the net energy usage of a Concept relative to the Baseline, and the Locational Marginal Price (LMP) for power in the San Diego area.

The CWASim model output Net Energy was used to quantify net energy usage. The CWASim Net Energy output is the difference between the CWASim Energy Generation and Energy Consumption metrics. Energy Generation quantified the modeled energy generation at seven facilities associated with the water system: Miramar, Alvarado, and Twin Oaks Valley Water Treatment Plants, the Rancho Peñasquitos Hydroelectric Facility, Hodges Pump Storage Hydroelectric Facility, and the SDCWA offices in San Diego and Escondido. Energy

Consumption quantified the modeled energy consumption to treat and deliver water, including consumption by supply sources, conveyance, treatment, pumped storage, and offices. As described in Section 3.3.1.1, the Task 2.5 model runs were performed individually for each Concept, and projects from only a single Concept were implemented for each run (i.e., only projects were implemented in the Conveyance Improvement model run for Task 2.5), except that all projects in the Baseline model run were implemented in all model runs (i.e., Baseline projects were included in the Conveyance Improvement model run in addition to Conveyance Improvement projects beyond the Baseline). The net energy usage for each Concept was then subtracted from the Baseline net energy usage to calculate the net energy usage relative to Baseline for each Concept.

The avoided cost used in the SDBS economic analysis was based on the LMP for power in the San Diego area. LMP is the marginal cost of supplying, at least cost, an additional increment of electric demand at a specific location on the power network. There are two different LMPs available from the California Independent System Operator: day-ahead market LMPs and real-time dispatch LMPs (California ISO, 2018). In the day-ahead market, generators offer supply while load-serving entities bid demand. The ISO will commit the lowest cost generators based on required demand, producing 24-hour clearing prices. This provides generators notice of generation expectations for the next operating day while also providing some price certainty. The real-time market acts as a balancing market where the day-ahead commitments are balanced against actual demand and system constraints in making real-time dispatch decisions. Less price volatility is generally expected within the day-ahead clearing prices and the vast majority of system load is committed in the day-ahead market. The difference in price between the two markets is relatively small, generally about $1 per MWh. Therefore, the day-ahead market LMPs are used to value energy for the economic assessment. The California ISO website indicated the day-ahead market LMP for the San Diego area as of September 10, 2018 was about $34 per megawatt hour (MWh).

Assuming that the current methods and costs of generating power will continue into the future, the value of energy was calculated by multiplying the LMP by the annual change in net power for each Concept relative to the Baseline to obtain an annual value of change in net power relative to the Baseline (Table 82).

Table 82. Estimated change in net energy and value of power.

Concept	Annual Net Energy Usage Relative to Baseline (MWh)	Value of Energy Usage Saved Relative to Baseline
Conveyance Improvement	4,097	-$139,297
Enhanced Conservation	-527,521	$17,935,706

Concept	Annual Net Energy Usage Relative to Baseline (MWh)	Value of Energy Usage Saved Relative to Baseline
Gray Water Use	-6,786	$230,735
Groundwater	-33,739	$1,147,135
Imported Water	-15,318	$520,798
Potable Reuse	-145,542	$4,948,425
Recycled Water	-80,923	$2,751,385
Seawater Desalination	56,731	-$1,928,869
Stormwater BMPs	-236	$8,031
Stormwater Capture	-1,571	$53,416
Urban & Agricultural Water Use Efficiency	-7,897	$268,484
Watershed & Ecosystem Management	-13,510	$459,355

The analysis of energy consumption did not include calculations of GHGs. Due to information limitations associated with future energy supply mix (e.g., in 2015, the year of analysis), the calculation of GHGs was not possible and was, therefore, outside of the scope of this Study.

6.2. Economic Assessment Results

The economic assessment supplemented the trade-off analysis by providing a sense of the economic values associated with three categories of quantifiable and monetized effects associated with the Concepts relative to the Baseline. However, it needs to be emphasized that the economic values in the economic assessment represent only some of the effects that could be monetized. Therefore, this economic assessment should not be considered a complete economic analysis for use in completing a full benefit-cost type of analysis. Furthermore, benefits that cannot be monetized still have value, and thus, the trade-off analysis provides a more complete picture of the total effects of the Concepts. However, despite its limitations, the economic assessment did provide information that can be used to assess the economic effects of each Concept on water supply reliability, recreation, and energy use. The results of the economic assessment are presented in Table 83.

Table 83. Estimated value of quantified and monetized effects relative to Baseline.

Concept	Annual Value of a Change in Water Shortages Relative to Baseline	Annual Change in the Value of Recreation Activities Relative to Baseline	Annual Value of a Change in Net Energy Relative to Baseline	Net Annual Value of Quantified and Monetized Economic Effects Relative to Baseline
Conveyance Improvement	$167,800	$319,300	-$139,297	$347,803
Enhanced Conservation	$3,228,600	$69,549	$17,935,706	$21,233,855
Gray Water Use	$272,800	$1,123	$230,735	$504,658
Groundwater	$1,305,300	$3,083	$1,147,135	$2,455,518
Imported Water	$237,300	-$72	$520,798	$758,026
Potable Reuse	$2,185,100	$163,309	$4,948,425	$7,296,834
Recycled Water	$1,419,900	$2,032	$2,751,385	$4,173,317
Seawater Desalination	$1,883,700	$406	-$1,928,869	-$44,763
Stormwater BMPs	$8,200	$143	$8,031	$16,374
Stormwater Capture	$68,200	$311	$53,416	$121,927
Urban & Agricultural Water Use Efficiency	$230,500	$406	$268,484	$499,390
Watershed & Ecosystem Management	$195,700	-$82,790	$459,355	$572,265

The economic assessment indicated there are positive reduced water supply shortage benefits associated with all the Concepts relative to baseline conditions. Reduction in water supply shortages was an underlying goal of all Concepts because the purpose of the Concepts is to describe similar strategies or projects that could be used to meet the water demands of the region. Therefore, positive benefits associated with reduced water shortages would be expected for all Concepts. Similarly, there were positive or zero benefits associated with the value of recreation activity for all the Concepts except Watershed and Ecosystem Management and Imported Water. The Watershed and Ecosystem Management Concept had negative recreation benefits due to the inclusion of the Hodges Water Quality Improvement Program project in this Concept, which improves water quality, thereby allowing larger releases of stored water and resulting in lower reservoir elevations. Conveyance Improvement had the highest positive net value of recreation activities. The benefits and costs associated with the net value of energy usage was highly variable. Two Concepts, Seawater Desalination and Conveyance Improvements, used more energy compared to the baseline. The remaining Concepts used less energy compared to the baseline. Enhanced Conservation had the largest net benefit of decreased energy usage, with a value that was more than three times the value of the next highest Concept. Potable Reuse, Recycled Water, and Groundwater also provided significant positive value for energy usage. The net annual values including all three quantified and monetized effects for each Concept are shown in Figure 84.

Enhanced Conservation, Potable Reuse, and Recycled Water provided the greatest estimated quantifiable net benefit. The only Concept with a net negative benefit was Seawater Desalination. This was the result of a high negative net energy value compared to the other Concepts. Recreation values played a comparatively small role in the economic assessment results.

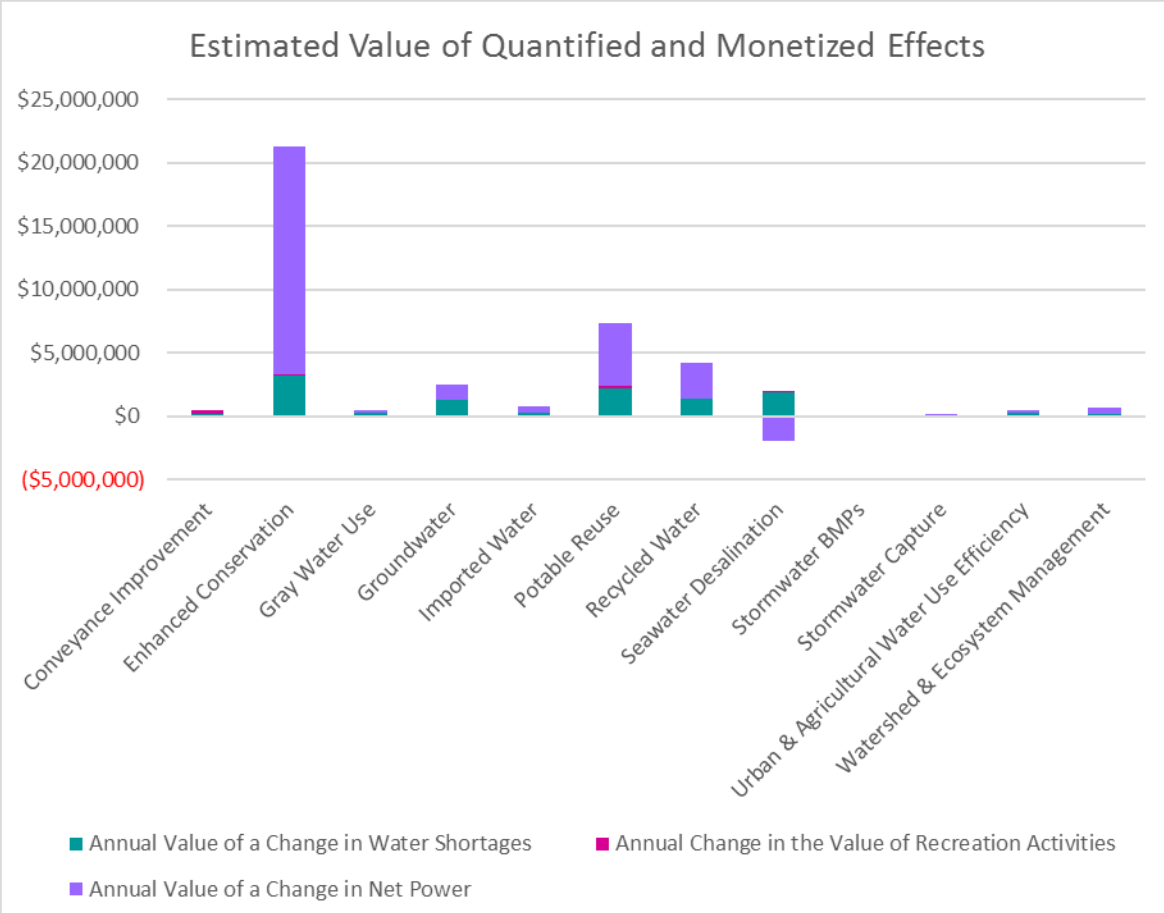


Figure 84. Estimated Annual Value of Quantified and Monetized Effects.

7. Discussion and Conclusions

The purpose of Task 2.5 of the San Diego Basin Study was to compare Concepts for meeting the San Diego region's water demands and addressing the impacts of increasing demand and climate variation through the 2050s. The Concepts represent a set of planned or conceptual projects that are being considered in the region. To compare the Concepts and account for the different types of benefits and costs that may be associated with the Concepts, Task 2.5 included two components:

1. Trade-off analysis (Chapters 3 through 5) to evaluate and compare different categories of benefits and costs, including categories of benefits and costs that cannot be quantified and monetized.

2. Supplemental assessment of potential economic benefits and financial effects associated with the Concepts (Chapter 6). This assessment was separate from the trade-off analysis

and is intended to provide supplemental information, focusing only on those benefits and costs that can be quantified and monetized.

The trade-off analysis and economic assessment performed for the Basin Study were designed to reveal the benefits and challenges associated with Concepts, highlight opportunities to improve Concept implementation, and enhance informed decision-making as it relates to investing in water management in the San Diego region. The Basin Study evaluated 12 Concepts using 13 Evaluation Objectives, which allowed for a large number of potential regional outcomes to be assessed. The results presented here represent the ranking of Concepts based on the specific set of Evaluation Objectives and categories of economic benefits analyzed, the Performance Measure scores calculated using data from the project-level and Concept-level surveys, GIS analysis, model outputs gathered for the Study, and the weights obtained from the Evaluation Objective importance weight survey performed as part of the Basin Study. Given the level of analysis, the result is not a list of prioritized Concepts recommended for implementation, but is instead a screening analysis that can be used to identify promising Concepts that address the impacts of climate change and increasing demands on water supplies within the San Diego region. These results could also provide supporting data for use in estimating the potential benefits of projects and Concepts as part of grant applications or when determining which projects merit more detailed examination.

7.1. Trade-Off Analysis

Trade-off analysis serves as a valuable tool to compare the ability of Concepts to achieve Evaluation Objectives defined by regional stakeholders. Concept rankings were determined by their total weighted scores on a set of 13 Evaluation Objectives. The Evaluation Objectives were based on Performance Measures calculated from survey responses, GIS analysis, and model outputs. The weights were determined from a survey of regional stakeholders. Task 2.5 included three trade-off analyses: a trade-off analysis including all Evaluation Objectives, a trade-off analysis including only cost and feasibility related Evaluation Objectives, and a trade-off analysis including only environmentally-related Evaluation Objectives. The primary focus of the Basin Study was the analysis including all Evaluation Objectives. The cost and feasibility and environmentally-related trade-off analyses were provided only as examples of how stakeholders could customize the analyses to their individual interests and needs, and are not discussed in detail here.

The trade-off analysis performed with all Evaluation Objectives indicated that the Urban and Agricultural Water Use Efficiency Concept generated the greatest overall positive effects as defined by the Evaluation Objectives. Five additional Concepts scored within 10% of the highest-scoring Concepts: Watershed and Ecosystem Management, Stormwater Capture, Recycled Water, Potable Reuse, and Stormwater BMPs. Groundwater and Conveyance

Improvement were within 15% of the highest-scoring Concept. Scores for all the Evaluation Objectives were not available for Enhanced Conservation, Gray Water Use, Imported Water Purchases, and Seawater Desalination, so they could not be directly compared. However, even with one missing Evaluation Objective, Gray Water Use had a point total above Conveyance Improvement, indicating that if it had been scored on all Evaluation Objectives, it may have performed relatively well.

7.1.1. Factors Influencing Trade-Off Analysis Results

Several factors should be considered when evaluating the trade-off analysis results. These factors include:

- The Evaluation Objectives included in the analysis and the corresponding Performance Measures used to estimate the effects of a Concept on an Evaluation Objective
- The measure of central tendency used to summarize the results of project-level and Concept-level surveys
- Whether a Concept could be scored for all Evaluation Objectives
- Scores on individual Evaluation Objectives
- The importance weights applied to each Evaluation Objective
- The meaning of the total trade-off analysis scores

7.1.1.1 Influence of Evaluation Objectives Included in the Analysis

The Evaluation Objectives and associated Performance Measures that were included in the trade-off analysis determined the range of criteria that were used to compare the Concepts. Evaluation Objectives measured the impacts generated by each Concept for the types of impacts that were considered important by stakeholders and decision-makers. Thirteen Evaluation Objectives associated with 26 Performance Measures were developed for the Basin Study, but some decision-makers may want to include only a subset of those criteria for their decision-making processes. As demonstrated in Sections 5.1 and 5.2, trade-off analyses can be performed with the full set of Evaluation Objectives or with smaller subsets of Evaluation Objectives. These analyses will reflect different priorities and may result in different total scores and rankings of Concepts.

Three trade-off analyses were performed for the Basin Study: an analysis with the full set of all Evaluation Objectives and two analyses with subsets of Evaluation Objectives. For example, the Urban and Agricultural Water Use Efficiency Concept received the highest cumulative point total for the analysis using all Evaluation Objectives, while the Watershed and Ecosystem Management Concept received the highest cumulative score for the environmentally-related subset of Evaluation Objectives.

7.1.1.2 The measure of central tendency used to summarize the results of project-level and Concept-level surveys

Because the use of mean survey scores could show differences between scores when a difference does not truly exist, a statistical analysis using pooled t-tests was performed to assess the potential for bias. The analysis determined that the potential for bias was low, meaning that mean scores generally provide an accurate measure of differences in Concept scores. A sensitivity analysis using median scores confirmed this finding, resulting in similar groupings of Concepts using median scores, although the order of Concepts in the overall rankings shifted slightly. For example, Watershed and Ecosystem Management ranked second using mean survey scores and fifth using median survey scores), Stormwater Capture ranked third using mean survey scores and second using median survey scores, Recycled Water ranked fourth using mean survey scores and third using median survey scores), and Potable Reuse ranked fifth using mean survey scores and fourth using median survey scores), and Stormwater BMPs (rank of 6 using both mean and median survey scores).

7.1.1.3 Whether a Concept Could be Scored on All Evaluation Objectives

As noted throughout the results, four Concepts could not be scored on all Evaluation Objectives: Enhanced Conservation (scored on only one Evaluation Objective because it could not be mapped for geospatial analysis and was not included in the project- or Concept-level surveys), Imported Water (scored on 10 of the 13 Evaluation Objectives because it could not be mapped for geospatial analysis), and Gray Water Use and Seawater Desalination (scored on 12 of the 13 Evaluation Objectives because they were missing project-level survey data related to Environmental Justice). Therefore, these Concepts could not be directly compared to the other Concepts based on their total weighted scores because their total possible points was lower than the Concepts scored on all Evaluation Objectives. Directly comparing these Concepts to the rest of the Concepts could lead to incorrect conclusions about the relative rankings of the Concepts.

7.1.1.4 Concept Scores on Individual Evaluation Objectives

Unweighted scores on individual Evaluation Objectives had a significant influence on the overall ranking of Concepts. The top overall scoring Concepts had individual Evaluation Objective scores that were consistently in the top tier of Concepts, although they were not necessarily the top scoring Concepts for every Evaluation Objective. Urban and Agricultural Water Use Efficiency, the highest scoring Concept for all Evaluation Objectives, scored higher than neutral for all Evaluation Objectives and did not receive an unweighted Evaluation Objective score below a neutral value of 3.00. It had the highest unweighted score for four Evaluation Objectives (Address Climate Change Through GHG Reduction, Cost Effectiveness, Project Complexity, and Provide for Scalability of Implementation), was the second-ranked Concept for unweighted scores on one Evaluation Objective (Environmental Justice), the third-ranked Concept for unweighted scores on three Evaluation Objectives (Protect Habitats, Wildlife, and Ecosystems, Regional Integration and Coordination, and Quality of Life/Recreation), and had the lowest unweighted score for only one Evaluation Objective (Reliability and Robustness).

Generally, most Concepts did not perform poorly for any particular Evaluation Objective, except for Project Complexity and Cost Effectiveness. Most Concepts scored relatively poorly for Project Complexity, with an average unweighted score of 2.70, and Cost Effectiveness, with an average unweighted score of 2.74. Only Urban and Agricultural Water Use Efficiency scored above 4.0 on these two Evaluation Objectives, with an unweighted score of 4.13 for Project Complexity and an unweighted score of 4.10 for Cost Effectiveness. No Concept received a less than neutral (3.00) score for Environmental Justice, Protect Habitats, Wildlife, and Ecosystems, Quality of Life/Recreation, or Reliability and Robustness.

Some Concepts with lower overall weighted scores had high scores for some individual unweighted Evaluation Objectives, but those high scores were offset by low scores for other individual Evaluation Objectives, even when the higher-scoring Evaluation Objectives were weighted more than the lower scoring Evaluation objectives. For example, Groundwater, which was ranked 7th overall, had the second-highest score for Optimize Local Supplies (the fourth highest weighted Evaluation Objective) but ranked near the bottom for Address Climate Change through GHG Reduction (ninth highest weight), Cost Effectiveness (seventh highest weight), Project Complexity (lowest weight), and Quality of Life/Recreation (second lowest weight).

A wide variation in Evaluation Objective scores within the same Concept may be an indicator that some Evaluation Objectives are not compatible with each other for that Concept. For example, in order to achieve a high Reliability and Robustness score, projects within a Concept may be relatively complex (resulting in a low Project Complexity score) and expensive (resulting in a low Cost Effectiveness score). The Potable Reuse, Seawater Desalination, and Groundwater Concepts showed this type of variation in scores when comparing Reliability and Robustness scoring with Project Complexity and Cost Effectiveness scoring. Potable Reuse scored 1.47 on Project Complexity and 1.63 on Cost Effectiveness, but 4.19 on Reliability and Robustness. Similarly, a high degree of complexity in a project (low Project Complexity score) may indicate that substantial integration and coordination is required to implement the project (resulting in a high Regional Integration and Coordination score). This type of situation can be seen for Potable Reuse and Seawater Desalination. Seawater Desalination received a score of 1.47 on Project Complexity, and a score of 3.81 on Regional Integration and Coordination.

The range of scores varied between Evaluation Objectives. The Project Complexity Evaluation Objective had the largest range of unweighted scores, ranging from a low of 1.47 for Seawater Desalination to a high of 4.13 for Urban and Agricultural Water Use Efficiency. Protect Habitats, Wildlife, and Ecosystems had the smallest range of unweighted scores, ranging from 3.00 for seven Concepts to 3.35 for Watershed and Ecosystem Management. All Concepts had at least one Evaluation Objective with an unweighted score above 4.0 except for Imported Water and Enhanced Conservation. Imported Water received a maximum unweighted score of 3.26 (for Project Complexity) and was not scored for three Evaluation Objectives. Enhanced Conservation received a maximum unweighted score of 2.60 (for Regional Economic Impact, which was the only Evaluation Objective for which the Concept received a score).

7.1.1.5 Influence of Evaluation Objective Weights

The Evaluation Objective weights contributed to the final ranking of Concepts and were important to consider in evaluating the results. Importance weights represented the contribution of each Evaluation Objective to regional well-being. When rating the importance of Evaluation Objectives, stakeholders identified Reliability and Robustness and Water Quality and Watersheds as the most important Evaluation Objectives in the survey that asked respondents to rank Evaluation Objectives on their relative importance, with weights of 10.0 on a 10-point scale. Climate Resilience, Optimize Local Supplies/Independence, and Protect Habitats, Wildlife, and Ecosystem Service had the next highest level of importance, with weights of 9.6, 9.4, and 9.2, respectively. Therefore, Concepts targeting and generating positive effects for these five Evaluation Objectives will tend to provide the greatest level of overall benefit to the region. However, other impact categories are still important and should not be ignored. The next tier of importance included Environmental Justice (weight of 8.7), Cost Effectiveness (weight of 8.5), Regional Integration and Coordination (weight of 8.5), and Address Climate Change Through Greenhouse Gas Reduction (weight of 8.2). The third tier of importance included Regional Economic Impact (weight of 7.8), Provide for Scalability of Implementation (weight of 7.7), Quality of Life/Recreation (weight of 7.4), and Project Complexity (weight of 7.3).
Gray Water Use scored highest for Climate Resilience and Seawater Desalination scored highest for Optimize Local Supplies.

Concepts that scored well on the Reliability and Robustness Evaluation Objective, which was given the highest level of importance based on the weighting survey responses (along with Protect Water Quality and Watersheds), did not consistently score among the highest or lowest in overall scoring. For example, Potable Reuse had the highest score of all Concepts for Reliability and Robustness but had an overall 5th highest ranking, which is near the middle of the ranked Concepts. The second highest scoring Concept for Reliability and Robustness was Recycled Water, which was ranked 4th overall for all Evaluation Objectives combined. Therefore, a high Reliability and Robustness score did not necessarily result in a high overall ranking for all Evaluation Objectives. A similar relationship also existed for the Optimize Local Supplies Evaluation Objective, with all Concepts generally scoring well and high scores for Optimize Local Supplies appearing for both top- and bottom-ranked Concepts. Despite the lack of relationship between the Reliability and Robustness score and the overall ranking, all the Concepts performed relatively well for Reliability and Robustness, supporting the view that Reliability and Robustness was an important component of all Concepts to meet the goal of improving operations of existing facilities and supplies and developing new water supply sources to meet demands.

7.1.1.6 Meaning of Total Weighted Scores

When evaluating trade-off analysis results it is also important to understand the meaning of the total weighted scores for all Evaluation Objectives. The total scores should not be interpreted as precise estimates of how “good” or “bad” a Concept or project is. Rather, the relative total points are an indicator of the overall magnitude of effects that can be associated with a Concept. The trade-off analysis results for all Evaluation Objectives combined indicated that Urban and Agricultural Water Use Efficiency generates benefits with the highest values, followed by Watershed and Ecosystem Management, Stormwater Capture, Recycled Water, Potable Reuse, and Stormwater BMPs. Gray Water Use, Watershed and Ecosystem Management, Potable Reuse, and Recycled Water Concepts generated benefits that had higher values than the other Concepts. The Groundwater and Conveyance Improvement Concepts had lower combined value. Cumulative scores for Imported Water Purchases, Enhanced Conservation, Gray Water Use, and Seawater Desalination could not be directly compared to the other Concepts because these Concepts only had scores for a subset of Evaluation Objectives.

7.1.2. Identification of Concept Strengths and Weaknesses

The unweighted scores that Concepts received on individual Evaluation Objectives in the context of their overall final weighted ranking can provide insight into the strengths and weaknesses of Concepts as well as how Concepts may be complementary. For example, Urban and Agricultural Water Use Efficiency was the highest overall scoring Concept. Its lowest single Evaluation Objective score was for Reliability and Robustness, with an unweighted score of 3.20. This is a relatively neutral score. Potable Reuse was the fifth highest Concept in overall combined scoring but scored highest for the Reliability and Robustness Evaluation Objective, with a score of 4.19, indicating that a strength of Potable Reuse projects is their reliability and robustness. Therefore, combining some Potable Reuse projects with projects in the Urban and Agricultural Water Use Efficiency Concept could bolster regional Reliability and Robustness.

Similarly, combining projects from the Watershed and Ecosystem Management Concept with projects from the Urban and Agricultural Water Use Efficiency Concept could improve regional protection of habitats, wildlife, and ecosystems. Urban and Agricultural Water Use Efficiency had a near-neutral score for the Protect Habitats, Wildlife, and Ecosystems Evaluation Objective (3.08) and it had its lowest unweighted Evaluation Objective score for this Evaluation Objective.. The Watershed and Ecosystem Management Concept had the highest Protect Habitats, Wildlife, and Ecosystems score of all Concepts (3.35), so the combination of the two Concepts would have additional benefits to habitats, wildlife, and ecosystems.

Another example of potential complementary Concepts is Seawater Desalination and Urban and Agricultural Water Use Efficiency or Gray Water. The Seawater Desalination Concept had the lowest individual Evaluation Objective score for Cost Effectiveness. Urban and Agricultural Water Use Efficiency and Gray Water Use both had the two highest scores for Cost

Effectiveness. Therefore, it may be possible to compensate for the low-cost effectiveness score of Seawater Desalination by also implementing some Urban and Agricultural Water Use Efficiency or Gray Water projects to improve overall cost effectiveness of regional water supplies.

There are many possible combinations of projects within Concepts that could potentially improve overall performance that are too numerous to discuss here. But, the above examples demonstrate the process that could be used to identify these performance improving combinations.

7.2. Supplemental Economic Assessment

The supplemental economic assessment evaluated three categories of benefits that could be quantified and monetized relative to Baseline conditions: municipal and industrial water supply reliability (reduced shortages), recreation (reservoir visitation), and net energy usage. These values were calculated from model outputs and economic values from literature. The economic assessment only includes a limited set of benefits that could be quantified and does not represent a full accounting of all economic effects that would be expected from each of the Concepts.

All the Concepts generated positive benefits associated with reducing water shortages. Enhanced Conservation generated the greatest reduced water shortage benefits compared to the Baseline conditions, followed by Potable Reuse and Seawater Desalination.

Differences in the value of recreation activities relative to the Baseline were significantly smaller than differences in the value of water shortages and the change in the value of net power. Conveyance Improvement generated the greatest recreation benefit, followed by Potable Reuse and Enhanced Conservation.

The reduction in net energy usage relative to the Baseline varied widely between Concepts. Enhanced Conservation had a reduction more than three times larger than the next highest Concept. This large decrease in energy usage can be explained by the significantly lower water deliveries required with the implementation of Enhanced Conservation that reduce energy costs for water import, treatment, and conveyance. Potable Reuse, Recycled Water, and Groundwater had net energy usage values that represented significant reductions compared to the Baseline. Net energy relative to baseline was negative for Seawater Desalination and slightly negative for Conveyance Improvement, indicating an increase in energy usage would be required for those Concepts compared to Baseline.

The combined quantified and monetized economic effects for the three categories of benefits analyzed were positive relative to the Baseline for all Concepts except Seawater Desalination. Enhanced Conservation generated the greatest overall positive benefit relative to the Baseline for the three categories of benefits analyzed and had a net annual value more three times larger than any other Concept, primarily due to its large reduction in energy usage.

7.3. Comparison of Economic Assessment to Trade-Off Analysis Ranking

There was some consistency in the Concept rankings for the trade-off analysis based on all the Evaluation Objectives and the economic assessment, but there were also several differences. The comparative rankings are shown in Table 84. Since the trade-off analysis for the Imported Water Purchases and Enhanced Conservation Concepts did not include all the Evaluation Objectives, the trade-off analysis and economic assessment results were not compared for these two Concepts.

Table 84. Comparison of Concept rankings for the trade-off analysis and economic assessment.

Concept	Trade-off analysis Ranking based on all Evaluation Objectives and Mean scores	Trade-off analysis Ranking based on all Evaluation Objectives and Median scores	Economic Assessment Ranking
Conveyance Improvement	8	9	9
Enhanced Conservation	NA	NA	1
Gray Water Use	NA	NA	7
Groundwater	7	8	4
Imported Water	NA	NA	5
Potable Reuse	5	4	2
Recycled Water	4	3	3
Seawater Desalination	NA	NA	12
Stormwater BMPs	6	7	11
Stormwater Capture	3	2	10
Urban & Agricultural Water Use Efficiency	1	1	8
Watershed & Ecosystem Management	2	5	6

Urban and Agricultural Water Use Efficiency was the top scoring Concept using mean and median survey score values but ranked 8th in the economic assessment, the largest difference in Concept ranking between the two analyses. The second largest difference for scored Concepts was Stormwater Capture (10th in the economic assessment, 2nd in the trade-off analysis using medians, and 3rd in the trade-off analysis using means). There was also a fairly large difference between the ranking of Stormwater BMPs (6th in the trade-off analysis using means, 7th in the trade-off analysis using medians, and 11th in the economic assessment). Conveyance

Improvement and Recycled Water had very similar rankings for the trade-off analysis and the economic assessment.

An important consideration when comparing the economic assessment results with the trade-off analysis results is the exclusion of energy effects in the trade-off analysis. The value of changes in net energy usage is included in the economic assessment and is the major driving factor in the economic assessment results.

7.4. Limitations and Opportunities

The trade-off analysis and economic assessment completed as part of the Basin Study can assist in decision-making as the San Diego region considers future investments in water supply management. The results may be used directly, or the techniques may be applied to a subset of the Concepts using the customized trade-off analysis tool developed as part of the Study (see Section 7.5). Regional water management agencies and organizations may use the results to help identify projects and approaches that would benefit from further study or to support project funding decisions or grant applications. The trade-off analysis evaluated 12 Concepts using 13 Evaluation Objectives, which represents a very large number of potential outcomes. Given the level of analysis, this evaluation is essentially a screening analysis which can be used to identify promising Concepts based on the set of Evaluation Objectives and weights identified as part of the Study.

Although regional water management agencies may use the results of the Basin Study as a tool for identifying promising projects and approaches for further study and eventual funding, the results are not intended to directly lead to funding. The Basin Study is a technical assessment and does not provide recommendations or represent a statement of policy or position of Reclamation, the Department of the Interior, or the City of San Diego. The Basin Study does not propose or address the feasibility of any specific project, program or plan. Nothing in the Study is intended, nor shall the Study be construed, to interpret, diminish, or modify the rights of any participant under applicable law. Nothing in the Study represents a commitment for provision of Federal funds.

Due to limited data availability, the economic assessment completed as part of the Study was limited in scope and does not represent the full range of costs and benefits that would need to be considered in an economic analysis.

The information available for the Enhanced Conservation, Imported Water Purchases, Seawater Desalination, and Gray Water Use Concepts was limited, resulting in these Concepts only receiving scores for a subset of the Evaluation Objectives. Because the projects in the Imported Water Purchases Concept could not be mapped, this Concept was only scored for Evaluation Objectives that did not require GIS data. Therefore, it excludes the Climate Resilience;

Environmental Justice; Protect Habitats, Wildlife, and Ecosystems; and Water Quality and Watersheds Evaluation Objective scores. In addition, it was not scored for the Optimize Local Supplies Evaluation Objective because the survey response for the single Imported Water Purchases Concept was changed to NA due to misinterpretation of the question by the survey respondent. Therefore, Imported Water Purchases only had scores for nine of the 13 Evaluation Objectives. Imported Water received a score of 21.58 out of a possible 37.40 points. The Enhanced Conservation Concept was split out from the Urban and Agricultural Water Use Efficiency Concept after the surveys were distributed and was a regional project that could not be mapped. Therefore, Enhanced Conservation only had a score for the Regional Economic Impact Evaluation Objective. Enhanced Conservation received a score of 2.03 out of a possible 3.90 points. Both Gray Water Use and Seawater Desalination had missing project-level survey data for Environmental Justice, so they received scores for only 12 of the 13 Evaluation Objectives and were not scored for the Environmental Justice Evaluation Objective.

Although Enhanced Conservation could not be scored for the majority of the Evaluation Objectives with the methods used for the other Concepts, it may be possible to gain insight into how Enhanced Conservation would score by its similarities to the Urban and Agricultural Water Use Efficiency Concept. The Enhanced Conservation and Urban and Agricultural Water Use Efficiency Concepts both relate to water conservation, but are distinct because the Enhanced Conservation Concept focuses on restrictions in water use imposed at the local, regional, or State level, while Urban and Agricultural Water Use Efficiency focuses on behavioral changes that encourage water efficiency. The actual practices implemented to achieve an imposed level of Enhanced Conservation may be quite similar to the practices encouraged through Urban and Agricultural Water Use Efficiency projects. Therefore, despite some differences, the relative scores of Enhanced Conservation for some Evaluation Objectives may be quite similar to Urban and Agricultural Water Use Efficiency. For example, both would likely score similarly on the Optimize Local Supplies Evaluation Objective because water conservation is, by definition, a local supply. They might also score similarly on the Reliability and Robustness Evaluation Objective for the same reason. Because the underlying projects or approaches to implement conservation would potentially be similar, the Concepts might score similarly on Address Climate Change Through Greenhouse Gas Reductions; Climate Resilience; Cost Effectiveness; Project Complexity; Protect Habitats, Wildlife, and Ecosystems; Quality of Life/Recreation; and Water Quality and Watersheds. The two Concepts may differ more on Environmental Justice, as a mandated water conservation amount may disproportionally affect some communities more than a water use efficiency program. They may also differ on Regional Economic Impact, as a mandated water conservation amount may have broader effects than a single water efficiency project. They may also differ on Regional Integration and Coordination, as the coordination, leveraging of assets, and integration of resources would likely differ between an imposed water restriction and a project encouraging water use efficiency. With the similarities and differences between these two Concepts in mind, it may be possible to estimate the scores of Enhanced

Conservation, and, if desired, an agency could use the customized trade-off analysis tool (see Section 7.5) to perform an analysis with the estimated scores.

7.5. Customized Trade-off Analysis Tool

Trade-off analysis provides a framework for evaluating the ability of various Concepts to meet the San Diego region's water demands and address the impacts of increasing demand and climate variation through the 2050s. Although the trade-off analysis documented in this Study incorporated input from a wide variety of stakeholders, it is likely that individual decision-makers may have somewhat different sets of objectives or differing views on the relative importance of objectives. It is also likely that future refinement of project plans or analysis will result in different values for Performance Measures. Therefore, a decision-support tool was developed as an affiliate product of this report, to enable an individual to perform the trade-off analysis using customized settings that reflect the individual's preferences. For example, the customized trade-off analysis tool enables the user to select a subset of Evaluation Objectives to include in the trade-off analysis, as well as adjust Evaluation Objective weights. This tool was developed in response to stakeholder interest in having the ability to customize the trade-off analysis to reflect their priorities. It enables individuals to update the analysis as new information and science becomes available, or as priorities in the region change. It could also be used to conduct a sensitivity analysis of the results reported in this Basin Study. The tool consists of a Microsoft Excel spreadsheet entitled "Customized Trade-off Analysis Tool" with a user guide/instructions, and is included in Appendix D.

The data used to complete the trade-off analysis documented in this Study had several missing Evaluation Objective and Performance Measure scores. However, if supplemental information can be collected to fill-in the missing information or if there is additional information to use as a proxy for missing Evaluation Objective and Performance Measure scores, then some or all of the missing scores could be added. This supplemental information could be used to complete a more comprehensive evaluation of the Enhanced Conservation and Imported Water Concepts.

7.6. Summary

The purpose of Task 2.5 was to compare Concepts for meeting the San Diego region's water demands and addressing the impacts of increasing demand and climate variation through the 2050s. The Concepts represent a set of planned or conceptual projects that are being considered in the region for the purposes of improving operations of existing facilities and supplies, and/or developing new water supply sources. Each Concept will result in a variety of benefits and costs, both direct and indirect, which could accrue inside or outside the project area. Some of the benefits and costs are quantifiable and can be monetized, some are quantifiable but cannot be monetized, and some are unquantifiable and cannot be monetized. Two evaluations were completed as part of Task 2.5, a trade-off analysis and a supplemental economic assessment. Although the two evaluations share some common measures, they represent very different perspectives. An economic assessment is based only on effects that can be quantified and monetized while a trade-off analysis can include a wider range of effects because monetization of effects, and in some cases precise quantitative measures, are not necessary as part of a trade-off analysis.

Based on the trade-off analysis using all Evaluation Objectives, Concepts can be divided into three groups based on the weighted scores for all Evaluation Objectives using mean survey scores. The top scoring Concept was Urban and Agricultural Water Use Efficiency, and five other Concepts scored within 10% of the top scoring Concept (Watershed and Ecosystem Management, Stormwater Capture, Recycled Water, Potable Reuse, Stormwater BMPs). Two additional Concepts scored within 15% of the top scoring Concept (Groundwater and Conveyance Improvement). Due to data limitations, not all Concepts could be scored on all Evaluation Objectives and therefore cannot be directly compared to the others. Imported Water Purchases, Enhanced Conservation, Seawater Desalination, and Gray Water Use were each not scored for one or more Concepts.

The economic assessment indicated there are positive benefits associated with all the Concepts relative to baseline conditions, except for Seawater Desalination. The economic assessment included evaluation of the value of water supply reliability, recreation, and net energy usage. All values for water supply reliability were positive, and all but two Concepts had positive values for recreation and net energy. Enhanced Conservation provided the highest net value for the three benefit categories that were analyzed, mainly as a result of its high positive energy usage reduction values (less energy used compared to Baseline). The negative net benefits associated with the Seawater Desalination Concept were driven by the negative net energy usage reduction value (more energy used compared to Baseline). Water supply reliability had only a moderate impact on overall Concept ranking for the economic assessment and recreation values played a comparatively small role in the economic assessment results.

Together, the results of the trade-off analysis and economic assessment can be used by stakeholders to identify promising Concepts that address the impacts of climate change and increasing demands on water supplies within the San Diego region. These results could also provide supporting data for use in estimating the potential benefits of projects and Concepts as part of grant applications or when determining which projects merit more detailed examination.

8. References

Automated Regional Justice Information System. (2018, May 22). *Crime Statistics*. Retrieved from http://www.arjus.org/SitePages/Home.aspx

Barakat & Chamberlin, Inc. (1994). *The Value of Water Supply Reliability: Results of a Contingent Valuation Survey of Residential Customers.* California Urban Water Agencies.

BBC Research and Consulting. (undated). *California Outdoor Recreation Economic Study: Statewide Contributions and Benefits.*

Bureau of Reclamation. (2012). *Colorado River Basin Water Supply and Demand Study* .

Bureau of Reclamation. (2016). *Sacramento and San Joaquin Rivers Basin Study.*

Bureau of Reclamation. (2018). *San Diego Basin Study Task 2.4 - Structural & Operations Concepts.*

California Department of Water Resources. (2016). *2016 Integrated Regional Water Management Grant Program Guidelines.* Retrieved from https://water.ca.gov/Work-With-Us/Grants-And-Loans/-/media/DWR-Website/Web-Pages/Programs/Integrated-Regional-Water-Management/Mapping-Tools/Files/Proposition-1-IRWM-Guidelines-2016.pdf

California Department of Water Resources. (n.d.). *DAC Mapping Tool*. Retrieved from https://gis.water.ca.gov/app/dacs/

California ISO. (2018). *Price Map*. Retrieved from http://www.caiso.com/TodaysOutlook/Pages/Prices.aspx

California Office of Environmental Health Hazard Assessment. (2018). *CalEnviroScreen 3.0 screening tool*. Retrieved from https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30

California State Parks. (2010). *The California Park Planner*. Retrieved from https://www.parks.ca.gov/pages/795/files/nov_2010_ca_park_planner_final2.pdf

Cannon, S., & Highland, L. (2005). Southern California - Wildfires and Debris Flows. *Fact Sheet 2005-3106*. United States Geological Survey. Retrieved from https://pubs.usgs.gov/fs/2005/3106/pdf/FS-3106.pdf

Carson, R. T., & Mitchell, R. (1987). *Economic Value of Reliable Water Supplies for Residential Water Users in the State Water Project Service Area.* The Metropolitan Water District of Southern California.

City of San Diego. (2008). *Report to the City Council about Reservoir Recreation Business Process Reengineering.* Retrieved from http://legacy.sandiegouniontribune.com/news/metro/images/081201sanders-fees.pdf

Griffin, R. C., & Mjelde, J. W. (2000). Valuing Water Supply Reliability. *American Journal of Agricultural Economics, 82*, 414-426.

Howe, C. W., & Smith, M. G. (1994). The Value of Water Supply Reliability in Urban Water Systems. *Journal of Environmental Economics and Management, 26,* 19-30.

Jenkins, M. W., Lund, J. R., & Howitt, R. E. (2003). Using Economic Loss Functions to Value Urban Water Scarcity in California. *Journal of the American Water Works Association, 95-2,* 58-70.

Koss, P., & Khawaja, M. S. (2001). The value of water supply reliability in California: a contingent valuation study. *Water Policy, 3,* pp. 165-174.

Neher, C. J., Duffield, J. W., & Patterson, D. A. (2013). Modeling the influence of water levels on recreational use at lakes Mead and Powell. *Journal of Lake and Reservoir Management*.

Platt, J., & Munger, D. (1999). *Impact of fluctuating reservoir elevation on recreation use and value.* Denver: Bureau of Reclamation.

San Diego Association of Governments. (2018). California Department of Forestry and Fire Protection (CAL FIRE) Fire Hazard Zone Severity Zone Maps.

San Diego Association of Governments. (2018a). *Regional Data Warehouse*. Retrieved from http://www.sangis.org/download

San Diego County Water Authority. (2009). *Metropolitan Water District Approves Water Supply Cutbacks, Significant Rate Hike*. Retrieved from http://www.sdcwa.org/metropolitan-water-district-approves-water-supply-cutbacks-significant-rate-hike

San Diego County Water Authority. (2013). *Regional Water Facilities Optimization and Master Plan Update.* Retrieved from https://www.sdcwa.org/master-plan-documents

San Diego County Water Authority. (2016). *2015 Urban Water Management Plan.* Retrieved from https://www.sdcwa.org/sites/default/files/UWMP2015.pdf

San Diego County Water Authority. (2018). *Interim Long-Range Water Demand Forecast Reset Dry-Year Scenarios and Revised Supply Mix*. Retrieved from https://www.sdcwa.org/sites/default/files/2016-12/Board/2018_Agendas/2018_03_22FormalBoardPacketSEC.pdf

San Diego County Water Authority and U.S. Army Corps of Engineers. (2007). *Carryover Storage and San Vicente Dam Raise Project Final Environmental Impact Report.* Retrieved from https://www.sdcwa.org/enviro-carry-over-storage-san-vicente

San Diego Integrated Regional Water Management Group. (2013). Retrieved from http://sdirwmp.org/2013-irwm-plan-update

San Diego Region Copermittees and San Diego County Public Works. (2017). *San Diego Stormwater Resources Plan.* Retrieved from http://www.sdirwmp.org/pdf/SDRegionSWRP_Final_June2017.pdf

Syphard, A. D., Gershunov, A., Lawson, D. M., Rivera-Huerta, H., Guzman-Morales, J., & Jennings, M. K. (2018). San Diego Wildfires: Drivers of Change and Future Outlook. *San Diego County Ecosystems: The Ecological Impacts of Climate Change on a Biodiversity Hotspot*, pp. 15-17. Retrieved from https://drive.google.com/file/d/1UMzSuB1FRfaHIaFkAWDxgwumoB8C5z1B/view

U.S. Census Bureau. (2012). *Households and Families: 2010 - Census Briefs.* Retrieved from https://www.census.gov/prod/cen2010/briefs/c2010br-14.pdf

U.S. Department of Homeland Security, Federal Emergency Management Agency. (2018). *National Flood Hazard Layer Web Map Service*. Retrieved from https://hazards.fema.gov/femaportal/wps/portal/

U.S. Geological Survey. (2014). *Estimated use of water in the United States in 2010.* U.S. Geological Survey Circular 1405. Retrieved from http://dx.doi.org/10.3133/cir1405

U.S. Geological Survey. (2018). *U.S. Geological Survey Coastal Storm Modeling System*. Retrieved from Point Blue Our Coast Our Future: http://data.pointblue.org/apps/ocof/cms/index.php?page=flood-map

United States Geological Survey. (2018, October 31). *Post-Fire Flooding and Debris Flow*. Retrieved from https://ca.water.usgs.gov/wildfires/wildfires-debris-flow.html

Appendices

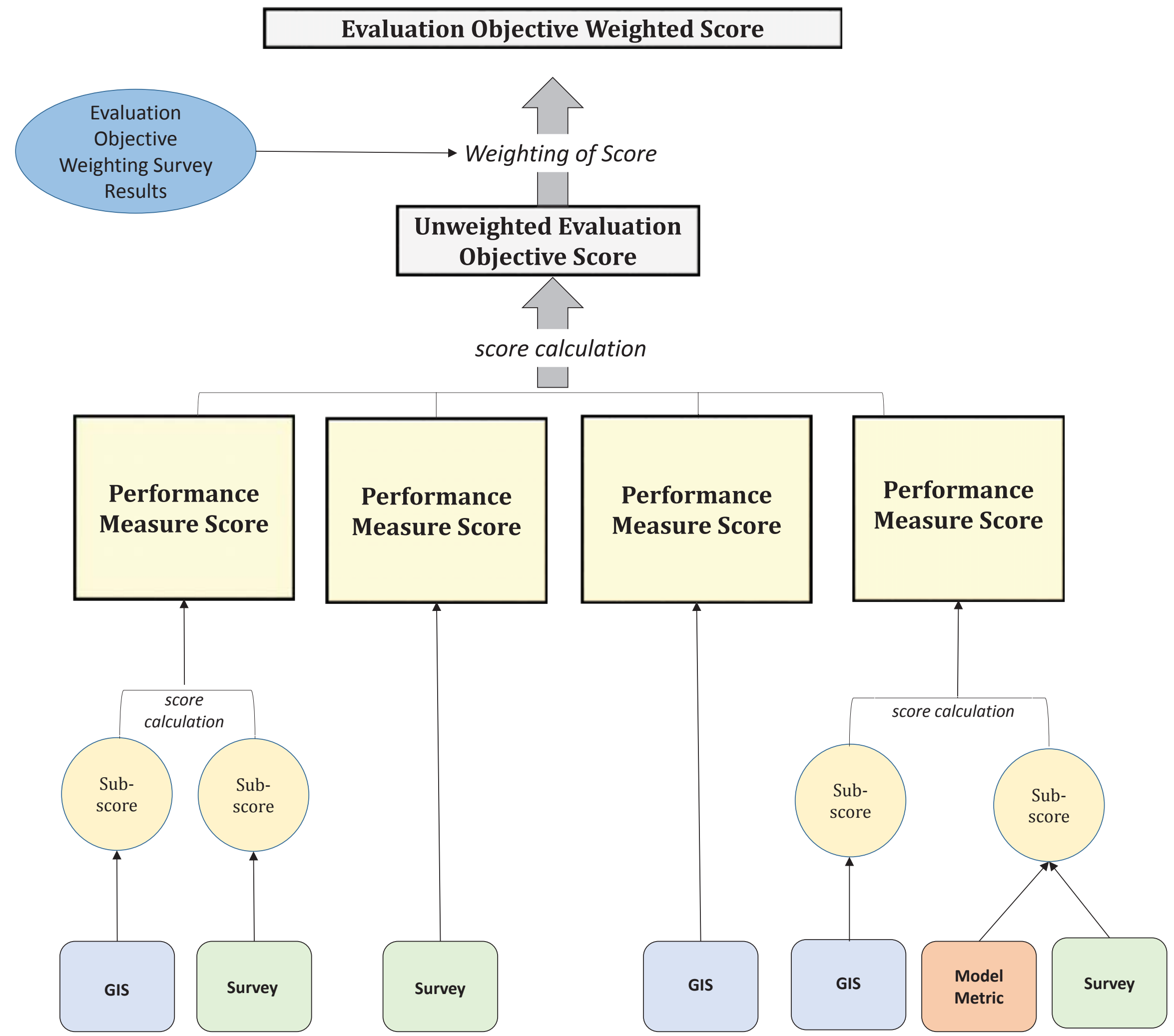
Appendix A: Decision Trees for All Evaluation Objectives and Performance Measures

Decision Trees for Trade-Off Analysis Evaluation Objectives and Performance Measures

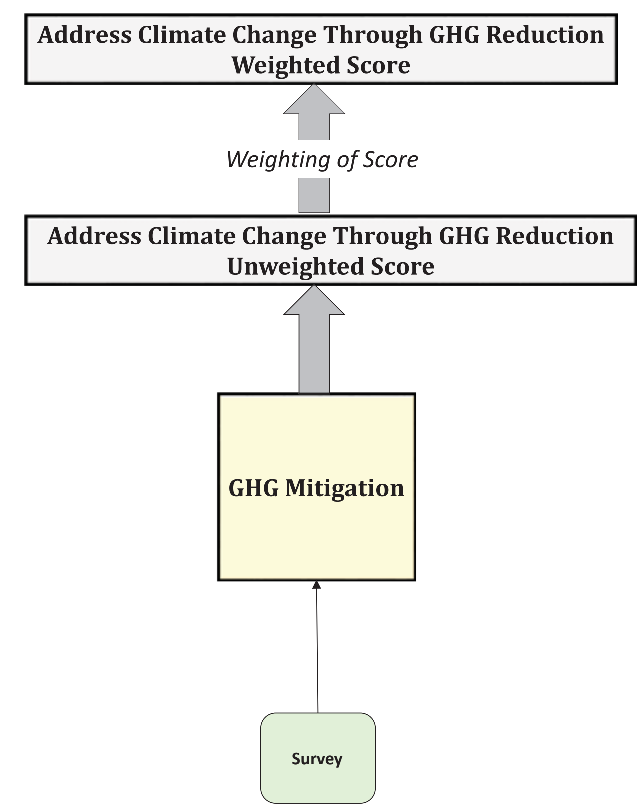
San Diego Basin Study

Task 2.5

Illustration of Trade-Off Analysis Scoring Process

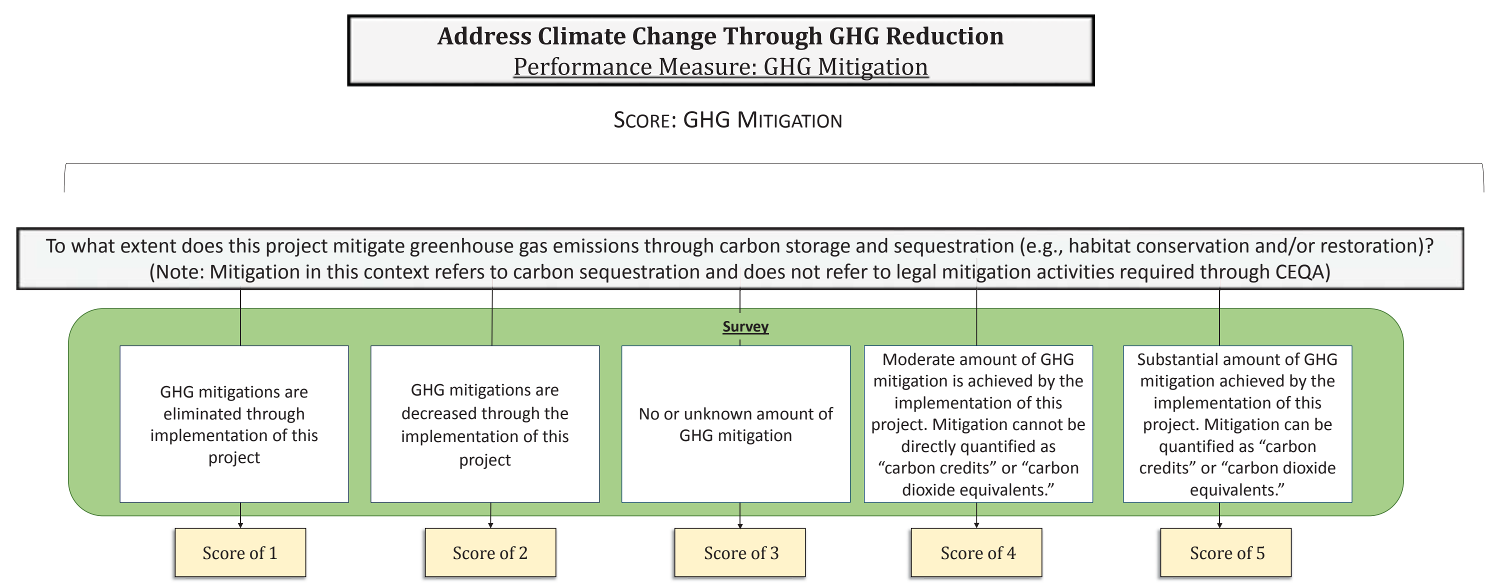


Evaluation Objective: **Address Climate Change Through GHG Reduction**

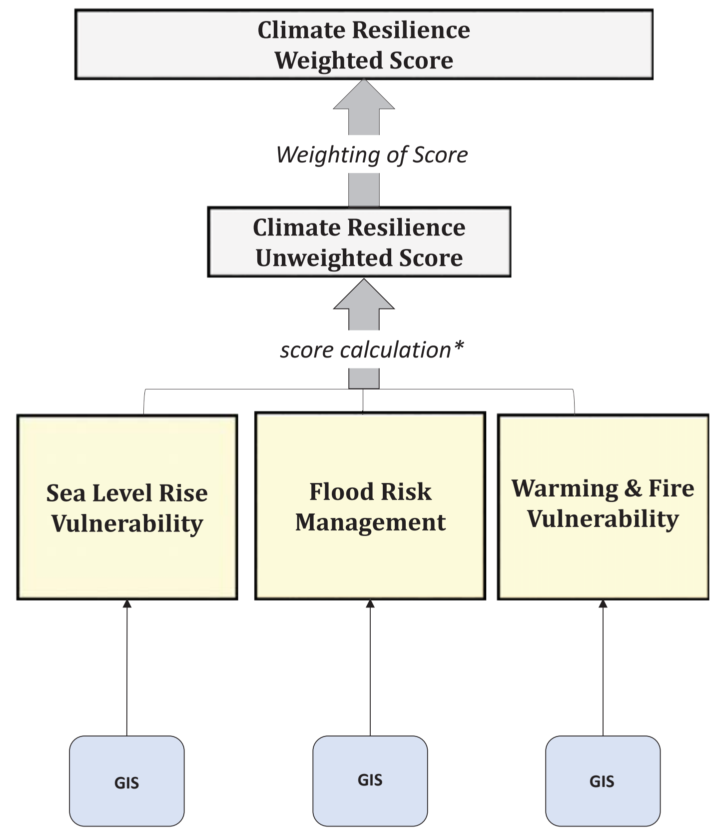


Evaluation Objective: **Address Climate Change Through GHG Reduction**

Performance Measure: **GHG Mitigation**

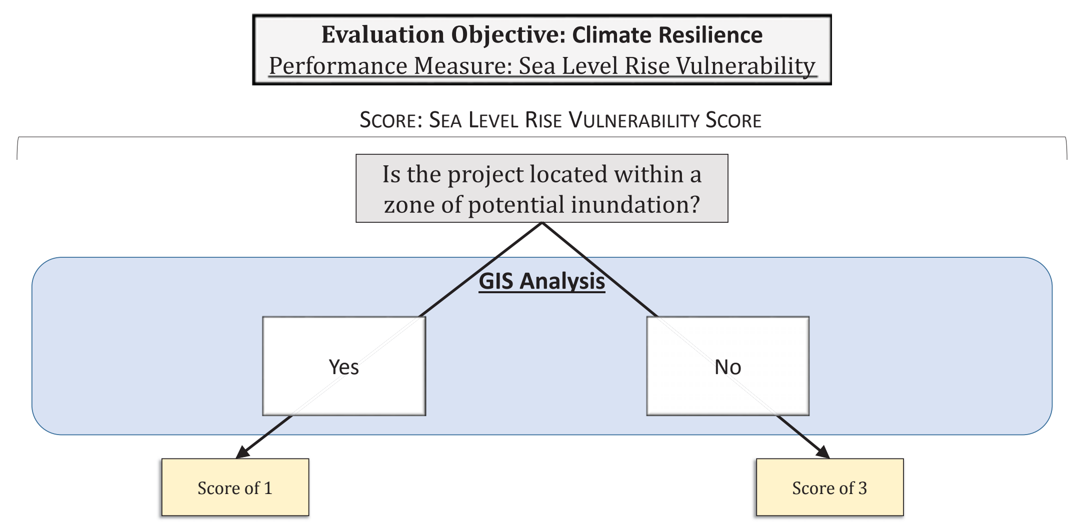


Evaluation Objective: **Climate Resilience**



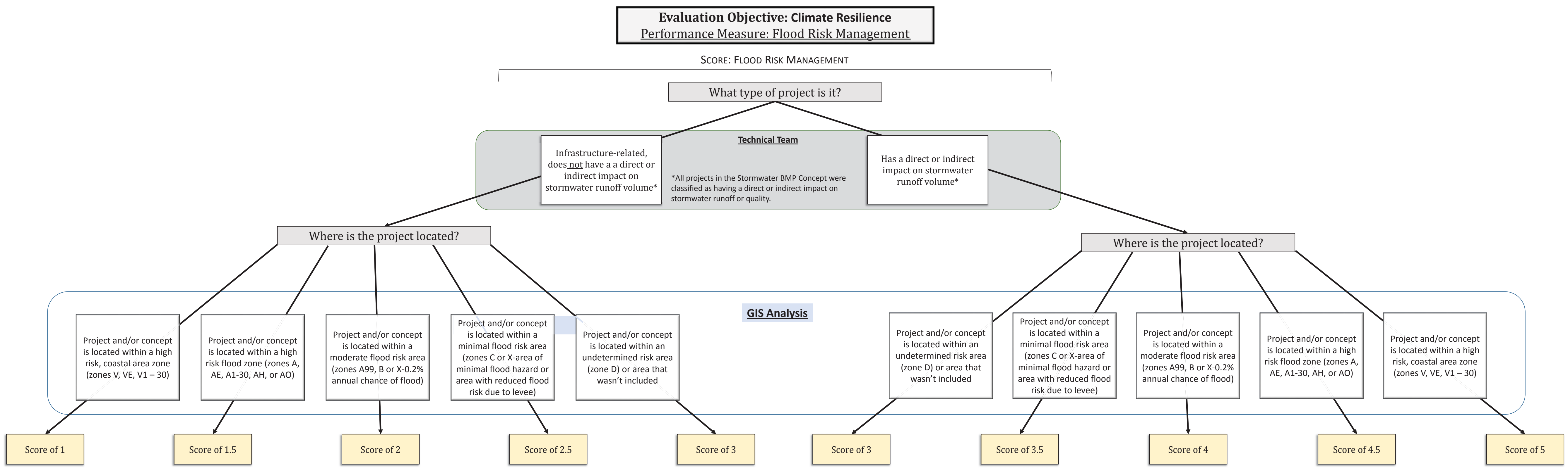
*Climate Resilience Raw Score = (average of Sea Level Rise Resilience and Flood Risk Management Scores) X Warming and Fire Resilience Score , scaled from 1 to 5

Evaluation Objective: **Climate Resilience**
Performance Measure: **Sea Level Rise Vulnerability**

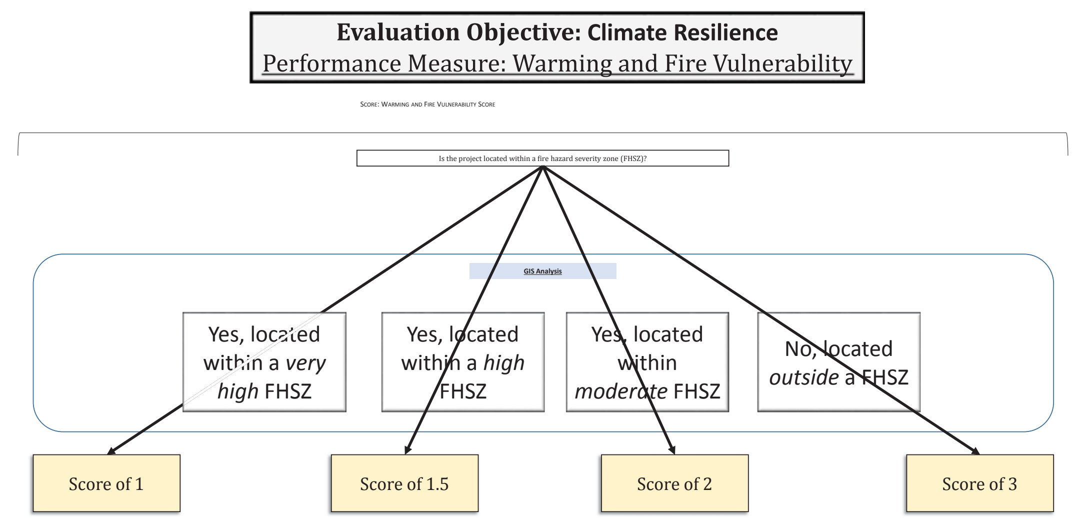


Evaluation Objective: **Climate Resilience**

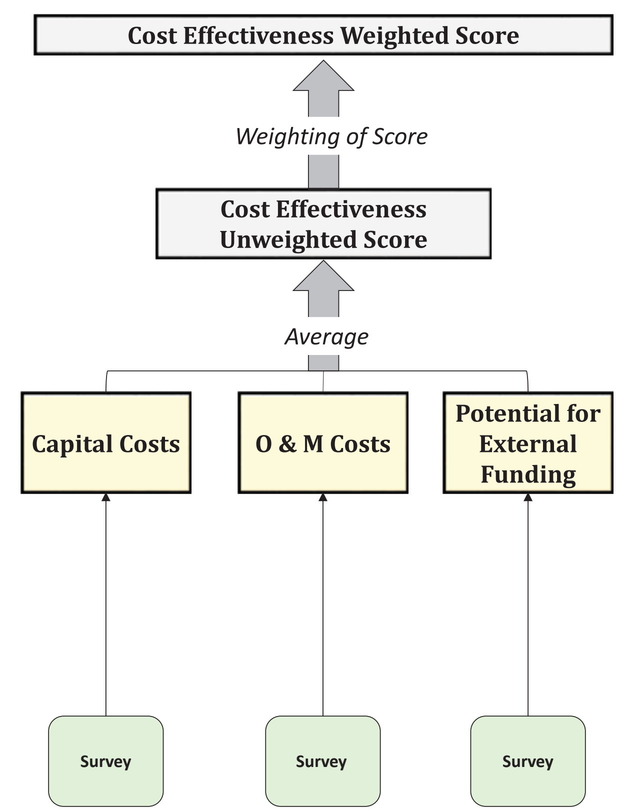
Performance Measure: **Flood Risk Management**



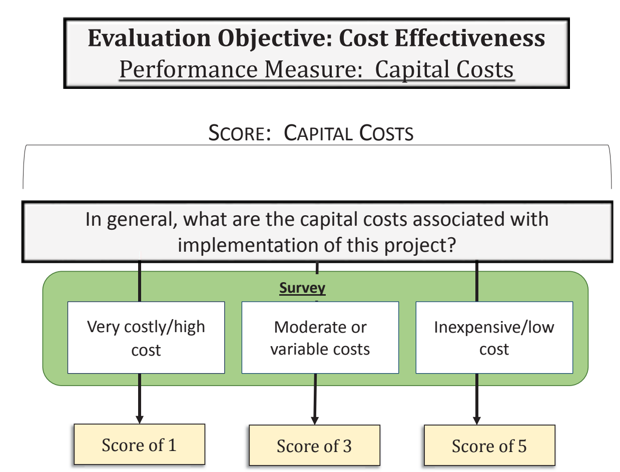
Evaluation Objective: **Climate Resilience**
Performance Measure: **Warming and Fire Vulnerability**



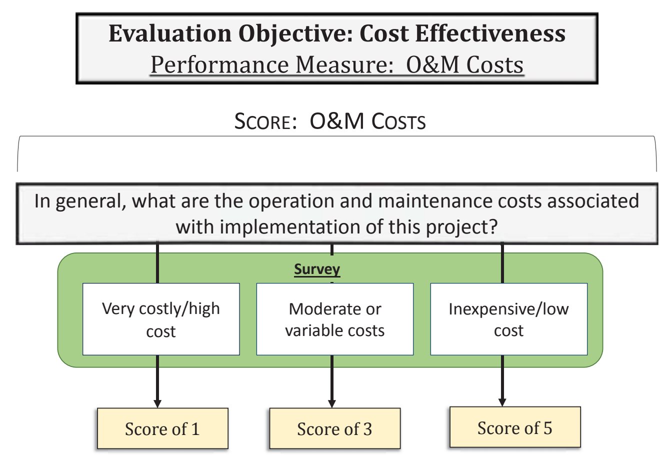
Evaluation Objective: **Cost Effectiveness**



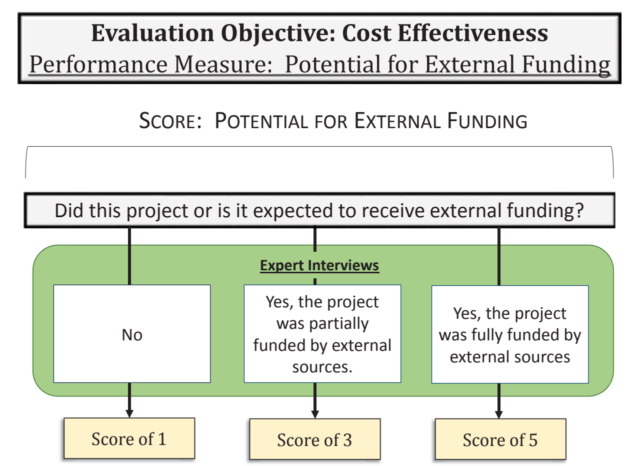
Evaluation Objective: **Cost Effectiveness**
Performance Measure: **Capital Costs**



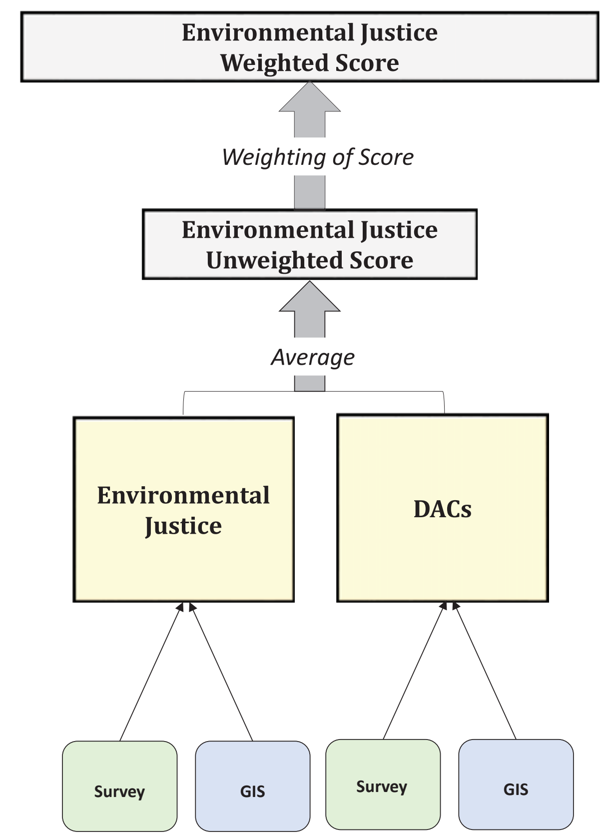
Evaluation Objective: **Cost Effectiveness**
Performance Measure: **O&M Costs**



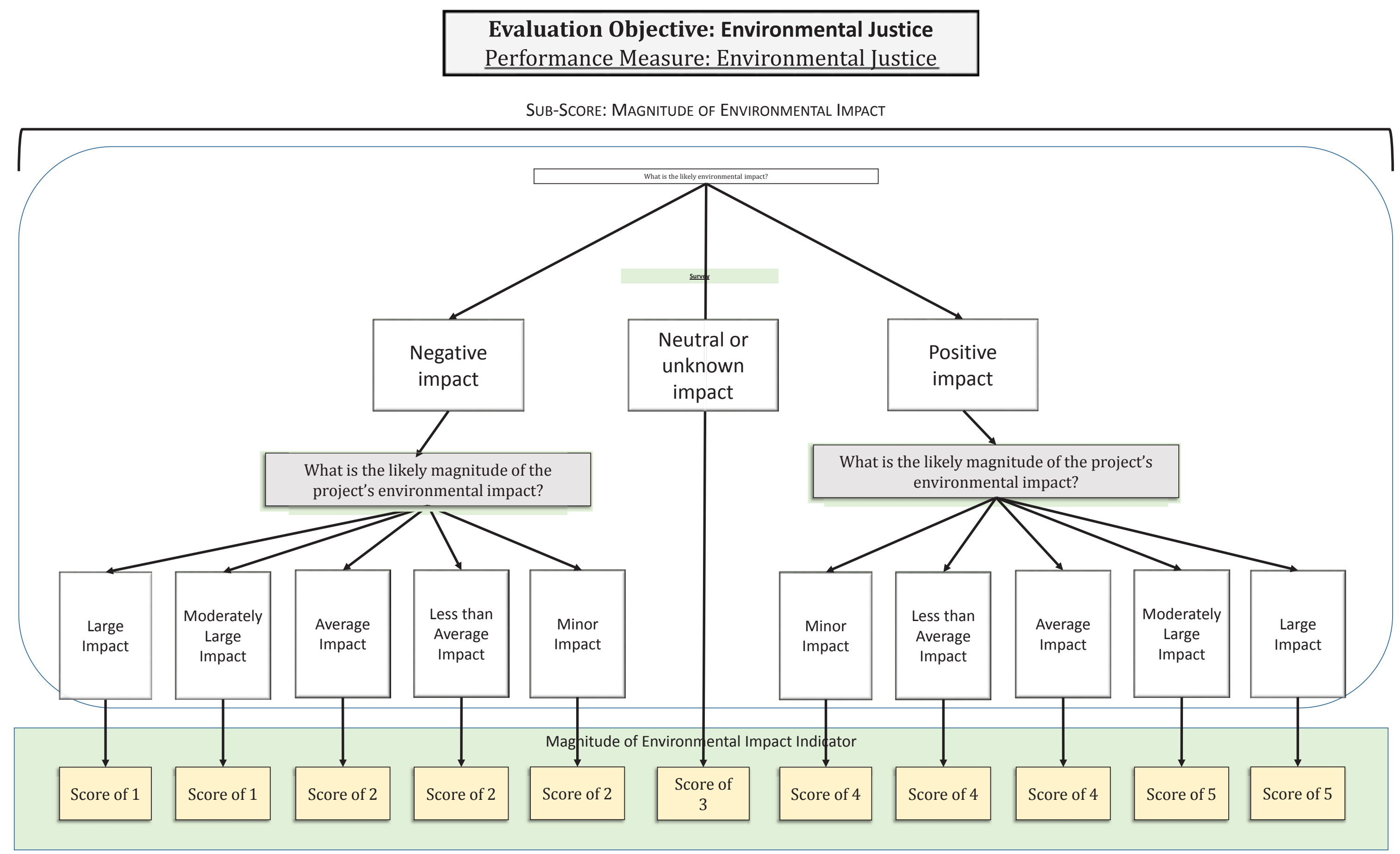
Evaluation Objective: **Cost Effectiveness**
Performance Measure: **Potential for External Funding**



Evaluation Objective: **Environmental Justice**

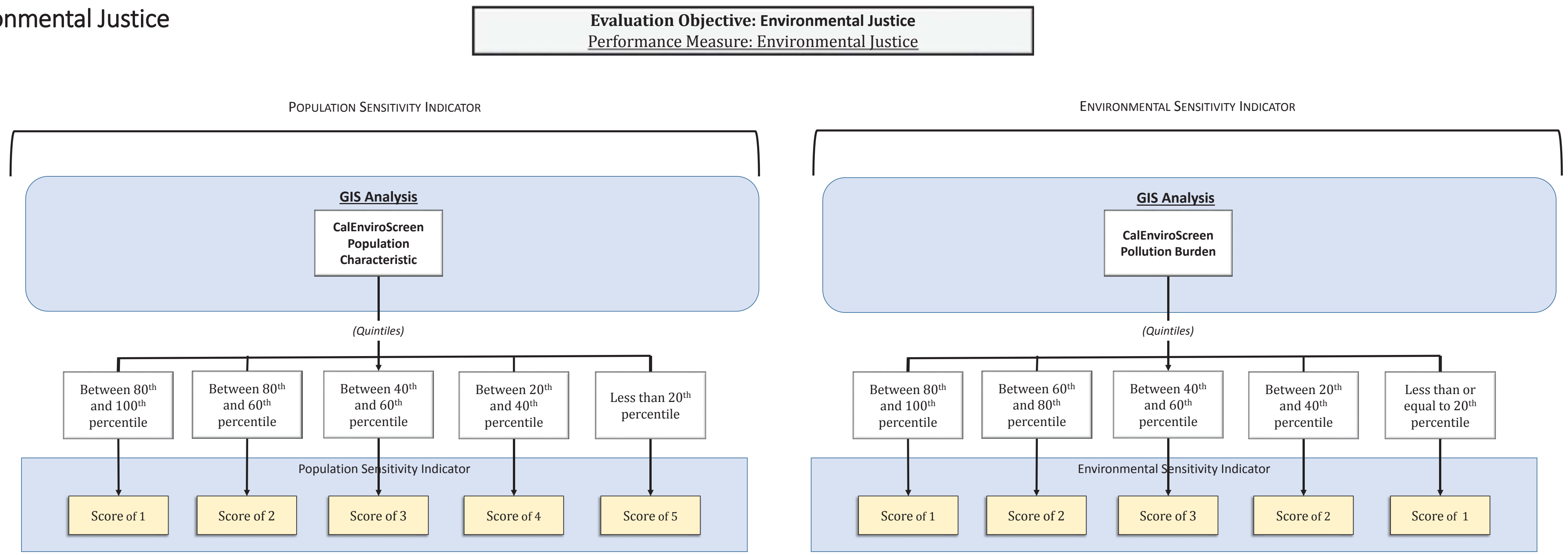


Evaluation Objective: **Environmental Justice**
Performance Measure: **Environmental Justice**

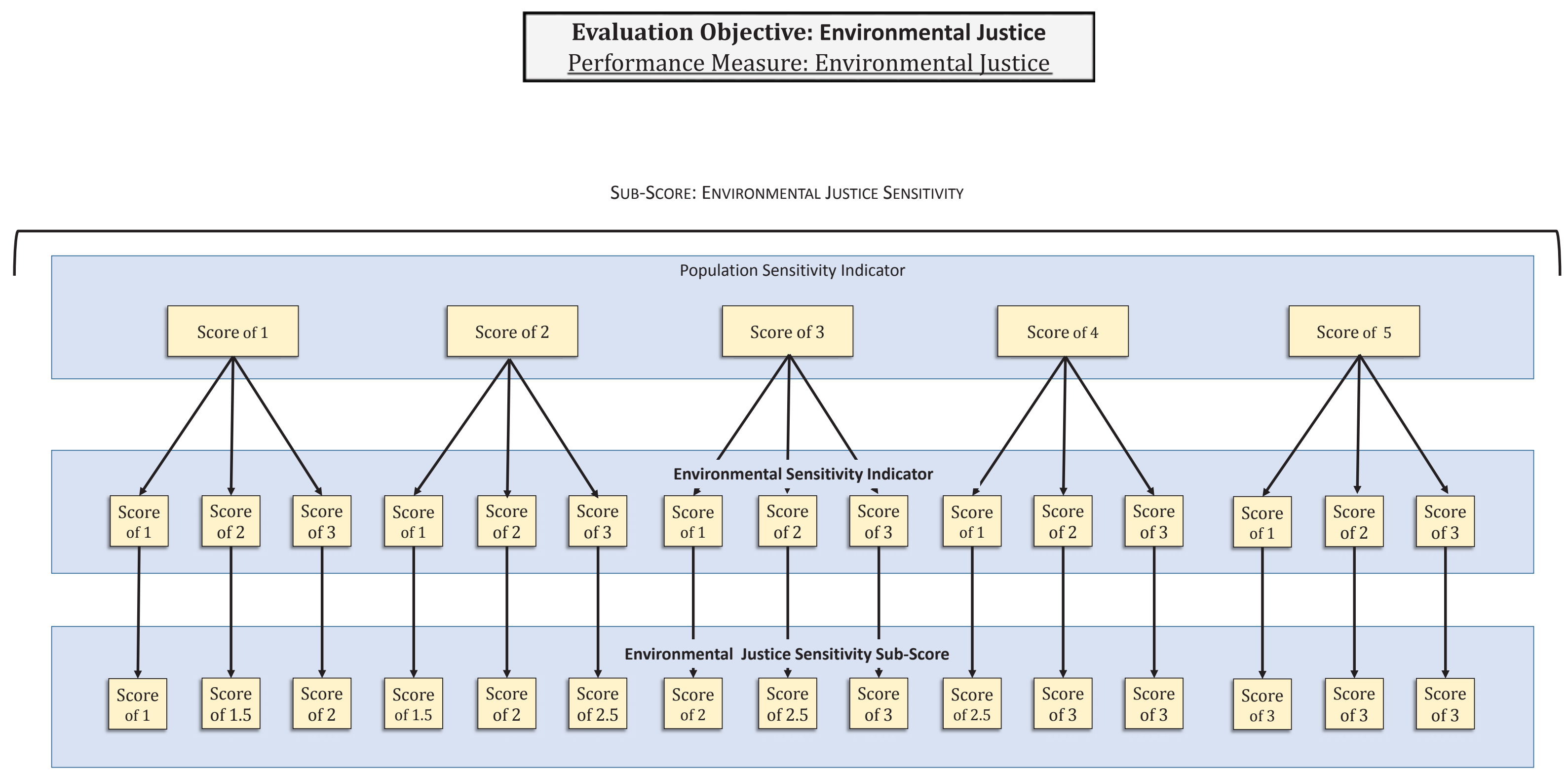


Evaluation Objective: **Environmental Justice**

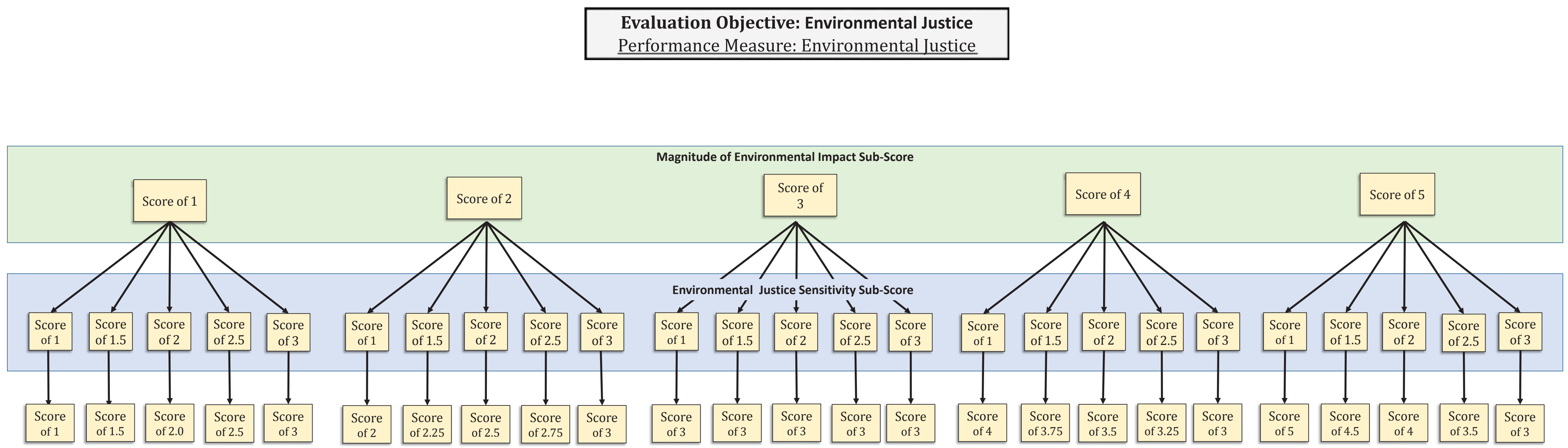
Performance Measure: **Environmental Justice**



Evaluation Objective: **Environmental Justice**
Performance Measure: **Environmental Justice**

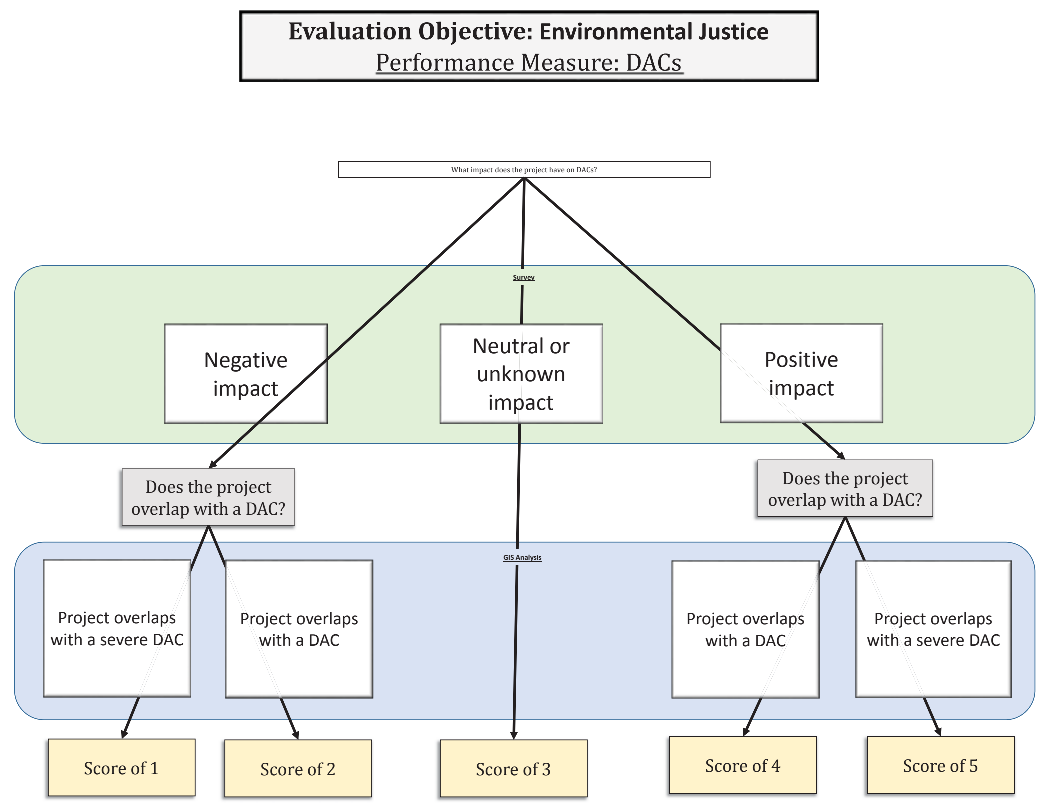


Evaluation Objective: **Environmental Justice**
Performance Measure: **Environmental Justice**

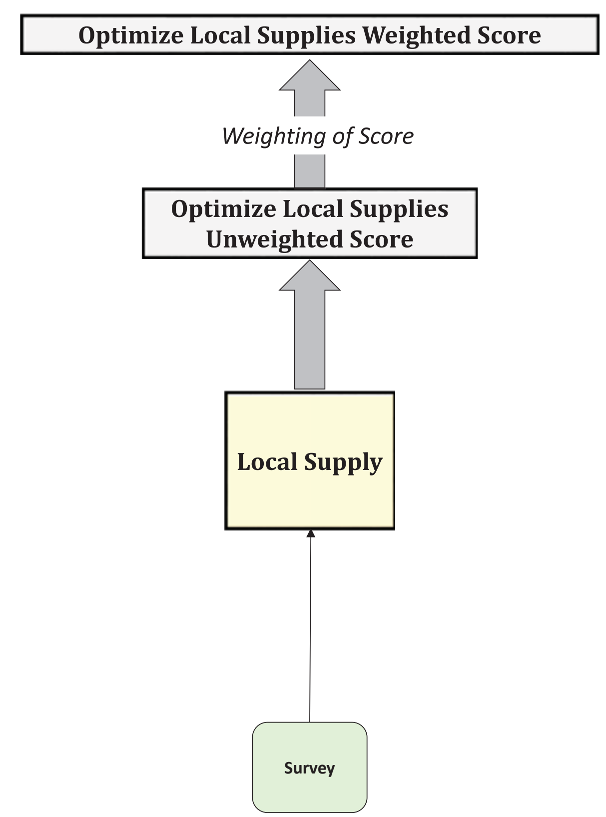


Evaluation Objective: **Environmental Justice**

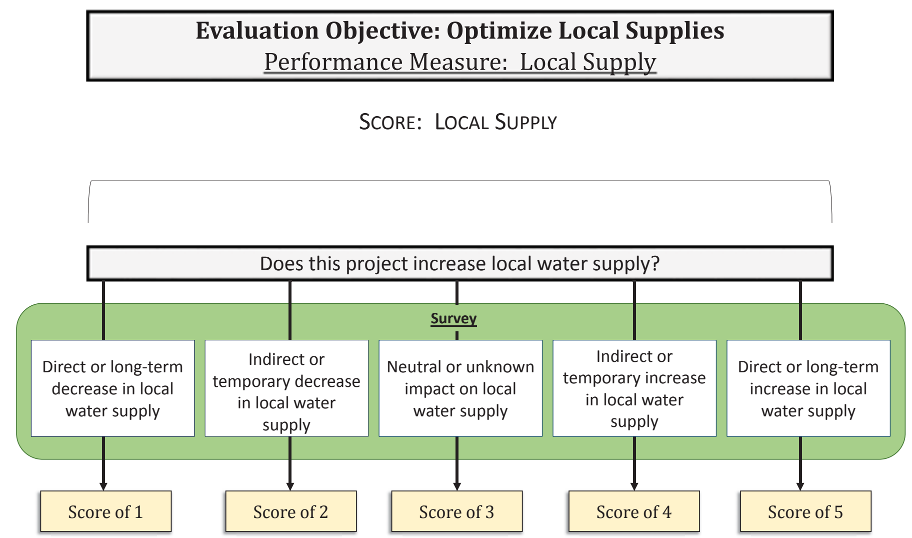
Performance Measure: **DACs**



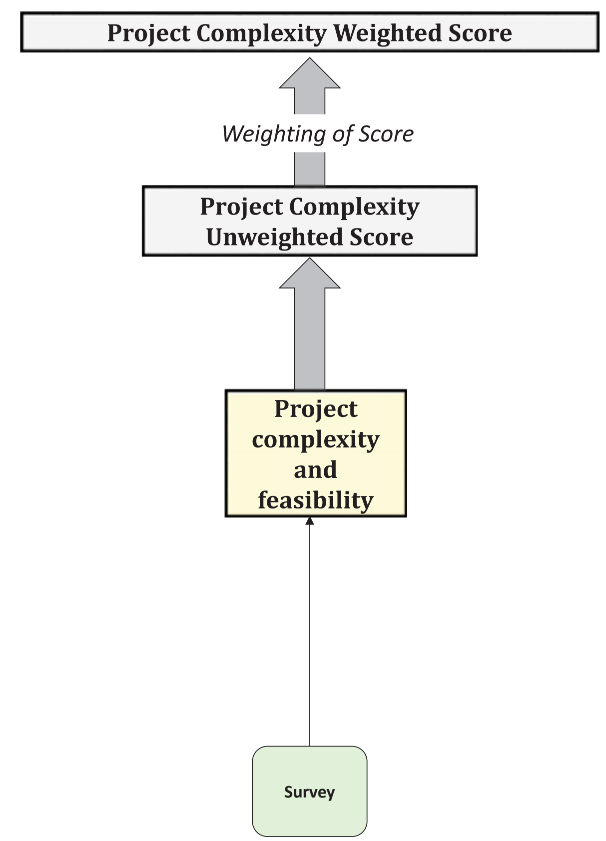
Evaluation Objective: **Optimize Local Supplies**



Evaluation Objective: **Optimize Local Supplies**
Performance Measure: **Local Supply**

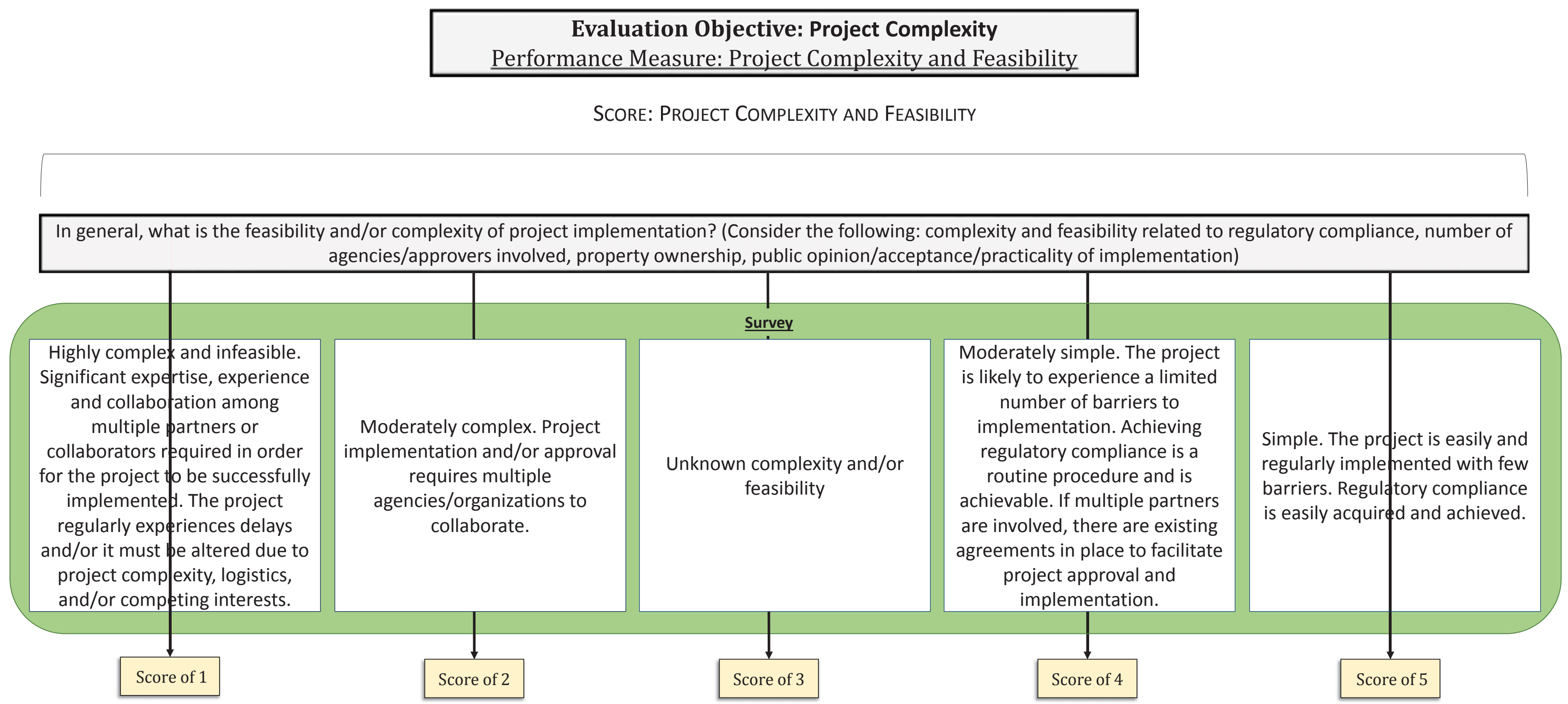


Evaluation Objective: **Project Complexity**

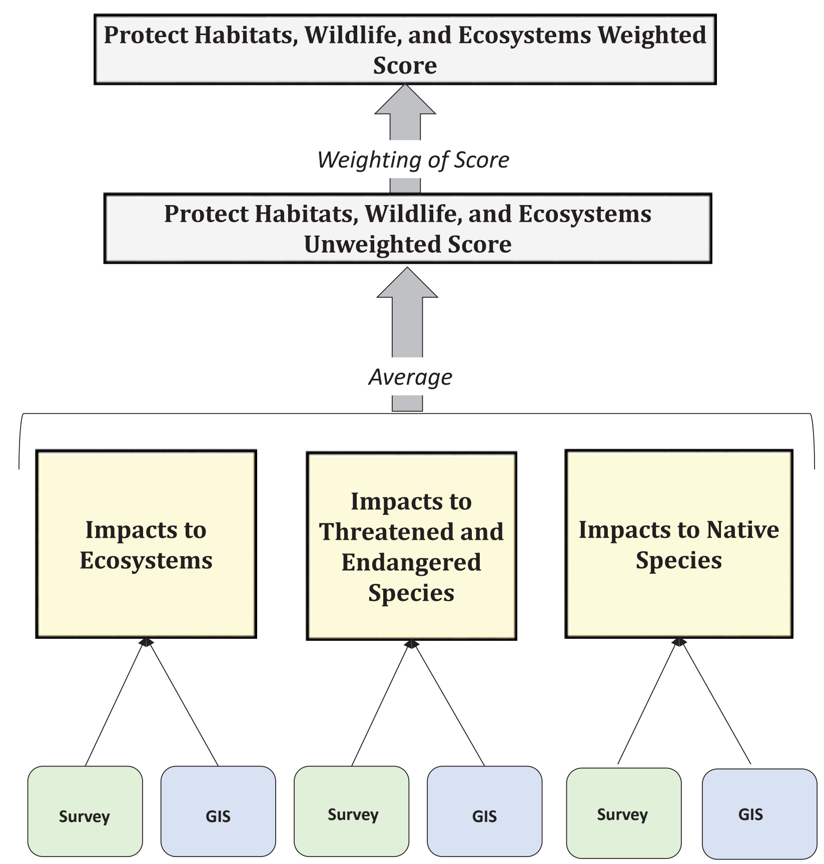


Evaluation Objective: **Project Complexity**

Performance Measure: **Project Complexity**

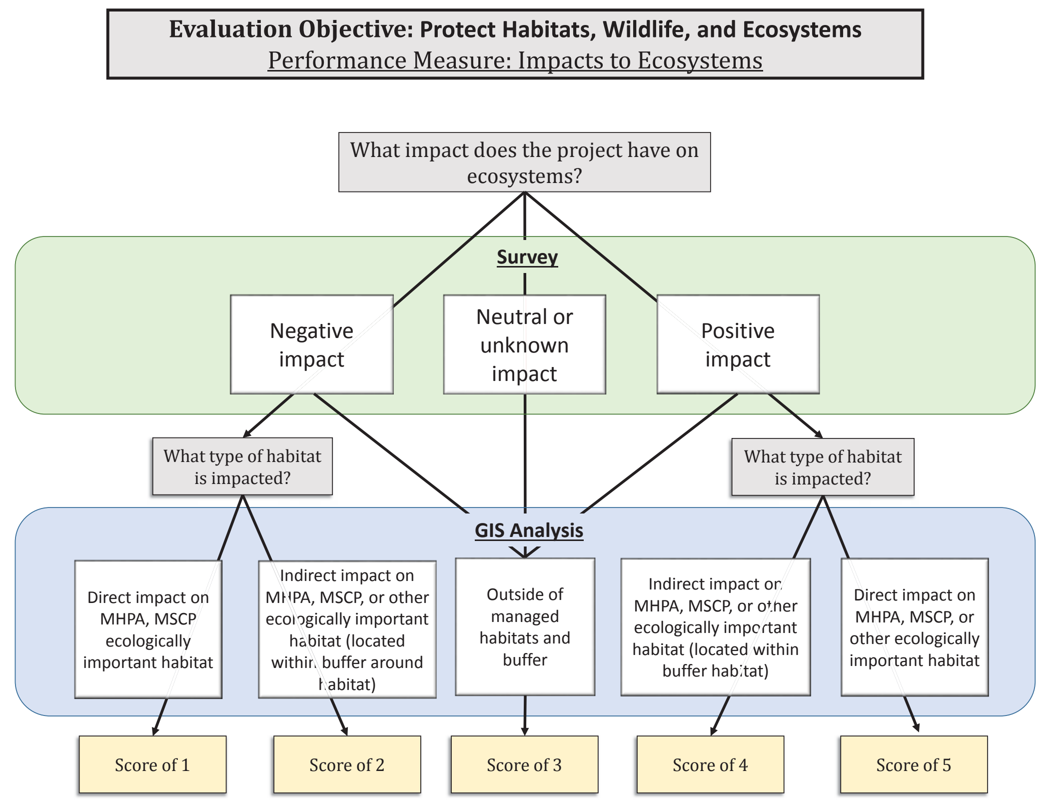


Evaluation Objective: **Protect Habitats, Wildlife, and Ecosystems**



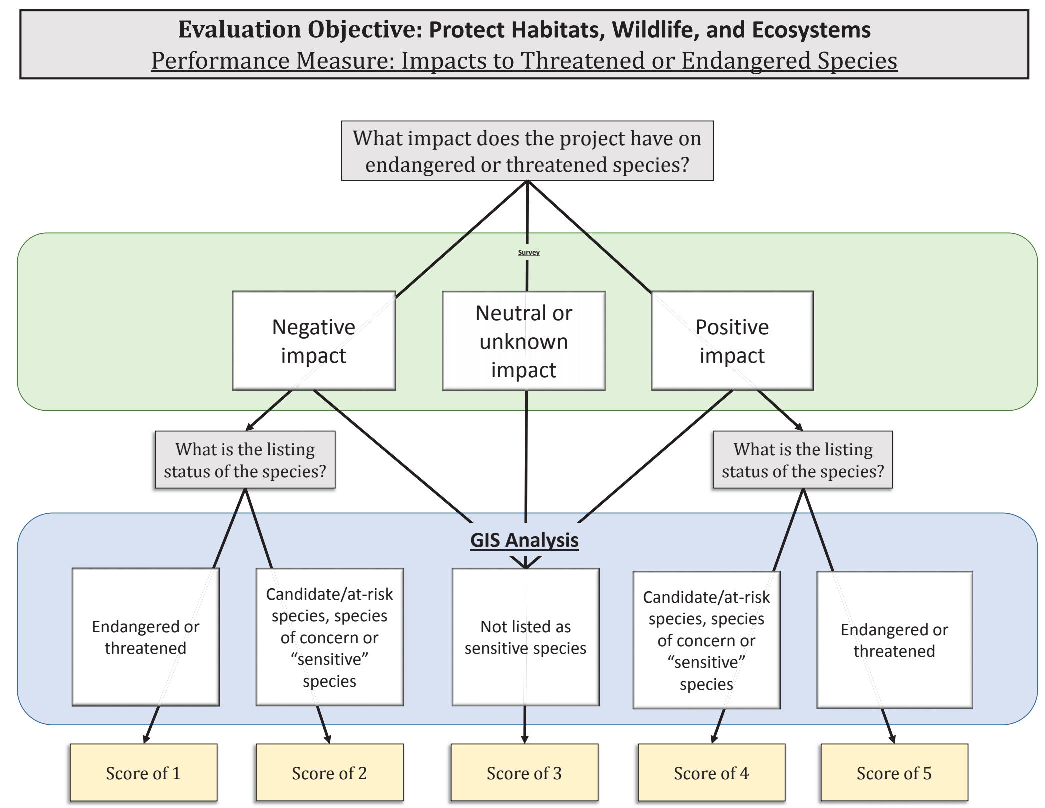
Evaluation Objective: **Protect Habitats, Wildlife, and Ecosystems**

Performance Measure: **Impacts to Ecosystems**



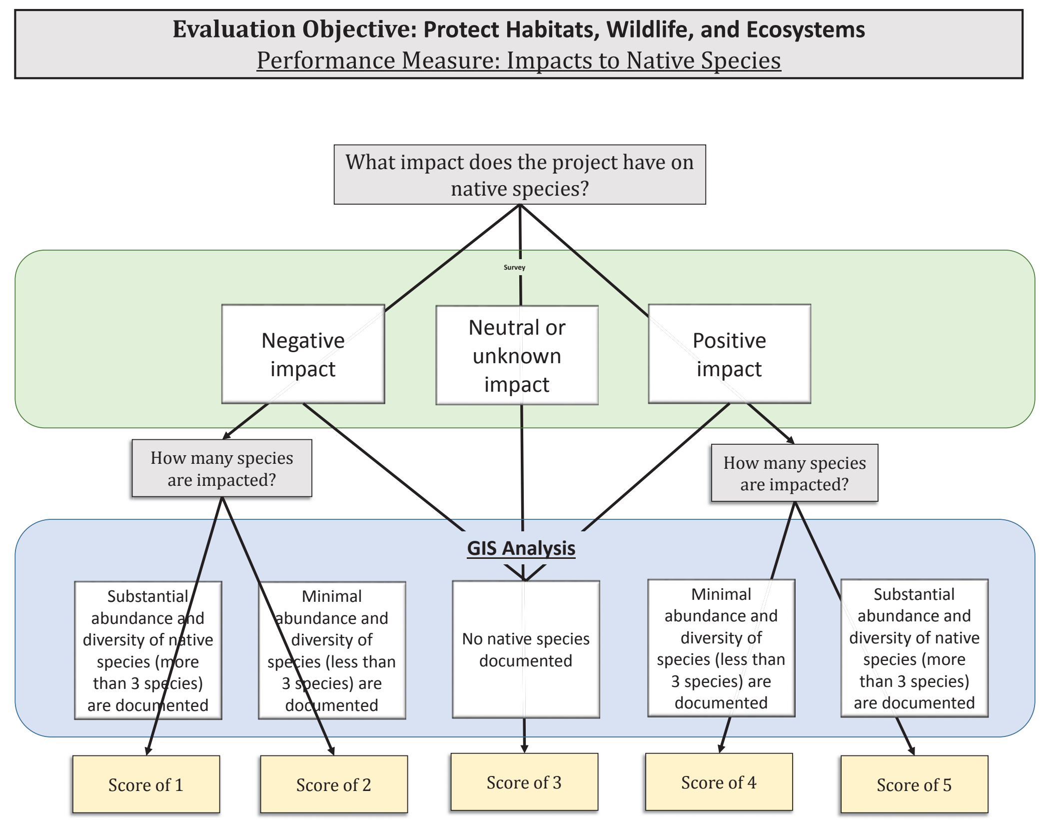
Evaluation Objective: **Protect Habitats, Wildlife, and Ecosystems**

Performance Measure: Impacts to Threatened or Endangered Species

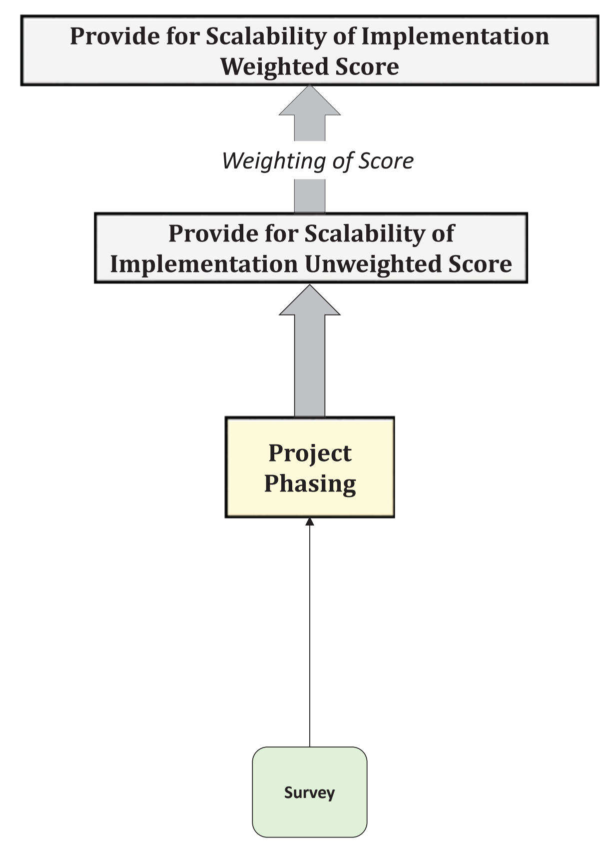


Evaluation Objective: **Protect Habitats, Wildlife, and Ecosystems**

Performance Measure: **Impacts to Native Species**

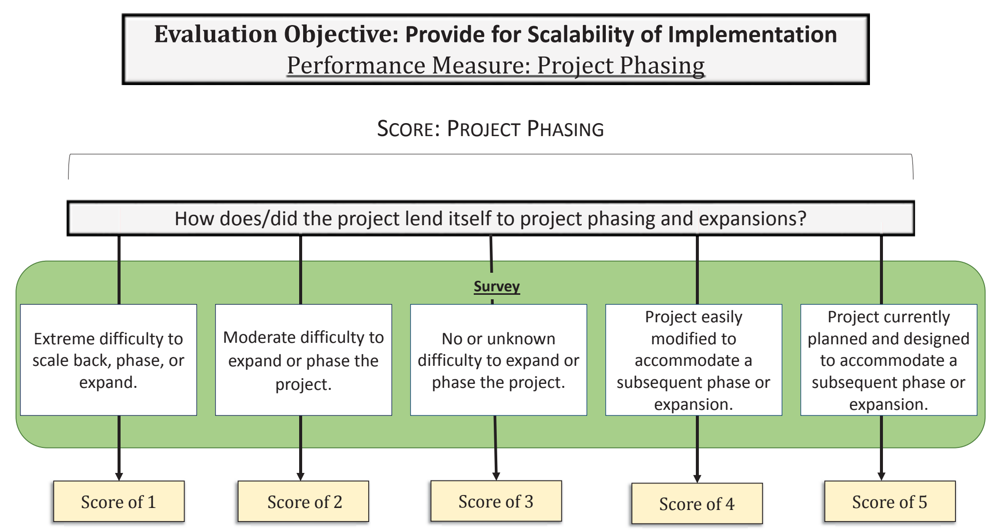


Evaluation Objective: **Provide for Scalability of Implementation**

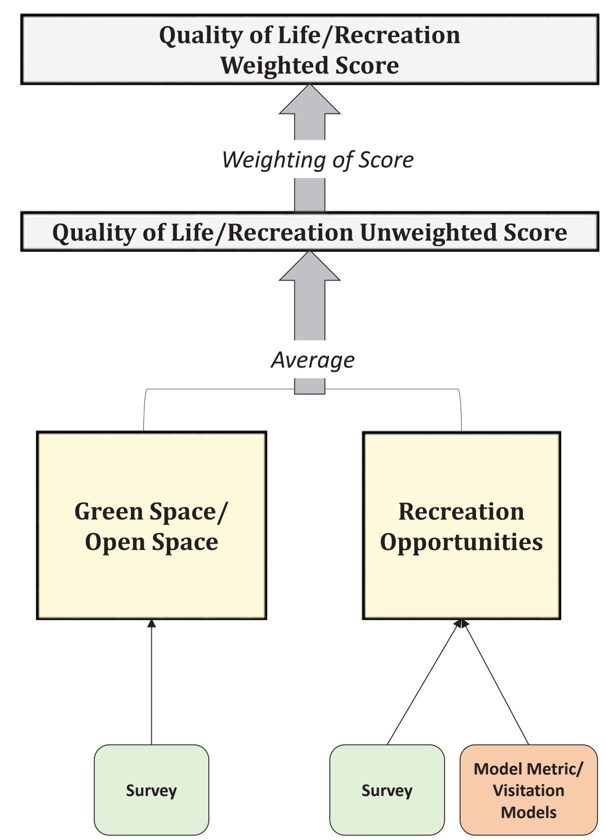


Evaluation Objective: **Provide for Scalability of Implementation**

Performance Measure: **Project Phasing**

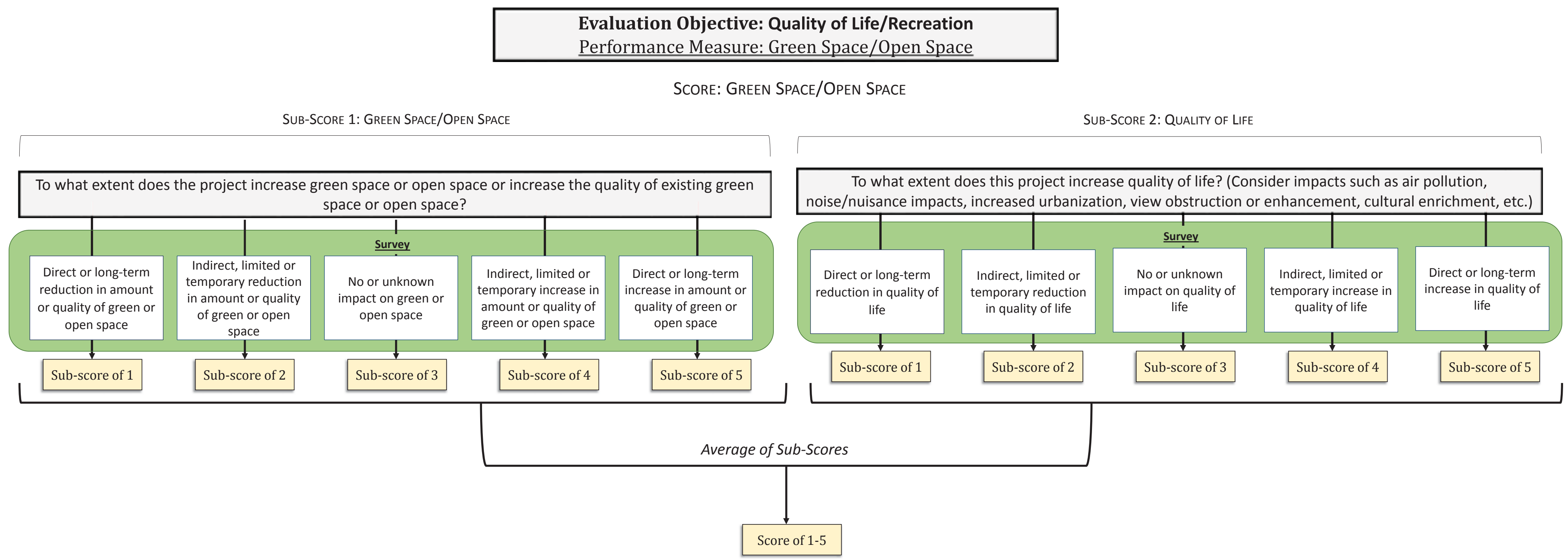


Evaluation Objective: **Quality of Life/Recreation**

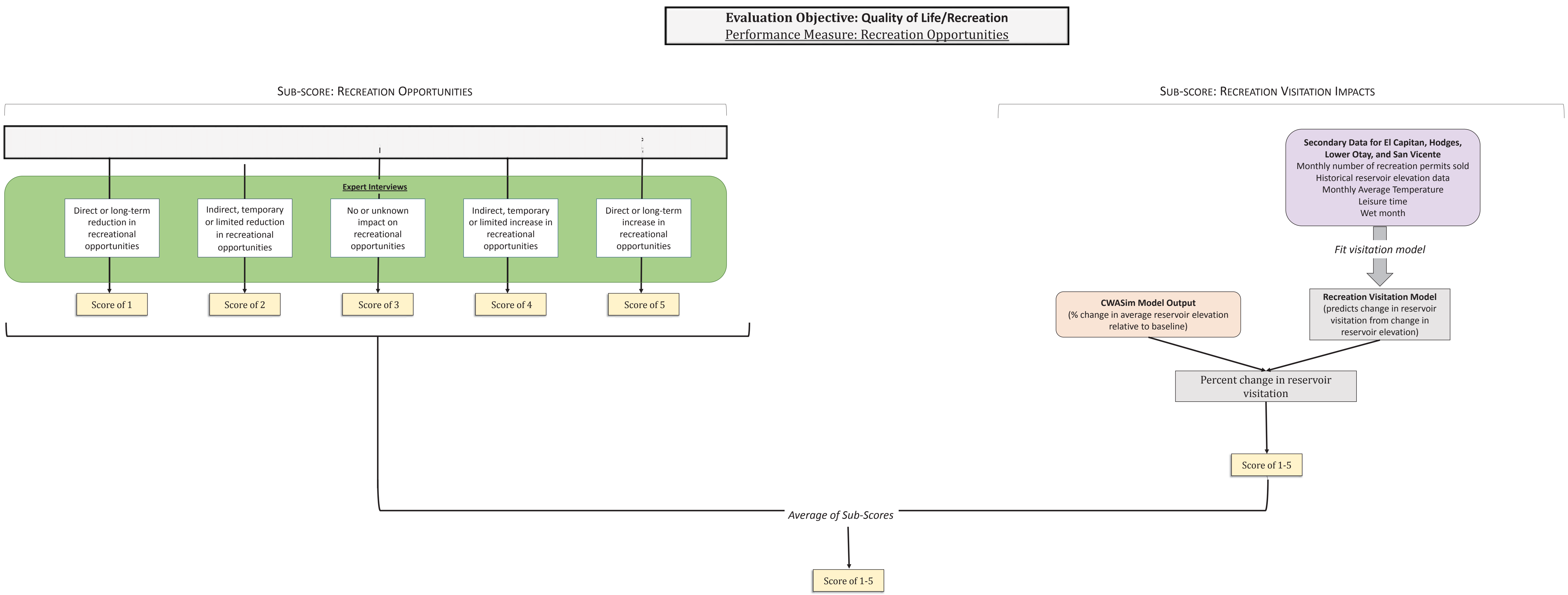


Evaluation Objective: **Quality of Life/Recreation**

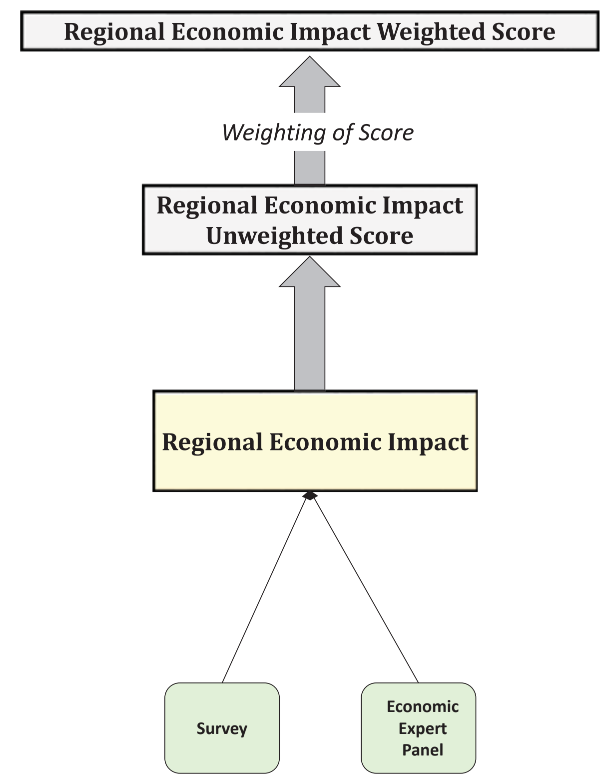
Performance Measure: **Green Space/Open Space**



Evaluation Objective: **Quality of Life/Recreation**
Performance Measure: **Recreation Opportunities**

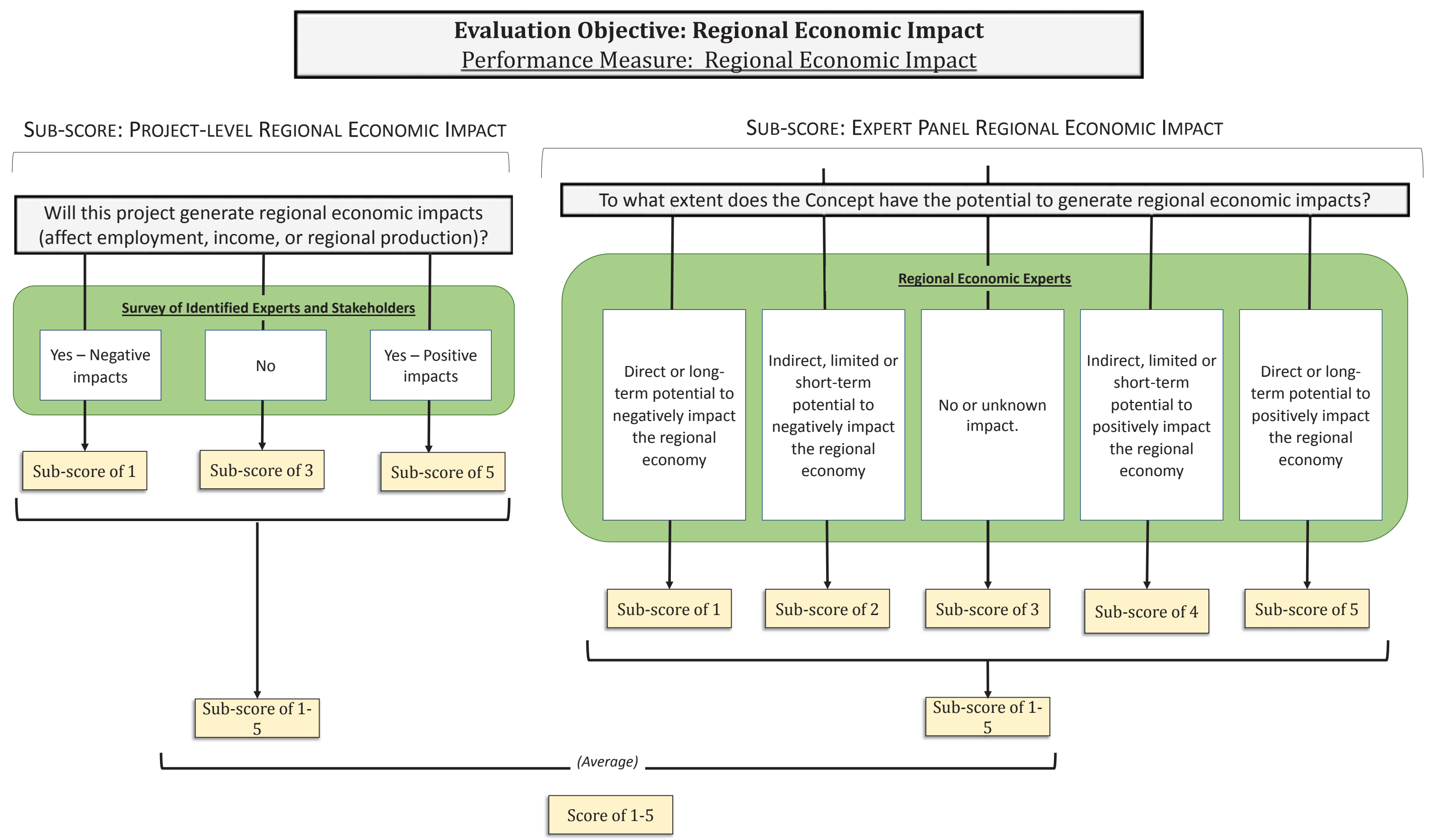


Evaluation Objective: **Regional Economic Impact**

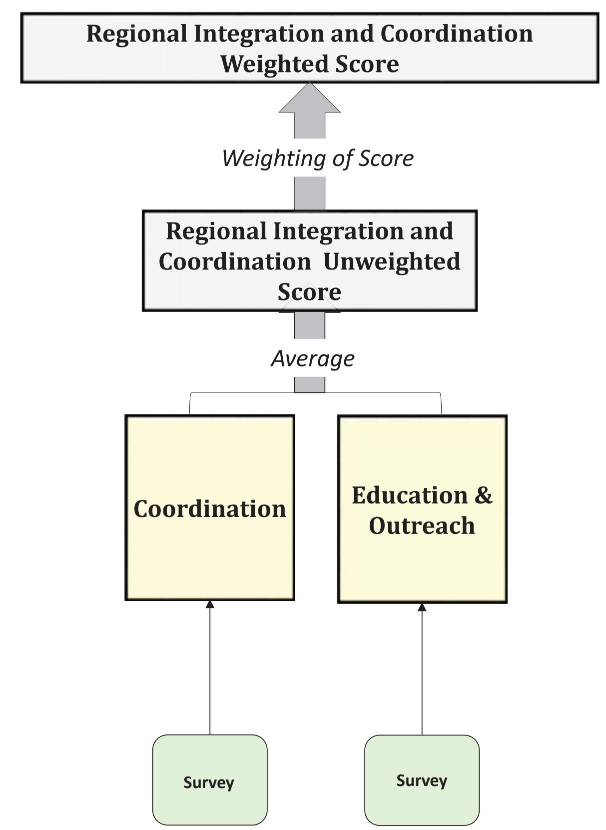


Evaluation Objective: **Regional Economic Impact**

Performance Measure: **Regional Economic Impact**

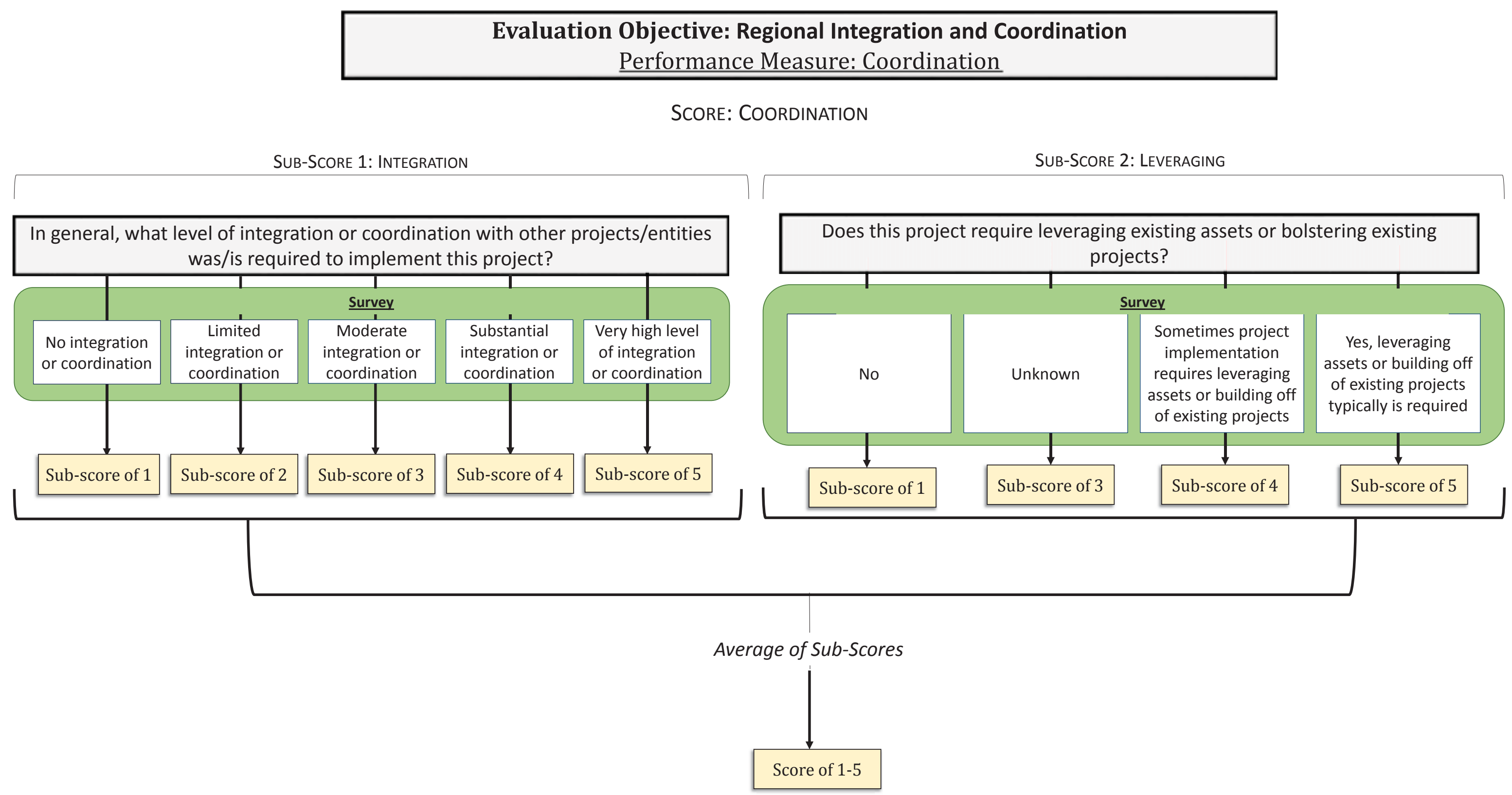


Evaluation Objective: **Regional Integration and Coordination**



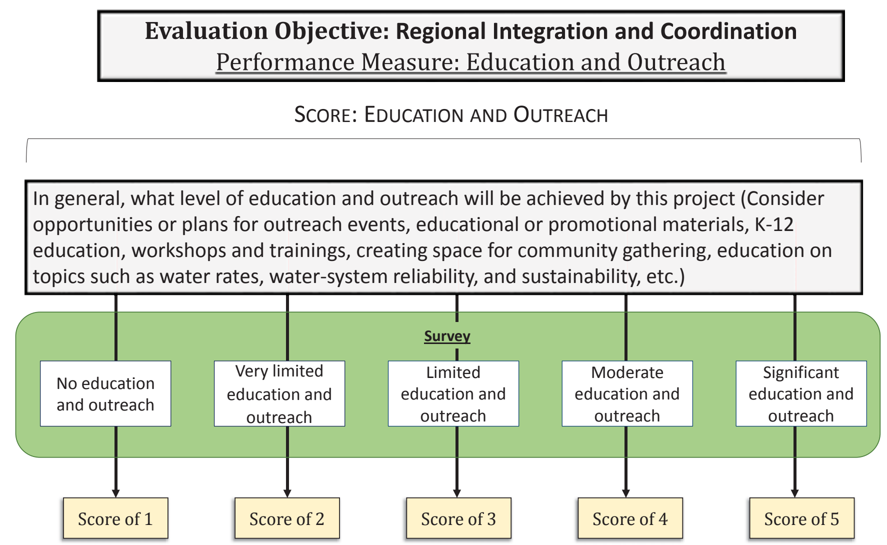
Evaluation Objective: **Regional Integration and Coordination**

Performance Measure: **Coordination**

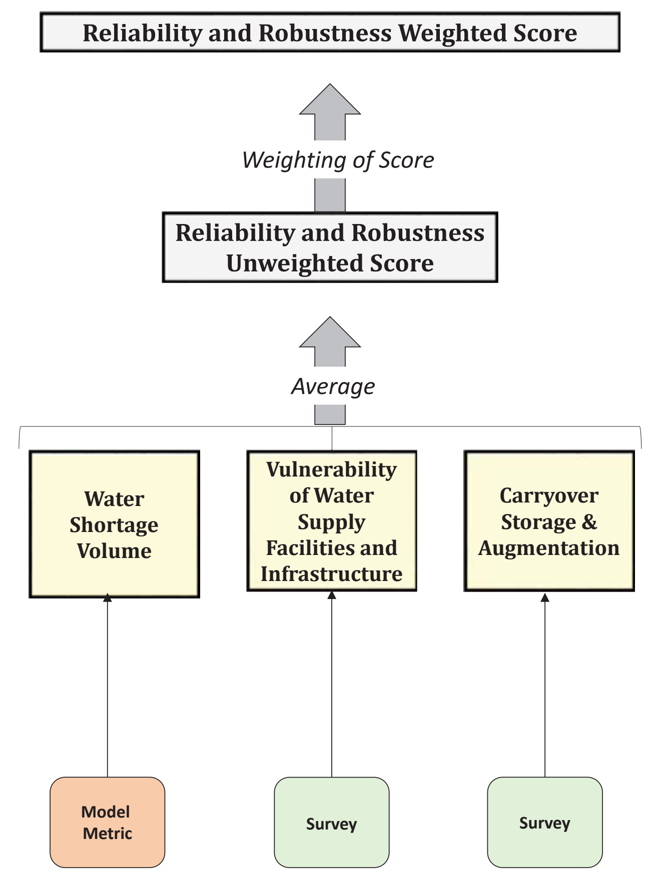


Evaluation Objective: **Regional Integration and Coordination**

Performance Measure: **Education and Outreach**



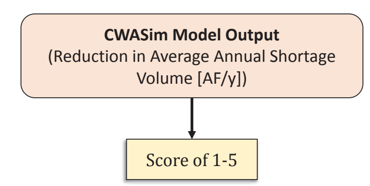
Evaluation Objective: **Reliability and Robustness**



Evaluation Objective: **Reliability and Robustness**
Performance Measure: **Water Shortage Volume**

Evaluation Objective: Reliability and Robustness
Performance Measure: Water Shortage Volume

SCORE: WATER SHORTAGE VOLUME



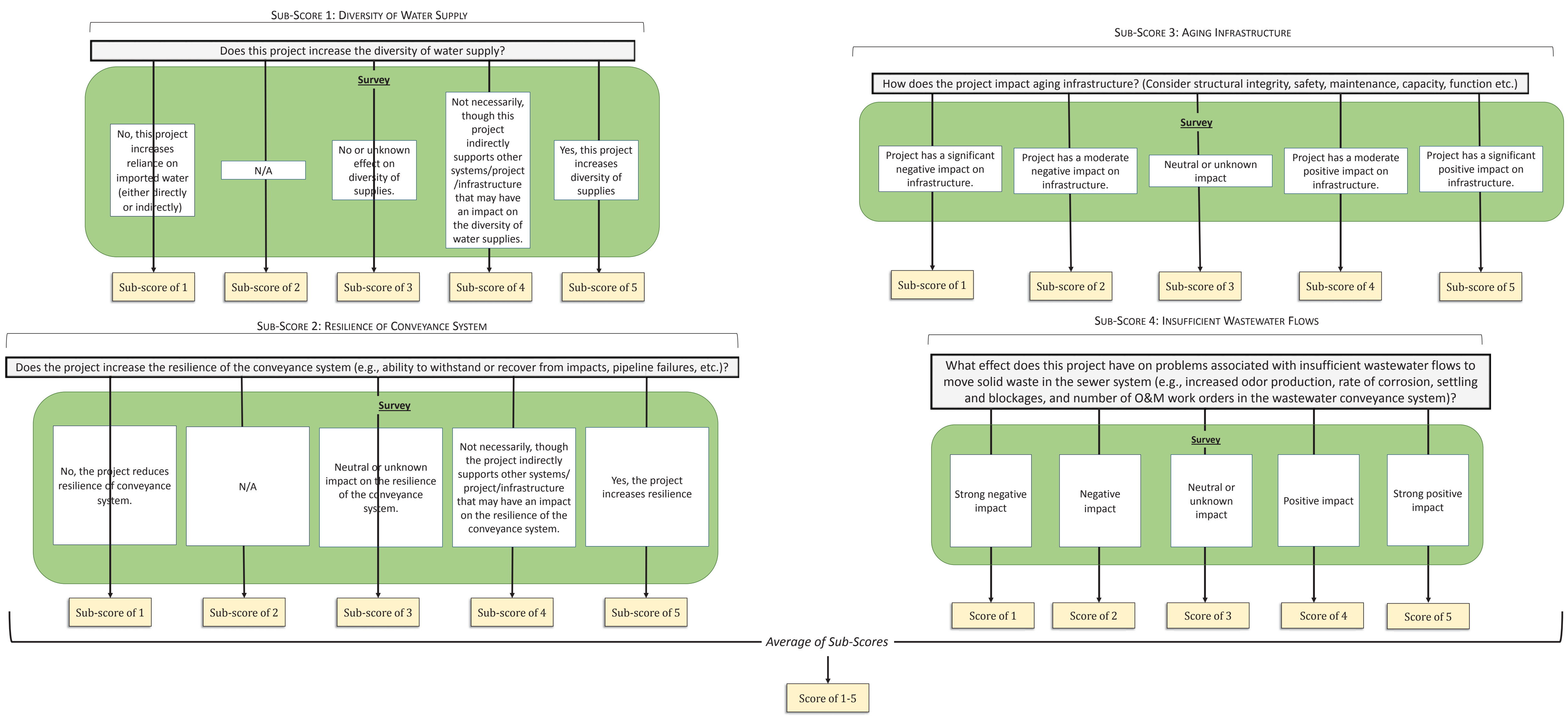
Evaluation Objective: **Reliability and Robustness**

Performance Measure: **Vulnerability of Water Supply Facilities and Infrastructure**

Evaluation Objective: Reliability and Robustness

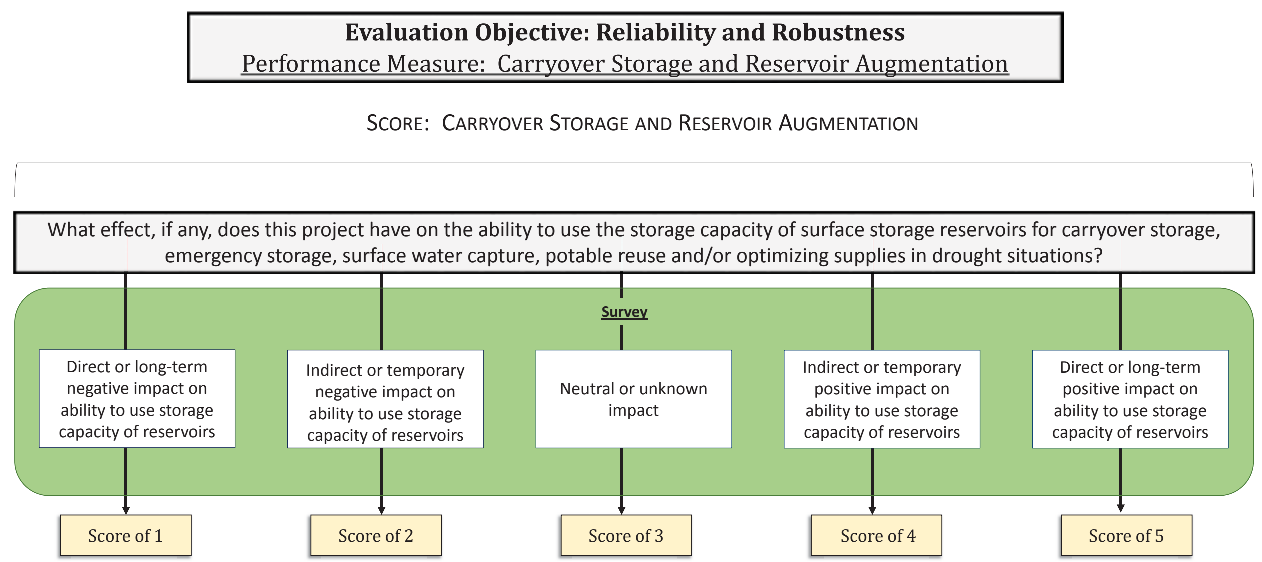
Performance Measure: Vulnerability of Water Supply Facilities and Infrastructure

SCORE: VULNERABILITY OF WATER SUPPLY FACILITIES AND INFRASTRUCTURE

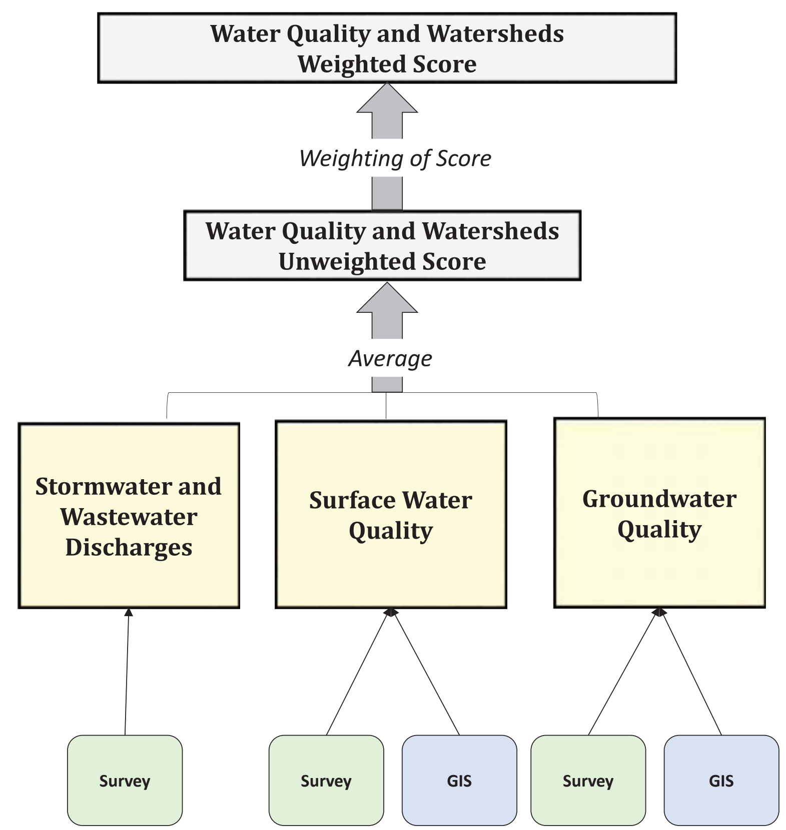


Evaluation Objective: **Reliability and Robustness**

Performance Measure: **Carryover Storage and Reservoir Augmentation**

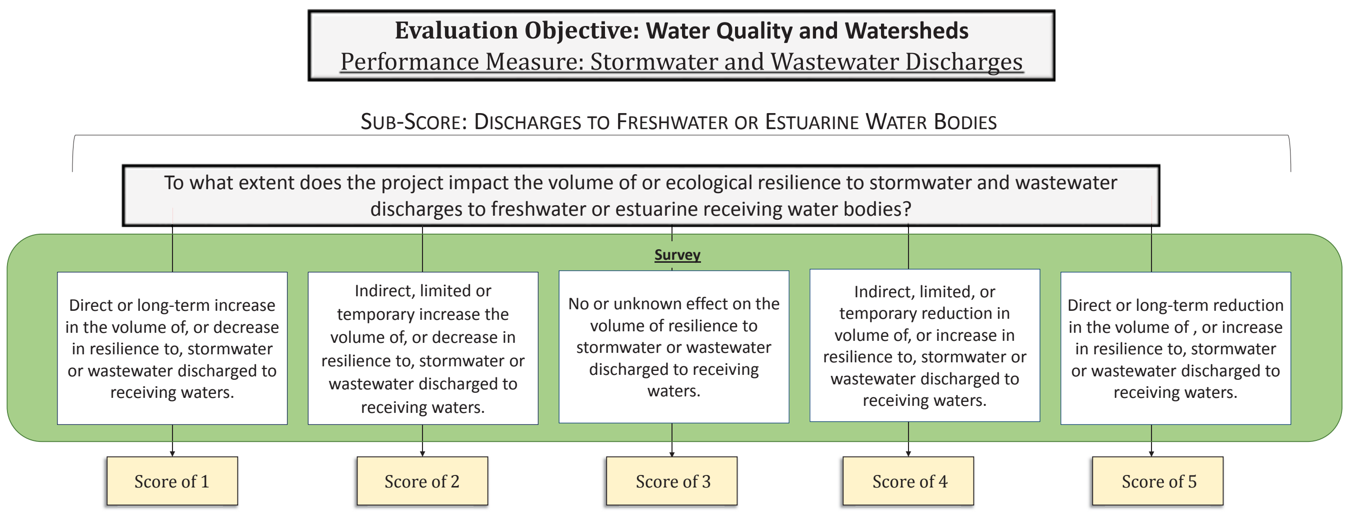


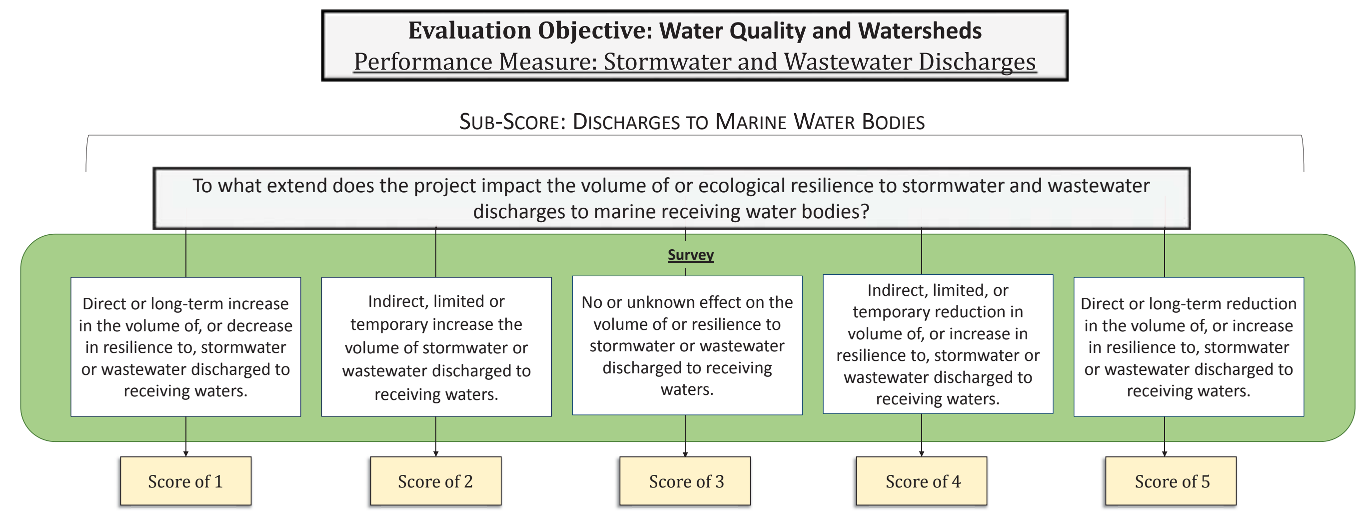
Evaluation Objective: **Water Quality and Watersheds**



Evaluation Objective: **Water Quality and Watersheds**

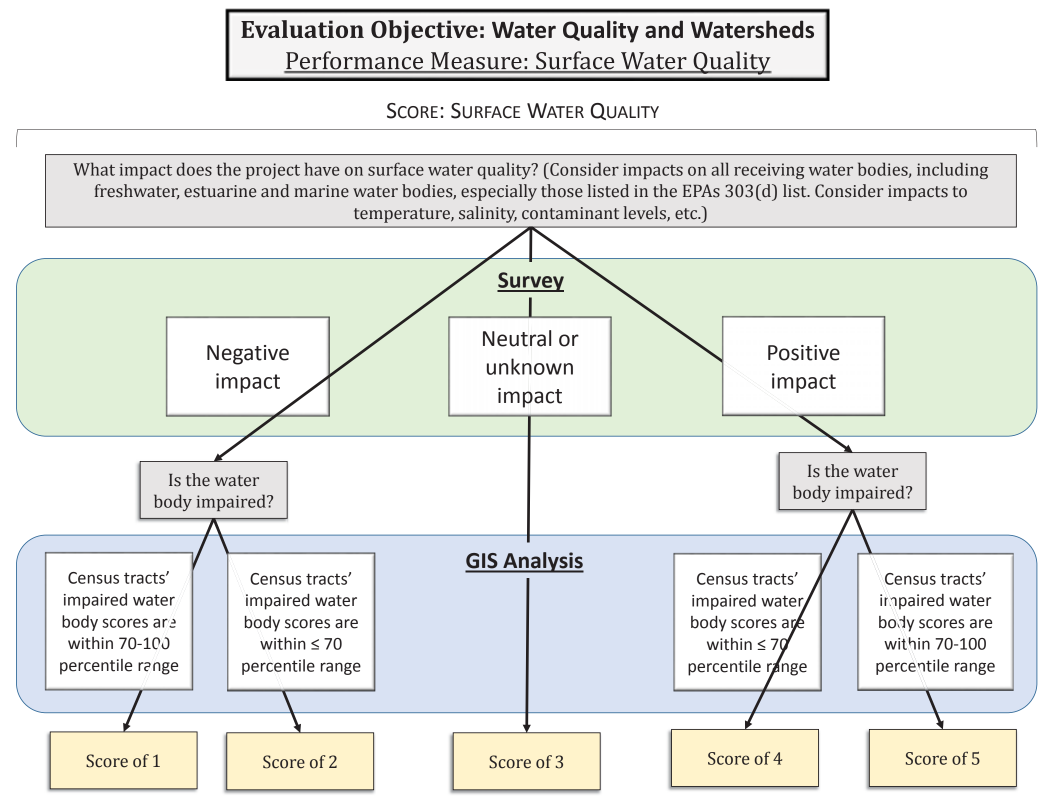
Performance Measure: **Stormwater and Wastewater Discharge**





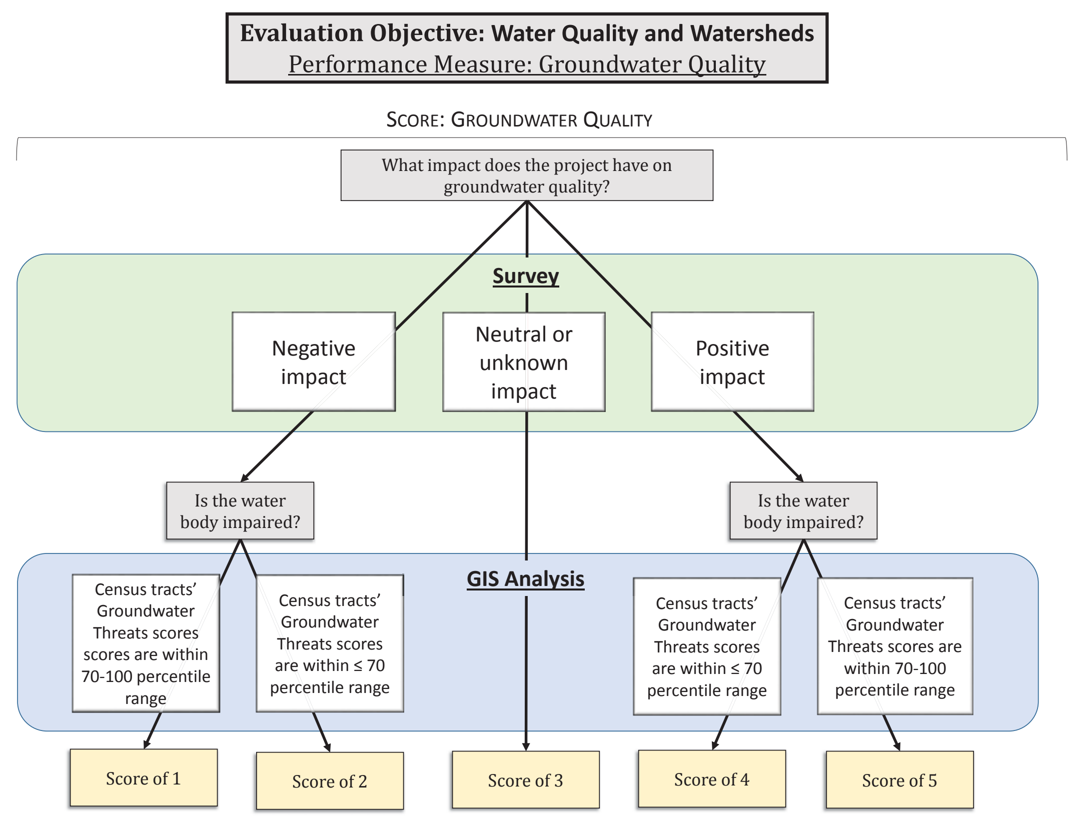
Evaluation Objective: **Water Quality and Watersheds**

Performance Measure: **Surface Water Quality**



Evaluation Objective: **Water Quality and Watersheds**

Performance Measure: **Groundwater Quality**



Appendix B: Surveys Used to Gather Data for Task 2.5

Evaluation Objective Weighting Survey

The Evaluation Objective Weighting Survey was used to gather data on the relative importance of Evaluation Objectives for use in the trade-off analysis. The survey was implemented via an online form and distributed by the City of San Diego on October 30, 2013 to a list of over 400 people consisting of the STAC and IRWM stakeholder list. Survey responses were due on November 22, 2017. During the month of December 2017, the City followed up with representatives of San Diego County Water Authority member agencies who had not yet responded to request their participation. In total, 71 responses were received. The data was provided to Reclamation for analysis.

San Diego Basin Study: Task 2.5- Tradeoff Analysis

The City of SAN DIEGO

Background

An important goal of the San Diego Basin Study is to provide a meaningful analysis of the strategies for addressing the impacts of increasing demands and climate change on water supply for the region. This will be accomplished through the Impacts Analysis to be performed in Task 2.4, and the Tradeoff Analysis to be performed in Task 2.5.

Throughout the study, the Study Team has requested stakeholder input from the Study Technical Advisory Committee and public stakeholders. Last spring, stakeholders helped us identify *Portfolios of Adaptation Concepts* and their associated projects, which represent the many different water management strategies that will be evaluated in the Basin Study. This summer, stakeholders helped identify *Evaluation Objectives*, which will be used to evaluate or score the different *Adaptation Concepts* in the Tradeoff Analysis.

Purpose of the Survey

The goal of this survey is to solicit the input of stakeholders on the relative importance of *Evaluation Objectives*. The survey contains 13 *Evaluation Objectives* to rate on a scale of 1 (least important) to 10 (most important). Results of this survey will be used to develop an importance weight for each *Evaluation Objective*. The importance weights from the survey will be used to create weighted scores for each *Adaptation Concept*. The trade-off analysis will compare *Adaptation Concepts* across all *Evaluation Objectives* for multiple climate scenarios and *Portfolios* using the weighted scores. For more information on tradeoff analyses, please see attached PDF in email invitation, which includes the Tradeoff Analysis Overview and Example.

Example of Importance Rating

As an example, consider the *Evaluation Objective*, "Cost Effectiveness". How important is "Cost Effectiveness" when deciding whether and how to implement an *Adaptation Concept*? If "Cost Effectiveness" is a very important consideration, it should be rated high in importance. Or, if "Cost Effectiveness" is not as important, then it should be rated lower. Your rating, combined with ratings of other survey participants, will help the Study Team understand the relative importance of "Cost Effectiveness" among the other *Evaluation Objectives*. For instance, is" Cost Effectiveness' a more, less, or equally important consideration than "Provide Reliability and Robustness"?

Instructions

1. Before completing your survey, please read the definition of each Evaluation Objective.

2. For each Evaluation Objective,

    a. Ask yourself: How important is this particular Evaluation Objective when considering the implementation of a water management strategy (e.g., Adaptation Concept)?

    If this particular Evaluation Objective is important, then it should be rated high in importance.
    If this particular Evaluation Objective is not as important for a future project, then it should be rated lower in importance.

    b. Rate the Objective on a scale of 1 (least important) to 10 (most important). You may assign the same level of importance to multiple Evaluation Objectives.

Provide Reliability and Robustness:

Adaptation Concepts that support highly available, secure, consistent, and flexible water supply sources and associated infrastructure, capable of meeting regional demand under normal, drought, and emergency conditions.

1 2 3 4 5 6 7 8 9 10

Optimize Local Supplies/Independence:

Adaptation Concepts that improve or support the region’s ability to use local water supplies and/or reduce the reliance on imported water.

1 2 3 4 5 6 7 8 9 10

Cost Effectiveness:

Adaptation Concepts that reduce the total present value capital, operation and maintenance costs to the region and/or have a strong potential for external funding.

1 2 3 4 5 6 7 8 9 10

Regional Integration and Coordination:

Adaptation Concepts that support community engagement, education, and coordination with regional partners to leverage existing assets and projects, reduce project barriers, and/or build community support and knowledge of water issues.

1 2 3 4 5 6 7 8 9 10

Provide for Scalability of Implementation:

Adaptation Concepts that provide flexibility in project phasing and expansion.

1 2 3 4 5 6 7 8 9 10

Minimize Project Complexity:

Adaptation Concepts that reduce inherent challenges associated with project complexity or feasibility (e.g, regulatory compliance, number of agencies/approvers, property ownership, public opinion/acceptance/practicality of implementation).

1 2 3 4 5 6 7 8 9 10

Promote High Quality of Life/Recreation

Adaptation Concepts that increase green/open space benefits and other improvements to quality of life, including providing recreational opportunities such as swimming, boating, and fishing.

1 2 3 4 5 6 7 8 9 10

Promote Environmental Justice

Adaptation Concepts that promote fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation and enforcement of environmental laws, regulations and policies as it relates to water supply. This includes distributing project benefits equitably throughout the basin, and/or directly benefiting Disadvantaged Communities (as defined by the California Department of Water Resources).

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

Support Regional Economy

Adaptation Concepts that increase the potential for local job creation or are likely to positively impact the regional economy (e.g., promote tourism or other industries).

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

Enhance Climate Resilience

Adaptation Concepts that directly or indirectly improve the region's ability to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience, related to climate variability and climate change, such as flooding, wildfire, sea level rise, and extreme heat. (Note: Regional resilience to drought is included in the Evaluation Objective, Provide Reliability and Robustness)

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

Protect Habitats, Wildlife, and Ecosystem Services

Adaptation concepts that support maintenance, enhancement, or expansion of natural environments and species or reduce negative impacts to ecosystems and threatened or endangered species.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

Protect Water Quality and Watersheds

Adaptation Concepts that prevent, reduce, mitigate, or remove physical or biological contamination of water resources, including groundwater basins, surface waters, and 303(d) listed water bodies.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

Address Climate Change Through Greenhouse Gas Reduction

Adaptation Concepts that reduce, mitigate, or sequester greenhouse gas emissions.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

Name

First Last

Affiliation

Area of Expertise (check all that apply)

- [ ] Ecology/Biology
- [ ] Watershed Science/Limnology
- [ ] Conservation, Restoration, Mitigation
- [ ] Oceanography/Marine Science
- [ ] Engineering – Design
- [ ] Engineering – Construction
- [ ] Climate Change
- [ ] Community Outreach and Education
- [ ] Environmental Policy/Planning/Analysis
- [ ] DACs (Disadvantaged Communities)
- [ ] Finance
- [ ] Water Utility – Operations
- [ ] Other

If you chose Other for Area of Expertise, please specify:

Email

Concept-Level Questionnaire

The Concept-level questionnaire was used to gather data on the Concepts analyzed in the San Diego Basin Study from stakeholders. The questionnaire was implemented as a Microsoft Excel spreadsheet. It contained an instruction tab and a tab for data input that listed each Concept-level question. Most questions had dropdown menus for agency representatives to select answers; other questions allowed the respondent to input a number or other value. The questionnaire was distributed by the City of San Diego between March 10 and March 20, 2018 to the STAC (26 individuals) and IRWM RAC (28 individuals). Survey responses were due on March 30, 2018. In total, 16 responses were received. The data was provided to Reclamation for analysis.

San Diego Basin Study Adaptation Concept Questionnaire

Name	
Affiliation:	

Instructions: *Please answer the following questions below (column C) for each Adaptation Concept (top row, columns D through S).*
1. Click on a blue cell. A drop down arrow will appear in the right corner of the cell.
2. Click on the dropdown arrow and select from the possible answer choices. If you are unable to view the full text of the answer choice, select the answer to view it in the cell. You may view each one until you have selected your final answer choice.

Evaluation Objective	Performance Measure	Adaptation Concept Question↓	Conveyance Improvement	Drought Restriction/ Allocation	Firm Water Supply Agreements	Gray Water Use	Groundwater	Imported Water Purchases	Local Surface Water Reservoirs	Potable Reuse	Recycled Water	Seawater Desalination	Stormwater BMPs	Stormwater Capture	Urban and Agricultural Water Use Efficiency	Watershed and Ecosystem Management
PROVIDE RELIABILITY AND ROBUSTNESS	Vulnerability of Water Supply Facilities and Infrastructure	Does this Adaptation Concept increase the diversity of water supply? a. No, this Adaptation Concept increases reliance on imported water (either directly or indirectly). b. N/A c. No or unknown effect on diversity of supplies d. Not necessarily, though the Adaptation Concept indirectly supports other systems/project/infrastructure that may have an impact on the diversity of water supplies. e. Yes, the Adaptation Concept increases diversity of supplies.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN
		Does the Adaptation Concept increase the resilience of the conveyance system (e.g., ability to withstand or recover from impacts, pipeline failures, etc.)? a. No, Adaptation Concept reduces resilience of conveyance system. b. N/A c. Neutral or unknown impact on the resilience of the conveyance system. d. Not necessarily, though the Adaptation Concept indirectly supports other systems/project/infrastructure that may have an impact on the resilience of the conveyance system. e. Yes, the Adaptation Concept increases resilience.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		How does the Adaptation Concept impact aging infrastructure? (Consider structural integrity, safety, maintenance, etc.) a. Adaptation Concept has a significant negative impact on infrastructure. b. Adaptation Concept has a moderate negative impact on infrastructure. c. Neutral or unknown impact d. Adaptation Concept has a moderate positive impact on infrastructure. e. Adaptation Concept has a significant positive impact on infrastructure.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		What effect does this Adaptation Concept have on problems associated with insufficient wastewater flows to move solid waste (e.g., increased odor production, rate of corrosion, settling and blockages, and number of O&M work orders in the wastewater conveyance system)? a. Strong negative impact b. Negative impact c. Neutral or unknown impact d. Positive impact e. Strong positive impact	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]

	Carryover Storage and Reservoir Augmentation	What effect, if any, does this Adaptation Concept have on the ability to use the storage capacity of surface storage reservoirs for carryover storage, emergency storage, surface water capture, potable reuse and/or optimizing supplies in drought situations? a. Direct or long-term negative impact on ability to use storage capacity of reservoirs b. Indirect or temporary negative impact on ability to use storage capacity of reservoirs c. Neutral or unknown impact d. Indirect or temporary positive impact on ability to use storage capacity of reservoirs e. Direct or long-term positive impact on ability to use storage capacity of reservoirs	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
OPTIMIZE LOCAL SUPPLIES/ INDEPENDENCE	Local Supply	Does this Adaptation Concept increase local water supply? a. Direct or long-term decrease in local water supply b. Indirect or temporary decrease in local water supply c. Neutral or unknown impact on local water supply d. Indirect or temporary increase in local water supply e. Direct or long-term increase in local water supply	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
COST EFFECTIVENESS	Capital Costs	In general, what are the capital costs associated with implementation of projects in this Adaptation Concept? a. Very costly/high cost b. Moderate or variable costs c. Inexpensive/low cost	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
	O&M Costs	In general, what are the operation and maintenance costs associated with implementation of projects in this Adaptation Concept? a. Very costly b. Moderate or variable costs c. Inexpensive/low cost	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
REGIONAL INTEGRATION AND COORDINATION	Coordination	In general, what level of integration or coordination with other projects/entities is required to implement a project within this Adaptation Concept? a. No integration or coordination b. Limited integration or coordination c. Moderate integration or coordination d. Substantial integration or coordination e. Very high level of integration or coordination	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		Generally, in order to implement a project within this Adaptation Concept, does it require leveraging existing assets or bolstering existing projects? a. No integration or coordination b. Limited integration or coordination c. Moderate integration or coordination d. Substantial integration or coordination e. Very high level of integration or coordination	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		Are any regulatory barriers removed by the projects within this Adaptation Concept? (Consider effect on pathways for implementation of water projects, including identifying and obtaining local and regional funds and overcoming regulatory obstacles and mandates.) a. No or unknown b. Yes	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]

	Education and Outreach	In general, what level of education and outreach will be achieved by projects within this Adaptation Concept? (Consider opportunities or plans for outreach events, educational or promotional materials, K-12 education, workshops and trainings, creating space for community gathering, etc.) a. No education and outreach b. Very limited education and outreach c. Limited education and outreach d. Moderate education and outreach e. Significant education and outreach	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
PROVIDE FOR SCALABILTIY OF IMPLEMENTATION	Project Phasing	In general, how does the Adaptation Concept lend itself to project phasing and expansions? a. Extreme difficulty to scale back, phase, or expand. b. Moderate difficulty to expand or phase the project. c. No or unknown difficulty to expand or phase the project. d. Project easily modified to accommodate a subsequent phase or expansion. e. Project currently planned and designed to accommodate a subsequent phase or expansion.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
PROJECT COMPLEXITY	Project Complexity and Feasibility	In general, what is the feasibility and/or complexity of project implementation within this Adaptation Concept? (Consider the following: complexity and feasibility related to regulatory compliance, number of agencies/approvers involved, property ownership, public opinion/acceptance/practicality of implementation) a. Highly complex and infeasible. Significant expertise, experience and collaboration among multiple partners or collaborators required in order for these types of projects to be successfully implemented. Projects regularly experience delays and/or must be altered due to project complexity, logistics, and/or competing interests. b. Moderately complex. Project implementation and/or approval requires multiple agencies/organizations to collaborate. c. Unknown complexity and/or feasibility d. Moderately simple. Projects within this Adaptation Concept are likely to experience a limited number of barriers to implementation. Achieving regulatory compliance is a routine procedure and is achievable. If multiple partners are involved, there are existing agreements in place to facilitate project approval and implementation. e. Simple. Projects are easily and regularly implemented with few barriers. Regulatory compliance is easily acquired and achieved.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
QUALITY OF LIFE /RECREATION	Green Space/Open Space	To what extent does the Adaptation Concept increase green space or open space or increase the quality of existing green space or open space? a. Direct or long-term reduction in amount or quality of green or open space b. Indirect, limited or temporary reduction in amount or quality of green or open space c. No or unknown impact on green or open space d. Indirect, limited or temporary increase in amount or quality green or open space e. Direct or long-term increase in amount or quality of green or open space	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		To what extent does this Adaptation Concept increase quality of life? (Consider impacts such as air pollution, noise/nuisance impacts, increased urbanization, view obstruction or enhancement, cultural enrichment, etc.) a. Direct or long-term reduction in quality of life	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]

		b. Indirect or limited or temporary reduction in quality of life c. No or unknown impact on quality of life d. Indirect, limited or temporary increase in quality of life e. Direct or long-term increase in quality of life														
	Recreation Opportunities	To what extent do projects within the Adaptation Concept increase recreational opportunities? (Consider impact on recreation opportunities such as trails/hiking, community gathering space, wildlife watching, swimming, boating, fishing as an incidental benefit to water supply storage and conveyance) a. Direct or long-term reduction in recreational opportunities b. Indirect, temporary or limited reduction in recreational opportunities c. No or unknown impact on recreational opportunities d. Indirect, temporary or limited increase in recreational opportunities e. Direct or long-term increase in recreational opportunities	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
WATER QUALITY AND WATERSHEDS	Stormwater and Wastewater Discharges	To what extent does the Adaptation Concept the volume of or ecological resilience to stormwater and wastewater discharges to freshwater or estuarine receiving water bodies? a. Direct or long-term increase in the volume of or decrease in the ecological resilience to stormwater or wastewater discharged to receiving waters. b. Indirect, limited or temporary increase the volume of or decrease in the ecological resilience to stormwater or wastewater discharged to receiving waters. c. No or unknown effect on the volume of or ecological resilience to stormwater or wastewater discharged to receiving waters. d. Indirect, limited, or temporary reduction in the volume of or increase in the ecological resilience to stormwater or wastewater discharged to receiving waters. e. Direct or long-term reduction in the volume of or increase in the ecological resilience to stormwater or wastewater discharged to receiving waters.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		To what extend does the Adaptation Concept impact the volume of or ecological resilience to stormwater and wastewater discharges to marine receiving water bodies? a. Direct or long-term increase in the volume of or decrease in the ecological resilience to stormwater or wastewater discharged to receiving waters. b. Indirect, limited or temporary increase the volume of or decrease in the ecological resilience to stormwater or wastewater discharged to receiving waters. c. No or unknown effect on the volume of or ecological resilience to stormwater or wastewater discharged to receiving waters. d. Indirect, limited, or temporary reduction in the volume of or increase in the ecological resilience to stormwater or wastewater discharged to receiving waters. e. Direct or long-term reduction in the volume of or increase in the ecological resilience to stormwater or wastewater discharged to receiving waters.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]

ADDRESS CLIMATE CHANGE THROUGH GHG REDUCTION	GHG Mitigation	To what extent does this Adaptation Concept mitigate greenhouse gas emissions through carbon storage and sequestration (e.g., habitat conservation and/or restoration)? a. GHG mitigations are eliminated through implementation of projects within this Adaptation Concept b. GHG mitigations are decreased through the implementation of projects within this Adaptation Concept c. No or unknown amount of GHG mitigation d. Moderate amount of GHG mitigation is achieved by the implementation of projects within this Adaptation Concept. Mitigation cannot be directly quantified as “carbon credits” or “carbon dioxide equivalents.” e. Substantial amount of GHG mitigation achieved by the implementation of projects within this Adaptation Concept. Mitigation can be quantified as “carbon credits” or “carbon dioxide equivalents.”	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]

Project-Level Questionnaire

The project-level questionnaire was used to gather data on individual projects from the lead agency for each project included in the San Diego Basin Study. The questionnaire was implemented as a Microsoft Excel spreadsheet. Each Excel sheet was customized to list only the projects for a specific agency. It contained an instruction tab and a tab for data input that listed each project-level question. Most questions had dropdown menus for agency representatives to select answers; other questions allowed the agency representative to input a number or other value. The questionnaire was distributed by the City of San Diego to agency representatives for each project included in the San Diego Basin Study (84 individuals) in March 2018. Survey responses were due in April 2018. In total, 40 responses were received. The data was provided to Reclamation for analysis.

San Diego Basin Study Project Questionnaire

Member Agency: Sample Agency

Instructions: *Please answer the following questions below (column C) for each project on the right (columns after C).For each project, do the following:*
1. Review the project contact information in the green cells and update as appropriate.
2. Click on a blue cell. A drop down list arrow will appear, or you will have the option to input a numerical value.
3. Click on the arrow and select from the possible answer choices. Some questions may require you to enter a numerical value instead of selecting an option from a dropdown. If you are unable to view the full text of the answer choice, select the answer to view it in the cell. You may view each one until you have selected your final answer choice.

			Project Title:	**Example Project 1**	**Example Project 2**
		Member Agency Contact	Name:	John Smith	John Smith
			Title:	Management Analyst	Management Analyst
			Phone Number	858-987-1234	858-987-1234
			Email Address	JSmith@agency.gov	JSmith@agency.gov
		Project Contact	Name:	Jane Johnson	Jane Johnson
			Title:	Utilities Administrator	Utilities Administrator
			Phone Number	858-987-5678	858-987-5678
Evaluation Objective	**Performance Measure**		Email Address	JJohnson@agency.gov	JJohnson@agency.gov
PROVIDE RELIABILITY AND ROBUSTNESS	Vulnerability of Water Supply Facilities and Infrastructure	Does this project increase the diversity of water supply? a. No, this project increases reliance on imported water (either directly or indirectly) b. N/A c. No or unknown effect on diversity of supplies. d. Not necessarily, though the project indirectly supports other systems/project/infrastructure that may have an impact on the diversity of water supplies. e. Yes, this project increases diversity of supplies		[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		Does the project increase the resilience of the conveyance system (e.g., ability to withstand or recover from impacts, pipeline failures, etc.)? a. No, the project reduces resilience of conveyance system. b. N/A c. Neutral or unknown impact on the resilience of the conveyance system. d. Not necessarily, though the project indirectly supports other systems/project/infrastructure that may have an impact on the resilience of the conveyance system. e. Yes, the project increases resilience.		[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		How does the project impact aging infrastructure? (Consider structural integrity, safety, maintenance, etc.) a. Project has a significant negative impact on infrastructure. b. Project has a moderate negative impact on infrastructure. c. Neutral or unknown impact d. Project has a moderate positive impact on infrastructure. e. Project has a significant positive impact on infrastructure.		[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		What effect does this project have on problems associated with insufficient wastewater flows to move solid waste (e.g., increased odor production, rate of corrosion, settling and blockages, and number of O&M work orders in the wastewater conveyance system)? a. Strong negative impact b. Negative impact c. Neutral or unknown impact d. Positive impact e. Strong positive impact		[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]

	Carryover Storage and Reservoir Augmentation	What effect, if any, does this project have on the ability to use the storage capacity of surface storage reservoirs for carryover storage, emergency storage, surface water capture, potable reuse and/or optimizing supplies in drought situations? a. Direct or long-term negative impact on ability to use storage capacity of reservoirs b. Indirect or temporary negative impact on ability to use storage capacity of reservoirs c. Neutral or unknown impact d. Indirect or temporary positive impact on ability to use storage capacity of reservoirs e. Direct or long-term positive impact on ability to use storage capacity of reservoirs	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
OPTIMIZE LOCAL SUPPLIES/ INDEPENDENCE	Local Supply	Does this project increase local water supply? a. Direct or long-term decrease in local water supply b. Indirect or temporary decrease in local water supply c. Neutral or unknown impact on local water supply d. Indirect or temporary increase in local water supply e. Direct or long-term increase in local water supply	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
COST EFFECTIVENESS	Capital Costs	In general, what are the capital costs associated with implementation of this project? a. Very costly/high cost b. Moderate or variable costs c. Inexpensive/low cost	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		Specifically, what are the capital costs associated with this project?	Enter a value	Enter a value
	O&M Costs	In general, what are the operation and maintenance costs associated with implementation of this project? a. Very costly/high cost b. Moderate or variable costs c. Inexpensive/low cost	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		Specifically, what are the O&M costs associated with this project?	Enter a value	Enter a value
	Potential for External Funding	Did this project or is it expected to receive external funding? a. No b. Yes, the project was/is expected to be partially funded by external sources. c. Yes, project was/is expected to be fully funded by external funding	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
REGIONAL INTEGRATION AND COORDINATION	Coordination	In general, what level of integration or coordination with other projects/entities was/is required to implement this project? a. No integration or coordination b. Limited integration or coordination c. Moderate integration or coordination d. Substantial integration or coordination e. Very high level of integration or coordination	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		Did/does this project leverage existing assets or bolter existing projects? a. No b. Unknown c. Sometimes, project implementation requires leveraging assets or building off of existing projects d. Yes, leveraging assets or building off of existing projects typically is required	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		Are any regulatory barriers removed by the project? (Consider effect on pathways for implementation of water projects, including identifying and obtaining local and regional funds and overcoming regulatory obstacles and mandates.) a. No or unknown. b. Yes	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]

	Education and Outreach	In general, what level of education and outreach will be achieved by this project? (Consider opportunities or plans for outreach events, educational or promotional materials, K-12 education, workshops and trainings, creating space for community gathering, education on topics such as water rates, water-system reliability, and sustainability, etc.) a. No education and outreach b. Very limited education and outreach c. Limited education and outreach d. Moderate education and outreach e. Significant education and outreach	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
PROVIDE FOR SCALABILTIY OF IMPLEMENTATION	Project Phasing	How does/did the project lend itself to project phasing and expansions? a. Extreme difficulty to scale back, phase, or expand. b. Moderate difficulty to expand or phase the project. c. No or unknown difficulty to expand or phase the project. d. Project easily modified to accommodate a subsequent phase or expansion. e. Project currently planned and designed to accommodate a subsequent phase or expansion.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
PROJECT COMPLEXITY	Project Complexity and Feasibility	In general, what is the feasibility and/or complexity of project implementation? (Consider the following: complexity and feasibility related to regulatory compliance, number of agencies/approvers involved, property ownership, public opinion/acceptance/practicality of implementation) a. Highly complex and infeasible. Significant expertise, experience and collaboration among multiple partners or collaborators required in order for these types of projects to be successfully implemented. Projects regularly experience delays and/or must be altered due to project complexity, logistics, and/or competing interests. b. Moderately complex. Project implementation and/or approval requires multiple agencies/organizations to collaborate. c. Unknown complexity and/or feasibility d. Moderately simple. This project is likely to experience a limited number of barriers to implementation. Achieving regulatory compliance is a routine procedure and is achievable. If multiple partners are involved, there are existing agreements in place to facilitate project approval and implementation. e. Simple. Projects are easily and regularly implemented with few barriers. Regulatory compliance is easily acquired and achieved.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
QUALITY OF LIFE/RECREATION	Green Space/Open Space	To what extent does the project increase green space or open space or increase the quality of existing green space or open space? a. Direct or long-term reduction in amount or quality of green or open space b. Indirect, limited or temporary reduction in amount or quality of green or open space c. No or unknown impact on green or open space d. Indirect, limited or temporary increase in amount or quality green or open space e. Direct or long-term increase in amount or quality of green or open space	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		To what extent does this project increase quality of life? (Consider impacts such as air pollution, noise/nuisance impacts, increased urbanization, view obstruction or enhancement, cultural enrichment, etc.) a. Direct or long-term reduction in quality of life b. Indirect or limited or temporary reduction in quality of life c. No or unknown impact on quality of life d. Indirect, limited or temporary increase in quality of life e. Direct or long-term increase in quality of life	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]

	Recreation Opportunities	To what extent does this project increase recreational opportunities? (Consider impact on recreation opportunities such as trails/hiking, community gathering space, wildlife watching, swimming, boating, fishing as an incidental benefit to water supply storage and conveyance) a. Direct or long-term reduction in recreational opportunities b. Indirect, temporary or limited reduction in recreational opportunities c. No or unknown impact on recreational opportunities d. Indirect, temporary or limited increase in recreational opportunities e. Direct or long-term increase in recreational opportunities	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
ENVIRONMENTAL JUSTICE	Environmental Justice	What is the likely environmental impact of this project? a. Negative impact b. No or unknown impact (If no or unknown impact, skip the next question) c. Positive impact	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		What is the likely magnitude of the project's environmental impact (1 to 5 relative scale)? a. Minor impact b. Less than average impact c. Average impact d. Moderately large impact e. Large impact	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		To what extent will this project generate environmental impacts? a. Localized impacts limited to the physical project area. b. Significant impacts beyond the project area but not to the entire watershed. c. Significant impacts on the entire watershed	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
	Disadvantaged Communities	What is the likely impact of this project on disadvantaged communities? a. Negative impact b. Neutral or unknown impact c. Positive impact	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
REGIONAL ECONOMIC IMPACT	Regional Economic Impact	Will this project generate regional economic impacts (affect employment, income, or regional production)? a. Yes – Negative impacts b. No – If No, skip to final water rate question c. Yes – Positive impacts	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		Will this project generate regional impacts beyond capital and operation and maintenance expenditures? a. No - Project related expenditures represent the vast majority of regional impacts. If No, skip to final water rate question b. Yes - Project related expenditures represent the majority of regional impacts but improved water supply, reliability, environmental conditions, or other improvements would be expected to increase economic activity in the region which will have positive regional impacts. c. Yes - Improved water supply, reliability, environmental conditions, or other improvements would be expected to have a significant impact on economic activity in the region and will have positive regional impacts.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		To what extent does the project have the potential to generate regional economic impacts beyond capital and operation and maintenance expenditures? a. Potential to negatively impact the regional economy by one or all of the following: i. Directly reduces jobs, ii. Increases cost of water to business, industry or agriculture, iii. Volatility or uncertainty in water rates/costs reduces confidence and investments, iv. Long-term maintenance costs are required to maintain water infrastructure b. Some potential to positively impact the regional economy by one or all of the following: i. Directly increases jobs, ii. Reduces cost of water to business, industry or agriculture, iii. Reduces volatility or uncertainty in water rates/costs c. Strong potential to positively impact the regional economy by one of all of the following: i. Directly increases jobs, ii. Reduces cost of water to	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]

		business, industry or agriculture, or iii. Reduces volatility or uncertainty in water rates/costs reduces confidence and investments		
		To what extent does the project have the potential to increase or decrease water rates? a. Direct or long-term potential to increase water rates b. Indirect, limited or short-term potential to increase water rates c. Unknown, neutral or no impact on water rates d. Indirect, limited or short-term potential to decrease water rates e. Direct or long-term potential to decrease water rates	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
PROTECT HABITATS, WILDLIFE, AND ECOSYSTEMS	Impacts to Endangered/Threatened Species	What likely impact does the project have on endangered/threatened species? a. Negative impact b. Neutral or unknown impact c. Positive impact	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		What likely impact does the project have on native species? a. Negative impact b. Neutral or unknown impact c. Positive impact	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
	Impacts to Ecosystems	Does the project restore or degrade habitat? a. Habitat degraded b. Neutral or unknown impact c. Habitat restored or conserved	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		Does this project involve mitigation? a. No b. Yes (if Yes, skip the next question for surface area of impact)	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		What is the surface area of impact? a. > 1 acre of habitat impacted b. < 1 acre of habitat impacted	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		What is the exact surface area of impact? (provide acreage of project impact area)	Enter a value	Enter a value
		What impact does this project have on ecosystems? a. Negative impact b. Neutral or unknown impact c. Positive impact	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
WATER QUALITY AND WATERSHEDS	Surface Water Quality	What impact does the project have on surface water quality? a. Negative impact b. Neutral or unknown impact c. Positive impact	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
	Groundwater Quality	What impact does the project have on groundwater quality? a. Negative impact b. Neutral or unknown impact c. Positive impact	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
	Stormwater and Wastewater Discharges	To what extent does the project impact the volume of, or ecological resilience to stormwater and wastewater discharges to *freshwater or estuarine* receiving water bodies? a. Direct or long-term increase in the volume of, or decrease in the ecological resilience to stormwater or wastewater discharged to receiving waters. b. Indirect, limited or temporary increase the volume of, or decrease in the ecological resilience to stormwater or wastewater discharged to receiving waters. c. No or unknown effect on the volume of or ecological resilience to stormwater or wastewater discharged to receiving waters.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]

		d. Indirect, limited, or temporary reduction in the volume of, or increase in the ecological resilience to stormwater or wastewater discharged to receiving waters. e. Direct or long-term reduction in the volume of, or increase in the ecological resilience to stormwater or wastewater discharged to receiving waters.		
		To what extend does the project impact the volume of, or ecological resilience to stormwater and wastewater discharges to *marine* receiving water bodies? a. Direct or long-term increase in the volume of, or decrease in the ecological resilience to stormwater or wastewater discharged to receiving waters. b. Indirect, limited or temporary increase the volume of, or decrease in the ecological resilience to stormwater or wastewater discharged to receiving waters. c. No or unknown effect on the volume of or ecological resilience to stormwater or wastewater discharged to receiving waters. d. Indirect, limited, or temporary reduction in the volume of, or increase in the ecological resilience to stormwater or wastewater discharged to receiving waters. e. Direct or long-term reduction in the volume of, or increase in the ecological resilience to stormwater or wastewater discharged to receiving waters.	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
ADDRESS CLIMATE CHANGE THROUGH GHG REDUCTION	GHG Mitigation	To what extent does this project mitigate greenhouse gas emissions through carbon storage and sequestration (e.g., habitat conservation and/or restoration)? (Note: Mitigation in this context refers to carbon sequestration and does not refer to legal mitigation activities required through CEQA) a. GHG mitigations are eliminated through the implementation of this project. b. GHG mitigations are decreased through the implementation of this project. c. No or unknown amount of GHG mitigation achieved by this project. d. Moderate amount of GHG mitigation is achieved by this project. Mitigation cannot be directly quantified as "carbon credits" or "carbon dioxide equivalents." e. Substantial amount of GHG mitigation achieved by this project. Mitigation can be quantified as "carbon credits" or "carbon dioxide equivalents."	[SELECT ANSWER FROM DROPDOWN]	[SELECT ANSWER FROM DROPDOWN]
		How many acres of habitat was conserved or restored by this project?	Enter a value	Enter a value
		What is the habitat type (i.e.riparian, wetland, estuarine, N/A)?	Enter a habitat type	Enter a habitat type

Appendix C: Pooled t-test Results for Project-Level and Concept Level Survey Questions

Abbreviations used to describe survey questions in this Appendix.

Evaluation Objective	Performance Measure and Sub-score	Survey Question Abbreviation	Short description of survey question	Asked in project-level survey?	Asked in Concept-level survey?
Address Climate Change through GHG Mitigation	GHG Mitigation	GHG-GM-1	Project/Concept mitigation of greenhouse GHG emissions	X	X
Cost Effectiveness	Capital Costs	CE-CC-1	Project/Concept capital costs	X	X
Cost Effectiveness	O&M Costs	CE-OM-1	Project/Concept O&M costs	X	X
Cost Effectiveness	Potential for External Funding	CE-EF-1	External funding expected for project?	X	
Environmental Justice	Environmental Justice	EJ-EJ-1	Environmental impact of this project?	X	
Environmental Justice	Environmental Justice	EJ-EJ-2	Magnitude of the project environmental impact?	X	
Environmental Justice	Disadvantaged Communities	EJ-DC-1	Impact of project on disadvantaged communities?	X	
Optimize Local Supplies	Local Supply	OLS-LS-1	Project/Concept increases local water supply?	X	X
Project Complexity	Project Complexity	PC-CF-1	Feasibility and/or complexity of project/Concept implementation?	X	X
Protect Habitats, Wildlife, and Ecosystems	Impacts to Threatened and Endangered Species	HW-ES-1	Project impact on endangered/threatened species?	X	
Protect Habitats, Wildlife, and Ecosystems	Impacts to Native Species	HW-ES-2	Project impact on native species?	X	
Protect Habitats, Wildlife, and Ecosystems	Impacts to Ecosystems	HW-E-5	Project impact on ecosystems?	X	
Scalability of Implementation	Project Phasing	SI-PP-1	Project/Concept lends itself to phasing and expansion?	X	X
Reliability and Robustness	Vulnerability of Water Supply Facilities and Infrastructure – Diversity of Water Supply	RR-V-1	Project/Concept increases diversity of water supply?	X	X

Evaluation Objective	Performance Measure and Sub-score	Survey Question Abbreviation	Short description of survey question	Asked in project-level survey?	Asked in Concept-level survey?
Reliability and Robustness	Vulnerability of Water Supply Facilities and Infrastructure – Resilience of the Conveyance System	RR-V-2	Project/Concept increases resilience of the conveyance system?	X	X
Reliability and Robustness	Vulnerability of Water Supply Facilities and Infrastructure – Aging Infrastructure	RR-V-3	How does the project/Concept impact aging infrastructure?	X	X
Reliability and Robustness	Vulnerability of Water Supply Facilities and Infrastructure – Insufficient Wastewater Flows	RR-V-4	Project/Concept affects insufficient wastewater flows to move solid waste problems?	X	X
Reliability and Robustness	Carryover Storage	RR-CS-1	Project/Concept affects ability to use surface storage for carryover storage?	X	X
Quality of Life/Recreation	Green Space/Open Space – Green Space/Open Space	QR-GS-1	Project/Concept increases green space or open space or improve quality?	X	X
Quality of Life/Recreation	Green Space/Open Space– Quality of Life	QR-GS-12	Project/Concept increases quality of life?	X	X
Quality of Life/Recreation	Recreation Opportunities – Recreation Opportunities	QR-RO-1	Project/Concept increases recreational opportunities?	X	X
Regional Economic Impact	Regional Economic Impact – General Regional Economic Impact	EI-EI-1	Will this project generate regional economic impacts (affect employment, income, or regional production)?	X	Expert Panel
Regional Economic Impact	Regional Economic Impact – Water Rates	EI-EI-4	To what extent does the project have the potential to increase or decrease water rates?	X	

Evaluation Objective	Performance Measure and Sub-score	Survey Question Abbreviation	Short description of survey question	Asked in project-level survey?	Asked in Concept-level survey?
Regional Integration and Coordination	Coordination - Integration	RI-C-1	Level of integration or coordination required for project/Concept.	X	X
Regional Integration and Coordination	Coordination - Leveraging	RI-C-2	Project/Concept leverages existing assets?	X	X
Regional Integration and Coordination	Education and Outreach	RI-EO-1	Level of education and outreach achieved by project/Concept.	X	X
Water Quality and Watersheds	Surface Water Quality	WQ-SW-1	Project impact on surface water quality?	X	
Water Quality and Watersheds	Groundwater Quality	WQ-GW-1	Project impact on groundwater quality?	X	
Water Quality and Watersheds	-Stormwater and Wastewater Discharges – Discharges to Freshwater or Estuarine Water Bodies	WQ-WW-1	Project/Concept impact on stormwater and wastewater discharges to freshwater or estuarine receiving water bodies.	X	X
Water Quality and Watersheds	Stormwater and Wastewater Discharges – Discharges to Marine Water Bodies	WQ-WW-2	Project/Concept impact on stormwater and wastewater discharges to marine receiving water bodies?	X	X

The results of the pooled t-statistic tests for each of the Concept-level and project-level survey questions are shown below

“SIG” indicates that there was a significant difference in the mean values based on the pooled t-tests at the 5% level of significance between the two Concepts that were compared

“ns” indicates the mean values were not statistically different.

“NA” indicates a comparison of the Concept to itself.

”—” indicates that a t-statistic could not be computed for the comparison because there were no responses or because the number of responses was too small (less than 5).

Table C-1. Significant differences in project-level survey question responses between Concepts

Concepts Compared		Project-Level Survey Question																													
Concept 1	Concept 2	GHG-GM-1	CE-CC-1	CE-OM-1	CE-EF-1	EJ-EJ-1	EJ-EJ-2	EJ-DC-1	OLS-LS-1	PC-CF-1	HW-E-5	HW-ES-1	HW-ES-2	SI-PP-1	RR-V-1	RR-V-2	RR-V-3	RR-V-4	RR-CS-1	QR-GS-1	QR-GS-12	QR-RO-1	EI-EI-1	EI-EI-4	RI-C-1	RI-C-2	RI-EO-1	WQ-WW-1	WQ-WW-2	WQ-SW-1	WQ-GW-1
Conveyance Improvement	Conveyance Improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Enhanced Conservation	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Gray water use	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Groundwater	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	--	ns	ns	SIG	SIG	ns	ns	ns	SIG	ns	SIG	ns	ns	ns	ns
	Imported Water Purchases	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Potable Reuse	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	ns	SIG	SIG	ns	ns	SIG	SIG	SIG	ns	SIG	ns	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns
	Recycled Water	SIG	ns	ns	SIG	SIG	ns	ns	SIG	SIG	ns	ns	ns	SIG	SIG	ns	SIG	ns	ns	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG
	Seawater Desalination	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater BMPs	ns	ns	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG	ns	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG	SIG	--	SIG
	Stormwater Capture	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Urban & Ag. Water Use Eff.	SIG	SIG	ns	SIG	SIG	ns	--	SIG	SIG	SIG	ns	SIG	SIG	ns	SIG	--	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns
	Watershed & Ecosystem Mgmt.	ns	ns	SIG	SIG	SIG	ns	SIG	ns	ns	SIG	SIG	SIG	ns	SIG	ns	ns	ns	ns	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG	ns	SIG	SIG	SIG
Enhanced Conservation	Enhanced Conservation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Gray water use	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Groundwater	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Imported Water Purchases	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Potable Reuse	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Recycled Water	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Seawater Desalination	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater BMPs	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater Capture	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Urban & Ag. Water Use Eff.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Watershed & Ecosystem Mgmt.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Concepts Compared		Project-Level Survey Question																													
Concept 1	**Concept 2**	**GHG-GM-1**	**CE-CC-1**	**CE-OM-1**	**CE-EF-1**	**EJ-EI-1**	**EJ-EI-2**	**EJ-DC-1**	**OLS-LS-1**	**PC-CF-1**	**HW-E-5**	**HW-ES-1**	**HW-ES-2**	**SI-PP-1**	**RR-V-1**	**RR-V-2**	**RR-V-3**	**RR-V-4**	**RR-CS-1**	**QR-GS-1**	**QR-GS-12**	**QR-RO-1**	**EI-EI-1**	**EI-EI-4**	**RI-C-1**	**RI-C-2**	**RI-EO-1**	**WQ-WW-1**	**WQ-WW-2**	**WQ-SW-1**	**WQ-GW-1**
Gray water use	Gray water use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Groundwater	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Imported Water Purchases	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Potable Reuse	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Recycled Water	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Seawater Desalination	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater BMPs	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater Capture	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Urban & Ag. Water Use Eff.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Watershed & Ecosystem Mgmt.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Groundwater	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Imported Water Purchases	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Potable Reuse	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	--	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	ns
	Recycled Water	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	--	ns	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	ns	SIG
	Seawater Desalination	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater BMPs	ns	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	ns	ns	SIG	SIG	ns	--	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	--	SIG
	Stormwater Capture	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Urban & Ag. Water Use Eff.	SIG	SIG	SIG	SIG	SIG	ns	--	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	--	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	ns	SIG	SIG	SIG	SIG	SIG
	Watershed & Ecosystem Mgmt.	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	--	ns	ns	SIG	SIG	SIG	SIG	ns	SIG	SIG	ns	ns	SIG	SIG	SIG
Imported Water Purchases	Imported Water Purchases	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potable Reuse	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Recycled Water	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Seawater Desalination	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater BMPs	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater Capture	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Urban & Ag. Water Use Eff.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Watershed & Ecosystem Mgmt.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Concepts Compared		Project-Level Survey Question																													
Concept 1	**Concept 2**	**GHG-GM-1**	**CE-CC-1**	**CE-OM-1**	**CE-EF-1**	**EJ-EJ-1**	**EJ-EJ-2**	**EJ-DC-1**	**OLS-LS-1**	**PC-CF-1**	**HW-E-5**	**HW-ES-1**	**HW-ES-2**	**SI-PP-1**	**RR-V-1**	**RR-V-2**	**RR-V-3**	**RR-V-4**	**RR-CS-1**	**QR-GS-1**	**QR-GS-12**	**QR-RO-1**	**EI-EI-1**	**EI-EI-4**	**RI-C-1**	**RI-C-2**	**RI-EO-1**	**WQ-WW-1**	**WQ-WW-2**	**WQ-SW-1**	**WQ-GW-1**
Potable Reuse	Potable Reuse	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Recycled Water	SIG	SIG	SIG	ns	SIG	SIG	SIG	ns	SIG	ns	ns	SIG	SIG	SIG	ns	ns	SIG	ns	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG
	Seawater Desalination	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater BMPs	ns	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
	Stormwater Capture	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Urban & Ag. Water Use Eff.	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	ns	SIG	SIG	--	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG
	Watershed & Ecosystem Mgmt.	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	--	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG
Recycled Water	Recycled Water	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Seawater Desalination	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater BMPs	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	ns	SIG	SIG	ns	SIG	SIG	SIG	SIG	--	SIG
	Stormwater Capture	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Urban & Ag. Water Use Eff.	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	ns	SIG	ns	SIG	SIG	--	SIG	SIG	ns	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
	Watershed & Ecosystem Mgmt.	SIG	ns	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	--	ns	ns	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG
Seawater Desalination	Seawater Desalination	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Stormwater BMPs	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater Capture	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Urban & Ag. Water Use Eff.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Watershed & Ecosystem Mgmt.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stormwater BMPs	Stormwater BMPs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Stormwater Capture	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Urban & Ag. Water Use Eff.	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	--	SIG	SIG	ns	SIG	ns	SIG	ns	SIG	SIG	SIG	ns	ns	SIG	SIG
	Watershed & Ecosystem Mgmt.	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	ns	ns	ns	SIG	ns	ns	SIG	ns	SIG	SIG	SIG	ns	ns	ns	SIG	SIG	SIG	ns	SIG	ns	SIG	ns
Stormwater Capture	Stormwater Capture	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Urban and Agricultural Water Use Efficiency	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Watershed and Ecosystem Management	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Urban and Ag. Water Use Efficiency	Urban & Ag. Water Use Eff.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Watershed & Ecosystem Mgmt.	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	--	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	ns	SIG	SIG

Concepts Compared		Project-Level Survey Question																													
Concept 1	**Concept 2**	**GHG-GM-1**	**CE-CC-1**	**CE-OM-1**	**CE-EF-1**	**EJ-EJ-1**	**EJ-EJ-2**	**EJ-DC-1**	**OLS-LS-1**	**PC-CF-1**	**HW-E-5**	**HW-ES-1**	**HW-ES-2**	**SI-PP-1**	**RR-V-1**	**RR-V-2**	**RR-V-3**	**RR-V-4**	**RR-CS-1**	**QR-GS-1**	**QR-GS-12**	**QR-RO-1**	**EI-EI-1**	**EI-EI-4**	**RI-C-1**	**RI-C-2**	**RI-EO-1**	**WQ-WW-1**	**WQ-WW-2**	**WQ-SW-1**	**WQ-GW-1**
Watershed & Ecosystem Management	Watershed & Ecosystem Mgmt.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table C-2. Significant differences in Concept-level survey question responses between Concepts

Concepts Compared		Concept-Level Survey Question																		
Concept 1	**Concept 2**	**GHG-GM-1**	**CE-CC-1**	**CE-OM-1**	**OLS-LS-1**	**PC-CF-1**	**SI-PP-1**	**RR-V-1**	**RR-V-2**	**RR-V-3**	**RR-V-4**	**RR-CS-1**	**QR-GS-1**	**QR-GS-12**	**QR-RO-1**	**RI-C-1**	**RI-C-2**	**RI-EO-1**	**WQ-WW-1**	**WQ-WW-2**
Conveyance Improvement	Conveyance Improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Enhanced Conservation	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Gray water use	ns	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	ns	SIG	SIG	SIG	SIG
	Groundwater	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	ns
	Imported Water Purchases	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG
	Potable Reuse	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	ns	ns	SIG	ns	SIG	SIG	SIG
	Recycled Water	ns	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
	Seawater Desalination	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG	ns	SIG	SIG	SIG
	Stormwater BMPs	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG
	Stormwater Capture	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	ns	ns	SIG	ns	ns	SIG	ns	SIG	SIG	SIG
	Urban & Ag. Water Use Eff.	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG
	Watershed & Ecosystem Mgmt.	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
Enhanced Conservation	Enhanced Conservation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Gray water use	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Groundwater	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Imported Water Purchases	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Potable Reuse	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Recycled Water	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Seawater Desalination	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater BMPs	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Stormwater Capture	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Urban & Ag. Water Use Eff.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Watershed & Ecosystem Mgmt.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gray water use	Gray water use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Groundwater	SIG	SIG	SIG	SIG	SIG	ns	ns	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG
	Imported Water Purchases	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
	Potable Reuse	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	ns	SIG

Concepts Compared		Concept-Level Survey Question																		
Concept 1	**Concept 2**	GHG-GM-1	CE-CC-1	CE-OM-1	OLS-LS-1	PC-CF-1	SI-PP-1	RR-V-1	RR-V-2	RR-V-3	RR-V-4	RR-CS-1	QR-GS-1	QR-GS-12	QR-RO-1	RI-C-1	RI-C-2	RI-EO-1	WQ-WW-1	WQ-WW-2
Gray water use (cont.)	Recycled Water	SIG	SIG	SIG	SIG	ns	ns	SIG	ns	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns
	Seawater Desalination	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	ns	SIG	SIG
	Stormwater BMPs	SIG	SIG	ns	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	ns	SIG	SIG
	Stormwater Capture	ns	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	ns	SIG	SIG
	Urban & Ag. Water Use Eff.	SIG	SIG	SIG	ns	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG
	Watershed & Ecosystem Mgmt.	SIG	SIG	ns	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	ns
Groundwater	Groundwater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Imported Water Purchases	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	ns	ns	SIG	SIG	SIG	SIG	SIG
	Potable Reuse	SIG	SIG	ns	ns	SIG	SIG	SIG	ns	SIG	ns	SIG	ns	SIG	SIG	ns	SIG	SIG	ns	SIG
	Recycled Water	SIG	ns	ns	ns	SIG	ns	SIG	ns	ns	ns	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
	Seawater Desalination	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	ns	SIG	SIG	ns	SIG	ns	SIG	SIG	SIG
	Stormwater BMPs	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
	Stormwater Capture	SIG	ns	SIG	SIG	ns	ns	ns	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG
	Urban & Ag. Water Use Eff.	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
	Watershed & Ecosystem Mgmt.	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
Imported Water Purchases	Imported Water Purchases	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potable Reuse	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	ns	SIG	ns	SIG	SIG	SIG
	Recycled Water	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG
	Seawater Desalination	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	ns	SIG	SIG	ns	SIG	ns	SIG
	Stormwater BMPs	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG
	Stormwater Capture	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG
	Urban & Ag. Water Use Eff.	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
	Watershed & Ecosystem Mgmt.	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG
Potable Reuse	Potable Reuse	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Recycled Water	ns	SIG	SIG	ns	SIG	ns	SIG	ns	SIG	ns	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns
	Seawater Desalination	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG
	Stormwater BMPs	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	ns

Concepts Compared		Concept-Level Survey Question																		
Concept 1	**Concept 2**	**GHG-GM-1**	**CE-CC-1**	**CE-OM-1**	**OLS-LS-1**	**PC-CF-1**	**SI-PP-1**	**RR-V-1**	**RR-V-2**	**RR-V-3**	**RR-V-4**	**RR-CS-1**	**QR-GS-1**	**QR-GS-12**	**QR-RO-1**	**RI-C-1**	**RI-C-2**	**RI-EO-1**	**WQ-WW-1**	**WQ-WW-2**
Potable Reuse (cont.)	Stormwater Capture	ns	SIG	SIG	ns	SIG	SIG	SIG	ns	ns	SIG	ns	ns	ns	SIG	SIG	ns	SIG	SIG	SIG
	Urban & Ag. Water Use Eff.	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	ns	SIG	ns
	Watershed & Ecosystem Mgmt.	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	ns
Recycled Water	Recycled Water	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Seawater Desalination	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG
	Stormwater BMPs	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	ns	ns	SIG	SIG	ns	SIG	SIG	ns	SIG	SIG
	Stormwater Capture	SIG	ns	ns	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG
	Urban & Ag. Water Use Eff.	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns
	Watershed & Ecosystem Mgmt.	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	ns	SIG	SIG	ns	ns
Seawater Desalination	Seawater Desalination	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Stormwater BMPs	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG
	Stormwater Capture	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	SIG
	Urban & Ag. Water Use Eff.	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
	Watershed & Ecosystem Mgmt.	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
Stormwater BMPs	Stormwater BMPs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Stormwater Capture	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	ns	ns
	Urban & Ag. Water Use Eff.	ns	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	SIG	ns	SIG	SIG	SIG	ns	SIG	SIG	SIG	ns
	Watershed & Ecosystem Mgmt.	SIG	ns	ns	SIG	SIG	SIG	SIG	ns	SIG	ns	ns	SIG	ns	SIG	SIG	ns	SIG	ns	SIG
Stormwater Capture	Stormwater Capture	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Urban and Agricultural Water Use Efficiency	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG
	Watershed and Ecosystem Management	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG
Urban and Ag. Water Use Efficiency	Urban & Ag. Water Use Eff.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Watershed & Ecosystem Mgmt.	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	ns	ns	ns
Watershed & Ecosystem Management	Watershed & Ecosystem Mgmt.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Appendix D: Customized Trade-Off Analysis

RECLAMATION
Managing Water in the West

The City of SAN DIEGO

San Diego Basin Study

Customized Trade-Off Analysis Tool

About the San Diego Basin Study Customized Trade-Off Analysis Tool:

This tool has been made available as a product of the San Diego Basin Study Task 2.5 Report.

This spreadsheet provides a framework for modifying the trade-off analysis by allowing modifications to the weights of importance of Evaluation Objectives, changes in the Evaluation Objectives included in the analysis, and changes in the Concepts included in the analysis.

Detailed information regarding the source of data and information and calculations used to score each Evaluation Objective is presented in Chapter 3 and Appendix A of the San Diego Basin Study Task 2.5 – Trade-Off Analysis and Opportunities Report. The user should reference this Report for specific questions regarding the scoring process.

It is not possible to change survey scores, GIS data, or model results through this tool. Therefore, it is not possible to change Performance Measure Scores or Unweighted Evaluation Objective Scores. If this functionality is desired, the full calculation spreadsheet including editable project-level and Concept-level data can be provided. Please send a request to Leslie Cleveland at the Bureau of Reclamation at lcleveland@usbr.gov.

For additional questions or suggestions

Contact Leslie Cleveland at the Bureau of Reclamation at lcleveland@usbr.gov.

Version Information:

Tool Publication Date:	5/10/2019
Last updated:	5/10/2019
Updated By:	Allison Odell
Customizations?	[Select Yes/No]
Customization Notes:	

SDBS Customized Trade-off Analysis Tool

Instructions for Conducting a Trade-off Analysis Using the San Diego Basin Study Customize Trade-Off Analysis Tool

Analysis Steps

Step 1	Print a copy of Appendix A of the San Diego Basin Study Task 2.5 – Trade-Off Analysis and Opportunities Report and these instructions for reference if desired.
Step 2	Go to the "User Inputs" tab. Select the importance weights (Default, Stepped, or Custom), Evaluation Objectives to be included in analysis, and Concepts to be included in analysis. Modifiable input data cells are color coded.
Step 3	Document customizations in order to more easily follow the impact of changes on trade-off analysis scores. Space is included on the About tab to record notes about customizations.
Step 4	Go to one of the 13 Evaluation Objective Tabs to view results for individual Evaluation Objectives. None of the cells on these tabs are modifiable.
Step 5	Go to the Trade-off Analysis Results tab to view results by Evaluation Objective and in total. None of the Trade-off Analysis Results tab cells are modifiable.
Step 6	Save results under a new spreadsheet name that reflects modification made to scoring.
Step 7	Repeat above steps if additional sensitivity analysis is desired.

Tab Descriptions

About	Information about the spreadsheet
Instructions	Includes a brief discussion of the steps necessary to modify the trade-off analysis to include different combinations of Evaluation Objectives and Concepts, to modify scoring of Evaluation Objectives and Concepts if new and/or improved data are available, and to vary the importance placed on different Evaluation Objectives.
Definitions	Provides definitions of the Evaluation Objectives and other terms used in this spreadsheet tool.
User Inputs	Includes three input components to trade-off analysis: Weights of different Evaluation Objectives, Evaluation Objectives Included in Trade-Off Analysis, Concepts Included in Trade-Off Analysis *Note: Weights of importance included in User Inputs tab are from results of survey conducted by the City of San Diego. Other weights can be entered by user if desired.*
Trade-off Analysis Results	Includes three tables: Total points for each concept evaluated in the trade-off analysis, weighted points for each Evaluation Objective by Concept, and unweighted points for each Evaluation Objective by Concept.
EO [Evaluation Objective Name]	Includes calculation tables and decision trees for each Evaluation Objective. See Definitions tab for a description of the Evaluation Objectives

Legend

(light yellow)	Editable cell
(blue)	Cell containing data sourced from GIS analysis performed as part of the San Diego Basin Study.
(green)	Cell containing data sourced from project- or Concept-level surveys performed as part of the San Diego Basin Study.
(orange)	Cell containing data sourced from CWASim modeling performed as part of the San Diego Basin Study.

SDBS Customized Trade-off Analysis Tool

Definitions

Evaluation Objective Definitions

Address Climate Change Through Greenhouse Gas Reduction	Concepts that reduce greenhouse gas emissions through energy efficiency improvements, industrial process modifications, transitions from fossil fuel to renewable energy sources, or by increasing carbon sequestration through habitat protection, restoration, or other activities that store carbon.
Climate Resilience	Concepts that directly or indirectly improve the regional resilience to the impacts of climate change: sea level rise, flooding, wildfire, and extreme heat. (Note: Regional resilience to drought is included in the Evaluation Objective, Provide Reliability and Robustness) *Note that data for directly evaluating resilience was not readily available or known for the majority of projects and, thus, an analysis of a project's ability to increase climate resilience was outside the scope of the study. Therefore, the Performance Measures in the Climate Resilience Evaluation Objective are focused on evaluating the vulnerability of individual projects to the impacts of climate change (e.g., warming and fire, sea level rise, and flooding). Also note that Regional resilience to drought is included in the Evaluation Objective, Reliability and Robustness.*
Cost Effectiveness	Concepts that reduce the total present value capital, and operation and maintenance costs to the region and/or have a strong potential for external funding.
Environmental Justice	Concepts that consider environmental justice issues, provide access to reliable/cost effective drinking water, distribute project benefits equitably throughout the basin, and/or directly benefit Disadvantaged Communities (as defined by the Department of Water Resources).
Optimize Local Supplies	Concepts that increase local water supplies and/or reduce the reliance on imported water
Project Complexity	Concepts that reduce inherent challenges associated with project complexity or feasibility (e.g., regulatory compliance, number of agencies/approvers, property ownership, public opinion/acceptance/practicality of implementation).
Protect Habitats, Wildlife, and Ecosystem Services	Concepts that reduce impacts to ecosystems and threatened or endangered species.
Provide for Scalability of Implementation	Concepts that provide flexibility in project phasing and expansion.
Quality of Life/Recreation	Concepts that increase green/open space benefits and other improvements to quality of life, including providing recreational opportunities such as swimming, boating, and fishing.
Regional Economic Impact	Concepts that increase the potential for local job creation or the regional economy (e.g., to tourism and other industries).
Regional Integration and Coordination	Concepts that support community engagement, education, and coordination with regional partners to leverage existing assets and projects, reduce project barriers, and/or build community support and knowledge of water issues.
Reliability and Robustness	Concepts that provide a reliable supply of drinking water, capable of meeting regional demand under normal, drought, and emergency conditions. This Objective includes management strategies to optimize infrastructure for the purposes of providing robust and reliable water supply.
Water Quality and Watersheds	Concepts that reduce stormwater and wastewater discharges to rivers and the ocean, and reduce water quality impacts to water resources, including groundwater basins, surface waters, and 303(d) listed water bodies.

Abbreviations

EO	Evaluation Objective
NA	Not Applicable. Used when a score cannot be calculated for a Performance Measure or Evaluation Objective
PM	Performance Measure

Other Definitions

Concept	San Diego Basin Study (SDBS) Concepts represent groups of similar strategies or projects that could be used to meet the water demands of the region. These Concepts are used as the basis for analysis in the Study. Concepts were defined to characterize existing and potential future approaches. Concepts are defined by one or more Projects.
Concept-Level Survey Results	The average of the Concept-level survey results received for a particular Concept.
Cumulative Points	The sum of the weighted scores for all Evaluation Objectives for each Concept
Evaluation Objective	Criteria developed through stakeholder input to characterize desired outcomes.
Maximum Possible Points	The maximum possible cumulative points that could be achieved by an Concept. Calculated by multiplying the maximum unweighted score on each Evaluation Objective (5.0) by the weight for each Evaluation Objective, dividing by 10, then summing for all Evaluation Objectives
Performance Measure	Metric to calculate Evaluation Objective scores based upon a combination of survey responses, modeling results and/or GIS analyses.
Project	Projects represent actual or theoretical proposed modifications to existing facilities, construction of new facilities, modifications to system operations, modifications to policy, or other proposed activities. Most SDBS Projects are based on actual proposed projects, including projects listed as verifiable, additional planned, and conceptual in the 2015 SDCWA Urban Water Management Plan (UWMP); the 2013 San Diego County Water Authority (SDCWA) Master Plan; the 2013 IRWM Plan; the 2017 Stormwater Resources Plan or other similar planning documents and lists. Other Projects represent a theoretical project idea or type of project, but are not tied to a specific proposed implementation.
Project-Level Survey Results	The average of the project-level survey results received for projects in a particular Concept
Project-Level/Concept-Level Survey Averaging Method	The method of combining project-level and Concept-level survey results to obtain a single value for each Concept **Average All:** Average all project-level and Concept-level survey results together without distinguishing between project-level and Concept-level to obtain the value for the Concept **Group Then Average:** Calculate the average project-level survey result and the average Concept-level survey result then take the average of the two groups to obtain the value for the Concept
Relative Points	The cumulative points converted to a 100-point scale. Calculated by dividing the cumulative points by the maximum possible points and multiplying by 100.
Stepped Rankings	A method for determining weights. The user must assign a rank to each Concept and set the minimum and maximum weight value that is desired. A set of equally spaced weights between the minimum and maximum weights in the order of the rankings will be automatically calculated.
Unweighted Score	The score calculated from its Performance Measures as described by the decision trees and in Chapter 3 in the Task 2.5 Interim Report.
Weighted Score	The unweighted score multiplied by the weight divied by the maximum weight (10.0)
Weights	Numeric values representing the relative importance of each Evaluation Objective. A maximum weight of 10.0 is possible.

SDBS Customized Trade-off Analysis Tool

Customizable Inputs

Instructions

Describe Customization

Enter a description of the customized settings and/or purpose of customization of the trade-off analysis

Select Evaluation Objective Weights

Select the type of Evaluation Objective weights to use and input required information:

- If Default is selected, no additional inputs are needed. The trade-off analysis will use the weights determined in the SDBS importance ranking survey.
- If Stepped is selected, input the highest and lowest weight values (between 1 and 10) and input rankings between 1 and 13 into the Stepped Weights column. Note that multiple Evaluation Objectives may have the same ranking.
- If Custom is selected, input weight values between 1 and 10 into the Custom Weights column.

Select Evaluation Objectives to Use in the Trade-Off Analysis

Use the dropdown to select which Evaluation Objectives should be used in the trade-off analysis.

Select Concepts to Use in the Trade-Off Analysis

Use the dropdown to select which Concepts should be used in the trade-off analysis.

Trade-off Analysis

Customization Name

[ENTER NAME]

Customization Notes

[ENTER NOTES]

Evaluatation Objective Weights

Type of Weights:	Default (SDBS Survey)
Stepped Weight High	10
Stepped Weight Low	3

Evaluation Objective	Custom Weights	Stepped Rankings	Default (Values from SDBS Importance Weight Survey	Weights Used in Trade-off Analysis
Address Climate Change Through Greenhouse Gas Reduction	8.2	13	8.2	8.20
Climate Resilience	9.6	10	9.6	9.60
Cost Effectiveness	8.5	3	8.5	8.50
Environmental Justice	8.7	8	8.7	8.70
Optimize Local Supplies	9.4	2	9.4	9.40
Project Complexity	7.3	6	7.3	7.30
Protect Habitats, Wildlife, and Ecosystem Services	9.2	11	9.2	9.20
Provide for Scalability of Implementation	7.7	5	7.7	7.70
Quality of Life/Recreation	7.4	7	7.4	7.40
Regional Economic Impact	7.8	9	7.8	7.80
Regional Integration and Coordination	8.5	4	8.5	8.50
Reliability and Robustness	10.0	1	10.0	10.00
Water Quality and Watersheds	10.0	12	10.0	10.00

Evaluation Objectives to Use

Evaluation Objective	Include in calculation?
Address Climate Change Through Greenhouse Gas Reduction	Yes
Climate Resilience	Yes
Cost Effectiveness	Yes
Environmental Justice	Yes
Optimize Local Supplies	Yes
Project Complexity	Yes
Protect Habitats, Wildlife, and Ecosystem Services	Yes
Provide for Scalability of Implementation	Yes
Quality of Life/Recreation	Yes
Regional Economic Impact	Yes
Regional Integration and Coordination	Yes
Reliability and Robustness	Yes
Water Quality and Watersheds	Yes

Concepts to Use

Concepts	Include in calculation?
Conveyance Improvement	Yes
Enhanced Conservation	Yes
Gray Water Use	Yes
Groundwater	Yes
Imported Water Purchases	Yes
Potable Reuse	Yes
Recycled Water	Yes
Seawater Desalination	Yes
Stormwater BMPs	Yes
Stormwater Capture	Yes
Urban and Agricultural Water Use Efficiency	Yes
Watershed and Ecosystem Management	Yes

Trade-Off Analysis Results

Customized Trade-Off Analysis Name: [ENTER NAME]

Summary Scores for Evaluation Objectives Weighted by Importance

Concept	Cumulative Weighted Scores	Number of Evaluation Objectives Scored	Maximum Possible Points	Relative points on a 1 to 100 scale	Rank
Conveyance Improvement	35.82	13	56.15	84.96	8
Enhanced Conservation	2.03	1	3.90	NA	NA
Gray Water Use	36.50	12	51.80	NA	NA
Groundwater	37.66	13	56.15	89.34	7
Imported Water Purchases	24.30	10	42.00	NA	NA
Potable Reuse	39.03	13	56.15	92.58	5
Recycled Water	39.62	13	56.15	93.97	4
Seawater Desalination	33.64	12	51.80	NA	NA
Stormwater BMPs	38.42	13	56.15	91.12	6
Stormwater Capture	39.67	13	56.15	94.10	3
Urban & Ag. Water Use Efficiency	42.16	13	56.15	100.00	1
Watershed and Ecosystem Management	39.72	13	56.15	94.21	2

Weighted Evaluation Objective Scores

Concept	Address Climate Change through GHG Reduction	Climate Resilience	Cost Effectiveness	Environmental Justice	Optimize Local Supplies	Project Complexity	Protect Habitats, Wildlife, and Ecosystems	Provide for Scalability of Implementation	Quality of Life/Recreation	Regional Economic Impact	Regional Integration and Coordination	Reliability and Robustness	Water Quality and Watersheds
Conveyance Improvement	2.61	2.47	1.88	2.61	3.57	2.15	2.76	2.52	2.69	3.16	2.39	3.78	3.24
Enhanced Conservation	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.03	NA	NA	NA
Gray Water Use	2.67	4.80	3.12	NA	3.98	2.23	2.76	2.77	2.35	2.73	2.70	3.20	3.19
Groundwater	2.48	3.57	1.82	2.68	4.67	1.47	2.82	2.36	2.24	3.40	3.02	3.78	3.36
Imported Water Purchases	1.95	NA	2.62	NA	2.64	2.38	2.76	2.16	2.23	2.21	2.16	3.20	NA
Potable Reuse	2.61	2.54	1.62	2.72	4.55	1.28	2.76	2.91	2.56	3.74	3.57	4.19	3.98
Recycled Water	2.88	2.70	2.13	2.65	4.61	2.28	2.76	2.96	2.77	3.63	3.09	3.90	3.26
Seawater Desalination	1.93	4.80	1.39	NA	4.70	1.07	2.76	1.95	2.23	2.84	3.23	3.91	2.83
Stormwater BMPs	2.75	4.17	2.44	2.85	3.31	2.27	2.94	2.48	2.91	2.54	2.62	3.29	3.86
Stormwater Capture	2.60	4.80	2.27	2.61	4.49	1.80	2.76	2.60	2.39	3.12	3.08	3.63	3.52
Urban & Ag. Water Use Efficiency	3.08	3.60	3.49	3.05	4.00	3.02	2.84	3.14	2.79	3.28	3.17	3.20	3.53
Watershed and Ecosystem Management	2.97	3.82	2.48	3.30	3.62	2.07	3.08	2.70	3.00	2.82	2.64	3.49	3.73

Unweighted Evaluation Objective Scores

	Unweighted Scores for Address Climate Change through Greenhouse Gas (GHG) Reduction	Unweighted Scores for Climate Resilience	Unweighted Scores for Cost Effectiveness	Unweighted Scores for Environmental Justice	Unweighted Scores for Optimize Local Supplies	Unweighted Scores for Project Complexity	Unweighted Scores for Protect Habitats, Wildlife, Ecosystems	Unweighted Scores for Provide for Scalability of Implementation	Unweighted Scores for Quality of Life/Recreation	Unweighted Scores for Regional Economic Impact	Unweighted Scores for Regional Integration and Coordination	Unweighted Scores for Reliability and Robustness	Unweighted Scores for Water Quality and Watersheds
Conveyance Improvement	3.19	2.57	2.22	3.00	3.80	2.95	3.00	3.27	3.63	4.05	2.81	3.78	3.24
Enhanced Conservation	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.60	NA	NA	NA
Gray Water Use	3.25	5.00	3.67	NA	4.24	3.06	3.00	3.60	3.17	3.50	3.18	3.20	3.19
Groundwater	3.03	3.72	2.14	3.08	4.97	2.01	3.06	3.07	3.02	4.36	3.55	3.78	3.36
Imported Water Purchases	2.38	NA	3.08	NA	2.81	3.26	3.00	2.80	3.02	2.83	2.54	3.20	NA
Potable Reuse	3.19	2.65	1.91	3.13	4.84	1.75	3.00	3.78	3.46	4.80	4.20	4.19	3.98
Recycled Water	3.52	2.81	2.50	3.05	4.91	3.13	3.00	3.85	3.74	4.65	3.63	3.90	3.26
Seawater Desalination	2.35	5.00	1.63	NA	5.00	1.47	3.00	2.53	3.02	3.64	3.81	3.91	2.83
Stormwater BMPs	3.35	4.34	2.87	3.28	3.53	3.11	3.19	3.22	3.93	3.25	3.08	3.29	3.86
Stormwater Capture	3.18	5.00	2.67	3.00	4.78	2.46	3.00	3.38	3.24	4.00	3.63	3.63	3.52
Urban & Ag. Water Use Efficiency	3.75	3.75	4.10	3.50	4.26	4.13	3.08	4.07	3.77	4.20	3.73	3.20	3.53
Watershed and Ecosystem Management	3.63	3.97	2.92	3.79	3.85	2.83	3.35	3.50	4.05	3.61	3.10	3.49	3.73

SDBS Customized Trade-off Analysis Tool

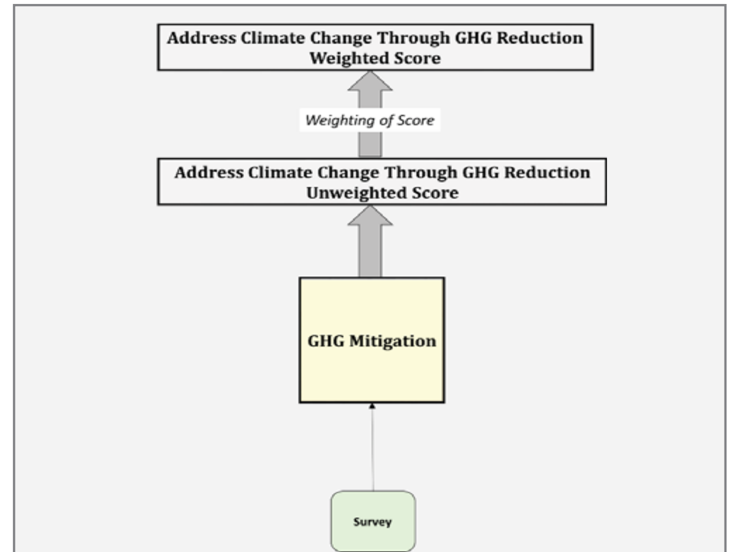
Evaluation Objective (EO): Address Climate Change through Greenhouse Gas (GHG) Reduction

Calculation Tables

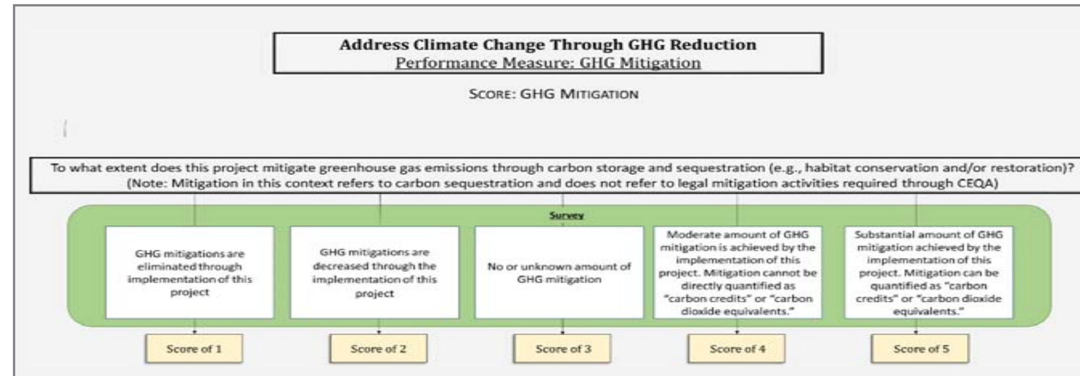
PM & EO: GHG Mitigation Performance Measure and Address Climate Change through GHG Mitigation Evaluation Objective

Concept	Project-Level Survey Responses for GHG Mitigation	Concept-Level Survey Responses for GHG Mitigation	Difference between Project-level and Concept-level Survey Responses	Number of Project-level Survey Responses	Number of Concept-level Survey Responses	GHG Mitigation Performance Measure Score	Address Climate Change through GHG Reduction Unweighted EO Score
Conveyance Improvement	3.00	3.38	0.38	4	16	3.19	3.19
Enhanced Conservation	NA	NA	NA	0	0	NA	NA
Gray Water Use	3.00	3.27	0.27	1	15	3.25	3.25
Groundwater	3.13	2.93	0.19	8	15	3.03	3.03
Imported Water Purchases	3.00	2.33	0.67	1	15	2.38	2.38
Potable Reuse	3.00	3.38	0.38	10	16	3.19	3.19
Recycled Water	3.50	3.53	0.03	16	15	3.52	3.52
Seawater Desalination	3.50	2.20	1.30	2	15	2.35	2.35
Stormwater BMPs	3.10	3.60	0.50	20	15	3.35	3.35
Stormwater Capture	3.00	3.20	0.20	2	15	3.18	3.18
Urban and Agricultural Water Use Efficiency	4.50	3.64	0.86	2	14	3.75	3.75
Watershed and Ecosystem Management	2.79	4.47	1.68	14	15	3.63	3.63

Decision Trees



Decision tree for Address Climate Change Through GHG Reduction Evaluation Objective.



Decision tree for the GHG Mitigation Performance Measure associated with the Address Climate Change Through GHG Reduction Evaluation Objective

SDBS Customized Trade-off Analysis Tool

Evaluation Objective (EO): Climate Resilience

Calculation Tables

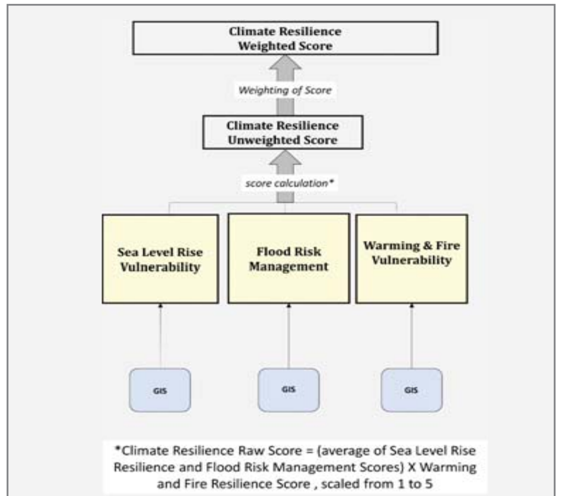
EO: Climate Resilience Evaluation Objective

Concept	Warming and Fire Vulnerability Performance Measure Score	Flood Risk Management Performance Measure Score	Sea Level Rise Vulnerability Performance Measure Score	Calculated Climate Resilience Evaluation Objective Score[1]	Climate Resilience Evaluation Objective Unweighted Score (rescaled)[2]
Conveyance Improvement	1.60	2.30	3.00	4.24	2.57
Enhanced Conservation	NA	NA	NA	NA	NA
Gray Water Use	3.00	2.50	3.00	8.25	5.00
Groundwater	2.45	2.18	2.82	6.14	3.72
Imported Water Purchases	NA	NA	NA	NA	NA
Potable Reuse	1.63	2.54	2.83	4.37	2.65
Recycled Water	1.80	2.29	2.86	4.64	2.81
Seawater Desalination	3.00	2.50	3.00	8.25	5.00
Stormwater BMPs	2.74	2.22	3.00	7.16	4.34
Stormwater Capture	3.00	2.50	3.00	8.25	5.00
Urban and Agricultural Water Use Efficiency	2.25	2.50	3.00	6.19	3.75
Watershed and Ecosystem Management	2.47	2.31	3.00	6.56	3.97

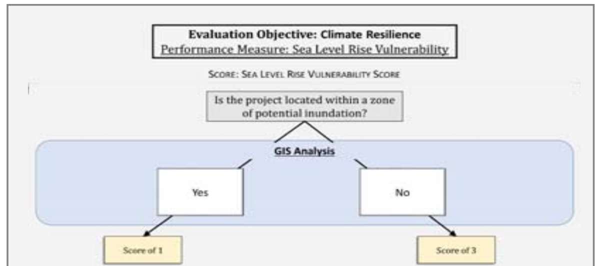
[1] Climate Resilience Calculated Score = (average of Sea Level Rise Resilience and Flood Risk Management Scores) × Warming and Fire Resilience Score

[2] Score scaled from 1 to 5

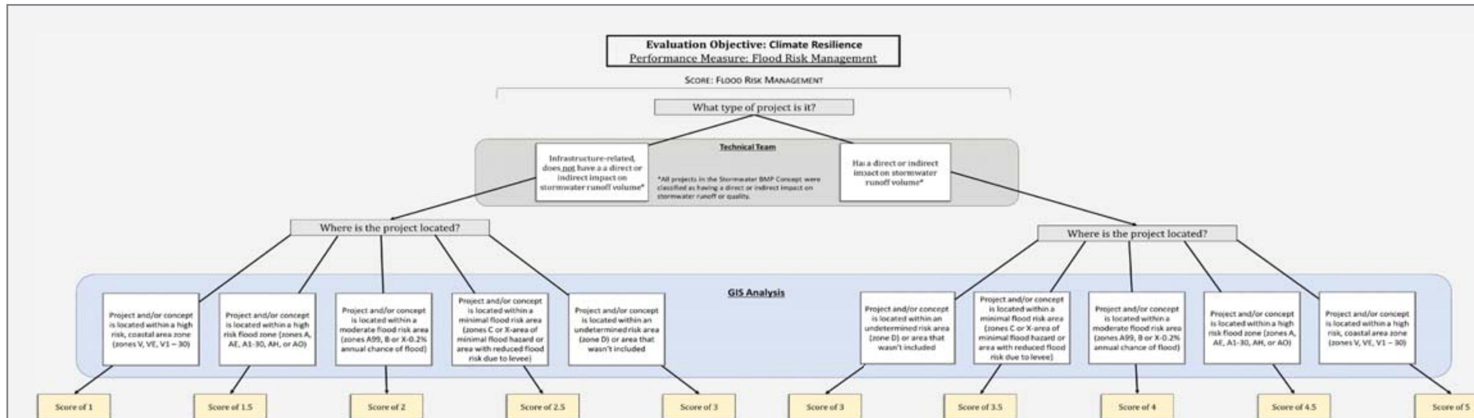
Decision Trees



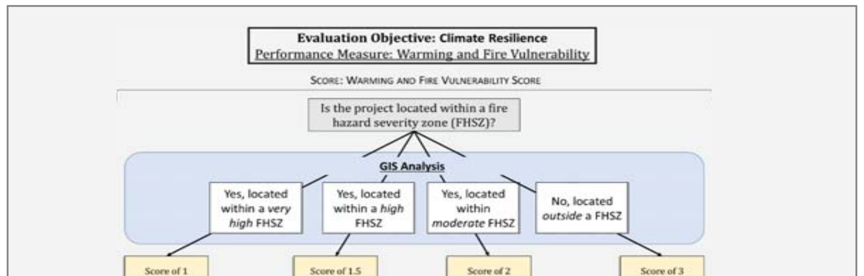
Decision tree for Climate Resilience Evaluation Objective.



Decision tree for Sea Level Rise Vulnerability Performance Measure associated with the Climate Resilience Evaluation Objective.



Decision tree for Flood Risk Management Performance Measure associated with the Climate Resilience Evaluation Objective.



Decision tree for Warming and Fire Vulnerability Performance Measure associated with the Climate Resilience Evaluation Objective.

SDBS Customized Trade-off Analysis Tool

Evaluation Objective (EO): Cost Effectiveness

Calculation Tables

PM: Capital Costs Performance Measure

Concept	Project-level Survey Results for Capital Costs	Concept-level Survey Results for Capital Costs	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Capital Costs Performance Measure Scores
Conveyance Improvement	2.33	1.63	0.71	6	16	1.98
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	5.00	3.75	1.25	1	16	3.82
Groundwater	1.50	2.00	0.50	8	16	1.75
Imported Water Purchases	3.00	3.00	0.00	1	16	3.00
Potable Reuse	1.00	1.38	0.38	10	16	1.19
Recycled Water	2.38	1.88	0.50	16	16	2.13
Seawater Desalination	2.00	1.25	0.75	2	16	1.33
Stormwater BMPs	2.20	3.38	1.18	20	16	2.79
Stormwater Capture	4.00	2.00	2.00	2	16	2.22
Urban and Agricultural Water Use Efficiency	4.20	4.13	0.08	5	16	4.16
Watershed and Ecosystem Management	2.29	3.38	1.09	14	16	2.83

PM: O&M Costs Performance Measure

Concept	Project-level Survey Results for O&M Costs	Concept-level Survey Results for O&M Costs	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	O&M Costs Performance Measure Scores
Conveyance Improvement	3.80	2.87	0.93	5	15	3.33
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	5.00	4.13	0.88	1	16	4.18
Groundwater	1.86	2.00	0.14	7	16	1.93
Imported Water Purchases	3.00	3.25	0.25	1	16	3.24
Potable Reuse	2.40	1.88	0.53	10	16	2.14
Recycled Water	3.75	2.25	1.50	16	16	3.00
Seawater Desalination	3.00	1.38	1.63	2	16	1.56
Stormwater BMPs	2.40	3.88	1.48	20	16	3.14
Stormwater Capture	5.00	2.50	2.50	2	16	2.78
Urban and Agricultural Water Use Efficiency	4.20	4.50	0.30	5	16	4.35
Watershed and Ecosystem Management	1.71	3.88	2.16	14	16	2.79

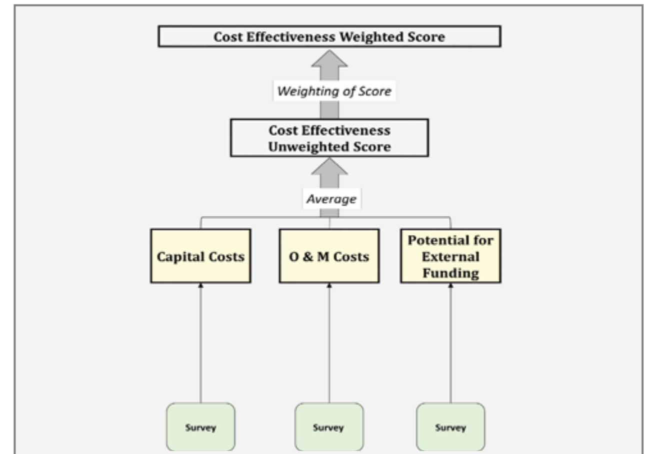
PM: Potential for External Funding Performance Measure

Concept	Project-Level Survey Results for Potential for External Funding	External Funding Performance Measure Scores
Conveyance Improvement	1.33	1.33
Enhanced Conservation	NA	NA
Gray Water Use	3.00	3.00
Groundwater	2.75	2.75
Imported Water Purchases	3.00	3.00
Potable Reuse	2.40	2.40
Recycled Water	2.38	2.38
Seawater Desalination	2.00	2.00
Stormwater BMPs	2.68	2.68
Stormwater Capture	3.00	3.00
Urban and Agricultural Water Use Efficiency	3.80	3.80
Watershed and Ecosystem Management	3.14	3.14

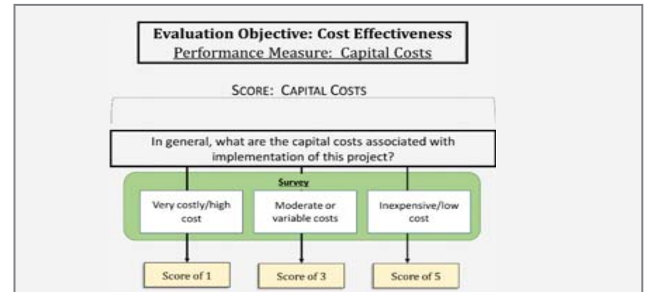
EO: Cost Effectiveness Evaluation Objective

Concept	Capital Costs Performance Measure Scores	O&M Costs Performance Measure Scores	External Funding Performance Measure Scores	Cost Effectiveness Evaluation Objective Unweighted Scores
Conveyance Improvement	1.98	3.33	1.33	2.22
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.82	4.18	3.00	3.67
Groundwater	1.75	1.93	2.75	2.14
Imported Water Purchases	3.00	3.24	3.00	3.08
Potable Reuse	1.19	2.14	2.40	1.91
Recycled Water	2.13	3.00	2.38	2.50
Seawater Desalination	1.33	1.56	2.00	1.63
Stormwater BMPs	2.79	3.14	2.68	2.87
Stormwater Capture	2.22	2.78	3.00	2.67
Urban and Agricultural Water Use Efficiency	4.16	4.35	3.80	4.10
Watershed and Ecosystem Management	2.83	2.79	3.14	2.92

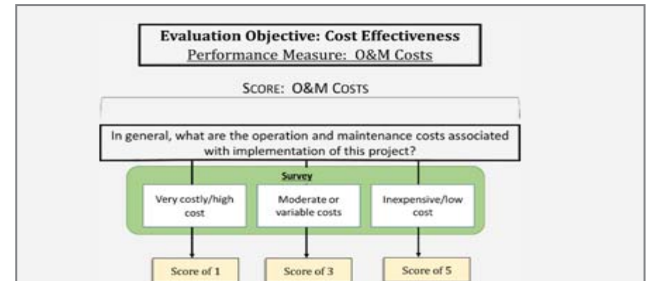
Decision Trees



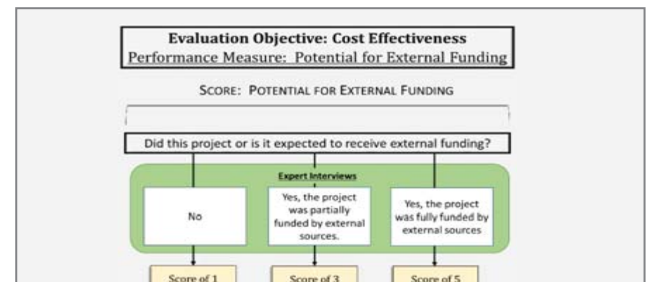
Decision tree for Cost Effectiveness Evaluation Objective.



Decision tree for Capital Costs Performance Measure associated with the Cost Effectiveness Evaluation Objective.



Decision tree for O&M Costs Performance Measure associated with the Cost Effectiveness Evaluation Objective.



Decision tree for Potential for External Funding Performance Measure associated with the Cost Effectiveness Evaluation Objective.

SDBS Customized Trade-off Analysis Tool

Evaluation Objective (EO): Environmental Justice

Calculation Tables

PM: Environmental Justice Performance Measure

Concept	Environmental Justice Performance Measure Scores
Conveyance Improvement	3.00
Enhanced Conservation	NA
Gray Water Use	NA
Groundwater	3.17
Imported Water Purchases	NA
Potable Reuse	3.25
Recycled Water	3.09
Seawater Desalination	NA
Stormwater BMPs	3.41
Stormwater Capture	3.00
Urban and Agricultural Water Use Efficiency	3.00
Watershed and Ecosystem Management	3.58

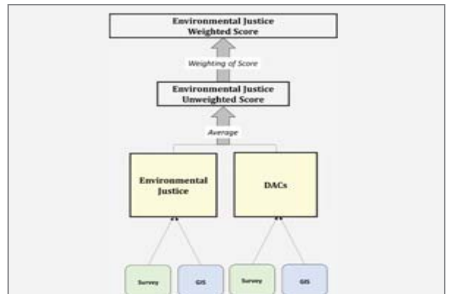
PM: DACs Performance Measure

Concept	DACs Performance Measure Scores
Conveyance Improvement	3.00
Enhanced Conservation	NA
Gray Water Use	NA
Groundwater	3.00
Imported Water Purchases	NA
Potable Reuse	3.00
Recycled Water	3.00
Seawater Desalination	3.00
Stormwater BMPs	3.14
Stormwater Capture	3.00
Urban and Agricultural Water Use Efficiency	4.00
Watershed and Ecosystem Management	4.00

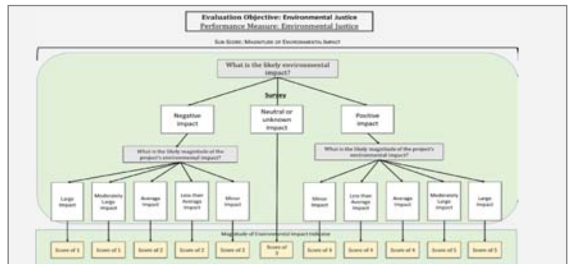
EO: Environmental Justice Evaluation Objective

Concept	Environmental Justice Performance Measure Scores	DACs Performance Measure Scores	Environmental Justice Evaluation Objective Unweighted Scores
Conveyance Improvement	3.00	3.00	3.00
Enhanced Conservation	NA	NA	NA
Gray Water Use	NA	NA	NA
Groundwater	3.17	3.00	3.08
Imported Water Purchases	NA	NA	NA
Potable Reuse	3.25	3.00	3.13
Recycled Water	3.09	3.00	3.05
Seawater Desalination	NA	3.00	NA
Stormwater BMPs	3.41	3.14	3.28
Stormwater Capture	3.00	3.00	3.00
Urban and Agricultural Water Use Efficiency	3.00	4.00	3.50
Watershed and Ecosystem Management	3.58	4.00	3.79

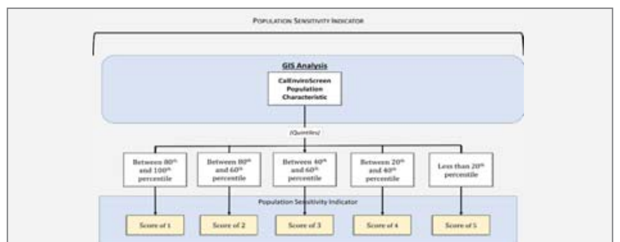
Decision Trees



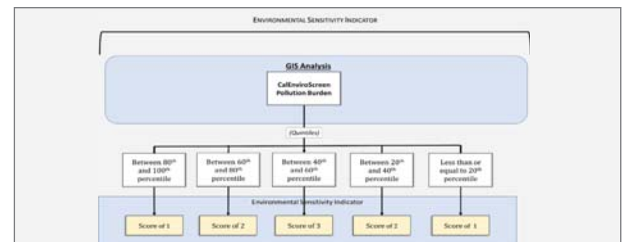
Decision tree for the Environmental Justice Evaluation Objective.



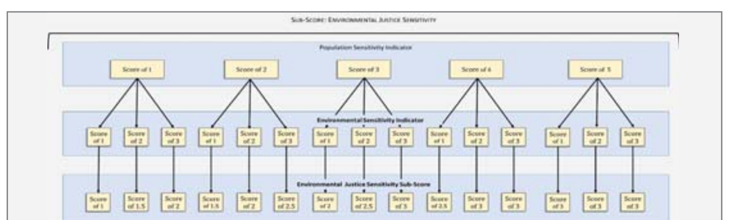
Decision tree for Magnitude of Environmental Impact Sub-score for the Environmental Justice Performance Measure associated with the Environmental Justice Evaluation Objective.



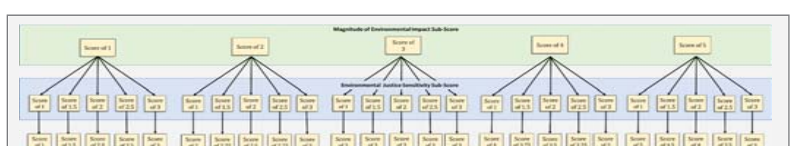
Decision tree for the Population Sensitivity Indicator used to calculate the Environmental Justice Sensitivity Sub-score as part of the Environmental Justice Performance Measure.



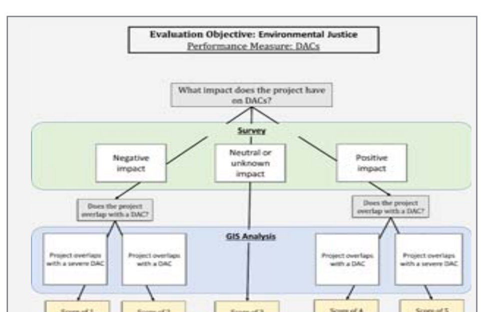
Decision tree for the Environmental Sensitivity Indicator used to calculate the Environmental Justice Sensitivity Sub-score as part of the Environmental Justice Performance Measure.



Decision tree for the Environmental Justice Sensitivity Sub-score associated with the Environmental Justice Performance Measure.



Decision tree for the Environmental Justice Performance Measure associated with the Environmental Justice Evaluation Objective.



Decision tree for the DACs Performance Measure associated within the Environmental Justice Evaluation Objective.

SDBS Customized Trade-off Analysis Tool

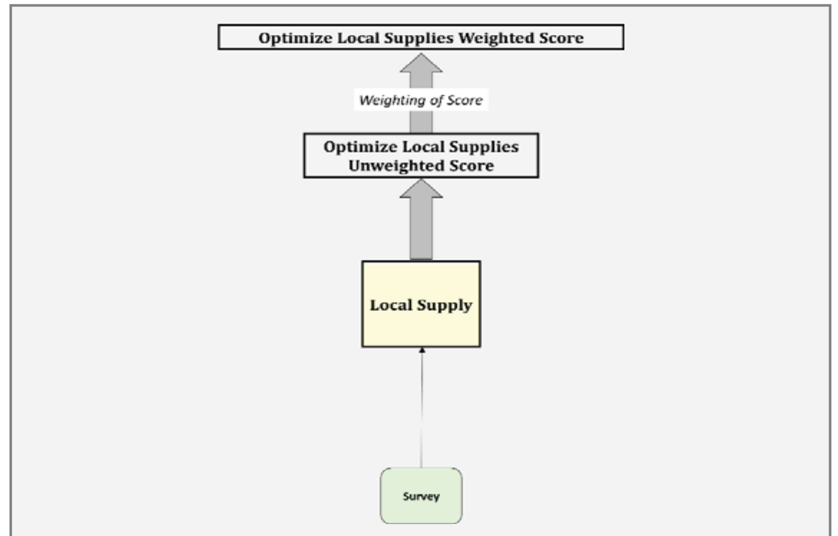
Evaluation Objective (EO): Optimize Local Supplies

Calculation Tables

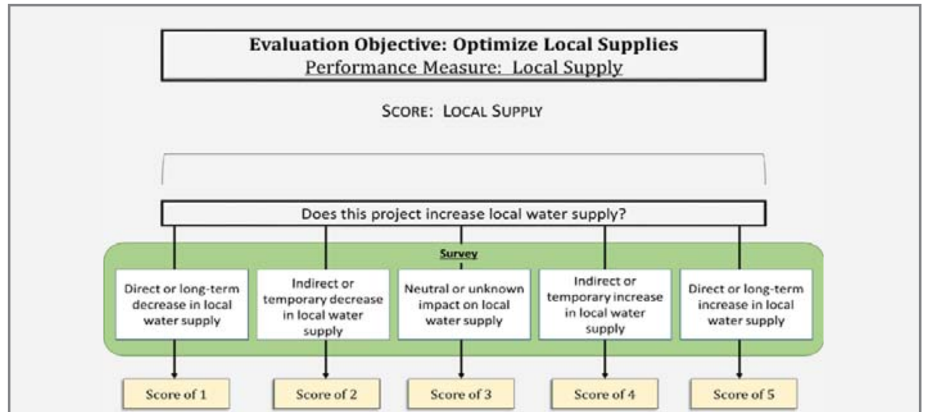
EO: Optimize Local Supplies Evaluation Objective

Concept	Project-level Survey Results for Optimize Local Supplies	Concept-level Survey Results for Optimize Local Supplies	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Local Supply Performance Measure Score	Optimize Local Supplies Evaluation Objective Unweighted Score
Conveyance Improvement	3.67	3.94	0.27	6	16	3.80	3.80
Enhanced Conservation	NA	NA	NA	0	0	NA	NA
Gray Water Use	5.00	4.19	0.81	1	16	4.24	4.24
Groundwater	5.00	4.94	0.06	9	16	4.97	4.97
Imported Water Purchases	NA	2.81	NA	0	16	2.81	2.81
Potable Reuse	4.80	4.88	0.08	10	16	4.84	4.84
Recycled Water	4.88	4.94	0.06	16	16	4.91	4.91
Seawater Desalination	5.00	5.00	0.00	2	16	5.00	5.00
Stormwater BMPs	3.62	3.44	0.18	13	16	3.53	3.53
Stormwater Capture	5.00	4.75	0.25	2	16	4.78	4.78
Urban and Agricultural Water Use Efficiency	4.20	4.31	0.11	5	16	4.26	4.26
Watershed and Ecosystem Management	3.83	3.88	0.04	6	16	3.85	3.85

Decision Trees



Decision tree for the Optimize Local Supplies Evaluation Objective.



Decision tree for the Local Supply Performance Measure associated with the Optimize Local Supplies Evaluation Objective.

SDBS Customized Trade-off Analysis Tool

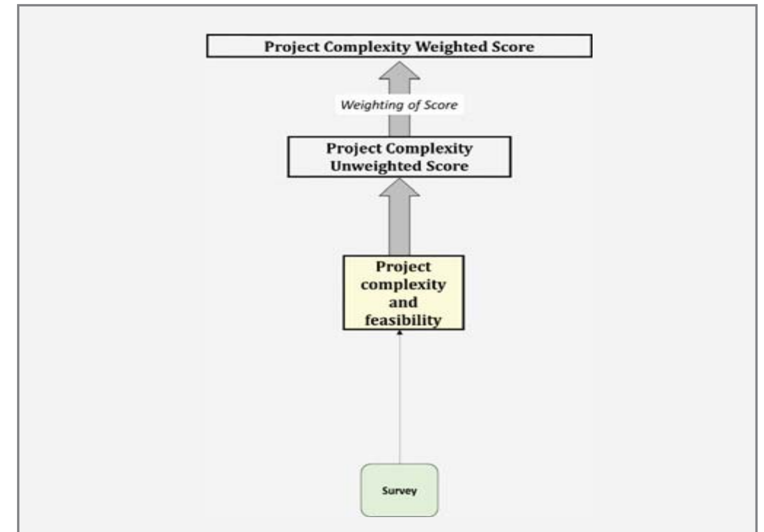
Evaluation Objective: Project Complexity

User Input and Calculation Tables

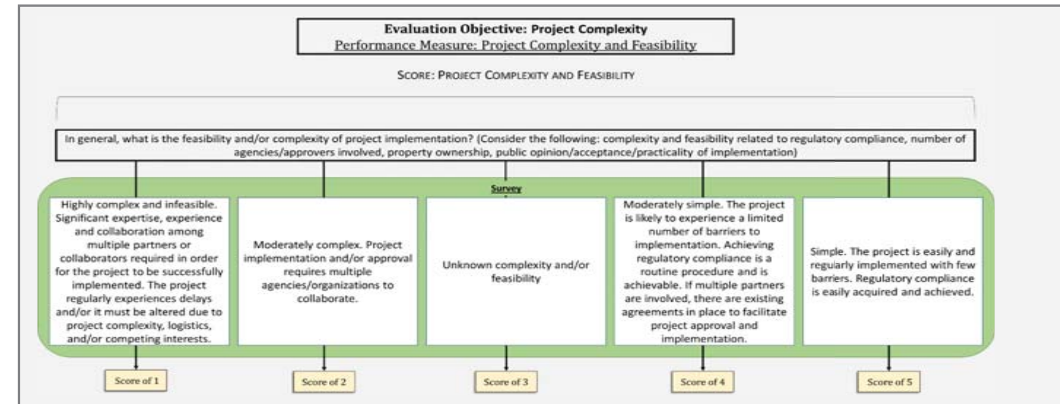
EO: Project Complexity Evaluation Objective

Concept	Project-level Survey Results for Project Complexity	Concept-level Survey Results for Project Complexity	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Project Complexity Performance Measure Scores	Project Complexity Evaluation Objective Unweighted Scores
Conveyance Improvement	2.83	3.06	0.23	6	16	2.95	2.95
Enhanced Conservation	NA	NA	NA	0	0	NA	NA
Gray Water Use	4.00	3.00	1.00	1	16	3.06	3.06
Groundwater	1.89	2.13	0.24	9	16	2.01	2.01
Imported Water Purchases	4.00	3.21	0.79	1	16	3.26	3.26
Potable Reuse	1.70	1.80	0.10	8	16	1.75	1.75
Recycled Water	3.25	3.00	0.25	18	16	3.13	3.13
Seawater Desalination	2.00	1.40	0.60	2	16	1.47	1.47
Stormwater BMPs	2.75	3.47	0.72	20	16	3.11	3.11
Stormwater Capture	3.50	2.33	1.17	2	16	2.46	2.46
Urban and Agricultural Water Use Efficiency	4.20	4.07	0.13	5	16	4.13	4.13
Watershed and Ecosystem Management	2.60	3.07	0.47	14	16	2.83	2.83

Decision Trees



Decision tree for the Project Complexity Evaluation Objective.



Decision tree for Project Complexity and Feasibility Performance Measure associated with the Project Complexity Evaluation Objective.

SDBS Customized Trade-off Analysis Tool

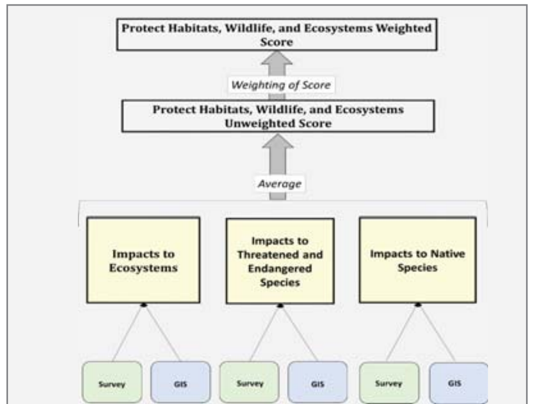
Evaluation Objective: Protect Habitats, Wildlife, and Ecosystem Services

Calculation Tables

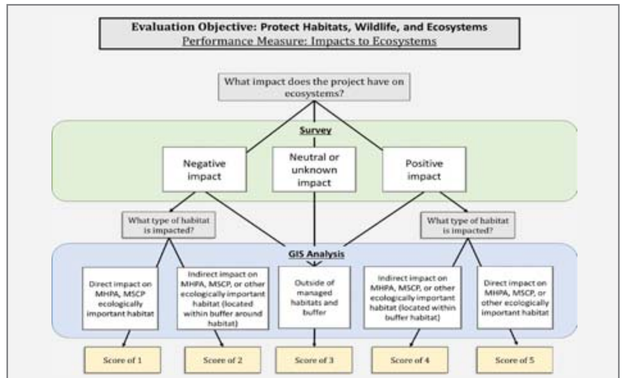
EO: Protect Habitats, Wildlife, and Ecosystem Services Evaluation Objective

Concept	Impacts to Ecosystems Performance Measure Scores	Impacts to Threatened and Endangered Performance Measure Scores	Impacts to Native Species Performance Measure Scores	Protect Habitats, Wildlife, and Ecosystem Services Evaluation Objective Unweighted Scores
Conveyance Improvement	3.00	3.00	3.00	3.00
Enhanced Conservation	NA	NA	NA	NA
Gray water use	3.00	3.00	3.00	3.00
Groundwater	3.00	3.00	3.18	3.06
Imported Water Purchases	3.00	3.00	3.00	3.00
Potable Reuse	3.00	3.00	3.00	3.00
Recycled Water	3.00	3.00	3.00	3.00
Seawater Desalination	3.00	3.00	3.00	3.00
Stormwater BMPs	3.23	3.08	3.26	3.19
Stormwater Capture	3.00	3.00	3.00	3.00
Urban and Agricultural Water Use Efficiency	3.00	3.00	3.25	3.08
Watershed and Ecosystem Management	3.36	3.06	3.64	3.35

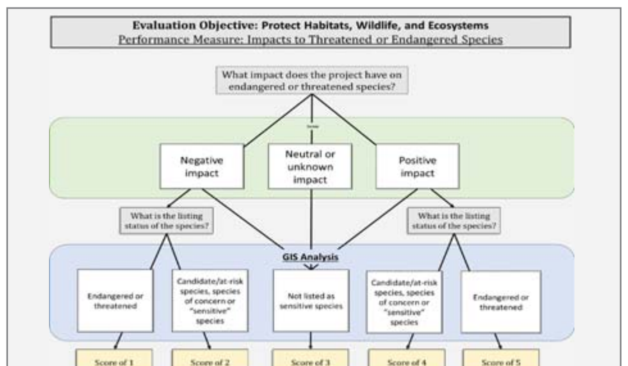
Decision Trees



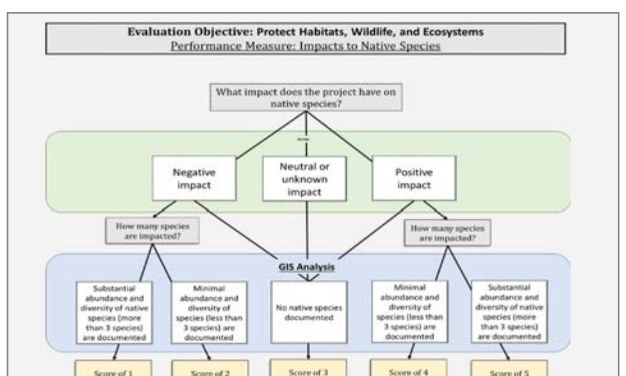
Decision tree for the Protect Habitats, Wildlife and Ecosystem Services Evaluation Objective.



Decision tree for Impacts to Ecosystems Performance Measure associated with the Protect Habitats, Wildlife and Ecosystem Services Evaluation Objective.



Decision tree for Impacts to Threatened and Endangered Species Performance Measure associated with the Impacts to Ecosystems Evaluation Objective.



Decision tree for Impacts to Native Species Performance Measure associated with the Impacts to Ecosystems Evaluation Objective.

SDBS Customized Trade-off Analysis Tool

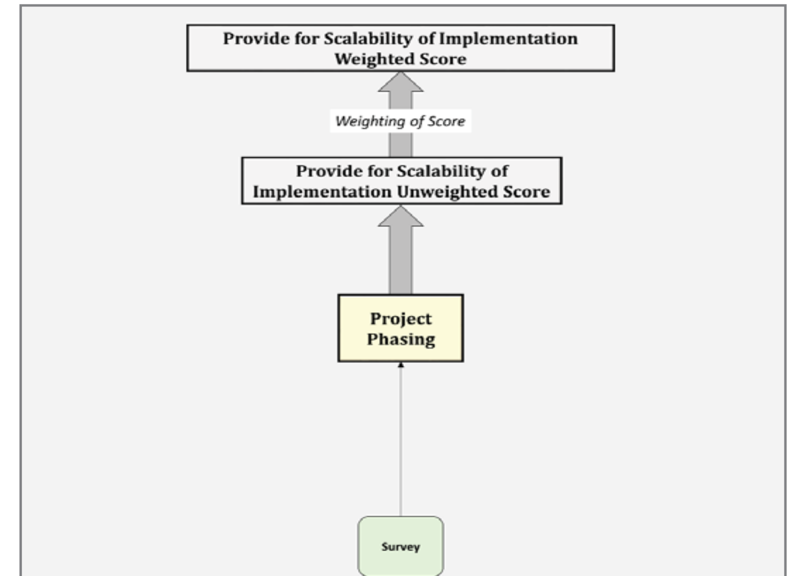
Evaluation Objective: Provide for Scalability of Implementation

Calculation Tables

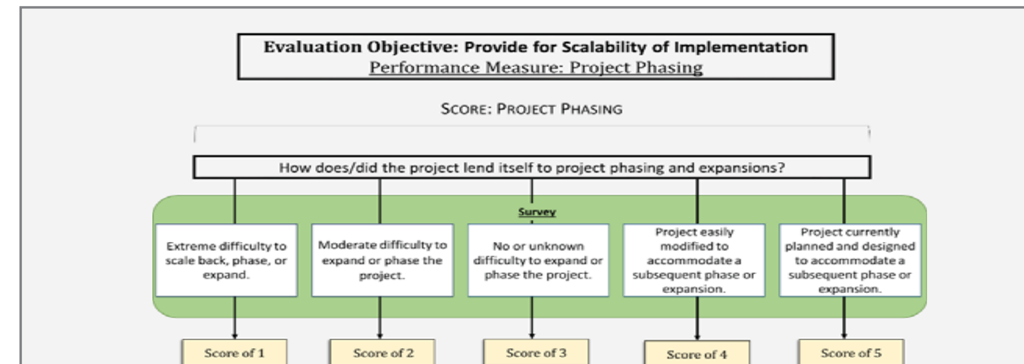
EO Provide for Scalability of Implementation Evaluation Objective

Concept	Project-level Survey Results for Project Phasing	Concept-level Survey Results for Project Phasing	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Project Phasing Performance Measure Score	Scalability of Implementation Evaluation Objective Unweighted Score
Conveyance Improvement	3.00	3.53	0.53	6	15	3.27	3.27
Enhanced Conservation	NA	NA	NA	0	0	NA	NA
Gray Water Use	4.00	3.57	0.43	1	14	3.60	3.60
Groundwater	2.78	3.36	0.58	9	14	3.07	3.07
Imported Water Purchases	1.00	2.93	1.93	1	14	2.80	2.80
Potable Reuse	3.70	3.86	0.16	10	14	3.78	3.78
Recycled Water	4.13	3.57	0.55	16	14	3.85	3.85
Seawater Desalination	3.50	2.38	1.12	2	13	2.53	2.53
Stormwater BMPs	3.15	3.29	0.14	20	14	3.22	3.22
Stormwater Capture	4.00	3.29	0.71	2	14	3.38	3.38
Urban and Agricultural Water Use Efficiency	4.00	4.14	0.14	5	14	4.07	4.07
Watershed and Ecosystem Management	3.14	3.86	0.71	14	14	3.50	3.50

Decision Trees



Decision tree for the Provide for Scalability of Implementation Evaluation Objective.



Decision tree for Project Phasing Performance Measure associated with the Provide for Scalability of Implementation Evaluation Objective.

SDBS Customized Trade-off Analysis Tool

Evaluation Objective (EO): Quality of Life/Recreation

Calculation Tables

Sub-Score: Green Space/Open Space Sub-Score within the Green Space/Open Space Performance Measure

Concept	Project-level Survey Results for Green Space/Open Space	Concept-level Survey Results for Green Space/Open Space	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Green Space/Open Space Sub-scores
Conveyance Improvement	2.83	2.87	0.03	6	15	2.85
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	4.00	3.27	0.73	1	15	3.31
Groundwater	3.11	3.07	0.04	9	15	3.09
Imported Water Purchases	3.00	3.07	0.07	1	15	3.06
Potable Reuse	3.00	3.13	0.13	10	15	3.07
Recycled Water	4.38	3.80	0.58	16	15	4.09
Seawater Desalination	3.00	2.93	0.07	2	15	2.94
Stormwater BMPs	4.45	4.13	0.32	20	15	4.29
Stormwater Capture	3.50	3.27	0.23	2	15	3.29
Urban and Agricultural Water Use Efficiency	4.60	3.47	1.13	5	15	4.03
Watershed and Ecosystem Management	4.86	4.60	0.26	14	15	4.73

Sub-Score: Quality of Life Sub-Score within the Green Space/Open Space Performance Measure

Concept	Project-level Survey Results for Quality of Life	Concept-level Survey Results for Quality of Life	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Quality of Life Sub-scores
Conveyance Improvement	4.00	3.47	0.53	6	15	3.73
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	5.00	3.27	1.73	1	15	3.38
Groundwater	3.22	3.00	0.22	9	15	3.11
Imported Water Purchases	3.00	3.07	0.07	1	15	3.06
Potable Reuse	3.80	3.60	0.20	10	15	3.70
Recycled Water	4.38	3.73	0.64	16	15	4.05
Seawater Desalination	4.00	3.27	0.73	2	15	3.35
Stormwater BMPs	4.60	4.47	0.13	20	15	4.53
Stormwater Capture	4.00	3.53	0.47	2	15	3.59
Urban and Agricultural Water Use Efficiency	5.00	4.00	1.00	5	15	4.50
Watershed and Ecosystem Management	4.57	4.53	0.04	14	15	4.55

PM: Green Space/Open Space Performance Measure

Concept	Green Space/Open Space Sub-scores	Quality of Life Sub-scores	Green Space/Open Space Performance Measure Scores
Conveyance Improvement	2.85	3.73	3.29
Enhanced Conservation	NA	NA	NA
Gray Water Use	3.31	3.38	3.34
Groundwater	3.09	3.11	3.10
Imported Water Purchases	3.06	3.06	3.06
Potable Reuse	3.07	3.70	3.38
Recycled Water	4.09	4.05	4.07
Seawater Desalination	2.94	3.35	3.15
Stormwater BMPs	4.29	4.53	4.41
Stormwater Capture	3.29	3.59	3.44
Urban and Agricultural Water Use Efficiency	4.03	4.50	4.27
Watershed and Ecosystem Management	4.73	4.55	4.64

Sub-Score: Recreation Opportunities Sub-Scores

Concept	Project-level Survey Results for Recreation Opportunities	Concept-level Survey Results for Recreation Opportunities	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Recreation Opportunities Sub-scores
Conveyance Improvement	2.83	3.07	0.24	6	14	2.95
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	3.00	3.00	0.00	1	15	3.00
Groundwater	2.89	2.87	0.02	9	15	2.88
Imported Water Purchases	3.00	2.93	0.07	1	15	2.94
Potable Reuse	3.10	3.00	0.10	10	15	3.05
Recycled Water	4.13	3.47	0.66	16	15	3.80
Seawater Desalination	3.00	2.73	0.27	2	15	2.76
Stormwater BMPs	4.32	3.50	0.82	19	14	3.91
Stormwater Capture	2.50	3.13	0.63	2	15	3.06
Urban and Agricultural Water Use Efficiency	4.00	3.07	0.93	5	15	3.53
Watershed and Ecosystem Management	4.50	4.40	0.10	14	15	4.45

Sub-Score Recreation Visitation Sub-Score

Concept	Estimated Change in Recreation Visitation (Number of Visits)	Percent Change in Recreation Visitation Relative to Baseline	Visitation Impacts Sub-Score
Conveyance Improvement	13,358	8.14%	5.00
Enhanced Conservation	2,910	1.77%	3.44
Gray Water Use	47	0.03%	3.01
Groundwater	129	0.08%	3.02
Imported Water Purchases	-3	0.00%	3.00
Potable Reuse	6,833	4.16%	4.02
Recycled Water	85	0.05%	3.01
Seawater Desalination	17	0.01%	3.00
Stormwater BMPs	6	0.00%	3.00
Stormwater Capture	13	0.01%	3.00
Urban and Agricultural Water Use Efficiency	17	0.01%	3.00
Watershed and Ecosystem Management	-3,464	-2.11%	2.48

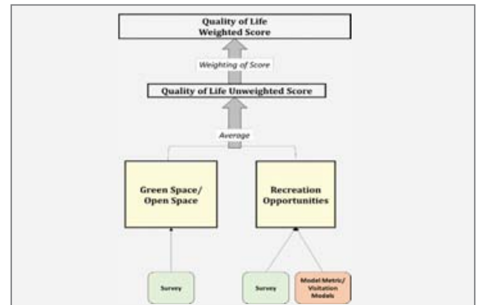
PM: Recreation Opportunities Performance Measure

Concept	Recreation Opportunities Sub-scores	Visitation Impacts Sub-Score	Recreation Opportunities Performance Measure Scores
Conveyance Improvement	2.95	5.00	3.98
Enhanced Conservation	NA	3.44	NA
Gray Water Use	3.00	3.01	3.00
Groundwater	2.88	3.02	2.95
Imported Water Purchases	2.94	3.00	2.97
Potable Reuse	3.05	4.02	3.54
Recycled Water	3.80	3.01	3.40
Seawater Desalination	2.76	3.00	2.88
Stormwater BMPs	3.91	3.00	3.45
Stormwater Capture	3.06	3.00	3.03
Urban and Agricultural Water Use Efficiency	3.53	3.00	3.27
Watershed and Ecosystem Management	4.45	2.48	3.47

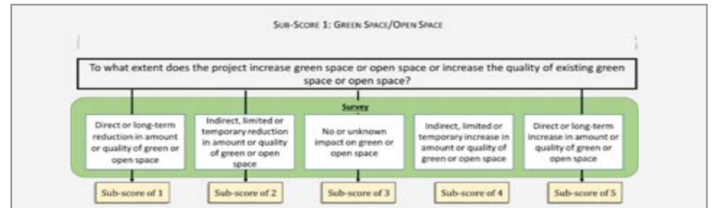
EO: Quality of Life/Recreation Evaluation Objective

Concept	Green Space/Open Space Performance Measure Scores	Recreation Opportunities Performance Measure Scores	Quality of Life Evaluation Objective Unweighted Scores
Conveyance Improvement	3.29	3.98	3.63
Enhanced Conservation	NA	NA	NA
Gray Water Use	3.34	3.00	3.17
Groundwater	3.10	2.95	3.02
Imported Water Purchases	3.06	2.97	3.02
Potable Reuse	3.38	3.54	3.46
Recycled Water	4.07	3.40	3.74
Seawater Desalination	3.15	2.88	3.02
Stormwater BMPs	4.41	3.45	3.93
Stormwater Capture	3.44	3.03	3.24
Urban and Agricultural Water Use Efficiency	4.27	3.27	3.77
Watershed and Ecosystem Management	4.64	3.47	4.05

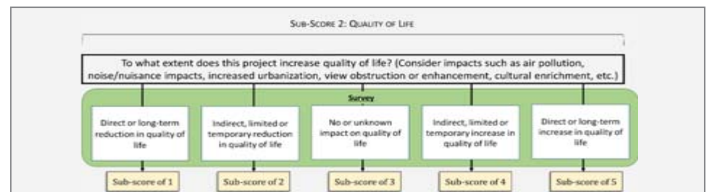
Decision Trees



Decision tree for the Quality of Life Evaluation Objective.

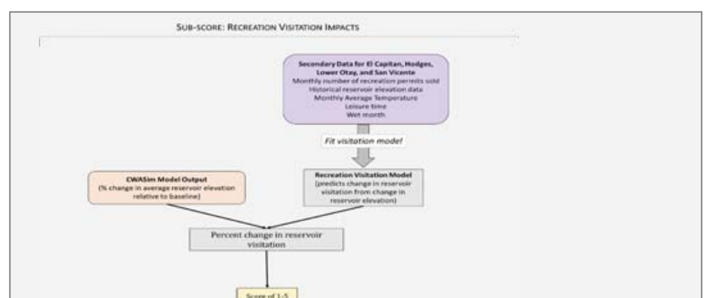


Decision tree for the Green Space/Open Space Sub-Score for the Green Space/Open Space Performance Measure associated with the Quality of Life/Recreation Evaluation Objective.



Decision tree for the Quality of Life Sub-Score for the Green Space/Open Space Performance Measure associated with the Quality of Life/Recreation Evaluation Objective.

Decision tree for Recreation Opportunities Sub-Score for the Recreation Opportunities Performance Measure associated with the Quality of Life/Recreation Evaluation Objective.



Decision tree for Recreation Visitation Sub-Score for the Recreation Opportunities Performance Measure associated with the Quality of Life/Recreation Evaluation Objective.

SDBS Customized Trade-off Analysis Tool

Evaluation Objective: Regional Economic Impact

Calculation Tables

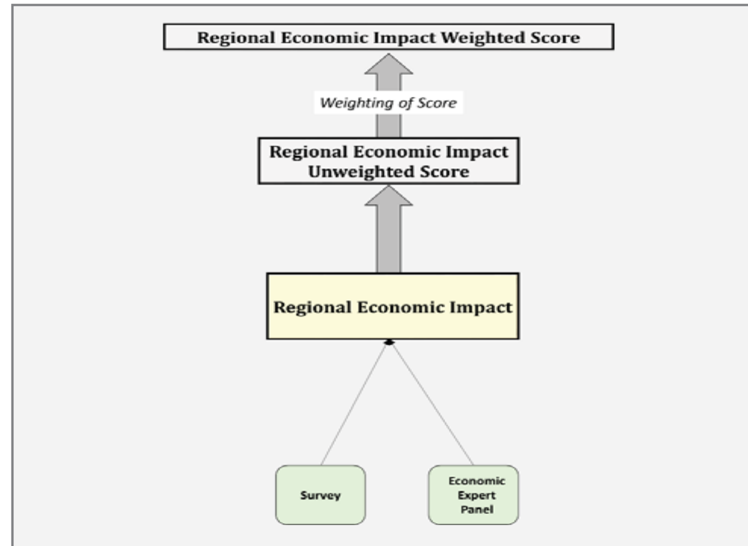
PM: Regional Economic Impact Performance Measure

Concept	Project- level Survey Results for General Regional Economic Impact	Expert Panel Results for General Regional Economic Impact	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Surveys/Observations	# of Expert Observations	General Regional Economic Impact Sub-scores
Conveyance Improvement	4.33	3.70	0.63	6	5	4.05
Enhanced Conservation	NA	2.60	NA	0	5	2.60
Gray Water Use	5.00	3.20	1.80	1	5	3.50
Groundwater	4.11	4.60	0.49	9	5	4.36
Imported Water Purchases	3.00	2.80	0.20	1	5	2.83
Potable Reuse	4.60	5.00	0.40	10	5	4.80
Recycled Water	4.50	4.80	0.30	16	5	4.65
Seawater Desalination	4.00	3.50	0.50	2	5	3.64
Stormwater BMPs	3.40	3.10	0.30	20	5	3.25
Stormwater Capture	5.00	3.60	1.40	2	5	4.00
Urban and Agricultural Water Use Efficiency	5.00	3.40	1.60	5	5	4.20
Watershed and Ecosystem Management	3.43	3.80	0.37	14	5	3.61

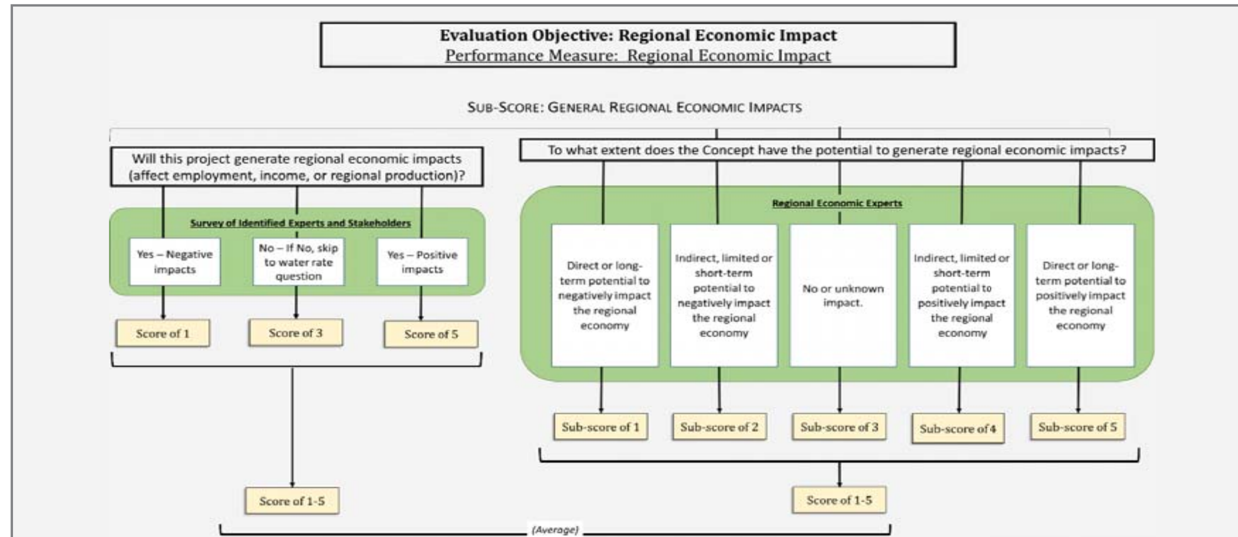
EO: Regional Economic Impact Evaluation Objective

Concept	Regional Economic Impact Performance Measure and Evaluation Objective Unweighted Score
Conveyance Improvement	4.05
Enhanced Conservation	2.60
Gray Water Use	3.50
Groundwater	4.36
Imported Water Purchases	2.83
Potable Reuse	4.80
Recycled Water	4.65
Seawater Desalination	3.64
Stormwater BMPs	3.25
Stormwater Capture	4.00
Urban and Agricultural Water Use Efficiency	4.20
Watershed and Ecosystem Management	3.61

Decision Trees



Decision Tree for Regional Economic Impact Evaluation Objective.



Decision tree for General Regional Economic Impacts Sub-Score for the Regional Economic Impact Performance Measure associated with the Regional Economic Impact Evaluation Objective.

SDBS Customized Trade-off Analysis Tool

Evaluation Objective: Regional Integration and Coordination

Calculation Tables

Sub-Score: Integration Sub-Score within the Coordination Performance Measure

	Project-level Survey Results for Integration	Concept-level Survey Results for Integration	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Integration Sub-Scores
Conveyance Improvement	2.17	2.81	0.65	6	16	2.49
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	2.00	2.56	0.56	1	16	2.53
Groundwater	3.78	3.56	0.22	9	16	3.67
Imported Water Purchases	3.00	3.19	0.19	1	16	3.18
Potable Reuse	4.30	3.75	0.55	10	16	4.03
Recycled Water	2.63	3.13	0.50	16	16	2.88
Seawater Desalination	3.00	4.38	1.38	2	16	4.22
Stormwater BMPs	2.40	2.50	0.10	20	16	2.45
Stormwater Capture	1.50	3.38	1.88	2	16	3.17
Urban and Agricultural Water Use Efficiency	3.40	2.38	1.03	5	16	2.89
Watershed and Ecosystem Management	2.00	3.13	1.13	14	16	2.56

Sub-Score Leveraging Sub-Score within the Coordination Performance Measure

	Project-level Survey Results for Leveraging	Concept-level Survey Results for Leveraging	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Leveraging Sub-Scores
Conveyance Improvement	4.50	3.25	1.25	6	4	3.88
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	3.00	1.69	1.31	1	13	1.79
Groundwater	4.00	3.67	0.33	9	6	3.83
Imported Water Purchases	5.00	2.89	2.11	1	9	3.10
Potable Reuse	5.00	3.00	2.00	10	4	4.00
Recycled Water	4.88	3.86	1.02	16	7	4.37
Seawater Desalination	3.00	3.50	0.50	2	2	3.25
Stormwater BMPs	2.58	2.86	0.28	19	14	2.72
Stormwater Capture	4.00	3.14	0.86	2	7	3.33
Urban and Agricultural Water Use Efficiency	3.40	1.80	1.60	5	15	2.60
Watershed and Ecosystem Management	1.92	2.50	0.58	13	14	2.21

PM: Coordination Performance Measure

	Integration Sub-Scores	Leveraging Sub-Scores	Coordination Performance Measure Scores
Conveyance Improvement	2.49	3.88	3.18
Enhanced Conservation	NA	NA	NA
Gray Water Use	2.53	1.79	2.16
Groundwater	3.67	3.83	3.75
Imported Water Purchases	3.18	3.10	3.14
Potable Reuse	4.03	4.00	4.01
Recycled Water	2.88	4.37	3.62
Seawater Desalination	4.22	3.25	3.74
Stormwater BMPs	2.45	2.72	2.58
Stormwater Capture	3.17	3.33	3.25
Urban and Agricultural Water Use Efficiency	2.89	2.60	2.74
Watershed and Ecosystem Management	2.56	2.21	2.39

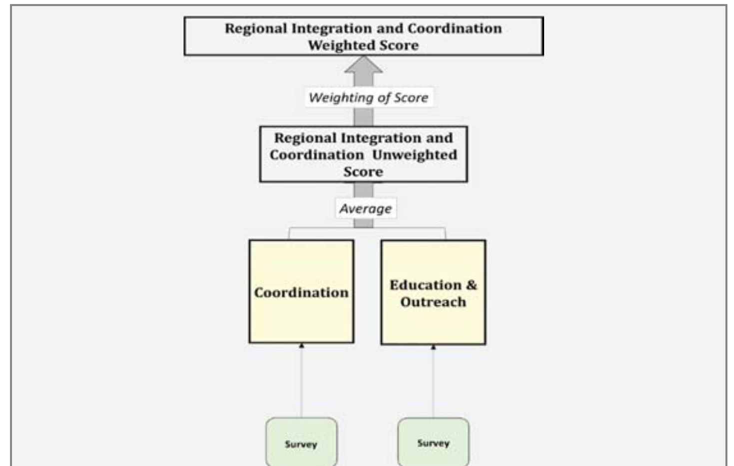
PM: Education and Outreach Performance Measure

Concept	Project-Level Survey Scores for Education and Outreach	Concept-Level Survey Scores for Education and Outreach	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Education and Outreach Performance Measure Scores
Conveyance Improvement	2.33	2.53	0.20	6	15	2.43
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	5.00	4.14	0.86	1	14	4.20
Groundwater	3.33	3.36	0.02	9	14	3.35
Imported Water Purchases	3.00	1.86	1.14	1	14	1.93
Potable Reuse	4.20	4.57	0.37	10	14	4.39
Recycled Water	3.44	3.86	0.42	16	14	3.65
Seawater Desalination	3.00	4.00	1.00	2	14	3.88
Stormwater BMPs	3.15	4.00	0.85	20	14	3.58
Stormwater Capture	3.50	4.07	0.57	2	14	4.00
Urban and Agricultural Water Use Efficiency	5.00	4.43	0.57	5	14	4.71
Watershed and Ecosystem Management	3.29	4.36	1.07	14	14	3.82

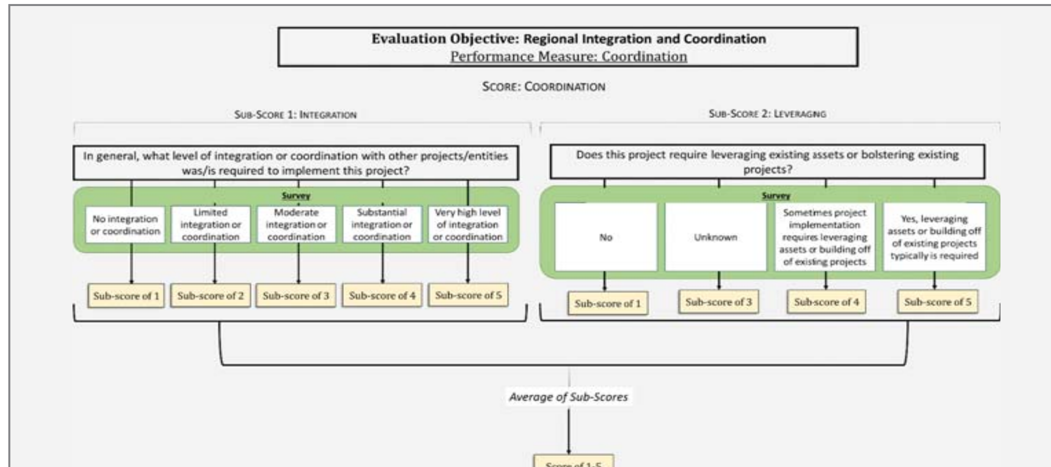
EO: Regional Integration and Coordination Evaluation Objective

	Coordination Performance Measure Scores	Education and Outreach Performance Measure Scores	Regional Integration and Coordination Evaluation Objective Unweighted Score
Conveyance Improvement	3.18	2.43	2.81
Enhanced Conservation	NA	NA	NA
Gray Water Use	2.16	4.20	3.18
Groundwater	3.75	3.35	3.55
Imported Water Purchases	3.14	1.93	2.54
Potable Reuse	4.01	4.39	4.20
Recycled Water	3.62	3.65	3.63
Seawater Desalination	3.74	3.88	3.81
Stormwater BMPs	2.58	3.58	3.08
Stormwater Capture	3.25	4.00	3.63
Urban and Agricultural Water Use Efficiency	2.74	4.71	3.73
Watershed and Ecosystem Management	2.39	3.82	3.10

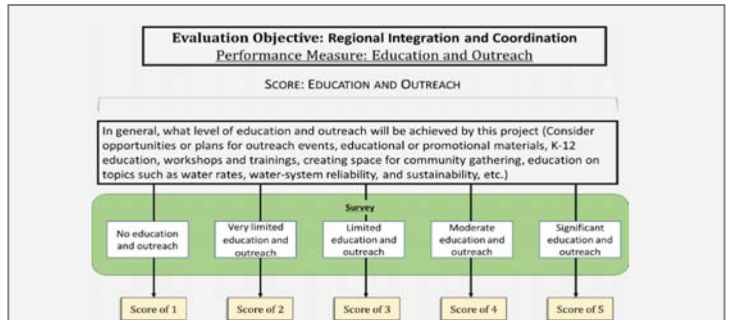
Decision Trees



Decision tree for the Regional Integration and Coordination Evaluation Objective.



Decision tree for the Coordination Performance Measure associated with the Regional Integration and Coordination Evaluation Objective.



Decision tree for the Education and Outreach Performance Measure associated with the Regional Integration and Coordination Evaluation Objective.

SDBS Customized Trade-off Analysis Tool

Evaluation Objective (EO): Reliability and Robustness

Calculation Tables

PM: Water Shortage Volume Performance Measure

Concept	Reduction in Average Annual Shortage (AF/y)[1]	Water Shortage Volume Performance Measure Score (Shortage Reduction on a 1 to 5 scale)
Conveyance Improvement	246	3.10
Enhanced Conservation	4,734	5.00
Gray Water Use	400	3.17
Groundwater	1,914	3.81
Imported Water purchases	348	3.15
Potable Reuse	3,204	4.35
Recycled Water	2,082	3.88
Seawater Desalination	2,762	4.17
Stormwater BMPs	12	3.01
Stormwater Capture	100	3.04
Urban and Agricultural Water Use Efficiency	338	3.14
Watershed and Ecosystem Management	287	3.12

[1]Relative to Baseline

Sub-Score: Diversity of Water Supply Sub-score

Concept	Project-level Survey Results for Diversity of Water Supply	Concept-level Survey Results for Diversity of Water Supply	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Diversity of Water Supply Sub-scores
Conveyance Improvement	3.83	4.00	0.17	6	16	3.92
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	5.00	4.69	0.31	1	16	4.71
Groundwater	5.00	4.81	0.19	9	16	4.91
Imported Water Purchases	5.00	2.44	2.56	1	16	2.59
Potable Reuse	4.60	5.00	0.40	10	16	4.80
Recycled Water	5.00	4.94	0.06	16	16	4.97
Seawater Desalination	5.00	4.94	0.06	2	16	4.94
Stormwater BMPs	3.25	3.13	0.13	20	16	3.19
Stormwater Capture	5.00	4.75	0.25	2	16	4.78
Urban and Agricultural Water Use Efficiency	3.80	3.88	0.08	5	16	3.84
Watershed and Ecosystem Management	3.29	3.38	0.09	14	16	3.33

Sub-Score: Resilience of Conveyance System Sub-score

Concept	Project-level Survey Results for Resilience of Conveyance System	Concept-level Survey Results for Resilience of Conveyance System	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Resilience of Conveyance System Sub-scores
Conveyance Improvement	4.33	4.94	0.60	6	16	4.64
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	3.00	3.50	0.50	1	16	3.47
Groundwater	3.56	3.56	0.01	9	16	3.56
Imported Water Purchases	NA	2.81	NA	0	16	2.81
Potable Reuse	4.10	3.56	0.54	10	16	3.83
Recycled Water	4.19	3.50	0.69	16	16	3.84
Seawater Desalination	5.00	3.69	1.31	2	16	3.83
Stormwater BMPs	3.75	3.25	0.50	20	16	3.50
Stormwater Capture	3.50	3.63	0.13	2	16	3.61
Urban and Agricultural Water Use Efficiency	2.40	3.44	1.04	5	16	2.92
Watershed and Ecosystem Management	4.21	3.13	1.09	14	16	3.67

Sub-Score Aging Infrastructure Sub-score

Concept	Project-level Survey Results for Aging Infrastructure	Concept-level Survey Results for Aging Infrastructure	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Aging Infrastructure Sub-scores
Conveyance Improvement	5.00	4.63	0.38	2	16	4.81
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	NA	3.25	NA	0	16	3.25
Groundwater	NA	3.13	NA	0	16	3.13
Imported Water Purchases	NA	2.69	NA	0	16	2.69
Potable Reuse	4.80	2.94	1.86	5	16	3.87
Recycled Water	4.67	3.19	1.48	9	16	3.93
Seawater Desalination	NA	2.93	NA	0	15	2.93
Stormwater BMPs	5.00	3.38	1.63	5	16	4.19
Stormwater Capture	4.00	2.88	1.13	1	16	2.94
Urban and Agricultural Water Use Efficiency	NA	3.50	NA	0	16	3.50
Watershed and Ecosystem Management	5.00	3.06	1.94	1	16	4.03

Sub-Score: Insufficient Wastewater Flows Sub-score

Concept	Project-level Survey Results for Insufficient Wastewater Flows	Concept-level Survey Results for Insufficient Wastewater Flows	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Insufficient Wastewater Flows Sub-scores
Conveyance Improvement	3.00	3.69	0.69	6	16	3.34
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	2.00	2.13	0.13	1	16	2.12
Groundwater	3.00	3.25	0.25	9	16	3.13
Imported Water Purchases	3.00	3.44	0.44	1	16	3.41
Potable Reuse	3.50	3.19	0.31	10	16	3.34
Recycled Water	3.00	3.19	0.19	16	16	3.09
Seawater Desalination	3.00	3.44	0.44	2	16	3.39
Stormwater BMPs	3.20	3.06	0.14	20	16	3.13
Stormwater Capture	3.00	3.69	0.69	2	16	3.61
Urban and Agricultural Water Use Efficiency	2.80	2.38	0.43	5	16	2.59
Watershed and Ecosystem Management	3.00	3.06	0.06	14	16	3.03

PM: Vulnerability of Water Supply Facilities and Infrastructure Performance Measure

Concept	Diversity of Water Supply Sub-scores	Resilience of Conveyance System Sub-scores	Aging Infrastructure Sub-scores	Insufficient Wastewater Flows Sub-scores	Vulnerability of Water Supplies and Infrastructure Performance Measure Scores
Conveyance Improvement	3.92	4.64	4.81	3.34	4.18
Enhanced Conservation	NA	NA	NA	NA	NA
Gray Water Use	4.71	3.47	3.25	2.12	3.39
Groundwater	4.91	3.56	3.13	3.13	3.68
Imported Water Purchases	2.59	2.81	2.69	3.41	2.88
Potable Reuse	4.80	3.83	3.87	3.34	3.96
Recycled Water	4.97	3.84	3.93	3.09	3.96
Seawater Desalination	4.94	3.83	2.93	3.39	3.78
Stormwater BMPs	3.19	3.50	4.19	3.13	3.50
Stormwater Capture	4.78	3.61	2.94	3.61	3.74
Urban and Agricultural Water Use Efficiency	3.84	2.92	3.50	2.59	3.21
Watershed and Ecosystem Management	3.33	3.67	4.03	3.03	3.52

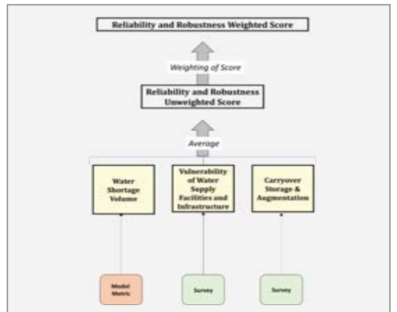
PM: Carryover Storage Performance Measure

Concept	Project-level Survey Results for Carryover Storage	Concept-level Survey Results for Carryover Storage	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Survey Responses	# of Concept-Level Survey Responses	Carryover Storage Performance Measure Scores
Conveyance Improvement	3.83	4.27	0.43	6	15	4.05
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray Water Use	3.00	3.06	0.06	1	16	3.06
Groundwater	4.00	3.69	0.31	9	16	3.84
Imported Water Purchases	4.00	3.56	0.44	1	16	3.59
Potable Reuse	4.20	4.31	0.11	10	16	4.26
Recycled Water	4.13	3.63	0.50	16	16	3.88
Seawater Desalination	4.00	3.75	0.25	2	16	3.78
Stormwater BMPs	3.17	3.56	0.40	12	16	3.36
Stormwater Capture	4.50	4.06	0.44	2	16	4.11
Urban and Agricultural Water Use Efficiency	3.00	3.50	0.50	5	16	3.25
Watershed and Ecosystem Management	3.83	3.81	0.02	6	16	3.82

EO: Reliability and Robustness Evaluation Objective

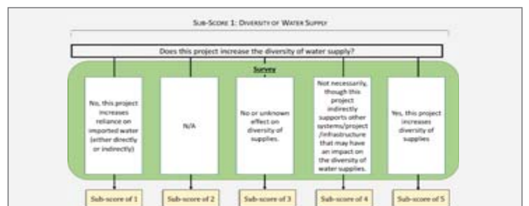
Concept	Water Shortage Volume Performance Measure Scores	Vulnerability of Water Supply Facilities and Infrastructure Performance Measure Scores	Carryover Storage Performance Measure Scores	Reliability and Robustness Evaluation Objective Unweighted Scores
Conveyance Improvement	3.10	4.18	4.05	3.78
Enhanced Conservation	5.00	NA	NA	NA
Gray Water Use	3.17	3.39	3.06	3.20
Groundwater	3.81	3.68	3.84	3.78
Imported Water purchases	3.15	2.88	3.59	3.20
Potable Reuse	4.35	3.96	4.26	4.19
Recycled Water	3.88	3.96	3.88	3.90
Seawater Desalination	4.17	3.78	3.78	3.91
Stormwater BMPs	3.01	3.50	3.36	3.29
Stormwater Capture	3.04	3.74	4.11	3.63
Urban and Agricultural Water Use Efficiency	3.14	3.21	3.25	3.20
Watershed and Ecosystem Management	3.12	3.52	3.82	3.49

Decision Trees

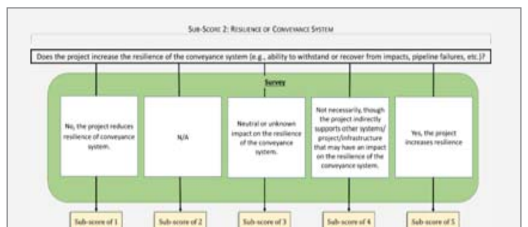


Decision tree for the Reliability and Robustness Evaluation Objective.azz

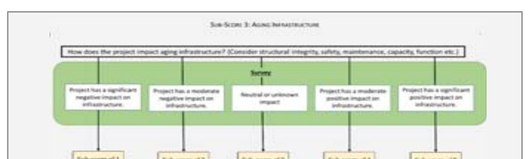
Decision tree for Water Shortage Volume Performance Measure associated with the Reliability and Robustness Evaluation Objective.



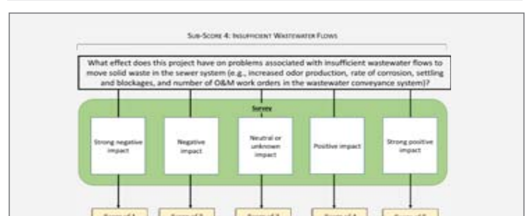
Decision tree for the Diversity of Water Supply sub-score for the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure associated with the Reliability and Robustness Evaluation Objective.



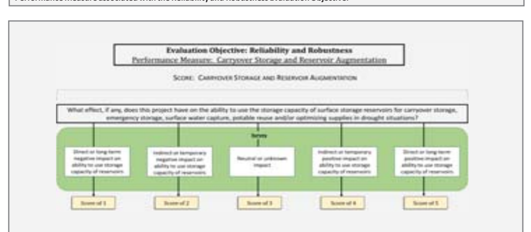
Decision tree for the Resilience of Conveyance System sub-score for the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure associated with the Reliability and Robustness Evaluation Objective.



Decision tree for the Aging Infrastructure sub-score for the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure associated with the Reliability and Robustness Evaluation Objective.



Decision tree for the Insufficient Wastewater Flows sub-score for the Vulnerability of Water Supply Facilities and Infrastructure Performance Measure associated with the Reliability and Robustness Evaluation Objective.



SDBS Customized Trade-off Analysis Tool

Evaluation Objective: Water Quality and Watersheds

Calculation Tables

Sub-Score: Freshwater/Estuarine Discharges Sub-Score within the Stormwater and Wastewater Discharges Performance Measure

	Project-level Survey Results for Freshwater/ Estuarine Discharges	Concept-level Survey Results for Freshwater/ Estuarine Discharges	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Surveys/Observations	# of Concept-Level Surveys/Observations	Freshwater/ Estuarine Discharges Sub-scores
Conveyance Improvement	3.17	3.20	0.03	6	15	3.18
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray water use	3.00	3.53	0.53	1	15	3.50
Groundwater	3.14	3.40	0.26	7	15	3.27
Imported Water Purchases	3.00	2.73	0.27	1	15	2.75
Potable Reuse	3.00	3.60	0.60	10	15	3.30
Recycled Water	3.50	3.93	0.43	16	15	3.72
Seawater Desalination	3.00	2.60	0.40	2	15	2.65
Stormwater BMPs	3.90	4.47	0.57	20	15	4.18
Stormwater Capture	5.00	4.53	0.47	2	15	4.59
Urban and Agricultural Water Use Efficiency	3.80	4.20	0.40	5	15	4.00
Watershed and Ecosystem Management	3.21	4.14	0.93	14	14	3.68

Sub-Score: Marine Discharges Sub-Score within the Stormwater and Wastewater Discharges Performance Measure

	Project-level Survey Scores for Marine Discharges	Concept-level Survey Scores for Marine Discharges	Difference between Project-level and Concept-level Survey Responses	# of Project-Level Surveys/Observations	# of Concept-Level Surveys/Observations	Marine Discharges Sub-scores
Conveyance Improvement	3.17	3.33	0.17	6	15	3.25
Enhanced Conservation	NA	NA	NA	0	0	NA
Gray water use	3.00	3.67	0.67	1	15	3.63
Groundwater	3.29	3.40	0.11	7	15	3.34
Imported Water Purchases	3.00	2.80	0.20	1	15	2.81
Potable Reuse	3.60	4.07	0.47	10	15	3.83
Recycled Water	3.75	3.93	0.18	16	15	3.84
Seawater Desalination	3.00	2.27	0.73	2	15	2.35
Stormwater BMPs	4.40	4.33	0.07	20	15	4.37
Stormwater Capture	4.50	4.53	0.03	2	15	4.53
Urban and Agricultural Water Use Efficiency	4.20	4.13	0.07	5	15	4.17
Watershed and Ecosystem Management	4.43	3.87	0.56	14	14	4.15

PM: Stormwater and Wastwater Discharges Performance Measure

Concept	Freshwater/ Estuarine Discharges Sub-scores	Marine Discharges Sub-scores	Stormwater and Wastewater Discharges Performance Measure Scores
Conveyance Improvement	3.18	3.25	3.22
Enhanced Conservation	NA	NA	NA
Gray Water use	3.50	3.63	3.56
Groundwater	3.27	3.34	3.31
Imported Water Purchases	2.75	2.81	2.78
Potable Reuse	3.30	3.83	3.57
Recycled Water	3.72	3.84	3.78
Seawater Desalination	2.65	2.35	2.50
Stormwater BMPs	4.18	4.37	4.28
Stormwater Capture	4.59	4.53	4.56
Urban and Agricultural Water Use Efficiency	4.00	4.17	4.08
Watershed and Ecosystem Management	3.68	4.15	3.91

PM: Surface Water Quality Performance Measure

Concept	Surface Water Quality Performance Measure Scores
Conveyance Improvement	3.00
Enhanced Conservation	NA
Gray Water use	3.00
Groundwater	3.00
Imported Water Purchases	NA
Potable Reuse	4.25
Recycled Water	3.00
Seawater Desalination	3.00
Stormwater BMPs	4.11
Stormwater Capture	3.00
Urban and Agricultural Water Use Efficiency	3.50
Watershed and Ecosystem Management	4.07

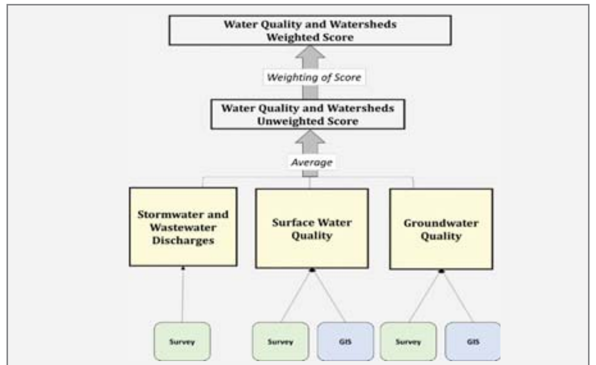
PM: Groundwater Quality Performance Measure

Concept	Groundwater Quality Performance Measure Scores
Conveyance Improvement	3.50
Enhanced Conservation	NA
Gray Water use	3.00
Groundwater	3.78
Imported Water Purchases	NA
Potable Reuse	4.13
Recycled Water	3.00
Seawater Desalination	3.00
Stormwater BMPs	3.21
Stormwater Capture	3.00
Urban and Agricultural Water Use Efficiency	3.00
Watershed and Ecosystem Management	3.21

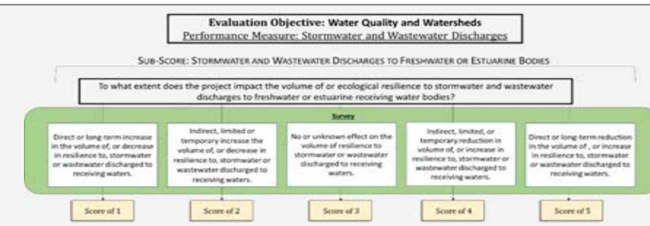
EO: Water Quality and Watersheds Evaluation Objective

Concept	Stormwater and Wastewater Discharges Performance Measure Scores	Surface Water Quality Performance Measure Score	Groundwater Quality Performance Measure Score	Water Quality and Watersheds Evaluation Objective Unweighted Score
Conveyance Improvement	3.22	3.00	3.50	3.24
Enhanced Conservation	NA	NA	NA	NA
Gray Water Use	3.56	3.00	3.00	3.19
Groundwater	3.31	3.00	3.78	3.36
Imported Water Purchases	2.78	NA	NA	NA
Potable Reuse	3.57	4.25	4.13	3.98
Recycled Water	3.78	3.00	3.00	3.26
Seawater Desalination	2.50	3.00	3.00	2.83
Stormwater BMPs	4.28	4.11	3.21	3.86
Stormwater Capture	4.56	3.00	3.00	3.52
Urban and Agricultural Water Use Efficiency	4.08	3.50	3.00	3.53
Watershed and Ecosystem Management	3.91	4.07	3.21	3.73

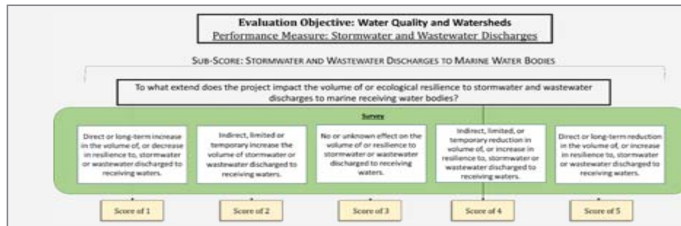
Decision Trees



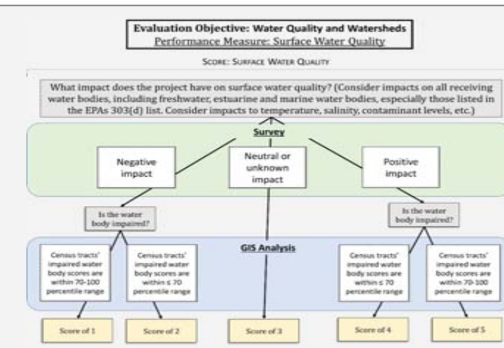
Decision tree for the Water Quality and Watersheds Evaluation Objective.



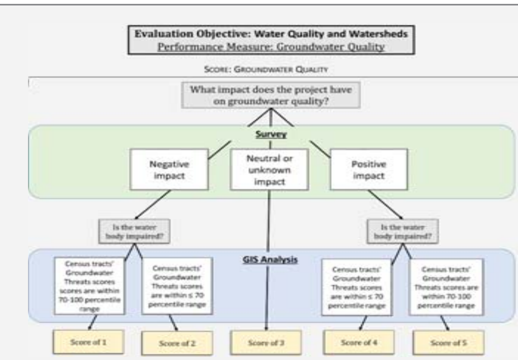
Decision tree for Stormwater and Wastewater Discharges to Freshwater Bodies Sub-Score for the Stormwater and Wastewater Discharges Performance Measure associated with the Water Quality and Watersheds Evaluation Objective.



Decision tree for Stormwater and Wastewater Discharges to Marine Bodies Sub-Score for the Stormwater and Wastewater Discharges Performance Measure associated with the Water Quality and Watersheds Evaluation Objective.



Decision tree for Surface Water Quality Performance Measure associated with the Water Quality and Watersheds Evaluation Objective.



Decision tree for Groundwater Quality Performance Measure associated with the Water Quality and Watersheds Evaluation Objective.

Appendix E: San Diego Basin Study Projects

Project Name	Baseline	Baseline+	Enhanced Conservation	Increase Supplies	Optimize Existing Facilities	Watershed Health & Ecosystem Restoration	Concept	CWASim SDCWA Member Agency	Project Source Document	Status	To be Modeled?	CWASim Model Status	Model Implementation	Demand Scenario	Modeling Notes/Questions	Confirmed by	Scenario Model Input	2015	2020	2025	2030	2035	2040	2050 (assumed equivalent to 2040 unless a 2050 value is known)
4S Ranch WRF/Olivenhain MWD	X	X	X	X	X	X	Recycled Water	Olivenhain Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Olivenhain	UWMP	Water Supply Volume (AF/yr)	915	915	915	915	915	915	915
69th St Green Street						X	Watershed and Ecosystem Management	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-
Alternative Compliance Retrofit Project Avenida Del Diablo Park, Escondido						X	Watershed and Ecosystem Management	City of Escondido	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-
Alternative Compliance Retrofit Project El Norte Parkway and Rincon Villa Drive, Escondido						X	Stormwater BMPs	City of Escondido	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-
Alternative Compliance Retrofit Project Mountain View Park, Escondido						X	Stormwater BMPs	City of Escondido	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-
Alvarado Water Treatment Plant	X	X	X	X	X	X	Conveyance Improvement	City of San Diego	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 442 AF/day (120 mgd).	UWMP	Treatment Plant Capacity	-	-	-	-	-	-	-
Badger Water Treatment Plant	X	X	X	X	X	X	Conveyance Improvement	Santa Fe Irrigation District and San Dieguito Water District	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 123 AF/day.	UWMP	Treatment Plant Capacity	-	-	-	-	-	-	-
Bakersfield Street and San Altos Channel Restoration						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to conservation for Sweetwater Authority	SWRP list	Water Supply Volume (AF/yr)	-	-	-	12	12	12	12
Barrett Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	City of San Diego	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 37,900 AF. Includes surcharge capacity.	UWMP/City Staff Mann	Reservoir Capacity	-	-	-	-	-	-	-
Broadway Channel Flood Risk Reduction and Water Quality Improvements						X	Stormwater BMPs	Helix Water District	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-
Broadway/Federal Blvd Green Street						X	Watershed and Ecosystem Management	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-
Cadiz additional imported supplies				X			Imported Water Purchases	Otay Water District	N/A	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to conservation for Otay Water District	Bob Kennedy provided volume and timeline	Water Supply Volume (AF/yr)	-	-	-	5,000	5,000	5,000	5,000
Camp Pendleton Desalination Facility				X			Seawater Desalination	SDCWA	UWMP N/A (Additional Planned?) - Desalination	Planned	Yes	Included - Approved	Model Logic	2050	See Writeup. Master Plan considered 50-150 MGD for CP.	Water Authority	Facility Production Capacity (AF/yr)	-	-	-	-	-	-	-
Canton Dr Green Street						X	Watershed and Ecosystem Management	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-
Carlsbad Desalination Plant	X	X	X	X	X	X	Seawater Desalination	Carlsbad Municipal Water District	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 153.4 AF/day (50 mgd).	UWMP	Facility Production Capacity (AF/yr)	-	-	-	-	-	-	-
Carlsbad WRF - Landscape, Agriculture 2025				X			Recycled Water	Carlsbad Municipal Water District	UWMP Additional Planned - Recycled Water	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Carlsbad recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	328	328	328	328	328
Carlsbad WRF - Landscape, Agriculture 2050				X			Recycled Water	Carlsbad Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Carlsbad recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	616	616	616
Carlsbad WRF/Carlsbad MWD	X	X	X	X	X	X	Recycled Water	Carlsbad Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Carlsbad	UWMP	Water Supply Volume (AF/yr)	1,903	2,831	2,831	2,831	2,831	2,831	2,831
Central Avenue Green Street						X	Watershed and Ecosystem Management	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-
City of Oceanside Loma Alta Slough Restoration Project						X	Stormwater BMPs	City of Oceanside	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-
Connection #1-North City Water Reclamation Plant/City of San Diego	X	X	X	X	X	X	Recycled Water	Olivenhain Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Olivenhain	UWMP	Water Supply Volume (AF/yr)	356	623	623	623	623	623	623
Connection #2-North City Water Reclamation Plant/City of San Diego	X	X	X	X	X	X	Recycled Water	Olivenhain Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Olivenhain	UWMP	Water Supply Volume (AF/yr)	15	20	20	20	20	20	20
Conservation from 2015 UWMP	X	X	X	X	X	X	Urban and Agricultural Water Use Efficiency	SDCWA	N/A	Existing	Yes	Included - Approved	Input Demands Spreadsheet	2015	Conservation input by member agency	UWMP	Water Supply Volume (AF/yr)	50,000	-	89,110	-	-	102,834	155,468
Conservation Home Makeover in the Chollas Creek Watershed		X	X	X	X	X	Gray Water Use	Groundwork San Diego	IRWM - Prop 84.4		Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Conservation table for City of San Diego	IRWM Prop84-4 Grant Agreement with DWR	Conservation Volume (AF/yr)			10.7	10.7	10.7	10.7	11

Project Name	Baseline	Baseline+	Enhanced Conservation	Increase Supplies	Optimize Existing Facilities	Watershed Health & Ecosystem Restoration	Concept	CWASim SDCWA Member Agency	Project Source Document	Status	To be Modeled?	CWASim Model Status	Model Implementation	Demand Scenario	Modeling Notes/Questions	Confirmed by	Scenario Model Input	2015	2020	2025	2030	2035	2040	2050 (assumed equivalent to 2040 unless a 2050 value is known)
Crossover Pipeline	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Untreated. Current capacity is 200 cfs.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Dixon Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	City of Escondido	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 2,610 AF	UWMP	Reservoir Capacity	-	-	-	-	-	-	-
Dulzura Conduit Refurbishment					X		Conveyance Improvement	City of San Diego	N/A	Conceptual	Yes	Included - Approved	Model Logic	2050	Increase capacity from 19 MGD in baseline to 40 MGD. Also reduce loss from 10% to 0%.	UWMP	conveyance capacity							
East County Advanced Water Purification Program Phase 1		X	X	X	X	X	Potable Reuse	Padre Dam Municipal Water District	UWMP Additional Planned - Potable Reuse	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Padre Dam's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	0	3,920	3,920	3,920	3,920	3,920
East County Advanced Water Purification Program Phase 2		X	X	X	X	X	Potable Reuse	Padre Dam Municipal Water District	UWMP Additional Planned - Potable Reuse	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Padre Dam's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	7616	7616	7616	7616	7,616
East County Advanced Water Purification Program Phase 3				X			Potable Reuse	Padre Dam Municipal Water District	UWMP Project Concept - Potable Reuse	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Padre Dam recycled/reuse supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	-	5,824	5,824
El Capitan Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	City of San Diego	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	The Division of Safety Of Dams (DSOD) restricted the storage level at El Capitan Dam at 700 feet elevation which translates to 147 feet lake gauge level (USGS Datum is 553 feet) where the capacity of the reservoir is 50,732.5 AF. This restriction is reflected in the model as a reduction in the usable pool (emergency and seasonal). The total capacity of El Capitan is	Rosalva/DOSD Restrictions/ Supkreet Mann	Reservoir Capacity	-	-	-	-	-	-	-
El Monte Pipeline	X	X	X	X	X	X	Conveyance Improvement	City of San Diego	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Untreated. Model capacity 150 cfs.	City Staff	Pipeline Capacity	-	-	-	-	-	-	-
Encina Wastewater Water Reuse Project				X			Potable Reuse	Carlsbad Municipal Water District	N/A	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Carlsbad's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	16,802	16,802	16,802
Enhanced Conservation			X				Enhanced Conservation	SDCWA	N/A	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Implement in model to reflect project/portfolio description. Reduce demand by 1% per year, startring in 2020 using SBX7 target for CWA.	UWMP	Conservation Volume (AF/yr)	0	not calculated	52,265	not calculated	not calculated	not calculated	179,582
Escondido Pump Station	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 20 cfs	UWMP	Pump Station Capacity	-	-	-	-	-	-	-
Escondido-Vista Water Treatment Plant	X	X	X	X	X	X	Conveyance Improvement	City of Escondido	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 332 AF/day (90 mgd).	UWMP	Treatment Plant Capacity	-	-	-	-	-	-	-
Extension 153 Phase I				X			Recycled Water	Olivenhain Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Olivenhain's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	189	189	189	189	189
Extension 153 Phase II				X			Recycled Water	Olivenhain Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Olivenhain's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	300	300	300	300
Fallbrook Plant #1/Fallbrook PUD	X	X	X	X	X	X	Recycled Water	Fallbrook Public Utility District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Fallbrook	UWMP	Water Supply Volume (AF/yr)	600	1,200	1,200	1,200	1,200	1,200	1,200
Federal Blvd Channel						X	Watershed and Ecosystem Management	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Gafner WRF/Leucadia CWD	X	X	X	X	X	X	Recycled Water	Carlsbad Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Carlsbad	UWMP	Water Supply Volume (AF/yr)	247	247	247	247	247	247	247
Golden Ave Green Street						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Graywater pilot project				X			Gray Water Use	City of San Diego	City of San Diego UWMP	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to conservation for City of San Diego	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	2,575	2,575	2,575
Groundwater Extraction Santee/El Monte				X			Groundwater	City of San Diego	N/A	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Groundwater supply for City of SD	George Adrian	**Water Supply Volume (AF/yr)**	-	-	1,300	1,300	1,300	1,300	1,300
Groundwater Production Well 101	X	X	X	X	X	X	Groundwater	Helix Water District	UWMP Verifiable - Groundwater	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Groundwater supply for Helix	UWMP	Water Supply Volume (AF/yr)	93	130	130	130	130	130	130
Groundwater Production Wells	X	X	X	X	X	X	Groundwater	SDCWA	UWMP Verifiable - Groundwater	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Baseline groundwater table from UWMP for all member agencies	UWMP	Water Supply Volume (AF/yr)	6,480	7,510	8,700	9,740	9,740	9,740	9,740
Hale Avenue Resource Recovery Facility (HARRF) - Landscape, Agriculture, Industrial, PR				X			Recycled Water	City of Escondido	UWMP Additional Planned - Recycled Water	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Escondido's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	1,380	7,130	8,130	8,130	8,130	8,130
Hale Avenue RRF/WRF/City of Escondido	X	X	X	X	X	X	Recycled Water	City of Escondido	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Escondido	UWMP	Water Supply Volume (AF/yr)	600	3,000	3,650	4,400	4,400	4,400	4,400
Hale Avenue RRF/WRF/City of Escondido	X	X	X	X	X	X	Recycled Water	Rincon del Diablo Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Rincon	UWMP	Water Supply Volume (AF/yr)	3300	3100	4000	4000	4000	4000	4,000
Hodges Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	City of San Diego	N/A	Existing	Yes	Included - Approved	Input Spreadsheet and Model Logic	2015	Input Spreadsheet: Total Modeled Capacity 33,600 AF. Includes surcharge capacity. Model Logic: Dashboard setting to control release rate. Hodges releases are restricted to 6.245 mgd due to water quality restrictions	UWMP/City Staff Mann	Reservoir Capacity	-	-	-	-	-	-	-
Hodges Water Quality Improvement Program		X	X	X	X	X	Watershed and Ecosystem Management	City of San Diego	IRWM - Prop 84.4	Planned	Yes	Included - Approved	Model Logic	2050	Hodges Water Quality Improvement Program results in removal of release restrictions due to water quality. Baseline should have water quality restrictions in place, limiting release to 6.245 mgd. Remove restrictions in Baseline+ (release rate = 150 mgd), turn on at 2050.	City Staff	conveyance capacity							
Integrated Water Resource Solutions for the Carlsbad Watershed		X	X	X	X	X	Recycled Water	San Elijo Joint Powers Authority (San Elijo JPA)	IRWM - Prop 84.4		Yes	Included - Approved	Input Demands Spreadsheet	2025	Carlsbad recycled/potable reuse supply	UWMP	Water Supply Volume (AF/yr)		100	100	100	100	100	100
Intergrated Water Resource Solutions for the Carlsbad Watershed				X			Recycled Water	Olivenhain Municipal Water District	IRWM - Prop 84.4	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Olivenhain's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	100	100	100	100
Joint RW Transmission Project with SFID and OMWD				X			Recycled Water	Olivenhain Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Olivenhain's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	400	400	400	400	400
La Mesa-Sweetwater Extension Treated	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Treated. Not included in the model, simplified through ECRTWIP	CH2M	Pipeline Capacity	-	-	-	-	-	-	-
Lake Henshaw	X	X	X	X	X	X	Local Surface Water Reservoirs	Vista Irrigation District	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 53,400 AF. Includes surcharge capacity.	UWMP	Reservoir Capacity	-	-	-	-	-	-	-

Project Name	Baseline	Baseline+	Enhanced Conservation	Increase Supplies	Optimize Existing Facilities	Watershed Health & Ecosystem Restoration	Concept	CWASim SDCWA Member Agency	Project Source Document	Status	To be Modeled?	CWASim Model Status	Model Implementation	Demand Scenario	Modeling Notes/Questions	Confirmed by	Scenario Model Input	2015	2020	2025	2030	2035	2040	2050 (assumed equivalent to 2040 unless a 2050 value is known)
Lake Hodges Pump Station	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 760 cfs	SDCWA	Pump Station Capacity	-	-	-	-	-	-	-
Lake Jennings	X	X	X	X	X	X	Local Surface Water Reservoirs	Helix Water District	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 9,790 AF	UWMP	Reservoir Capacity	-	-	-	-	-	-	-
Lake Poway	X	X	X	X	X	X	Local Surface Water Reservoirs	City of Poway	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 3,320 AF	UWMP	Reservoir Capacity	-	-	-	-	-	-	-
Lake Wohlford	X	X	X	X	X	X	Local Surface Water Reservoirs	City of Escondido	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 6,940 AF. Includes surcharge capacity.	UWMP	Reservoir Capacity	-	-	-	-	-	-	-
Las Colinas Channel Improvments						X	Stormwater BMPs	Padre Dam Municipal Water District	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Lemon Grove Avenue Green Streets						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Leucadia Roadside Park Stormwater Capture/Reuse Project						X	Stormwater BMPs	San Dieguito Water District	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Levy Water Treatment Plant	X	X	X	X	X	X	Conveyance Improvement	Helix Water District	N/A	Existing	Yes	Included - Approved	Model Logic	2015	106 MGD	UWMP	Treatment Plant Capacity	-	-	-	-	-	-	-
Lilac Hills Ranch WRF				X			Recycled Water	Valley Center Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Valley Center's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	147	294	294
Lincoln St Green Street						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Local Drought Restriction/Allocation	X	X	X	X	X	X	Drought Restriction/Allocation	N/A	N/A	Existing	No	Not Able to Model	N/A		Include as Baseline Project but do not model. Model will show shortage if it can't meet all demands, but in reality water agencies would implement short term restrictions according to drought management plans/policies.	UWMP/SDCWA Water Shortage Contingency Plan	N/A	-	-	-	-	-	-	-
Loveland Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	Sweetwater Authority	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 25,400 AF	UWMP	Reservoir Capacity	-	-	-	-	-	-	-
Low Impact Development Urban Runoff Control Projects for the Tijuana Estuary						X	Stormwater BMPs	City of San Diego	SWRP - Listed	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to conservation for City of San Diego	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	3	3	3
Lower Moosa Canyon WRF				X			Recycled Water	Valley Center Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Valley Center's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	370	460	580	700	700	700
Lower Otay Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	City of San Diego	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 49,849 AF. Includes surcharge capacity.	UWMP/City Staff Mann	Reservoir Capacity	-	-	-	-	-	-	-
Madera St Green Street						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Main Street Promenade Extension						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to conservation for Sweetwater Authority	UWMP	Water Supply Volume (AF/yr)	-	-	-	23	23	23	23
Mapleview Street - Green Infrastructure and Stormwater QualityImprovement Project						X	Stormwater BMPs	County of San Diego	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Massachusetts Blvd Green Street						X	Watershed and Ecosystem Management	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Meadowlark WRF				X			Recycled Water	Carlsbad Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Carlsbad's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	187	187	187
Meadowlark WRF (via Mahr Reservoir) /Vallecitos WD	X	X	X	X	X	X	Recycled Water	Carlsbad Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Carlsbad	UWMP	Water Supply Volume (AF/yr)	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Meadowood WRF				X			Recycled Water	Valley Center Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Valley Center's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	100	143	143	143	143
Middle Sweetwater River Basin Groundwater Well System				X			Groundwater	Otay Water District	UWMP Project Concept - Groundwater	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Otay's groundwater supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	1,000	1,000	1,000	1,000
Miramar Pump Station	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 60 cfs	UWMP	Pump Station Capacity	-	-	-	-	-	-	-
Miramar Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	City of San Diego	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Capacity in the model 6,050 AF, is based on SDCWA Reservoir Summary Report (March 1990). Does not include dead pool.	SDCWA Reservoir Summary Report (1990)	Reservoir Capacity	-	-	-	-	-	-	-
Miramar Water Treatment Plant	X	X	X	X	X	X	Conveyance Improvement	City of San Diego	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 531 AF/day (144 mgd).	UWMP	Treatment Plant Capacity	-	-	-	-	-	-	-
Mission Basin Desalter Facility - 1st & 2nd Phase of Desal Expansion & IPR	X	X	X	X	X	X	Groundwater	City of Oceanside	UWMP Verifiable - Groundwater	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Groundwater supply for Oceanside	UWMP	Water Supply Volume (AF/yr)	3,300	3,300	3,700	3,700	3,700	3,700	3,700

Project Name	Baseline	Baseline+	Enhanced Conservation	Increase Supplies	Optimize Existing Facilities	Watershed Health & Ecosystem Restoration	Concept	CWASim SDCWA Member Agency	Project Source Document	Status	To be Modeled?	CWASim Model Status	Model Implementation	Demand Scenario	Modeling Notes/Questions	Confirmed by	Scenario Model Input	2015	2020	2025	2030	2035	2040	2050 (assumed equivalent to 2040 unless a 2050 value is known)
Mission Trails Projects Alternative 1		X	X	X	X	X	Conveyance Improvement	SDCWA	CWA Facilities Master Plan	Conceptual	Yes	Included - Approved	Model logic	2025	Implemented per Regional Facilities Master Plan modeling as increase in conveyance capacity. Include for 2025 level as CWA is currently requesting bids for design.	UWMP	Conveyance capacity							
Mission Valley Brackish Groundwater Recovery Project				X			Groundwater	City of San Diego	UWMP Project Concept - Groundwater	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to City of San Diego's groundwater supply	UWMP	Water Supply Volume (AF/yr)	-	-	840	1,680	1,680	1,680	1,680
Morena Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	City of San Diego	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Capacity in the model 50,200 AF, is based on SDCWA Reservoir Summary Report (March 1990). This is does not include deadpool.	SDCWA Reservoir Summary Report (1990)	Reservoir Capacity	-	-	-	-	-	-	-
Moreno-Lakeside Pipeline	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	93 cfs	SDCWA CIP Water Facilities System Schematic	Pipeline Capacity	-	-	-	-	-	-	-
Ms. Smarty-Plants Grows Water-Wise Schools		X	X	X	X	X	Urban and Agricultural Water Use Efficiency	City of San Diego	IRWM - Prop 84.4	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Added to City of San Diego conservation table	UWMP	N/A	-	-	-	6	6	6	6
Mt. Vernon St Green Street						X	Watershed and Ecosystem Management	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Murray Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	City of San Diego	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 5,200 AF. Includes surcharge capacity.	UWMP/City Staff Mann	Reservoir Capacity	-	-	-	-	-	-	-
Murray Urban Runoff Diversion System Capture		X	X	X	X	X	Stormwater Capture	City of San Diego	N/A	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to City of San Diego's conservation volume	City Staff	Water Supply Volume (AF/yr)	-	-	200	200	200	200	200
Mutual Water Company wells within district	X	X	X	X	X	X	Groundwater	Yuima Municipal Water District	UWMP Verifiable - Groundwater	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	None	UWMP	Water Supply Volume (AF/yr)	7,000	7,000	7,000	7,000	7,000	7,000	7,000
MWD Allocation	X	X	X	X	X	X	Drought Restriction/Allocation	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	See model documentation			-	-	-	-	-	-	-
MWD Imported Water	X	X	X	X	X	X	Imported Water Purchases	SDCWA	Baseline	Existing	Yes	Included - Approved	Model Logic	2015	See model documentation	UWMP	Available Water Volume	-	-	-	-	-	-	-
National City Well Field	X	X	X	X	X	X	Groundwater	Sweetwater Authority	UWMP Verifiable - Groundwater	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Groundwater supply for Sweetwater	UWMP	Water Supply Volume (AF/yr)	2,100	2,100	2,100	2,100	2,100	2,100	2,100
Nestor Creek Channel Restoration						X	Watershed and Ecosystem Management	City of San Diego	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
New Local Supply Rincon del Diablo - Hale Avenue RRF/ City of Escondido/WRFs				X			Potable Reuse	Rincon del Diablo Municipal Water District	UWMP Additional Planned - Potable Reuse	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Rincon's recycled/potable reuse supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	200	1,000	1,000	1,000
North Ave and Grove Green Street						X	Watershed and Ecosystem Management	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
North City WRP - Project 1				X			Recycled Water	City of Poway	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Poway's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	100	100	100	100	100	100
North City WRP - Project 2				X			Recycled Water	City of Poway	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Poway's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	50	50	50	50	50	50
North City WRP/City of San Diego	X	X	X	X	X	X	Recycled Water	City of Poway	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Addition to Poway's recycled supply	UWMP	Water Supply Volume (AF/yr)	645	645	645	645	645	645	645
North City WRP/City of San Diego	X	X	X	X	X	X	Recycled Water	City of San Diego	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Addition to City of SD's recycled supply	UWMP	Water Supply Volume (AF/yr)	7029	12500	12500	12500	12500	12500	12,500
North County Distribution Pipeline	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Treated. Modeled in aggregate fashion by delivery of water from Second Aqueduct.	SDCWA CIP Water Facilities System Schematic	Pipeline Capacity	-	-	-	-	-	-	-
North District Recycled System/RW Chapman WRF				X			Recycled Water	Otay Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Otay's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	4,400	4,400	4,400	4,400
North San Diego County Regional Recycled Water Project-Phase II		X	X	X	X	X	Recycled Water	Olivenhain Municipal Water District	IRWM - Prop 84.2	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to Olivenhain's recycled water table	UWMP	Water Supply Volume (AF/yr)	-	-	-	6,790	6,790	6,790	6,790
North Village WRF				X			Recycled Water	Valley Center Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Valley Center's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	-	105	105
North WWTP Landscape Application				X			Recycled Water	Camp Pendleton	UWMP Additional Planned - Recycled Water	Planned	No	Not Able to Model	Not modeled. Included in Summary by Concept spreadsheet.		Not modeled because the CWASim model does not include a demand node for Camp Pendleton	UWMP	Water Supply Volume (AF/yr)	-	90	90	90	90	90	90
North WWTPs/USMC	X	X	X	X	X	X	Recycled Water	Camp Pendleton	UWMP Verifiable - Recycled Water	Verifiable	No	Not Able to Model	Not modeled. Included in Summary by Concept spreadsheet.		Not modeled because the CWASim model does not include a demand node for Camp Pendleton	UWMP	Water Supply Volume (AF/yr)	450	510	510	510	510	510	510
Northwest Quadrant /Meadowlark WRF/Vallecitos WD	X	X	X	X	X	X	Recycled Water	Olivenhain Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Addition to Olivenhain's recycled water table	UWMP	Water Supply Volume (AF/yr)	358	459	459	459	459	459	459
Olivenhain Pump Station	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 314 cfs	UWMP	Pump Station Capacity	-	-	-	-	-	-	-
Olivenhain Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	SDCWA	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 25,382 AF. Includes surcharge capacity.	UWMP	Reservoir Capacity	-	-	-	-	-	-	-
Olivenhain Water Treatment Plant	X	X	X	X	X	X	Conveyance Improvement	Olivenhain	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 104 AF/day.	UWMP	Treatment Plant Capacity	-	-	-	-	-	-	-
Olivenhain-Hodges Pipeline*	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 760 cfs	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Otay Mesa Lot 7 Groundwater Well System (capacity)				X			Groundwater	Otay Water District	UWMP Project Concept - Groundwater	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Otay's groundwater supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	400	400	400	400
Otay River Valley GW Aquifer Studies & Field Investigations				X			Groundwater	Otay Water District	UWMP Project Concept - Groundwater	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to City of San Diego's groundwater supply	UWMP	Water Supply Volume (AF/yr)	-	-	3,900	3,900	3,900	3,900	3,900

Project Name	Baseline	Baseline+	Enhanced Conservation	Increase Supplies	Optimize Existing Facilities	Watershed Health & Ecosystem Restoration	Concept	CWASim SDCWA Member Agency	Project Source Document	Status	To be Modeled?	CWASim Model Status	Model Implementation	Demand Scenario	Modeling Notes/Questions	Confirmed by	Scenario Model Input	2015	2020	2025	2030	2035	2040	2050 (assumed equivalent to 2040 unless a 2050 value is known)
Otay Water Treatment Plant	X	X	X	X	X	X	Conveyance Improvement	City of San Diego	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 125 AF/day (34 mgd).	UWMP	Treatment Plant Capacity	-	-	-	-	-	-	-
P12	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 190 cfs	SDCWA	Pipeline Capacity							
Palm St Green Street						X	Watershed and Ecosystem Management	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Paradise Creek Restoration Phase II						X	Watershed and Ecosystem Management	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Paradise Valley Creek Water Quality and Community Enhancement						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Perdue Water Treatment Plant	X	X	X	X	X	X	Conveyance Improvement	Sweetwater Authority	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 92 AF/day.	UWMP	Treatment Plant Capacity	-	-	-	-	-	-	-
Pipeline 1 and 2 (First Aqueduct)	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Treated (North of Crossover Pipeline) and Untreated (South of Crossover Pipeline). Capacity 40 cfs downstream of crossover to Levy. Minimum flow 12.5 cfs.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Pipeline 3 (Second Aqueduct)	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Treated or Untreated. P5 + P3 = 780 cfs before 7/1/2024, and 720 cfs after. 235 cfs downstream of TOV.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Pipeline 3/Pipeline 4 Conversion					X		Conveyance Improvement	SDCWA	CWA Facilities Master Plan	Conceptual	Yes	Included - Approved	Model Logic	2050	Timeline is beyond 2040, so turn on at 2050 Including Option 1 from 2013 Master Plan only, not option 2.	Water Authority	Model Logic							
Pipeline 4 (Second Aqueduct)	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Treated or Untreated. Treated flow of 450 cfs downstream of TOV. Minimum flow 40 cfs. Minimum demands South of TOV to keep P4 flowing North to South 232 cfs.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Pipeline 4 (Second Aqueduct) Relining	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Expected to reduce capacity at Delivery Point to 395 cfs.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Pipeline 5 (Second Aqueduct)	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Untreated. P5 + P3 = 780 cfs before 7/1/2024, and 720 cfs after. Downstream of TOV conveyance capacity of 636 cfs.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Pipeline 5 (Second Aqueduct) Relining	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Untreated. P5 + P3 = 780 cfs before 7/1/2024, and 720 cfs after.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Pomerado Pipeline	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Untreated. Capacity 220 cfs.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Potable Reuse/Hale Avenue Resource Recovery Facility (HARRF)				X			Potable Reuse	City of Escondido	UWMP Project Concept - Potable Reuse	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Escondido's recycled/potable reuse supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	4,000	5,000	5,000	5,000
Pure Water - Los Penasquitos Creek Urban Dry-Weather Water Harvesting						X	Stormwater BMPs	City of San Diego	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Pure Water San Diego Phase 1 - North City		X	X	X	X	X	Potable Reuse	City of San Diego	UWMP Additional Planned - Potable Reuse	Planned	Yes	Included - Approved	Model Logic	2025	See write up. North City to Miramar, 30 mgd by 2021	Jeff Pasek	Water Supply Volume (AF/yr)	-	-	-	-	-	-	-
Pure Water San Diego Phase 2 - Central				X			Potable Reuse	City of San Diego	UWMP Additional Planned - Potable Reuse	Planned	Yes	Included - Approved	Model Logic	2050	See write up. Central Facility to San V at 53 mgd.	Jeff Pasek	Facility Production Capacity (AF/yr)	-	-	-	-	-	-	-
Quantification Settlement Agreement	X	X	X	X	X	X	Firm Water Supply Agreements	SDCWA	Baseline	Existing	Yes	Included - Approved	Model logic	2015	See model documentation	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	-	-	-
R. W. Chapman WRF/Otay WD	X	X	X	X	X	X	Recycled Water	Otay Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Otay	UWMP	Water Supply Volume (AF/yr)	1100	1100	1100	1100	1100	1100	1,100
Rainwater harvesting						X	Stormwater Capture	City of San Diego	City of San Diego UWMP	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to conservation for City of San Diego	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	416	416	416
Ramona Pipeline	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Treated. Capacity 104 cfs.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Rancho Cielo				X			Recycled Water	Olivenhain Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Olivenhain's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	100	100	100	100

Project Name	Baseline	Baseline+	Enhanced Conservation	Increase Supplies	Optimize Existing Facilities	Watershed Health & Ecosystem Resetoration	Concept	CWASim SDCWA Member Agency	Project Source Document	Status	To be Modeled?	CWASim Model Status	Model Implementation	Demand Scenario	Modeling Notes/Questions	Confirmed by	Scenario Model Input	2015	2020	2025	2030	2035	2040	2050 (assumed equivalent to 2040 unless a 2050 value is known)
Rancho del Rey Groundwater Well Development (capacity)		X	X	X	X	X	Groundwater	Otay Water District	UWMP Additional Planned - Groundwater	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Added to Otay's groundwater supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	500	500	500	500
Rancho Pipeline	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 600 cfs of Untreated conveyance downstream of Rancho	SDCWA	Pipeline Capacity							
Ray Stoyer WRF - Landscape, Irrigation, Dust Control				X			Recycled Water	Padre Dam Municipal Water District	UWMP Additional Planned - Recycled Water	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Padre Dam's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	1,008	1,008	1,008	1,008	1,008
Ray Stoyer WRF (Existing)/Padre Dam MWD	X	X	X	X	X	X	Recycled Water	Padre Dam Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Padre Dam	UWMP	Water Supply Volume (AF/yr)	896	896	896	896	896	896	896
Ray Stoyer WRF (Existing)/Padre Dam MWD	X	X	X	X	X	X	Recycled Water	Padre Dam Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Padre Dam	UWMP	Water Supply Volume (AF/yr)	1120	1120	1120	1120	1120	1120	1,120
Regional Demand Management Program Expansion		X	X	X	X	X	Urban and Agricultural Water Use Efficiency	SDCWA	IRWM - Prop 84.3	Planned	No	Not Able to Model	N/A	-	Based upon IRWM Prop 84-3 grant agreement, include in Baseline + portfolio without any associated water volumes	UWMP	Conservation Volume (AF/yr)	-	-	-	-	-	-	-
Regional Drought Resilience Program		X	X	X	X	X	Urban and Agricultural Water Use Efficiency	SDCWA	IRWM - Prop 84.4	Planned	yes	Included - Approved	Input Demands Spreadsheet	2050	Allocate conservation savings evenly amongst all member agencies.	UWMP	Conservation Volume (AF/yr)	-	-	-	1,809	1,809	1,809	1,809
Re-rating of Carlsbad Desalination for higher flow				X			Seawater Desalination	Carlsbad Municipal Water District	N/A	Conceptual	Yes	Included - Approved	Model Logic	2025	Increase rated capacity from 50MGD to 53MGD per Eric Rubalcava.	UWMP	Facility Production Capacity (AF/yr)	-	-	-	-	-	-	-
Richard A. Reynolds Desalination Facility	X	X	X	X	X	X	Groundwater	City of San Diego	UWMP Verifiable - Groundwater	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2025	Groundwater supply for City of San Diego	UWMP	Water Supply Volume (AF/yr)		2,600	2,600	2,600	2,600	2,600	2,600
Richard A. Reynolds Desalination Facility	X	X	X	X	X	X	Groundwater	Sweetwater Authority	UWMP Verifiable - Groundwater	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Groundwater supply for Sweetwater	UWMP	Water Supply Volume (AF/yr)	3,600	6,200	6,200	6,200	6,200	6,200	6,200
Rincon Customer-Driven Demand Management Program		X	X	X	X	X	Urban and Agricultural Water Use Efficiency	Rincon del Diablo Municipal Water District	IRWM - Prop 84.3	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2025	Added to Rincon's conservation values	UWMP	Conservation Volume (AF/yr)	-	-	400	400	400	400	400
Rosarito Beach Desalination				X			Seawater Desalination	Otay Water District	UWMP Additional Planned - Desalination	Planned	Yes	Included - Approved	Model Logic	2050	See write up.	Otay	Facility Production Capacity (AF/yr)	-	-	-	-	-	-	-
Safari Drought Response and Outreach		X	X	X	X	X	Recycled Water	City of San Diego	IRWM - Prop 84.4	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2025	City of San Diego recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	72	72	72	72	72
Safari Park Storm Water Capture and Reuse Project						X	Stormwater BMPs	City of San Diego	SWRP - Listed	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to conservation for City of San Diego	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	5	5	5
Safari Park Water Reuse Sustainability and Watershed Protection Prgram						X	Stormwater BMPs	City of San Diego	SWRP - Listed	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to conservation for City of San Diego	UWMP	Water Supply Volume (AF/yr)	-	-	-	-	19	19	19
San Diego County Reservoir Intertie					X		Conveyance Improvement	City of San Diego	N/A	Conceptual	Yes	Included - Approved	Input Spreadsheet and Model Logic	2050	Model Logic: Adjust two settings on Reservoir Operations dashboard in model. Input Spreadsheet: Remove DSOD restriction on El Capitan Reservoir See write up for detailed description.	City Staff	Facility Production Capacity (AF/yr)	-	-	-	-	-	-	-
San Diego Formation - Southeaster San Diego, including Mt Hope				X			Groundwater	City of San Diego	UWMP Project Concept - Groundwater	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to City of San Diego's groundwater supply	UWMP	Water Supply Volume (AF/yr)	-	-	800	1,600	1,600	1,600	1,600
San Diego Healthy Headwaters Restoration		X	X	X	X	X	Watershed and Ecosystem Management	City of San Diego	IRWM - Prop 84.4	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
San Diego Water Conservation Program		X	X	X	X	X	Urban and Agricultural Water Use Efficiency	City of San Diego	IRWM - Prop 84.4	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Added to City of San Diego's conservation values	UWMP	Conservation Volume (AF/yr)	-	-	-	75	75	75	75
San Diego Water Use Reduction Program		X	X	X	X	X	Urban and Agricultural Water Use Efficiency	City of San Diego	IRWM - Prop 84.3	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2025	Added to City of San Diego's conservation values	UWMP	Conservation Volume (AF/yr)	-	-	381	381	381	381	381
San Dieguito Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	San Dieguito Water District/ Santa Fe Irrigation District	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 883 AF	UWMP	Reservoir Capacity	-	-	-	-	-	-	-
San Dieguito River Basin Brackish GW Recovery and Treatment				X			Groundwater	Olivenhain Municipal Water District	UWMP Project Concept - Groundwater	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Olivenhain's groundwater supply	UWMP	Water Supply Volume (AF/yr)	-	560	560	560	560	560	560
San Elijo WRF/San Elijo JPA	X	X	X	X	X	X	Recycled Water	Santa Fe Irrigation District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Santa Fe	UWMP	Water Supply Volume (AF/yr)	500	500	500	500	500	500	500
San Elijo WRF/San Elijo JPA	X	X	X	X	X	X	Recycled Water	City of Del Mar	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Del Mar	UWMP	Water Supply Volume (AF/yr)	90	100	125	150	150	150	150
San Elijo WRF/San Elijo JPA	X	X	X	X	X	X	Recycled Water	San Dieguito Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for San Dieguito	UWMP	Water Supply Volume (AF/yr)	736	800	800	800	800	800	800
San Luis Rey Groundwater Study				X			Groundwater	Rainbow Municipal Water District	UWMP Project Concept - Groundwater	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Rainbow's groundwater	UWMP	Water Supply Volume (AF/yr)	-	4,000	4,000	4,000	4,000	4,000	4,000
San Luis Rey WRF - Short/Long-Term Expansion	X	X	X	X	X	X	Potable Reuse	City of Oceanside	UWMP Verifiable - Potable Reuse	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2025	Recycled supply for Oceanside	UWMP	Water Supply Volume (AF/yr)	-	3300	3300	3300	3300	3300	3,300
San Luis Rey WWTP/City of Oceanside - Phase 1 Expansion	X	X	X	X	X	X	Recycled Water	City of Oceanside	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Oceanside	UWMP	Water Supply Volume (AF/yr)	130	400	1,700	2,900	3,060	3,500	3,500
San Marino Drive Green Street and Dry Weather Flow Management Sweetwater						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to conservation for Sweetwater Authority	UWMP	Water Supply Volume (AF/yr)	-	-	-	3	3	3	3
San Marino Drive Green Street and Dry Weather Flow Management Vallecitos						X	Stormwater BMPs	Vallecitos Water District	SWRP - Listed	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to conservation for City of San Diego	UWMP	Water Supply Volume (AF/yr)	-	-	-	2	2	2	2
San Miguel Green Street						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-

Project Name	Baseline	Baseline+	Enhanced Conservation	Increase Supplies	Optimize Existing Facilities	Watershed Health & Ecosystem Resetoration	Concept	CWASim SDCWA Member Agency	Project Source Document	Status	To be Modeled?	CWASim Model Status	Model Implementation	Demand Scenario	Modeling Notes/Questions	Confirmed by	Scenario Model Input	2015	2020	2025	2030	2035	2040	2050 (assumed equivalent to 2040 unless a 2050 value is known)
San Pasqual Brackish Groundwater Recovery Project				X			Groundwater	City of San Diego	UWMP Project Concept - Groundwater	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to City of San Diego's groundwater supply	UWMP	Water Supply Volume (AF/yr)	-	-	1,235	1,427	1,539	1,619	1,619
San Vicente 3rd Pump Drive and Power		X	X	X	X	X	Conveyance Improvement	SDCWA	CWA Facilities Master Plan	Conceptual	Yes	Included - Approved	Model Logic	2050	Increase San Vicente Pump Station from 300 cfs to 444 cfs. Turn on at 2050	SDCWA/Eric Rubacalva	Facility Production Capacity (AF/yr)	-	-	-	-	-	-	-
San Vicente GW Production Well	X	X	X	X	X	X	Groundwater	City of San Diego	UWMP Verifiable - Groundwater	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Groundwater supply for City of San Diego	UWMP	Water Supply Volume (AF/yr)	500	500	500	500	500	500	500
San Vicente Pipeline/Tunnel*	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Untreated. Capacity 444 cfs from West to East.	Regional Facilities Optimization Plan SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
San Vicente Pump Station	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 300 cfs	SDCWA/Eric Rubacalva	Pump Station Capacity	-	-	-	-	-	-	-
San Vicente Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	City of San Diego	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 272,528 AF. Includes surcharge capacity.	UWMP/City Staff Mann	Reservoir Capacity	-	-	-	-	-	-	-
San Vicente WRP/Ramona MWD	X	X	X	X	X	X	Recycled Water	Ramona Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Ramona	UWMP	Water Supply Volume (AF/yr)	480	500	525	525	525	525	525
Santa Fe Valley WRF/Rancho Santa Fe CSD	X	X	X	X	X	X	Recycled Water	Olivenhain Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Olivenhain	UWMP	Water Supply Volume (AF/yr)	140	140	140	140	140	140	140
Santa Margarita Conjunctive-Use Project - Local surface water recharge and expansion of Camp Pendleton groundwater recovery program		X	X	X	X	X	Groundwater	Fallbrook PUD Camp Pendleton	UWMP Additional Planned - Groundwater	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Fallbrook's groundwater supply	UWMP	Water Supply Volume (AF/yr)	-	3,100	3,100	3,100	3,100	3,100	3,100
Santa Maria WRP				X			Recycled Water	Ramona Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Ramona's recycled water	UWMP	Water Supply Volume (AF/yr)	-	3,000	3,000	3,000	3,000	3,000	3,000
Santa Maria WRP/Ramona MWD	X	X	X	X	X	X	Recycled Water	Ramona Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Included in Ramona's recycled table.	UWMP	Water Supply Volume (AF/yr)	230	230	230	230	230	230	230
SD12 Pipeline	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Untreated water diversion for Alvarado Capacity. Capacity 150 cfs.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Second Crossover Pipeline					X		Conveyance Improvement	SDCWA	CWA Facilities Master Plan	Conceptual	Yes	Included - Approved	Model Logic	2050	This project would increase untreated water conveyance between the 2nd and 1st AQ by approximately 94,000AF. Turn on at 2050.	Water Authority	Model Logic	-	-	-	-	-	-	-
SEJPA1-Quail Gardens	X	X	X	X	X	X	Recycled Water	Olivenhain Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Olivenhain	UWMP	Water Supply Volume (AF/yr)	144	50	50	50	50	50	50
SEJPA2-Village Park, Manchester Phase I	X	X	X	X	X	X	Recycled Water	Olivenhain Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2025	Recycled supply for Olivenhain	UWMP	Water Supply Volume (AF/yr)	-	236	236	236	236	236	236
Sewage Treatment Plants # 11 & #12/USMC	X	X	X	X	X	X	Recycled Water	Camp Pendleton	UWMP Verifiable - Recycled Water	Verifiable	No	Not Able to Model	Not modeled. Included in Summary by Concept spreadsheet.		Not modeled because the CWASim model does not include a demand node for Camp Pendleton	UWMP	Water Supply Volume (AF/yr)	148	-	-	-	-	-	-
SFID/SDWD/SEJPA Potable Reuse Project				X			Potable Reuse	Santa Fe Irrigation District	UWMP Additional Planned - Potable Reuse	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Santa Fe's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	550	550	550	550	550	550
Shadowridge WRP				X			Recycled Water	Vista Irrigation District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Vista's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	1,800	1,800	1,800	3,000	3,000
Skyline Dr and Kempt St Green Streets						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
South Bay WRP/City of San Diego	X	X	X	X	X	X	Recycled Water	City of San Diego	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for City of San Diego	UWMP	Water Supply Volume (AF/yr)	1166	1150	1150	1150	1150	1150	1,150
South Bay WRP/City of SD	X	X	X	X	X	X	Recycled Water	Otay Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for Otay	UWMP	Water Supply Volume (AF/yr)	3300	4570	4800	4900	5100	5400	5,400
South Santa Fe Green Street Project						X	Stormwater BMPs	Rainbow Municipal Water District	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
South WWTP - Indirect Potable Recharge				X			Potable Reuse	Camp Pendleton	UWMP Project Concept - Recycled Water	Conceptual	No	Not Able to Model	Not modeled. Included in Summary by Concept spreadsheet.		Not modeled because the CWASim model does not include a demand node for Camp Pendleton	UWMP	Water Supply Volume (AF/yr)	-	2,060	2,060	2,060	2,060	2,060	2,060
South WWTP - Injection to Las Flores Basin				X			Potable Reuse	Camp Pendleton	UWMP Additional Planned - Recycled Water	Planned	No	Not Able to Model	Not modeled. Included in Summary by Concept spreadsheet.		Not modeled because the CWASim model does not include a demand node for Camp Pendleton	UWMP	Water Supply Volume (AF/yr)	-	450	450	450	450	450	450
South WWTP - Injection to Santa Margarita Basin				X			Potable Reuse	Camp Pendleton	UWMP Additional Planned - Recycled Water	Planned	No	Not Able to Model	Not modeled. Included in Summary by Concept spreadsheet.		Not modeled because the CWASim model does not include a demand node for Camp Pendleton	UWMP	Water Supply Volume (AF/yr)	-	870	870	870	870	870	870
South WWTPs/USMC Baseline Recycled Water	X	X	X	X	X	X	Recycled Water	Camp Pendleton	UWMP Verifiable - Recycled Water	Verifiable	No	Not Able to Model	Not modeled. Included in Summary by Concept spreadsheet.		Not modeled because the CWASim model does not include a demand node for Camp Pendleton	UWMP	Water Supply Volume (AF/yr)	450	480	480	480	480	480	480
Spruce Street Channel Improvement Project						X	Stormwater BMPs	City of Escondido	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Storm water Capture off San Diego River along Alvarado Canyon and Fairmont Canyon to Fish and Wildlife site						X	Stormwater BMPs	City of San Diego	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-

Project Name	Baseline	Baseline+	Enhanced Conservation	Increase Supplies	Optimize Existing Facilities	Watershed Health & Ecosystem Restoration	Concept	CWASim SDCWA Member Agency	Project Source Document	Status	To be Modeled?	CWASim Model Status	Model Implementation	Demand Scenario	Modeling Notes/Questions	Confirmed by	Scenario Model Input	2015	2020	2025	2030	2035	2040	2050 (assumed equivalent to 2040 unless a 2050 value is known)
Sustaining Healthy Tributaries to the Upper San Diego River and Protecting Local Water Supplies		X	X	X	X	X	Watershed and Ecosystem Management	City of San Diego	IRWM - Prop 84.2	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Sutherland Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	City of San Diego	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Total Modeled Capacity 31,960 AF. Includes surcharge capacity.	UWMP/City Staff Mann	Reservoir Capacity	-	-	-	-	-	-	-
Sutherland-San Vicente Conduit	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Untreated. Capacity 50 cfs.	UWMP	Pipeline Capacity	-	-	-	-	-	-	-
Sweetwater Rd Green Street						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Sweetwater Reservoir	X	X	X	X	X	X	Local Surface Water Reservoirs	Sweetwater Authority	N/A	Existing	Yes	Included - Approved	Input Spreadsheet	2015	Sweetwater Reservoir capacity is currently restricted. Baseline capacity should be total capacity of 28,079 AF minus restriction of 7873 AF (27,700-7873 AF = 20,206 AF)	SDCWA Reservoir Summary Report (1990)	Reservoir Capacity	-	-	-	-	-	-	-
Sweetwater Reservoir Wetlands Habitat Recovery		X	X	X	X	X	Watershed and Ecosystem Management	Sweetwater Authority	IRWM - Prop 84.4	Planned	Yes	Included - Approved	Input Spreadsheet	2025	Sweetwater Reservoir Wetlands Habitat Recovery project will remove capacity restrictions. Total Modeled Capacity should be 28,079. Implement in 2025. Permits should be secured by summer 2019, with construction beginning fall 2019 and estimated to be complete by roughly 2022 . Once the permits are secured the 230' imported water level restriction will be removed and 7,873 AF can be additionally stored within the reservoir. Restriction will be removed before 2025	UWMP	Reservoir Capacity	-	-	-	-	-	-	-
Sweetwater River Park Bioretention						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Add to conservation for Sweetwater Authority	UWMP	Water Supply Volume (AF/yr)	-	-	-	43	43	43	43
Sycamore Creek Restoration						X	Watershed and Ecosystem Management	Padre Dam Municipal Water District	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-
TBD - Evaluation Multiple Options/TBD - Supply/ Source Treatment Plant/Agency for recycled water				X			Recycled Water	Santa Fe Irrigation District	UWMP Additional Planned - Recycled Water	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Santa Fe's recycled supply. Changed 50 to 0 for 2015 volume.	SFID - Bill Hunter	Water Supply Volume (AF/yr)	0	50	50	50	50	50	50
Telegraph Canyon Channel Improvement Project						X	Stormwater BMPs	Sweetwater Authority	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-
The 30 Inch Pipeline	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Current capacity is 75 cfs.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
The 30 Inch Pipeline Relining	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Expected to reduce capacity at Delivery Point to 70 cfs.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Tijuana River Floating Trash Capture System						X	Watershed and Ecosystem Management	City of San Diego	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	UWMP	N/A	-	-	-	-	-	-	-
Tri-Agency Pipeline	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Treated. Modeled in aggregate fashion by delivery of water from Second Aqueduct.	SDCWA	Pipeline Capacity	-	-	-	-	-	-	-
Twin Oaks Valley Pump Station	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	TOV minimum flow of 20 MGD to keep plant from shutting down. Downstream conveyance capacity of 636 cfs.	SDCWA	Pump Station Capacity	-	-	-	-	-	-	-
Twin Oaks Valley Water Treatment Plant	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 307 AF/day. Minimum flow of 20 MGD (61.4 AF/day) to keep plant from shutting down.	UWMP	Treatment Plant Capacity	-	-	-	-	-	-	-
UC San Diego Water Conservation and Watershed Protection		X	X	X	X	X	Urban and Agricultural Water Use Efficiency	City of San Diego	IRWM - Prop 84.4	Planned	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to City of San Diego's conservation volume	UWMP	Conservation Volume (AF/yr)	-			203	203	203	203
Valley Center (P2A) Pump Station	X	X	X	X	X	X	Conveyance Improvement	SDCWA	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 41 cfs	UWMP	Pump Station Capacity	-	-	-	-	-	-	-
Village Park Recycled Water Expansion Project				X			Recycled Water	Olivenhain Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Olivenhain's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	80	127	127	127	127	127
Vine Street Groundwater Production Facility	X	X	X	X	X	X	Groundwater	Lakeside Water District	UWMP Verifiable - Groundwater	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Groundwater supply for Lakeside	UWMP	Water Supply Volume (AF/yr)	700	700	700	700	700	700	700
W+157:181RP/Recycled Water Distribution System				X			Recycled Water	Rainbow Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Rainbow's recycled water	UWMP	Water Supply Volume (AF/yr)	-	300	670	1,000	1,600	1,600	1,600
Weese Water Treatment Plant	X	X	X	X	X	X	Conveyance Improvement	City of Oceanside	N/A	Existing	Yes	Included - Approved	Model Logic	2015	Capacity 77 AF/day.	UWMP	Treatment Plant Capacity	-	-	-	-	-	-	-

Project Name	Baseline	Baseline+	Enhanced Conservation	Increase Supplies	Optimize Existing Facilities	Watershed Health & Ecosystem Resetoration	Concept	CWASim SDCWA Member Agency	Project Source Document	Status	To be Modeled?	CWASim Model Status	Model Implementation	Demand Scenario	Modeling Notes/Questions	Confirmed by	Scenario Model Input	2015	2020	2025	2030	2035	2040	2050 (assumed equivalent to 2040 unless a 2050 value is known)
Welk WRF				X			Recycled Water	Valley Center Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2025	Addition to Valley Center's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	140	140	140	140	140
Woods Valley Ranch WRF (Phase 2)	X	X	X	X	X	X	Recycled Water	Valley Center Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2025	Recycled supply for VC	UWMP	Water Supply Volume (AF/yr)	-	90	175	184	184	184	184
Woods Valley Ranch WRF Phase 3				X			Recycled Water	Valley Center Municipal Water District	UWMP Project Concept - Recycled Water	Conceptual	Yes	Included - Approved	Input Demands Spreadsheet	2050	Addition to Valley Center's recycled supply	UWMP	Water Supply Volume (AF/yr)	-	-	-	50	150	168	168
Woods Valley Ranch WRF/VCMWD	X	X	X	X	X	X	Recycled Water	Valley Center Municipal Water District	UWMP Verifiable - Recycled Water	Verifiable	Yes	Included - Approved	Input Demands Spreadsheet	2015	Recycled supply for VC	UWMP	Water Supply Volume (AF/yr)	47	47	47	47	47	47	47
Woodside Avenue Complete Green Street						X	Stormwater BMPs	County of San Diego	SWRP - Listed	Planned	No	Not Able to Model	N/A		N/A	SWRP list	N/A	-	-	-	-	-	-	-