Appendix C:
Literature Review

ARLA

Initial Literature Review: Local Efforts, Precedents, and Initial Metrics Related to the SCWP

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Executive Summary

What is the Goal of this Project?

The first year of Safe Clean Water Program (SCWP or Program) implementation has illuminated the need to assess the extent to which the SCWP guidance, criteria, structure, and processes are driving meaningful progress toward achieving the 14 goals stated in the Program Implementation Ordinance [codified in Section 18.04 of the Los Angeles County Flood Control District (District) Code]. Accelerate Resilience L.A. (ARLA) therefore created this project (the Project) to help address this need. The Project will utilize a robust and collaborative scientific approach to identify metrics that represent select SCWP Goals, evaluate historical Program data against those metrics, and analyze the potential of future projects to accomplish the overarching Program goals collectively and equitably. The Project will aim to maximize attainment of SCWP Goals (and to consider opportunities to leverage investment and benefits of other regional infrastructure efforts). As part of the Project, ARLA convened a Working Group of three non-governmental and three municipal stakeholders ("Working Group"). The organizations and individuals were invited to participate given their specific mix of skill sets, backgrounds, and perspectives. The Working Group's goal is to provide consensus-based recommendations to the District (with consideration of the broader SCWP process, including the Regional Oversight Committee) regarding potential refinements to SCWP guidelines.

What is the Purpose of this Report?

This report summarizes an initial literature review of existing SCWP guidance for measuring Program and project success, and researches initial metrics that may be useful for measuring progress toward achieving the 14 Program goals. This literature review has identified a wide range of local, national, and international metrics and frameworks used in different parts of the world to inform a broad view of feasible approaches for measuring attainment of the SCWP Goals. The primary purpose of this report is to enable the Working Group to review the potential metrics identified and consider what, if any, modifications or augmentations need to be made to the current SCWP guidance, criteria, structure, and processes as they view necessary. It is expected that ARLA's SCWP Working Group will provide substantial input on the potential metrics identified through the literature review; thus, the initial considerations herein will undergo several iterations and will be modified with recommendations from the Working Group and expert consultation. Ultimately, the findings will evolve into a *Metric Definition and Model Assumptions* report (Appendix D).

How Does This Review Fit with Ongoing Efforts?

The SCWP Implementation Ordinance and its referenced guidance documents codify certain core elements, including the Program goals, definitions of specific terms, criteria for scoring projects related to Program goals, and requirements for tracking and reporting goals at the Program-scale; however, the District, public, and various SCWP committees have acknowledged that measurement of goals is often vague and could be enhanced with additional guidance. This literature review will support ongoing District-led efforts to adapt the Program by generating additional recommendations for enhanced guidance to serve as a source of input to the guiding questions in the ROC workbooks and the District's broader efforts. Recommendations will be generated through a scientifically driven process that seeks to build consensus between two groups of stakeholders (municipal and non-governmental) that have not always found alignment on these issues.

What SCWP Goals Are We Focusing on and Why?

The Working Group selected which specific Program goals warrant research, discussion, and expert consultation to inform SCWP recommendations, and will next utilize a consensus-based process to identify metrics for each prioritized Program goal. These metrics will then be assessed and modeled (via a variety of selected water capture projects) to quantify the benefits for balanced watershed projects stemming from the SCWP. Table 1 organizes the goals selected by the Working Group for further study. To note, the goals are listed vertically in decreasing order of Working Group prioritization (i.e. Water Quality was ranked first, multiple benefits was ranked third).

Table 1. Working Group Prioritized and Supplemental Goals.

1 – Working Group Prioritized Goals: Recommendations or analysis will require Working Group agreement on explicit metrics or methods.	**2 – Working Group Supplemental Goals:** Foundational to the structure of the Program and ongoing implementation, but do not necessarily warrant metrics to define success; ARLA will track input and recommendations related to these goals, but they will not be analyzed through the modeling process.
A. Water Quality	**H. Innovation**
C. Public Health & Community Investment	**I. Scientific Research**
E. Multiple Benefits	**L. Adaptive Management**
B. Water Supply	
F. Nature-Based Solutions	
J. DAC Benefits	
M. Green Jobs and Career Pathways	
D. Other Funding	
G. Spectrum of Project Sizes	
K. Proportionally Benefitting Municipalities	*Note: letters reflect the order in which goals are listed in District Code Section 18.04*
N. Operations and Maintenance	

How are the Goals Related?

Many of the SCWP Goals have complementary outcomes and may have overlapping metrics; for example, Nature-Based Solutions (NBS) can simultaneously yield public health, Water Quality, and Water Supply benefits—which, in turn, could yield benefits to Disadvantaged Communities (DACs). Part of the purpose of this work is to see if the 14 SCWP Goals have been meaningfully derived. Figure 1 suggests how the six goals prioritized highest by the Working Group are related (based on the existing Program definitions).

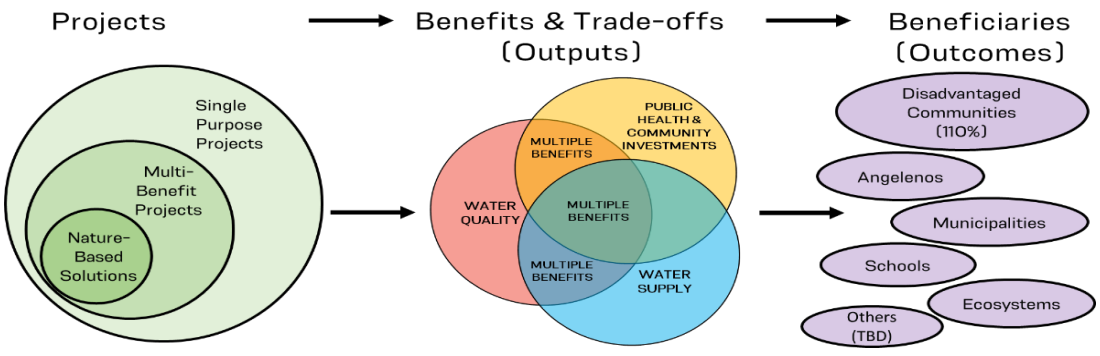

Figure 1. Potential relationship of Program components, including certain prioritized SCWP goals (adapted from Sarah Diringer, Pacific Institute, 2021).

What Initial Metrics are Recommended, and Where Do We Need Expert Advice?

An initial review of local, national, and international best practices was performed to understand the range of potential metrics related to the prioritized Program Goals. While the results and initial metrics listed in this literature review provide a valuable scientific foundation, the Working Group is charged with evaluating which metrics are most meaningful for demonstrating goal outcomes, what additional metrics should be considered, and where expert consultation is required to bolster understanding. Subsequent modeling analyses will then test the initial metrics, and enable the Working Group to review and adapt its recommendations on the basis of sound science.

Table 2 lists initial metrics for consideration related to each of the Working Group Prioritized Goals (sorted by Working Group priority), and notes where expert consultation is recommended.

Table 2. Potential metrics identified through literature review related to the Working Group prioritized Program Goals.

ID	Paraphrased Goal	Current SCWP Criteria/Metrics[1]	Potential Metrics Identified Through Literature Review (see Section 3.7 for complete summary of reviewed metrics)
A	**Water Quality**	• Reduction in Stormwater or Urban Runoff pollution, such as improvements in the chemical, physical, and biological characteristics of Stormwater or Urban Runoff (no metric specified) • Project pollutant removal efficiency from influent (%) • Dry weather urban runoff elimination (%) • Tributary area managed for dry weather (acres) • Cost effectiveness (as measured by dividing the 24-hour BMP capacity by the construction cost in $ millions)	Project-Scale • Total long-term pollutant load captured (pounds) Outfall- or Subwatershed-Scale • Frequency that discharges exceed Water Quality objectives (%) set by the Basin Plan, Total Maximum Daily Loads (TMDLs), California Toxic Rules (CTR), Municipal Action Levels (MALs), etc. Receiving Water- or Watershed Area-Scale • Biological objectives, such as improved California Stream Condition Index (CSCI) score (reference the proposed Basin Plan amendment in San Diego) or improved Algal Index of Biotic Integrity (IBI) score (unitless) • Decreased number of beach closures/improved grade on Heal the Bay's Beach Report Card (count, or % of days) • Direct attainment of other designated beneficial uses (varies)

[1] Safe Clean Water Program. SCWP soring criteria as derived from the Feasibility Study Guidelines: https://safecleanwaterla.org/wp-content/uploads/2019/08/Feasibility-Study-Guidelines-20190807-FINAL.pdf

ID	Paraphrased Goal	Current SCWP Criteria/Metrics[1]	Potential Metrics Identified Through Literature Review (see Section 3.7 for complete summary of reviewed metrics)
		Recommended Next Steps Technical Team to identify Water Quality metrics customized to each receiving water using already established Water Quality Objectives (WQOs) or TMDLs	
C	**Public Health & Community Investments**	Projects are awarded based on how many of the following Community Investment Benefits are accrued: ● Improved flood management, flood conveyance, or flood risk mitigation ● Creation, enhancement or restoration of parks, habitat, or wetlands ● Improved public access to waterway; ● Enhanced or new recreational opportunities ● Greening of schools ● Reducing local heat island effect and increasing shade ● Increasing the number of trees and/or other vegetation at the site locations that will increase carbon reduction/sequestration and improve air quality	**Climate resilience:** Decrease in mean/peak daytime local temperatures; measures of human comfort; heatwave risks; kWh/y and t C/y saved; etc. **Water management:** Flood peak reduction; increase in time to peak; absorption capacity of green surfaces, bioretention structures and trees; reduction of inundation risk for critical urban infrastructures (probability); etc. **Coastal resilience:** Shoreline characteristics and erosion protection; avoided damage costs; recreation and public access; estimates of species, individuals and habitats distribution; etc. **Habitat creation:** Area within project footprint covered by native grasses/herbs and/or native shrubs/trees immediately after project is completed and after plantings have grown to maturity (in ft^2 or m^2); layers of vegetation (in ft^2 or m^2) **Energy use:** Energy savings measured by kilowatt hours (kWh) of electricity and British thermal units (Btus) of natural gas over a specified planning period; level of CO_2 (and other greenhouse gases) emissions reduced or sequestered (valued using a "social cost of carbon" estimate) **Access to green space and providing additional recreational activities:** Distribution of public green space per capita (or capita in Disadvantaged Communities); recreational or cultural value (number of visitors, number of recreational/cultural activities); accessibility (measured as within a half-mile or a specified time) of urban green spaces for population; park pressure (measures the park size in relation to population density), park amenities; etc.

ID	Paraphrased Goal	Current SCWP Criteria/Metrics[1]	Potential Metrics Identified Through Literature Review (see Section 3.7 for complete summary of reviewed metrics)
		Recommended Next Steps	**Air quality:** Annual amount of pollutants captured by vegetation; premature deaths and hospital admissions averted per year; etc.
		Working Group to engage additional expert advice and stakeholders to determine what specific and/or additional factors are valued in specific communities throughout the District. Recommended academic experts include Dr. Sarah Diringer from the Pacific Institute and Jon Christensen and Dr. Gregory Pierce from the University of California, Los Angeles (UCLA)	**Urban regeneration:** Reclamation of contaminated land; reclamation of building materials; distribution, configuration, and diversity of green space and land use changes; etc.
			Participatory planning & governance: Openness of participatory processes; perceptions of citizens on urban nature; social values for urban ecosystems and biodiversity; policy learning concerning adapting policies and strategic plans by integrating ecosystem services and possibly their valuation; etc.
			Social justice & social cohesion: Availability and distribution of different types of parks and/or ecosystem services with respect to specific individual or household socioeconomic profiles and landscape design; being able to move freely from place to place; etc.
			Public health & well-being: Number and share of people being physically active; reduction of hospital admittance / deaths from extreme heat; reduced autoimmune diseases and allergies (potentially); proximity measures (green space of a specified size within a specified distance); Normalized Difference Vegetation Index (NDVI); etc.
E	**Multiple Benefits**	All projects submitted to Scoring Committee must demonstrate a Water Quality Benefit, and a Community Investment Benefit or a Water Supply Benefit, or both	Multi-benefit score/index accounting for magnitude and distribution of benefits, benchmarked by modeling results

ID	Paraphrased Goal	Current SCWP Criteria/Metrics[1]	Potential Metrics Identified Through Literature Review (see Section 3.7 for complete summary of reviewed metrics)
		Recommended Next Steps Working Group to explore criteria for measuring this goal by evaluating the results of the Pilot Analysis performed by the Technical Team. Results will reveal the cost-benefit trade-offs of different portfolios of Multi-Benefit Projects to inform data-driven recommendations for scoring criteria adjustments that objectively benchmark and incentivize the highest-value projects.	
B	**Water Supply**	● Cost-effectiveness (as measured by dividing the life-cycle cost by the annual stormwater capture amount) ● Annual amount of stormwater captured **Recommended Next Steps** Technical Team to collaborate closely with the Bureau of Reclamation (BoR) study to leverage the best available models and tools for predicting deep percolation of runoff to managed and usable groundwater aquifers	Project- or Program-Scale ● Acre-feet of water—that would have otherwise been discharged to the ocean, infiltrated to unmanaged or unused aquifers, or lost to evaporation—captured to replenish or augment local supply ● Potable or non-potable water use offset by capturing local stormwater Program-Scale ● Percentage of local water demand augmented/offset

ID	Paraphrased Goal	Current SCWP Criteria/Metrics[1]	Potential Metrics Identified Through Literature Review (see Section 3.7 for complete summary of reviewed metrics)
F	**Nature-Based Solutions (NBS)**	● Implements natural processes or mimics natural processes to slow, detain, capture, and absorb/infiltrate water in a manner that protects, enhances, and/or restores habitat, green space and/or usable open space ● Utilizes natural materials such as soils and vegetation with a preference for native vegetation ● Removes Impermeable Area from Project	Acknowledging that traditional cost-benefit analyses may not necessarily capture the multiple benefits of NBS currently or over time, the Working Group should work with experts to define appropriate, data-driven metrics to benchmark the requirements for NBS in each Watershed-Area and/or community as well as a mechanism to track priorities Program-wide. Decisions will be informed by modeling analyses that articulate the goals achieved by prioritizing a range of NBS versus non-NBS. See Water Quality, Water Supply, and Public Health and Community Investments above for additional recommended metrics measuring NBS outcomes. Examples of Nature-Based Solutions that address coastal storms, sea level rise, and erosion include: restoration of wetlands, mangroves, marshes, and oyster reefs, and the installation of living shorelines; wetland and reef restoration; and coastal wetlands. Examples of Nature-Based Solutions that address inland flooding include green roofs; rain gardens; bioswales; urban tree canopies; permeable pavements; protecting and/or restoring wetlands and marshes; and protecting and/or restoring riparian buffers. Examples of Nature-Based Solutions that address extreme heat include green roofs; enhancement of tree canopy; gardens; and any solutions that convert built environments to natural environments such as forests, wetlands, and vegetation.

ID	Paraphrased Goal	Current SCWP Criteria/Metrics[1]	Potential Metrics Identified Through Literature Review (see Section 3.7 for complete summary of reviewed metrics)
		Recommended Next Steps ● Working Group to define what problems should be solved with NBS ● Working Group to agree on definition/qualifying criteria for NBS projects ● Working Group to consult with expertise at either The Nature Conservancy (TNC) or colleagues recommended by the TNC ● Technical Team to conduct analysis to articulate the spectrum of benefits from various NBS	
J	**Disadvantaged Community (DAC) Benefits**	Not less than one hundred ten percent (110%) of the ratio of the DAC population to the total population in each Watershed Area	The Working Group should work to provide a clear definition for DAC benefits. Based on the Strategic Concepts in Organizing & Policy Education's (SCOPE) memo (to be released publicly in June 2021), SCOPE recommends that a DAC benefit be defined as a community investment benefit (that can be quantified as displayed in the "Public Health and Community Investments" row) and/or Nature-Based solution located in a DAC and providing needed benefits directly to that DAC population. In addition, the definition of "DAC benefits" should be clarified in addition to the definition of what "110 percent" really means. For example, partial accounting toward the 110 percent minimum benefit return on investment for DACs should be allowed. Quantification should be based on the actual "portion" of the project providing community engagement and DAC benefits based on the amended definition proposed in SCOPE's memo.

ID	Paraphrased Goal	Current SCWP Criteria/Metrics[1]	Potential Metrics Identified Through Literature Review (see Section 3.7 for complete summary of reviewed metrics)
		Recommended Next Steps	
		The Technical Team recommends engaging Dr. Manuel Pastor, or his colleagues, to further articulate key issues related to DACs (such as the definition of equity, green gentrification, and anti-displacement avoidance policies and advice on how DAC needs and benefits should be measured, tracked, and potentially customized to specific communities throughout the District, potentially using tools such as CalEnviroScreen 3.0 and the Los Angeles County Parks and Recreation Needs Assessment. [2]	

[2] Strategic Concepts in Organizing & Policy Education (SCOPE). Recommendations from Towards Equitable Implementation of the Safe Clean Water Program, June 2021.

1 Introduction

The following literature review summarizes background and initial research related to quantifying the SCWP Goals. The Working Group will rely on close consultation with experts to identify additional relevant resources, debate what metrics are most meaningful and appropriate to analyze the SCWP Goals throughout various Los Angeles County watersheds and communities, and ultimately build consensus around specific recommendations. Final metrics that the Working Group have come to a consensus on during Working Group meetings between January 2021 and January 2022 will be detailed in the Metric Definition and Model Assumptions report (Appendix D).

1.1 Study Background and Objectives

The SCWP promised Los Angeles County voters a multi-benefit approach to address a variety of water-related issues by improving Water Quality, achieving regulatory compliance, harvesting stormwater, prioritizing Nature-Based Solutions (NBS), increasing community investment, providing benefits to Disadvantaged Communities, and promoting green jobs, among other benefits. To help Regional Program applicants meet those diverse goals, scoring criteria and guidelines were initially developed to incentivize projects that simultaneously resolve water, environmental, compliance, and social issues; however, the first funding cycle of Stormwater Investment Plan (SIP) development featured extensive committee debate and public comments concerning the balance of NBS, community investments, and stormwater permit compliance. This public debate makes it clear that the Program must now be adaptively managed to drive projects and progress more efficiently toward SCWP Goals.

ARLA's SCWP Working Group Project proposes a robust and collaborative scientific approach to (1) establish agreed-upon metrics that define success for the suite of SCWP Goals, (2) evaluate historical Program data against those metrics, and (3) analyze the potential of future projects to accomplish the overarching Program goals collectively and equitably. To build consensus, a focused Working Group of three municipal and three non-governmental stakeholders will be engaged throughout the study to review, deliberate, and approve the Technical Team's findings. Outcomes will objectively address public comments and uncertainty about project scoring and prioritization that arose during the first year of Program implementation. The recommendations delivered as part of this study will ultimately support the District's efforts to adapt the Program and will outfit Watershed Coordinators with the best science-based tools to facilitate Steering Committee decisions and achieve workable SIPs that balance NBS, compliance, and community investment.

1.2 Literature Review Purpose

This literature review briefly researches what metrics have been developed elsewhere nationally and internationally to measure the success of NBS, community investments, DAC improvements, and other SCWP Goals. The literature review distills the Technical Team's research and institutional knowledge about ongoing local efforts and studies to develop a working knowledge-base, and identifies how connections with other efforts can be leveraged to build on local expertise and reduce redundancies. Findings will also inform current knowledge gaps that warrant consulting with subject area experts and stakeholders.

2 SCWP Goals and Definitions

The following section introduces the goals and key terms of the SCWP, which govern the Program and guide what metrics will subsequently be recommended to quantify Program and project success.

2.1 SCWP Implementation Ordinance

The SCWP Implementation Ordinance, adopted by the Los Angeles County Board of Supervisors in July 2019, codifies Program definitions and goals into the District Code by amending Chapter 16 and adding Chapter 18.[3] The Ordinance elements may be amended as necessary by the Los Angeles County Board of Supervisors without voter approval, unless the amendments would change the purpose, use, amount, or application of the Special Parcel Tax.

2.1.1 Codified Goals and Definitions

District Code Section (§) 18.04 states that the Program "…shall be implemented consistent with the following goals:" (**bold formatting** added to emphasize the key themes of each goal)

A. Improve **Water Quality** and contribute to attainment of water-quality requirements.
B. Increase **drought preparedness** by capturing more Stormwater and/or Urban Runoff to store, clean, reuse, and/or recharge groundwater basins.
C. Improve **public health** by preventing and cleaning up contaminated water, increasing access to open space, providing additional recreational opportunities, and helping communities mitigate and adapt to the effects of climate change through activities such as increasing shade and green space.
D. Leverage **other funding** sources to maximize SCW Program Goals.
E. Invest in infrastructure that provides **multiple benefits**.
F. Prioritize **Nature-Based Solutions**.
G. Provide a **spectrum of project sizes** from neighborhood to regional scales.
H. Encourage **innovation** and adoption of new technologies and practices.
I. Invest in independent **scientific research**.
J. Provide **DAC Benefits**, including Regional Program infrastructure investments, that are not less than one hundred ten percent (110%) of the ratio of the DAC population to the total population in each Watershed Area.
K. Provide Regional Program infrastructure funds t**hat benefit each Municipality in proportion** to the funds generated within their jurisdiction, after accounting for allocation of the one hundred ten percent (110%) return to DACs, to the extent feasible.
L. Implement an iterative planning and evaluation process to ensure **adaptive management**.
M. Promote **green jobs** and career pathways.
N. Ensure ongoing **operations and maintenance** for Projects.

[3] Safe Clean Water Program. Implementation Ordinance. https://safecleanwaterla.org/wp-content/uploads/2019/07/Implementation-Ordinance-2019-07-24-1.pdf

To assess progress toward achieving the Program Goals, the Implementation Ordinance specifically requires the various programs of the SCWP to report on the Water Quality Benefits, Water Supply Benefits, and Community Investment Benefits (which generally align with the first three SCWP Goals A, B, and C, respectively). These three goals and benefits will be described herein as the "core SCWP Goals" because many of the other SWCP goals are related to or dependent on them; the terms are defined in the Implementation Ordinance as follows to provide a (subjective) foundation for judging Program success:

Water Quality Benefit: a reduction in Stormwater or Urban Runoff pollution, such as improvements in the chemical, physical, and biological characteristics of Stormwater or Urban Runoff in the District. Activities resulting in this benefit include, but are not limited to: infiltration or treatment of Stormwater or Urban Runoff, non-point source pollutant control, and diversion of Stormwater or Urban Runoff to a sanitary sewer system. (§ 16.03.N)

Water Supply Benefit: an increase in the amount of locally available Water Supply, provided there is a nexus to Stormwater or Urban Runoff capture. Activities resulting in this benefit include, but are not limited to, the following: reuse and conservation practices, diversion of Stormwater or Urban Runoff to a sanitary sewer system for direct or indirect water recycling, increased groundwater replenishment or available yield, or offset of potable water use. (§ 16.03.O)

Community Investment Benefit: a benefit created in conjunction with a Project or Program, such as, but not limited to: improved flood management, flood conveyance, or flood risk mitigation; creation, enhancement, or restoration of parks, habitat or wetlands; improved public access to waterways; enhanced or new recreational opportunities; and greening of schools. A Community Investment Benefit also includes a benefit to the community derived from a Project or Program that improves public health by reducing heat island effect and increasing shade or planting of trees or other vegetation that increase carbon reduction/sequestration and improve air quality. (§ 16.03.F)

The Implementation Ordinance also defines the following terms relevant to tracking goals E, F, and J, respectively:

Multi-Benefit Project: a Project that has: (1) a Water Quality Benefit, and (2) a Water Supply Benefit or a Community Investment Benefit, or both. (§ 16.03.S)

Nature-Based Solution: a Project that utilizes natural processes that slow, detain, infiltrate or filter Stormwater or Urban Runoff. These methods may include relying predominantly on soils and vegetation; increasing the permeability of Impermeable Areas; protecting undeveloped mountains and floodplains; creating and restoring riparian habitat and wetlands; creating rain gardens, bioswales, and parkway basins; and enhancing soil through composting, mulching, and planting trees and vegetation, with preference for native species. Nature-Based Solutions may also be designed to provide additional benefits such as sequestering carbon, supporting biodiversity, providing shade, creating and enhancing parks and open space, and improving quality of life for surrounding communities. Nature-Based Solutions include Projects that mimic natural processes, such as green streets, spreading grounds and planted areas with water storage capacity. (§ 16.03.V)

Disadvantaged Community: a Census Block Group that has an annual median household income of less than eighty percent (80%) of the Statewide annual median household income (as defined in Water Code section 79505.5). (§ 16.03.H)

2.1.2 SCWP Guidance on Measuring Goals

The District and various SCWP committees are charged with the responsibility of determining whether—and the extent to which—the Program is achieving the goals listed above. The currently codified guidance for measuring goals is summarized below; however, various SCWP committees have acknowledged that the guidelines are relatively subjective and require further detail, as discussed in the next section.

Additionally, it is important to note that the geographic and temporal scale at which goals are assessed varies by Program and goal. For example, Water Supply Benefits are measured for individual projects in the Infrastructure Program over a 50-year period, although District Program annual reports are required to sum Water Supply benefits for the previous year at the Watershed-Area-scale. Future guidance would benefit from specifying when, and at what scale, goals should be measured and tracked.

Municipal Program Goal Measurement

Municipalities' annual SCWP progress and expenditure reports will be evaluated by the District and Regional Oversight Committee (ROC) to determine "…whether and the extent to which each Municipality's expenditures achieved SCW Program Goals…" (§ 18.06.D.3-4) This determination will be made based on each Municipality's summary of the Water Quality, Water Supply, and Community Investment Benefits realized through the use of SCW Program funds." (§ 18.06.D.2.a).

Regional Program Goal Measurement

Under the Regional Program, projects submitted by Watershed Area Steering Committees (WASCs) to the Scoring Committee for consideration must be "Multi-Benefit Projects" (§ 18.07.B.1.c.(2)). The Scoring Committee is composed of subject matter experts on Water Quality Benefits, NBS or Community Investment Benefits, and Water Supply Benefits (§ 18.07.C.4.a); note that the membership requirements imply that NBS and Community Investment Benefits may be interchangeable.

As with the Municipal Program, the ROC will review each WASC's Stormwater Investment Plan (SIP) to "determine whether and the extent to which each SIP achieves the SCW Program Goals" (§ 18.07.b.1.h); the ROC must be composed of "…subject-matter experts in the areas of Water Quality Benefits, Water Supply Benefits, Nature-Based Solutions and Community Investment Benefits, public health, sustainability, and or other fields related to Stormwater capture or the reduction of Stormwater or Urban Runoff pollutant." (§ 18.08.A.1) "A spectrum of Project types and sizes shall be implemented throughout the region, to the extent feasible, to be evaluated annually over a rolling five (5) year period;" (§ 18.07.B.2.e), and "Nature-Based Solutions shall be prioritized, to the extent feasible;" (§ 18.07.B.2.f). Further, the Regional Program clarifies that the District will validate that DAC Benefits are being achieved by working "with stakeholders and Watershed Coordinator(s) to utilize existing tools to identify high-priority geographies for water-quality improvement projects and other projects that create DAC Benefits within DACs," (§ 18.07.B.2.c). Watershed Coordinators are funded through the Regional Program by each WASC to build "…inclusion and meaningful engagement in pursuit of SCW Program Goals…" (§ 18.07.D.3).

The SCWP Feasibility Study Guidelines and associated project scoring criteria further clarify how SCWP Goals and benefits can be defined and characterized, as described in later sections of this literature review. Those guideline documents are included by reference in the SCWP Implementation Ordinance, but were developed—and may be subsequently amended—by the District's Chief Engineer (with at least 30 days advanced public notice) (§ 18.07.B.3 and § 18.07.C.4.c).

District Program Goal Measurement

The District is charged with evaluating overall Program success by preparing quarterly progress and expenditure reports, which include a summary of "…expenditures that achieve DAC Benefits." (§ 18.07.F.3.j). Infrastructure Program Project Developers shall report annually the Water Quality Benefits, Water Supply Benefits, Community Investment Benefits and the SCW Program Goals achieved during the prior year. (§ 18.07.F.4). WASCs must review the annual reports to evaluate whether "…expected benefits have significantly changed and remain consistent with the SCW Program Goals." (§ 18.07.F.5)

The Credit Program also references Water Quality, Water Supply, Community Investment, and Additional Activities Credits that are related to the SCWP Goals (§ 18.10.A). A list of eligible Stormwater improvement criteria are provided to calculate the maximum credit amount (18.10.B.1), while the other credits are applied if the Benefited Development can demonstrate Water Supply Benefits, Community Investment Benefits, or Additional Activities "…that confer benefits to the broader regional community related to SCW Program Goals," which are articulated in the Credit Program Procedures and Guidelines developed by the District, and included by reference in the Implementation Ordinance. (§ 18.10.B.5.b)

2.2 Recent SCWP Committee Commentary and Deliberation about Goals

During the July 20, 2020, ROC meeting, the ROC members expressed the need to further engage with the District, experts, and stakeholders to establish more specific goals for each Watershed Area (customized to local watershed and community priorities) and define baseline metrics for measuring Program effectiveness. The District responded by issuing a Staff memo on October 19, 2020, outlining an initial framework for developing enhanced Program guidance around the following topics:

- Topics directly related to the measurement of Program Goals:
    - Clarifying the prioritization of Nature-Based Solutions
    - Understanding Water Supply Benefits
    - Applying consistent DAC Benefits program policies

- Other topics related to Program implementation
    - Programming Partial Funding in Stormwater Investment Plans
    - Strengthening Community Engagement and Support

The District released the basic elements of interim guidance for Disadvantaged Community Benefits and Nature-Based Solutions (without public review) on April 30, 2021, and will continue working toward formalizing Program guidance adaptations through expert engagement and public review by April 30, 2022.

To begin this process, the ROC had discussed Water Supply Benefits and prioritization of Nature-Based Solutions during its meeting on January 28, 2021, and DAC Benefits and community engagement during its meeting on February 25, 2021. The District prepared two workbooks to guide discussions during both meetings, which summarized the ROC role; described common acronyms, terms, definitions, and existing SCWP guidance; included issue statements related to each topic; and provided a summary of principles and areas of potential common ground for upcoming Program guidance.[4] The contents of these workbooks and the resulting discussion among the ROC will provide one set of inputs for consideration by the Working Group as it assembles potential recommendations.

During the first funding cycle of SCWP Infrastructure Program applications, the Scoring Committee also identified "challenges that need to be resolved" through "additional research" to clarify Feasibility Study Guidelines and project scoring criteria that "were unclear or regularly misinterpreted," as briefly outlined in the *Draft Scoring Committee Recommendations Memo* presented to the District at the Scoring Committee meeting on June 22, 2020.[5]

[4] Safe Clean Water Program. Workbooks, January 28, 2021 and February 25, 2021. https://safecleanwaterla.org/wp-content/uploads/2021/01/20210128-ROC-Agenda-DRAFT-Workbook-clean-1.pdf and https://safecleanwaterla.org/wp-content/uploads/2021/02/02.25.2021-ROC-Agenda-Workbook.pdf

[5] Safe Clean Water Program. Scoring Committee Recommendations. https://safecleanwaterla.org/wp-content/uploads/2020/06/Scoring-Committee-Recommendations-DRAFT.pdf

2.3 Working Group Prioritization of Goals for Further Study and Assessment

A survey was issued prior to the first Working Group meeting to define the Working Group members' (and organizations') baseline priorities. The Working Group discussed the results and agreed upon which Program Goals warrant analysis and/or modeling under this study ("primary" goals) and which Goals warrant input from external subject matter experts. The results are summarized below, and the Goals were grouped into the following categories to organize research and discussion (note that the primary goals selected by the Working Group for modeling were categorized into "Prioritized" and "Supplemental" to differentiate the goals prioritized by the Working Group):

1. Working Group Prioritized – measurement will require Working Group agreement on explicit metrics and quantitative modeling
2. Working Group Supplemental – these goals are foundational to the structure of the Program and ongoing implementation, but do not necessarily warrant metrics to define success; ARLA will track input and recommendations related to these goals, but they will not be analyzed through the modeling process

Table 3. Summary of SCWP Goals, sorted by Working Group priority and ARLA study category (orange text indicates Working Group prioritized Program Goals).

ID	Paraphrased Goal	Full Text from § 18.04 - SCW Program Goals	Working Group Priority (1=highest)	Expertise Requested by Working Group (1=highest priority)	Additional Guidance Requested by ROC?	ARLA Study Category
A	**Water Quality**	Improve Water Quality and contribute to attainment of water-quality requirements.	1	1		**1 – Working Group Prioritized**
C	**Public Health and Community Investments**	Improve public health by preventing and cleaning up contaminated water, increasing access to open space, providing additional recreational opportunities, and helping communities mitigate and adapt to the effects of climate change through activities such as increasing shade and green space.	2	7		
E	**Multiple Benefits**	Invest in infrastructure that provides multiple benefits.	3	3		
B	**Water Supply**	Increase drought preparedness by capturing more Stormwater and/or Urban Runoff to store, clean, reuse, and/or recharge groundwater basins.	4	2	Yes	
F	**Nature-Based Solutions**	Prioritize Nature-Based Solutions.	5	4	Yes	
J	**DAC Benefits**	Provide DAC Benefits, including Regional Program infrastructure investments, that are not less than one hundred ten percent (110%) of the ratio of the DAC population to the total population in each Watershed Area.	6	5	Yes	
M	**Green Jobs**	Promote green jobs and career pathways.		6		
N	**Operations and Maintenance**	Ensure ongoing operations and maintenance for Projects.				
D	**Other Funding**	Leverage other funding sources to maximize SCW Program Goals.				
G	**Spectrum of Project Sizes**	Provide a spectrum of project sizes from neighborhood to regional scales.				

ID	Paraphrased Goal	Full Text from § 18.04 - SCW Program Goals	Working Group Priority (1=highest)	Expertise Requested by Working Group (1=highest priority)	Additional Guidance Requested by ROC?	ARLA Study Category
K	**Proportionally Benefiting Municipalities**	Provide Regional Program infrastructure funds benefiting each Municipality in proportion to the funds generated within their jurisdiction, after accounting for allocation of the one hundred ten percent (110%) return to DACs, to the extent feasible.				
H	**Innovation**	Encourage innovation and adoption of new technologies and practices.				
I	**Scientific Research**	Invest in independent scientific research.				
L	**Adaptive Management**	Implement an iterative planning and evaluation process to ensure adaptive management.				

3 Working Group Prioritized Goals

As discussed in the preceding section, the Working Group prioritized the following goals for collaborative development of further guidance:

- **Water Quality**
- **Public Health and Community Investment**
- **Multiple benefits**
- **Water Supply**
- **NBS**
- **DAC Benefits**

To objectively measure progress toward achieving each goal, quantitative metrics must be recommended and agreed upon for each. The summaries in the following sections provide initial metrics for consideration based on related programs and studies, starting with the "core" Program goals (Water Quality, Water Supply, Community Investments and Public Health), then followed by goals that are related to or derived from the core goals. Findings will be augmented through discussions with the Working Group and external experts to ultimately generate recommendations to the District.

Note that many Program goals are complementary, and some metrics may apply to multiple goals. Figure 2 suggests a conceptual framework for how the Goals and their respective outputs/outcomes may interact based on the current SCWP definitions presented in Section 2 SCWP Goals and Definitions. Before discussing specific metrics, the Working Group should agree on the synergies between overarching goals.

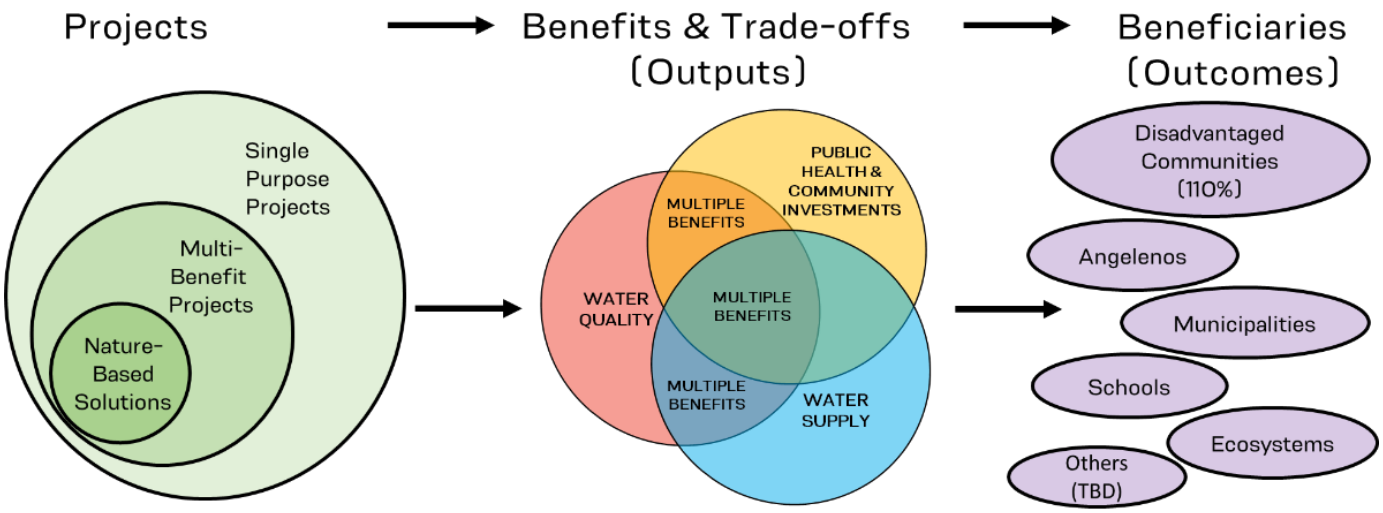

Figure 2. Potential relationship of Program components, including certain prioritized SCWP goals (adapted from Sarah Diringer, Pacific Institute, 2021).

3.1 Water Quality

The overarching goal of the federal Clean Water Act—and its local implementation and enforcement through the Municipal Separate Storm Sewer System (MS4) permitting process—is colloquially to restore and maintain "swimmable and fishable" water bodies. In practice, however, metrics for defining progress toward clean water can significantly vary from watershed to watershed based on the local beneficial uses of water bodies; historical, current, and potential future conditions and biological objectives; pollutant and runoff sources; and the scale at which progress is tracked (among other factors).

3.1.1 Current SCWP Guidance and Scoring Criteria

The SCWP definition of Water Quality Benefits aligns with the objective of the federal Clean Water Act, which is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (United States Code, Title 33, Chapter 26, Section 1251), although does not provide specific metrics for success. As shown in Table 4, the *Feasibility Study Guidelines, Exhibit A – Infrastructure Program Project Scoring Criteria* clarify that wet and dry-weather Water Quality benefits can be judged on the basis of "quantifying the pollutant reduction (i.e., concentration, load, exceedance day, etc.) for a class of pollutants using a similar analysis as the [(Enhanced) Watershed Management Program].[6] The analysis should be an average percent reduction comparing influent and effluent from the project over a ten-year period. Additional points are awarded based on the project's 24-hour capture efficiency (acre-feet capacity per $-million).

Table 4. SCWP scoring criteria for Water Quality Benefits.

Section	Score Range	Scoring Standards
A.1 Wet + Dry Weather Water Quality Benefits	50 points max	The Project provides water quality benefits
	20 points max	A.1.1: For Wet Weather BMPs Only: Water Quality Cost Effectiveness (Cost Effectiveness) = (24-hour BMP Capacity)[1] / (Capital Cost in $Millions) • <0.4 (acre feet capacity / $-Million) = 0 points • 0.4-0.6 (acre feet capacity / $-Million) = 7 points • 0.6-0.8 (acre feet capacity / $-Million) = 11 points • 0.8-1.0 (acre feet capacity / $-Million) = 14 points • >1.0 (acre feet capacity / $-Million) = 20 points *[1]. Management of the 24-hour event is considered the maximum capacity of a Project for a 24-hour period. For water quality focused Projects, this would typically be the 85th percentile design storm capacity. Units are in acre-feet (AF).*
- OR -	30 points max	A.1.2: For Wet Weather BMPs Only: Water Quality Benefit - Quantify the pollutant reduction (i.e. concentration, load, exceedance day, etc.) for a class of pollutants using a similar analysis as the E/WMP which uses the Districts Watershed Management Modeling System (WMMS). The analysis should be an average percent reduction comparing influent and effluent for the class of pollutant over a ten-year period showing the impact of the Project. Modeling should include the latest performance data to reflect the efficiency of the BMP type. <u>Primary Class of Pollutants</u> • >50% = 15 points • >80%= 20 points *(20 Points Max)* <u>Second or More Classes of Pollutant</u> • >50% = 5 points • >80%= 10 points (10 Points Max)
A.2 Dry Weather Only Water Quality Benefits	20 points	A.2.1: For dry weather BMPs only, Projects must be designed to capture, infiltrate, treat and release, or divert 100% (unless infeasible or prohibited for habitat, etc) of all tributary dry weather flows.
	20 points max	A.2.2: For Dry Weather BMPs Only. Tributary Size of the Dry Weather BMP • <200 Acres = 10 points • >200 Acres = 20 points

As currently structured, the project scoring criteria do not necessarily reward projects with the highest absolute impact at the watershed scale because points are awarded based on relative reduction; in other words, a project that captures one pound of pollutants and operates at 90 percent efficiency could be scored higher than a project that captures 1,000 pounds of pollutants but operates at 89 percent efficiency. The Scoring Committee acknowledged in its June 22, 2020, memorandum that the current framework disadvantages "larger projects that might actually reduce pollutant loading more than smaller projects that achieve a higher percentage reduction" and that where "a project could not score as a wet weather project, the Committee applied the dry weather scoring to try to maximize points for the applicant, though this did not always reflect the intent of the project."

To address these issues, the Scoring Committee suggested that the scoring criteria be amended to allow "a magnitude route such as pounds of pollutants removed, and a volume treatment route."

The scoring criteria for measuring the success of projects designed solely for dry weather flow treatment is a binary determination based on whether a project can capture, infiltrate, treat and release, or divert 100 percent of all tributary dry

[6] Safe Clean Water Program. Feasibility Study Guidelines. https://safecleanwaterla.org/wp-content/uploads/2019/08/Feasibility-Study-Guidelines-20190807-FINAL.pdf

weather flows; points are also awarded based on the size of the drainage area managed for dry weather flow. During the first two funding cycles of SCWP scoring, the Scoring Committee has recommended several "wet weather projects" be recategorized as "dry weather projects" to be awarded a higher Water Quality Benefits score.

3.1.2 Local, Related Examples

Although Water Quality improvement can be interpreted in different ways, regional benchmarks and objectives have been established by the Los Angeles Regional Water Quality Control Board through development of the *Water Quality Control Plan: Los Angeles Region Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties* (*Basin Plan*) and approval of Watershed Management Programs.

Basin Plan, Los Angeles Regional Water Quality Control Board (2019)[7]

Chapter 2 of the *Basin Plan* defines the **beneficial uses** of every receiving water throughout the Los Angeles Region, which are the essential clean water goals and endpoints driving Water Quality Benefits:

Municipal and Domestic Supply (MUN)
Uses of water for community, military, or individual Water Supply systems including, but not limited to, drinking Water Supply.

Agricultural Supply (AGR)
Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Industrial Process Supply (PROC)
Uses of water for industrial activities that depend primarily on Water Quality.

Industrial Service Supply (IND)
Uses of water for industrial activities that do not depend primarily on Water Quality including, but not limited to, mining, cooling Water Supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Groundwater Recharge (GWR)
Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of Water Quality, or halting of saltwater intrusion into freshwater aquifers.

Hydropower Generation (POW)
Uses of water for hydropower generation.

Water Contact Recreation (REC-1)
Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, waterskiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Limited Water Contact Recreation (LREC-1)
Uses of water for recreational activities involving body contact with water, where full REC-1 use is limited by physical conditions such as very shallow water depth and restricted access and, as a result, ingestion of water is incidental and infrequent.

Non-contact Water Recreation (REC-2)
Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Commercial and Sport Fishing (COMM)
Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

[7] Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties.
https://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/basin_plan_documentation.html

Freshwater Replenishment (FRSH)
Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).

Navigation (NAV)
Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Warm Freshwater Habitat (WARM)
Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat (EST)
Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Marine Habitat (MAR)
Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Rare, Threatened, or Endangered Species (RARE)
Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

Spawning, Reproduction, and/or Early Development (SPWN)
Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Aquaculture (AQUA)
Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Inland Saline Water Habitat (SAL)
Uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Freshwater Habitat (COLD)
Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Wetland Habitat (WET)
Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance Water Quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

Wildlife Habitat (WILD)
Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Migration of Aquatic Organisms (MIGR)
Uses of water that support habitats necessary for migration, acclimatization between fresh and saltwater , or other temporary activities by aquatic organisms, such as anadromous fish.

Shellfish Harvesting (SHELL)
Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

High Flow Suspension: The High Flow Suspension shall apply to water contact recreational activities associated with the swimmable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use, non-contact water recreation involving incidental water contact regulated under the REC-2 use, and the associated bacteriological objectives set to protect those activities. Water quality objectives set to protect (1) other recreational uses associated with the fishable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use and (2) other REC-2 uses (e.g., uses involving the aesthetic aspects of water) shall remain in effect at all times for waters where the (av) footnote appears in Table 2-1a. The High Flow Suspension shall apply on days with rainfall greater than or equal to ½ inch and the 24 hours following the end of the ½-inch or greater rain event, as measured at the nearest local rain gauge, using local Doppler radar, or using widely accepted rainfall estimation methods. The High Flow Suspension only applies to engineered channels, defined as inland, flowing surface water bodies with a box, V-shaped or trapezoidal configuration that have been lined on the sides and/or bottom with concrete. The water bodies to which the High Flow Suspension applies are identified in Table 2-1a in the column labeled "High Flow Suspension".

Preservation of Biological Habitats (BIOL)
Uses of water that support designated areas or habitats, such as Areas of Special Biological Significance (ASBS), established refuges, parks, sanctuaries, ecological reserves, or other areas where the preservation or enhancement of natural resources requires special protection. The following coastal waters have been designated as ASBS in the Los Angeles Region. For detailed descriptions of their boundaries see the Ocean Plan discussion in Chapter 5, Plans and Policies:

- San Nicolas Island and Begg Rock
- Santa Barbara Island and Anacapa Island
- San Clemente Island
- Mugu Lagoon to Latigo Point
- Santa Catalina Island, Subarea One, Isthmus Cove to Catalina Head
- Santa Catalina Island, Subarea Two, North End of Little Harbor to Ben Weston Point
- Santa Catalina Island, Subarea Three, Farnsworth Bank Ecological Reserve
- Santa Catalina Island, Subarea Four, Binnacle Rock to Jewfish Point

The following areas are designated Ecological Reserves or Refuges:

- Channel Islands National Marine Sanctuary
- Santa Barbara Island Ecological Reserve
- Anacapa Island Ecological Reserve
- Catalina Marine Science Center Marine Life
- Point Fermin Marine Life Refuge
- Farnsworth Bank Ecological Reserve
- Lowers Cove Reserve
- Abalone Cove Ecological Reserve
- Big Sycamore Canyon Ecological Reserve

To restore and maintain the beneficial uses for each waterbody, Chapter 3 of the *Basin Plan* designates numeric or narrative Water Quality objectives (metrics) to benchmark current conditions and measure progress. In many instances, pollutants are measured against multiple metrics to address both chronic (long-term) and acute (short-term) impairments caused by discharge of pollutants into receiving waters. Where appropriate and available, the *Basin Plan* also provides formulae and factors to adjust objectives to site-specific conditions.

Metrics are defined specific to the following impairments and pollutants:

- Ammonia
- Bacteria, Coliform
- Bioaccumulation
- Biochemical Oxygen Demand (BOD5)
- Biostimulatory Substances
- Chemical Constituents
- Chlorine, Total Residual
- Color
- Exotic Vegetation
- Floating Material
- Methylene Blue Activated Substances (MBAS)
- Mineral Quality
- Nitrogen (Nitrate, Nitrite)
- Oil and Grease
- Oxygen, Dissolved (DO)
- Pesticides
- pH
- Polychlorinated Biphenyls (PCBs)
- Priority Pollutants
- Radioactive Substances
- Solid, Suspended, or Settleable Materials
- Taste and Odor
- Temperature
- Toxicity
- Turbidity

Additionally, narrative objectives are provided for Wetland Hydrology and Habitat.

The *Basin Plan* also lists adopted Total Maximum Daily Loads (TMDLs) specific to certain water bodies. TMDLs set regulated limits on the discharge of pollutants to specific water bodies from specific sources or otherwise assign responsibility to achieve certain Water Quality objectives. The TMDLs relevant to discharge of Stormwater and Urban Runoff are also listed in the MS4 Permit and define the highest priority water body-pollutant combinations to be addressed through MS4 programs.

Watershed Management Programs (WMPs), L.A. County MS4 Permittees (2015-present)[8]

WMPs are plans developed by consortiums of municipalities (watershed management groups) to comply with the requirements of the MS4 Permit, including attaining Water Quality objectives defined in the Basin Plan for specific water bodies and beneficial uses. Metrics for measuring Water Quality improvement vary from WMP to WMP, with some programs designed to directly address receiving water beneficial uses using metrics such as number of days over a long-term period that receiving waters exceed toxic concentrations, whereas other programs simplify and translate Water Quality metrics to volume capture targets (acre-feet of stormwater captured during a specific critical storm event). Many WMPs are designed around an annual pollutant load reduction target as a proxy for reducing the frequency that stormwater and runoff concentrations exceed Water Quality objectives.

While the *Basin Plan* and associated TMDLs specify the critical conditions and frequencies over which pollutants should be evaluated, the Los Angeles Regional Water Quality Control Board's *Guidelines for Conducting Reasonable Assurance Analysis* recommend that regional WMPs plan to manage up to a 90th percentile condition (i.e., programs should be

[8] Los Angeles Regional Water Quality Control Board. Watershed Management Programs.
https://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/watershed_management/

designed to achieve Water Quality objectives 90 percent of the time).[9] The highest 10th percentile conditions are considered extreme events during which stormwater capture for Water Quality improvement may not be safe or feasible.

3.1.3 National Examples

Water quality goals are specific to each watershed, so it would not necessarily be appropriate to research metrics outside of the Los Angeles Region; however, the below examples demonstrate the broad range of potential metrics for characterizing Water Quality Benefits at both the project-scale and receiving water-scale.

District of Columbia MS4 Permit (2018)[10]

The District of Columbia includes both combined sewers and MS4s for drainage. Similar to the Los Angeles Region, the MS4 Permit is based on attaining numerical Water Quality objectives in receiving waters, although interim limits are articulated into specific, measurable, project-based metrics, including acres managed for onsite retention of a specific storm, square feet of new green roofs installed, new tree plantings, and pounds of trash captured. While these metrics are prescriptive, measurable, and multi-benefit, they may also be challenging to directly correlate incremental project-scale implementation with progress toward meaningful receiving water improvements.

Biological Objectives, San Diego Region (ongoing)

At the receiving water-scale, some Southern California regions are moving toward development of biological objectives more closely related to beneficial uses. The development of biological objectives has been discussed at varying degrees across Regional Boards and the State Water Resources Control Board in California. Overall, these have looked at establishing an objective that more directly measures the conditions of aquatic life in receiving waters, thus a more direct measure of the health and protection of the beneficial use. Impairments for Benthic Community Effects are already included in the states 303(d) listings based on bioassessments showing a diminished number of species and it is associated with a discharge of pollutants. While initial assessments looked at the Southern California Index of Biological Integrity (IBI), the recent focus is on the California Stream Condition Index (CSCI) score. The CSCI scores measure the observed versus expected taxa in a receiving water, with a maximum score of 1 indicating a perfect match. The recent San Diego Basin Plan Amendment (Resolution R9-2020-0234) adopted in December 2020 establishes a biological objective for perennial and seasonal streams based on a CSCI score greater than or equal to 0.79, which is the 10th percentile of all reference site scores.

There are ongoing discussions regarding the appropriate threshold value and exclusions. For example, the landscape constraints on stream biological integrity model developed by SCCWRP identifies whether a stream is likely unconstrained, possibly unconstrained, possibly constrained, or likely constrained based on the expected biological condition relative to landscape drivers. In other words, it identifies whether there are landscape constraints limiting the potential biological condition (e.g., CSCI score) of the stream. In addition, Algal Index of Biotic Integrity (IBI) scores may be referenced, though the development of an appropriate threshold value is far behind that of the CSCI scores.

3.1.4 Initial Metrics and Recommendations

It is critical that Water Quality metrics be developed at scales that are both environmentally meaningful and practically measurable. This means that metrics defined for individual projects must directly translate to progress toward attaining beneficial uses in downstream receiving waters.

The Technical Team recommends that metrics for measuring Water Quality improvement at a Watershed-Area-scale be locally driven and related as closely as possible to beneficial use attainment in the receiving waters; examples include

[9] Los Angeles Regional Water Quality Control Board. Guidelines for Conducting Reasonable Assurance Analysis. https://www.waterboards.ca.gov/rwqcb4/water_issues/programs/stormwater/municipal/watershed_management/tac/doc/RevisedRAAModelingCriteria1-22-14.pdf

[10] United States Environmental Protection Agency. D.C. Municipal Separate Storm Sewer System (MS4). https://www.epa.gov/npdes-permits/dc-municipal-separate-storm-sewer-system-ms4

biological objectives or beach closure days. At the project-scale, however, long-term pollutant load capture represents a meaningful metric to measure how site-specific improvements are reducing the discharge of pollutants to water bodies.

The Working Group ranked this goal the highest priority for engaging expert support; the Technical Team proposes to provide the requested expert support with in-house resources.

The following Water Quality metrics are listed for different scales of program assessment, and may be relevant depending on local Water Quality priorities:

Project-scale Examples

- Pollutant load captured/reduced
    - Percentage of baseline load captured (%)
    - Long-term total load reduced (pounds/year)
- Volumetric capture proxies
    - Acres managed for onsite retention of a specific design storm size (ac)
    - Runoff volume retained for a specific design storm (acre-feet)

Outfall- or Subwatershed-Scale Examples

- Decreased concentrations in outflows (%)
- Frequency that discharges exceed Water Quality objectives (%)

Receiving Water- or Watershed Area-Scale Examples

- Decreased concentrations under applicable critical conditions (e.g., metals consider chronic and acute CTR conditions, nutrients consider annual and summer averages and typical algal growth conditions, bacteria consider high-flow suspension (HFS) days) (%)
- Decreased concentration levels in fish tissue samples (mostly focused on mercury, selenium, PCBs, DDT, and Chlordane) (%)
- Decreased number of exceedance days, shortened exposure periods of exceedances (%, days)
- Biological objectives
    - Improved California Stream Condition Index (CSCI) score (reference the proposed Basin Plan amendment in San Diego) (unitless)
    - Improved Algal Index of Biotic Integrity (IBI) score (unitless)
- Decreased number of beach closures/improved grade on Heal the Bay's Beach Report Card (count, or % of days)
- Receiving water removed from the 303(d) list (i.e., meeting Basin Plan objectives) (count, or % of total currently listed)
- The *Los Angeles River Receiving Water Monitoring Program* combines metrics listed above to holistically assess waterbody health
    - What is the condition of streams in the Los Angeles River Watershed?
        - CSCI
        - Algal IBI
        - CA Rapid Assessment
        - Physical Habitat
        - Aquatic Chemistry
    - Are conditions at areas of unique interest getting better or worse?
        - Aquatic Chemistry
        - Biological and Riparian Habitat (CRAM) Condition
        - Physical Habitat
    - Are permitted discharges meeting Water Quality objectives in receiving waters?
        - Water reclamation plant monitoring
    - Is it safe to recreate?

        - Fecal Indicator Bacteria concentration exceedances (single sample and geomean) at recreational sites
        - Site usage
    - Are locally caught fish safe to eat?
        - Fish population
        - Fish tissue concentrations

3.2 Water Supply

A focus on drought preparedness and resilience strongly resonated with voters and aided in the successful adoption of the SCWP. While one drop of rainwater captured locally would seemingly correlate to one less drop that needs to be imported, the hydrogeological setting and local infrastructure greatly impacts whether captured runoff will meaningfully augment local supply.

3.2.1 Current SCWP Guidance and Scoring Criteria

The current scoring criteria award Water Supply Benefits points to projects on the basis of both total long-term volume capture and long-term capture efficiency (total life cycle cost per acre-feet captured). These metrics are quantitative and congruent to overarching Program goals, although additional guidance is needed to estimate where—and how much—infiltrated stormwater/urban runoff can be expected to percolate to groundwater aquifers to replenish and augment local Water Supply. For example, runoff infiltrated over a confined or contaminated aquifer may not necessarily contribute to additional local Water Supply. The *Feasibility Study Guidelines* address this uncertainty by requiring that "Where a Project's Water Supply Benefits include an increase in Water Supply through soil infiltration, the *Feasibility Study* should include an engineering analysis demonstrating that that the infiltrated water is reaching a managed, usable groundwater aquifer and confirmation that the agency managing the groundwater basin concurs."[11]

Additionally, some candidate projects are located upstream from existing spreading basins or other regional infiltration systems, so it is unclear how much water may have incidentally recharged downstream if it had not been captured upstream. The District intends to further evaluate the actual value added by capturing locally onsite and/or allowing downstream capacity to remain. The Scoring Committee acknowledged in its June 22, 2020, memo that, "For the Upper San Gabriel and Rio Hondo Watershed Areas, there is the added uncertainty of whether projects should get credit for Water Supply benefits when the majority of stormwater is already captured [downstream at Whittier Narrows Dam or existing spreading grounds]." The Scoring Committee also expressed uncertainty about awarding points to projects that divert to speculative (not yet constructed) water reclamation/reuse facilities.

The current criteria may disadvantage certain projects on the basis of setting within the watershed, groundwater basin, or sewershed, and the Scoring Committee suggested that future scoring criteria revisions be customized to the Water Supply constraints of each watershed.

On January 28, 2021, the ROC discussed the issues surrounding understanding Water Supply Benefits. Varying opinions remain about the interpretation of Water Supply benefits in relation to certain types of activities that may result in such a benefit. For example, the hydrology and size of each Watershed Area is different, and projects in some regions can more easily achieve groundwater storage of large volumes of water. In addition, other Watershed Areas and municipalities have programmatic approaches to consider, meaning that any one project may provide small or no Water Supply benefits until future projects are constructed.

[11] Safe Clean Water Program. Feasibility Study Guidelines. https://safecleanwaterla.org/wp-content/uploads/2019/08/Feasibility-Study-Guidelines-20190807-FINAL.pdf

In the ROC's *workbook*, several potential principles for upcoming Program guidance were introduced:[12]

1. Because the ability to provide a benefit to the region's Water Supply is not equal in all Watershed Areas, the goal of increasing regional drought preparedness through increased Water Supply could be evaluated with respect to relative Water Supply potential and other projects under consideration within that Watershed Area.
2. Consideration should be given to adjacent or interacting projects where one project may impact the other but currently is not, or cannot, be fully accounted for in the application and review process.
3. Clarification on the application of first flush and dry-weather flows.
4. The value of water capture on-site and/or allowing downstream capacity to remain, even if not creating "new water" should be explored with the understanding that new rights and new credits are not typically established through the scoring of SCWP Water Supply points.

The ROC and District suggest in the *workbook* that future guidance is needed for the following topics:

1. Projects claiming future Water Supply benefits that rely on future integrated projects to be implemented.
2. Projects within Watershed Areas where it is believed that 100 percent of stormwater runoff is captured/recharged or accounted for in management agreements.
3. Projects that may have no opportunity for stormwater capture/recharge as "supply."
4. How to calculate first flush flows and apply benefits for projects capturing such flows.
5. If/how environmental water could be counted toward the Water Supply benefit and the associated trade-offs.
6. Guidance/clarification to avoid any water right implications.
7. Clarifying the interpretation and application of Water Supply benefits, potentially as the capacity to capture water, rather than the water itself (but still in conjunction with the expected amounts that might be available to be captured in the future).

Table 5. SCWP Project Scoring Criteria for Water Supply Benefits.

B. Significant Water Supply Benefits	25 points max	The Project provides water re-use and/or water supply enhancement benefits
	13 points max	B1. Water Supply Cost Effectiveness. The Total Life-Cycle Cost[2] per unit of acre foot of Stormwater and/or Urban Runoff volume captured for water supply is: • >$2500/ac-ft = 0 points • $2,000–2,500/ac-ft = 3 points • $1500-2,000/ac-ft = 6 points • $1000–1500/ac-ft = 10 points • <$1000/ac-ft = 13 points *[2]. Total Life-Cycle Cost: The annualized value of all Capital, planning, design, land acquisition, construction, and total life O&M costs for the Project for the entire life span of the Project (e.g. 50-year design life span should account for 50-years of O&M). The annualized cost is used over the present value to provide a preference to Projects with longer life spans.*
	12 points max	B2. Water Supply Benefit Magnitude. The yearly additional water supply volume resulting from the Project is: • <25 ac-ft/year = 0 points • 25 - 100 ac-ft/year = 2 points • 100 - 200 ac-ft/year = 5 points • 200 - 300 ac-ft/year = 9 points • >300 ac-ft/year = 12 points

3.2.2 Local, Related Examples

L.A. County Basin Study, Bureau of Reclamation and the District (2016)

The *Los Angeles Basin Study* was conducted collaboratively between the District and the Bureau of Reclamation (BoR) to analyze: (1) the capacity to enhance existing District facilities to conserve increased stormwater and (2) estimate the

[12] ROC workbook on Water Supply and Nature-Based Solutions (NBS) (January 28, 2021): https://safecleanwaterla.org/wp-content/uploads/2021/01/20210128-ROC-Agenda-DRAFT-Workbook-clean-1.pdf

potential for new facilities to further augment Countywide water supplies. A key component of the Study was a trade-off analysis that comprehensively quantified and monetized the economic, financial, environmental, and social effects of alternative stormwater capture strategies. Other metrics applied in the Study included long-term acre-feet of water captured and comparison of captured volumes to projected water demand.

BoR Study, BoR (2021–ongoing)

The District entered into a Memorandum of Agreement with the BoR in August 2020, to collaborate on a study entitled *Evaluating Low Impact Development and Surface Water–Groundwater Interactions in the Los Angeles Basin*. The study is a continuation of the *Los Angeles Basin Study,* and has two objectives: (1) to determine deep percolation rates by physically monitoring stormwater infiltration practices and control areas, and (2) develop an infiltration modeling tool for estimating deep percolation to groundwater basins. These outcomes will inform and improve the measurement of Water Supply Benefits by refining the region's understanding of how much infiltrated stormwater/urban runoff can be expected to percolate to groundwater aquifers to replenish and augment local Water Supply. The tools may supplement or replace the *Feasibility Study Guidelines* requirement to perform an engineering analysis justifying deep percolation to a managed and usable aquifer.

Evaluating Potential Methods to Quantify Stormwater Capture, SCCWRP (2020)

The primary objective of the SCCWRP project is to identify and evaluate various technical methods for quantifying the potential volume of stormwater capture throughout California. Several methods are proposed to estimate the potential volume of stormwater capture, each of which relies on calculating or estimating a BMP's water balance. They include measuring changes to groundwater levels, measuring changes in Publicly Owned Treatment Works (POTW) inflow, measuring volumes of direct capture or industrial use, measuring changes in imported water, and measuring changes in water metering. Methods must be developed to scale from site-level to regional-level estimates, while direct regional estimates may omit site-scale opportunities for stormwater capture. Each method represents differing levels of effort, complexity in implementation, and potential accuracy, all of which need to be taken into consideration.

3.2.3 National Examples

No national examples were researched for this literature review.

3.2.4 Initial Metrics and Recommendations

Metrics for quantifying Water Supply augmentation are relatively explicit at both the project- and Program-scale (acre-feet of water—that would have otherwise been discharged to the ocean, infiltrated to unmanaged or unused aquifers, or lost to evaporation—captured to replenish or augment local supply; change in groundwater levels; changes in metered water use and imported water; percentage of water demand augmented/offset), although the methods and assumptions for measuring those metrics require additional research, agreement, and tools to clarify the issues previously discussed.

The Working Group ranked this goal the second highest priority for engaging expert support; the Technical Team proposes to provide the requested expert support with in-house resources, but also recommends collaborating closely with the BoR study to leverage the best available models and tools for predicting deep percolation of runoff to managed and usable groundwater aquifers.

3.3 Public Health and Community Investments

One of the signature elements of the SCWP is a focus on community investments to improve public health, climate change resilience, and local recreational opportunities. Note that the goal of public health is directly complementary to the goals of prioritizing Water Quality and Water Supply Benefits, and the cross-disciplinary nature of these goals speaks to the comprehensive nature of the SCWP. Multi-benefit projects across the District that capture stormwater within communities and close to its source create important benefits that address multiple determinants of public health. This subsection generally describes specific elements of the Program definition that could support the goals of public health that are not separately described in Section 3.1 Water Quality and Section 3.2.

Improved flood management, flood conveyance, and flood risk mitigation

Los Angeles County has a primarily dry climate; however, climate change impacts have led to more drastic climate swings that include intense, frequent rain storms when rainfall occurs. Multi-benefit projects that capture and manage stormwater can improve flood management, increase flood conveyance capacity, and provide mitigation against flood risk. Project elements that could address flooding concerns include retrofitting and/or increasing the size of existing stormwater infrastructure (e.g., pipes, culverts, channels, inlets, etc.) as part of SCWP projects. In addition, new stormwater infrastructure and stormwater capture facilities could be designed to manage larger design storms to provide resilience against current and future flooding conditions. Existing flooding concerns and drainage models, which vary by location, could be weighed against proposed project designs to determine potential flood attenuation impacts.

Creation, Enhancement, and/or Restoration of Parks, Habitat and/or Wetlands

Parks, habitat, and wetlands provide many benefits that support public health, ecosystem health, Water Quality, and Water Supply. Creation of these features means the addition of new features where they did not historically exist before and where they are not directly adjacent to existing features. Enhancement of these features means maintaining and managing the existing features for their particular function or value and protecting against future degradation. Enhancement could include new components like grading, berms, plantings, or invasive species controls. Restoration of these features means efforts to return a site to its natural or historical function if degraded. Note that there are very specific and nuanced requirements associated with habitat and wetland project features.

Whether projects that include restoration to meet mitigation requirements should be permitted to include the project element as an "added benefit" should be considered. Mitigation is required when projects or operations and maintenance efforts impact wetland or other sensitive environmental resources. Counting these elements in project scoring could be considered "duplicative" as mitigation at the site or at another location (also called compensatory mitigation) is already required by resource agencies and the project would not be permitted to proceed without it.

Figure 3. Restoration of Lake MacArthur is one of the approved SCWP projects that includes wetland and habitat project components (source: https://www.laconservancy.org/locations/macarthur-park).

Accessibility to Open Space and Waterways

Increasing accessibility to open space and waterways promotes public health, wellness, and physical activity, and adds recreational opportunities throughout the District. Project elements that could provide accessibility include the creation or

retrofitting of mobility features like trails, paths, or entry points to open space areas, parks, and/or waterways. Accessibility could be increased through the creation, rehabilitation, or restoration of open space or waterways that have access points to communities. Increasing accessibility may also include the development of usage agreements or acquisition of open space or park areas that are currently privately held. Accessibility is highly variable throughout the District; therefore, projects that increase equitable access, including access for DACs, are a priority for improving public health.

Figure 4. Adding access points and pathways along rivers like the Los Angeles River increases accessibility and promotes public health (source: https://newsroom.ucla.edu/releases/a-guide-to-turn-the-l-a-river-green).

Additional Recreational Opportunities

Additional recreational opportunities could result from recreational amenities and features being constructed as part of SCWP projects (e.g., playgrounds, bike lanes, trails, sports fields, etc.) or an increase in recreational opportunities resulting from improved Water Quality and accessibility to waterways (e.g., surfing, swimming, kayaking, fishing, etc.). Some recreation-based improvements like walking paths and bike lanes also support sustainability goals as they can support reduction in greenhouse gas emissions that would otherwise be generated by vehicles.

Greening of Schools

Greening of schools can include adding green infrastructure features to schools and/or incorporating green recreational amenities like fields, planting of trees, gardens, or landscaping where these features do not currently exist.

Mitigation of and Adaptation to the Effects of Climate Change

Mitigating, or reducing, climate change, involves the reduction of the flow and emissions of heat-trapping greenhouse gases into the environment, either by reducing sources of these gases or by enhancing "sinks" for these gases (e.g., trees, forests, soils, etc.). Adaptation, or adjusting to a changing climate, involves planning for actual or anticipated future climate impacts (e.g., sea level rise, more intense weather events, water scarcity, etc.). Climate change mitigation and adaptation directly benefit public health; many elements of SCWP projects can contribute to advancing these goals. Augmenting Water Supply, improving resilience against flood impacts, and adding bike/walking paths for green transportation are discussed within other subsections and have direct benefits toward climate change mitigation and adaptation. Other project elements that protect communities and public health from the effects of climate change include reducing the heat island effect, increasing shade, and/or planting trees and other vegetation that increase carbon reduction/sequestration and improve air quality.

3.3.1 Current SCWP Guidance and Scoring Criteria

The SCWP definition for Community Investment Benefits lists meaningful yet subjective metrics for measuring success, which are also reflected in the *Feasibility Study Guidelines, Exhibit A – Infrastructure Program Project* scoring criteria shown below in Table 6. The scoring criteria award projects points on an all-or-nothing basis if the project proponents can demonstrate that the defined benefits are achieved to any extent, and do not consider the magnitude, number, or extent of benefits created. For example, a project that eliminates repetitive loss flooding conditions from a DAC may be scored the same as a project that plants a single tree. The current criteria and guidelines would benefit from the definition of quantitative, absolute metrics related to the defined Community Investment Benefits so that progress can be clearly benchmarked and measured. For example, explicit metrics that could be loosely interpreted from the currently subjective Implementation Ordinance and associated guidelines could include number of unmet drainage needs mitigated; acres of parks, habitat, or wetlands restored; population within walking distance of new recreational opportunities; acres of schoolyards converted from impervious to vegetated; new acres of shade or tree canopy cover; acres of new perennial vegetation planted. In addition, there is no explicit incorporation of criteria that address DACs or environmental inequities in the scoring criteria. It has long been established within the Los Angeles Region that environmental inequities impact public health and the vibrance of communities. Consideration should be given to direct incorporation of environmental justice and DAC criteria.

In its June 22, 2020, memorandum, the Scoring Committee affirmed these needs by acknowledging the following:

> "Due to lack of clarity in definitions (and the fact that many community benefits derive from building Nature-Based projects), in many instances doing one thing (e.g., enhancing a park or adding a few trees) got applicants points in several categories, such as planting of trees, heat island reduction, and greenhouse gas reduction. Overall, many projects took credit for somewhat dubious benefits—for example, rebuilding (slightly) nicer ball fields after tearing up an old field for underground storage."[13]

Table 6. SCWP Scoring Criteria for Community Investment Benefits.

Section	Score Range	Scoring Standards
C. Community Investments Benefits	10 points max	The Project provides Community Investment Benefits
	10 points	C1. Project includes: • One of the Community Investment Benefits identified below = 2 points • Three distinct Community Investment Benefits identified below = 5 points • Six distinct Community Investment Benefits identified below = 10 points Community Investment Benefits include: • Improved flood management, flood conveyance, or flood risk mitigation • Creation, enhancement, or restoration of parks, habitat, or wetlands • Improved public access to waterways • Enhanced or new recreational opportunities • Greening of schools • Reducing local heat island effect and increasing shade • Increasing the number of trees increase and/or other vegetation at the site location that will increase carbon reduction/sequestration and improve air quality.

The Scoring Committee subsequently offered the following near-term recommendations:

> *Improve flood management, flood conveyance, or flood risk mitigation:*
>
> - The explanation and analysis should include: (1) details (if any) about any flooding issues in the area that the project will address, and/or (2) if flood risk is reduced in downstream rather than immediately

[13] Scoring Committee Recommendations. June 22, 2020. https://safecleanwaterla.org/wp-content/uploads/2020/06/Scoring-Committee-Recommendations-DRAFT.pdf

adjacent area, specific information about downstream flooding issues (if any) and the volume of water that will be retained or infiltrated relative to the capacity of the downstream problem area.

Create, enhance, or restore parks, habitat, or wetlands

- The explanation and analysis should include a graphic and/or description of the area of the site that is "created, enhanced, or restored" relative to the total project footprint. These more ecosystem-focused park improvements should be distinguished from the recreational points below by including planting plans with a preference for native habitats, such as:
    1. Native woodland
    2. Native shrubland
    3. Native savanna
    4. Native grassland
    5. Native riparian woodland
    6. Native marsh/meadow/vernal pool
    7. Open water

Improve public access to waterways

- Access and waterway should be better defined. Does access mean physical access, or is visual access sufficient? Does the waterway include constructed wetlands?
- The explanation and analysis should include, where relevant, a picture and/or description of the location of the project relative to the waterway.

Enhance or create new recreational opportunities

- The explanation and analysis should include, where relevant, a graphic and/or description of the area of the site that is "created, enhanced, or restored" relative to the total project footprint. The explanation should also specifically describe enhancements or restorations relative to the original project site, with supporting graphics where possible.

Create or enhance green spaces at schools

- The explanation and analysis should include, where relevant, a picture and/or description of the location of the project relative to the school.
- This Community Investment Benefit can be awarded only if the project is "at" a school, given that several applicants took credit for school adjacent projects or projects likely to attract students from local schools.

Improve public health by reducing local heat island effect and increasing shade

- The explanation and analysis should include a description of the relative increase in shade at the project site. It should also include the number of trees that will be added and the square feet of canopy added (once mature) compared to the pre-project site and compared to the total project footprint.

Improve public health by increasing the number of trees and/or other vegetation at the site location that will increase carbon reduction/sequestration and improve air quality

- The explanation and analysis should include the number and types of trees and plants to be added compared to the number and types at the site before construction begins, as well as an analysis of the amount of CO_2 that will be sequestered annually from that new vegetation (once it is mature).

3.3.2 Local, Related Examples

Numerous other programs, plans, and studies, both local to Los Angeles and nationally, include methods, metrics and/or criteria for evaluating public health and multi-benefit projects; however, comprehensive numerical criteria have yet to be clearly established for a Program like the SCWP. In many cases, inclusion of public health, community benefit, equity, and multi-benefit considerations are based on qualitative and largely subjective criteria, similar to current criteria for the SCWP.

Some of the public health and multi-benefit components have been assessed individually in the Los Angeles region and are noted, as appropriate.

Planting Stormwater Solutions: Project Attributes Benefitting Biodiversity & Wildlife Habitat (2020) [14]

According to The Nature Conservancy, from a biodiversity perspective, the best projects would result in outcomes such as permeable lands covering 100 percent of the project footprint; the conversion of grass and herb cover to native species; a project design that considers both the immediate results of conversion and the outcome once all plantings have grown to maturity; high native plant species richness; and ability to attract native animal species. The following criteria help outline the expected biodiversity benefits from projects:

(1) An accounting of the area (in square feet or square meters) within the project footprint that is currently covered by the following land cover categories. All lands should fall into one of these categories.
    (a) buildings (including buildings with green roofs)
    (b) roads
    (c) other impermeable paved surfaces (such as parking lots, fountains or concrete-lined water features, artificial turf, impermeable art installations, and other impermeable surfaces)
    (d) permeable pavement
    (e) bare ground
    (f) grass or herbs
    (g) trees and shrubs
(2) An accounting of how much area within the project footprint would be covered by each of these land cover categories immediately after the project is completed and all new project plantings are in place (in square feet or square meters). All lands should fall into one of these categories.
    (a) buildings (including buildings with green roofs)
    (b) roads
    (c) other impermeable paved surfaces (such as parking lots, fountains or concrete-lined water features, artificial turf, impermeable art installations, and other impermeable surfaces)
    (d) permeable pavement
    (e) bare ground
    (f) grass or herbs
    (g) trees and shrubs
(3) A projection of how much area within the project footprint would be covered by native grasses or herbs immediately after the project is completed and all new project plantings are in place. This value should be provided in square feet or square meters.
(4) A projection of how much area within the project footprint would be covered by native shrubs or trees immediately after the project is completed and all new project plantings are in place. This value should be provided in square feet or square meters.
(5) A projection of how much area within the project footprint would be covered by native grasses or herbs after plantings have grown to maturity (for example, after 15-25 years of growth). This value should be provided in square feet or square meters. The time (in years) required for the native grasses or herbs to reach maturity should be provided.
(6) A projection of how much area within the project footprint would be covered by native shrubs or trees after plantings have grown to maturity (for example, after 15-25 years of growth). This value should be provided in square feet or square meters. The estimated time (in years) required for the native trees and shrubs to reach maturity should be provided.

[14] Parker, S and Randall J. (2020) Planting Stormwater Solutions: Project Attributes Benefitting Biodiversity & Wildlife Habitat

(7) A projection of how much area within the project footprint would have two layers of vegetation cover after plantings have grown to maturity. This value should be provided in square feet or square meters.
(8) A projection of how much area within the project footprint would have three or more layers of vegetation cover after plantings have grown to maturity. This value should be provided in square feet or square meters.
(9) A "plant palette" or list of native plant taxa to be planted within the project footprint, ideally with numbers of individuals of each taxon indicated in the proposal.
(10) Information about the lands around the project area, including the distance from the project to the nearest parks and open spaces.

A Time of Opportunity Study, Prevention Institute (2018) [15]

The Prevention Institute developed a case study for the Water Foundation to evaluate water, health, and equity in the Los Angeles region. The study assesses an inclusive approach for health equity as investments in water and stormwater increase. The study notes that there is a potential for inequities resulting from these investments at the local and system-wide level, intentional or not, to further exacerbate existing inequities of low-income communities of color. The study states that consideration should be given to where and how projects are prioritized for stormwater, noting that traditional stormwater compliance "endpoints" are traditionally in majority white, affluent neighborhoods along the coastlines. In contrast, lower-income neighborhoods that are inland often are deprioritized and negatively impacted by inadequately sized and maintained infrastructure that causes flooding and health concerns associated with significant urbanization, pooled water and vector concerns, and limited recreational amenities. The recommendations included in the study include prioritizing public health and health equity when developing an integrated water management approach and prioritizing multi-benefit projects that have public support (e.g., expanding open space and recreational opportunities). In addition, the study strongly recommends the inclusion of community organizations and public health experts during the planning and design process when advancing Water Quality, capture, and resilience initiatives and projects. Developing public health perspectives backed by data would provide credibility to the water-making decision process and facilitate tangible progress toward equitable healthy community conditions. Investment in local data collection, research, and documentation of water- and health-related disparities is necessary to advance equity.

Lower Los Angeles River Revitalization Plan, the District and the San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy (2018) [16]

The Lower Los Angeles River Revitalization Plan assessed a number of public health and community benefit criteria as part of its development. This approach was developed in partnership with extensive community stakeholders and working groups and is representative of the priorities for this particular Watershed Area.

Objectives that were used to guide the evaluation of project opportunities are largely comparable to those described in the SCWP, and include the following objectives that are related to public health and multi-benefit projects:

- Conserve, Enhance, and Restore Habitat, Biodiversity and Floodplain Functions;
- Enhance Local Water Capture and Use;
- Improve Environmental Water Quality;
- Manage Flood Risk;
- Enhance Connectivity;
- Improve User Experience and Equitable Access;
- Enhance and Create Diverse, Vibrant Public Spaces;
- Increase Community Green Infrastructure;
- Increase Equitable Community Access to Multi-use Trails and Assets; and
- Promote Wellness and Physical Activity.

[15] Prevention Institute 2018. A Time of Opportunity. Water, health, and equity in the Los Angeles Region. https://www.preventioninstitute.org/sites/default/files/uploads/A%20Time%20of%20Opportunity.pdf
[16] Lower L.A. River Revitalization Plan. https://lowerlariver.org/#thePlan

Each of the objectives was weighed by a percentage of applicable metrics applied to each criterion (one to one hundred percent) and averaged across all metrics to develop an Opportunity Potential score. For each of the objectives, specific metrics were assessed to guide the potential impact of projects. For example, the metrics developed for "Increase equitable community access to multi-use trails and assets" includes: (1) the distance between access points serving the highest concentration of low-income residents and (2) acres of park space. Similarly, for the objective to "Promote Wellness and Physical Activity," metrics included: (1) length of multi-use trails and bikeways, (2) percent of population within 0.5 miles of a park, and (3) acres of parkland. Additional metrics related to public health are summarized in Table 7 through Table 9.

Table 7. Example Metrics Related to Habitat, Biodiversity, and Floodplain Functions (source: Lower LA Revitalization Plan).[17]

Objective: Conserve, Enhance, and Restore Habitat, Biodiversity, and Floodplain Functions		
Progress Metrics		
Vegetation coverage and terrestrial habitat connectivity	Vegetation coverage (CALVEG)	1,531 acres
	Habitat connectivity and quality	Baseline spatially mapped
	Tree canopy coverage (NDVI)	1,404 acres
Soft-bottom river and near-channel wetland habitat	Soft-bottom river	24.2 acres
	Near-channel wetland habitat	13 acres
Effective floodplain area		13 acres

[17] Lower L.A. Revitalization Plan. https://lowerlariver.org/#thePlan

Table 8. Example Metrics Related to Connectivity, User Experience, and Public Spaces (source: Lower LA Revitalization Plan).[18]

Objective: Enhance Connectivity	
Number of River Crossings	24
Average Distance between River Crossings	0.8 miles
Number of Crossings with Bike Lanes	2
Number of Crossings with Sidewalks	21
Length of Bike Path along LLAR	24 miles
Length of Multi-Use Trail along LLAR	8.7 miles
Number of Access Points	37 (East Side), 33 (West Side)
Average Distance between Access Points	0.38 miles
Number of Gateways	6
Objective: Enhance Consistent User Experience and Access	
Number of Light Poles	3
Number of 911 Call Boxes	8-19
Number of Restrooms	5
Number of Fix-It Stations	0
Number of Picnic Areas	4
Number of Water Fountains	6
Parking Space, square feet	TBD
Number of Signs and Wayfinding	44
Number of Benches	16
Number of Shade Structures	1
Objective: Create Public Spaces	
Number of Community Centers	19
Number of Equestrian Centers	5
Number of Parks	93
Acres of Park Space	742
Population within 0.5 Miles of Park	94%

[18] Lower L.A. Revitalization Plan. https://lowerlariver.org/#thePlan

Table 9. Example Metrics Related to Displacement, Homelessness, Local Businesses, Equitable Community Access and Assets, Wellness and Physical Activity, and Community Nature-Based Solutions (photo by Lower Los Angeles River Revitalization Plan).[19]

Objective: Prevent Gentrification-Induced Displacement	
Cost Burdened Households	52%
Households in Subsidized or Rent Assisted Housing	7%
Units Regulated by Rent Control Ordinance	0
Objective: Address Homelessness	
Number of homeless beds in LLAR	1,976
Number of shelters in LLAR	27
Cost Burdened Households	52%
Households in Subsidized or Rent Assisted Housing	7%
Units Regulated by Rent Control Ordinance	0
Objective: Support and Develop Local Business	
Unemployment rate	14.6%
Workforce educational opportunities	Unknown
Objective: Increase Equitable Community Access and Assets	
Distance between Access Points Serving Highest Concentration of Low Income Residents	2 miles
Acres of park space	742 acres
Objective: Promote Wellness and Physical Activity	
Healthy Food Sources, i.e. grocery stores, farmers markets, co-ops	Unknown
Multi-trails and Bikeways	32.7 miles
Population within 0.5 Miles of Park	94%
Acres of parks	732 acres
Objective: Increase Community Nature-based Solutions	
Tree canopy coverage (NDVI)	836 acres
Vegetation coverage	1,404 acres

Los Angeles County Tree Canopy Assessment, TreePeople and Center for Urban Resilience

The Los Angeles County Tree Canopy Map Viewer was developed by TreePeople and the Center for Urban Resilience (CURes) at Loyola Marymount University to assess existing and potential tree canopy cover.[20] The Map Viewer quantifies the existing tree canopy cover and indicates relative cover when compared to the Los Angeles County Average. The Map Viewer also includes theoretical areas where the establishment of tree canopy cover could be made through improvements. This assessment could be used to inform tree canopy cover needs and potential for a specific project location.

[19] Lower L.A. Revitalization Plan. https://lowerlariver.org/#thePlan
[20] The Journey to the Los Angeles County Tree Canopy Map Viewer https://storymaps.arcgis.com/stories/df083f2adb6a4650a738dbf2805674e2

Recommended Updates to Safe Clean Water Program, The Pacific Institute (2020)

A letter submitted to the L.A. County Board of Supervisors dated November 2, 2020, from the Pacific Institute offered the following recommendations for better integrating Community Investment Benefits and Nature-Based Solutions into project design and prioritization for the SCWP.

1. Combine scoring categories for Community Investment Benefits and Nature-Based Solutions: Merging these two sections will help to avoid redundancies in scoring. For example, inclusion of trees in a project currently provides points for enhancing habitats or parks, as well as additional points for reducing the urban heat island effect, sequestering carbon, and utilizing natural material. Instead, the addition of trees to the project design should be considered for its benefits in one scoring category, rather than multiple scoring categories. The Pacific Institute also recommends redefining NBS with a stronger focus on natural systems and the resulting benefits provided by incorporating natural elements into project designs.
2. To provide a fair comparison of benefits among projects, each benefit should be evaluated compared to a "no action scenario." Explicitly defining the baseline as existing conditions would allow for a more systematic comparison of projects presented to the committees.
3. Communicate benefits and trade-offs of each suite of proposed projects. Existing tools should be improved to demonstrate the quantitative CIB of projects in the Stormwater Investment Plan (SIP) in order to demonstrate the benefits of the suite of proposed projects together.

3.3.3 National Examples

EPA Prioritizing Wastewater and Stormwater Projects Using Stakeholder Input

The EPA published guidance for prioritizing wastewater and stormwater projects to meet CWA obligations with a focus on using stakeholder input to prioritize projects.[21] The evaluation criteria included following a triple bottom line approach that includes environmental, social, and economic considerations, which encompass public health and multi-benefit projects. The guidance notes that perceived importance across criteria will vary by region and stakeholder group, as is evidenced in the SCWP project scoring criteria and feedback on scoring to date. Three case studies were included in the guidance from Burlington, Vermont, Onondaga County, New York, and Santa Maria, California. In each of these cases, stakeholder input was used to incorporate a prioritization or relative weighting of performance criteria to meet their unique objectives. The metrics for public health considerations, community benefits, and multi-benefits were largely subjective, but some did contain relative guidance on establishment of priorities and metrics.

Philadelphia, Pennsylvania

The Philadelphia Water Department (PWD) developed a Triple Bottom Line (TBL)-oriented benefit-cost assessment of Combined Sewer Overflow (CSO) control alternatives, specifically: (1) traditional engineering approaches that rely on physical infrastructure such as large-scale concrete collection and storage systems and (2) green infrastructure.[22] The assessment addressed a number of benefits and external costs, including: recreational use and values; property values, as enhanced by low-impact development (LID) options; heat stress and related premature fatalities avoided; Water Quality and aquatic habitat enhancements and values; wetland enhancement and creation; poverty reduction benefits of local green infrastructure jobs; energy usage and related changes in carbon and other emissions; air quality pollutant removal from added vegetation; and construction- and maintenance-related disruption impacts. The quantitative metrics used for these categories are shown below:

- Recreational use and values: Total recreational benefits are a function of the additional recreational trips ("user days") and the benefit (or direct use value) derived from each trip. Visitation data and direct use values for a

[21] EPA 2017. Prioritizing Wastewater and Stormwater Projects Using Stakeholder Input. https://www.epa.gov/sites/production/files/2018-10/documents/prioritizing_wastewater_and_stormwater_projects_using_stakeholder_input.pdf

[22] Raucher, R., & Clements, J. (2010). A triple bottom line assessment of traditional and green infrastructure options for controlling CSO events in Philadelphia's watersheds. *Proceedings of the Water Environment Federation*, *2010*(9), 6776-6804.

variety of recreational uses and activities at Philadelphia's parks from the report, *How Much Value Does the City of Philadelphia Receive from its Park and Recreation System*, were used.

- Enhanced aesthetics (reflected in residential property values): Estimated aggregated increase in property values for each LID option and impacted city area were derived from a benefits transfer approach to interpret the relevant body of LID-related published hedonic valuation literature coupled with neighborhood-specific baseline property values.
- Heat stress-related premature fatalities avoided: Green infrastructure creates shade, reduces the amount of heat absorbing materials, and emits water vapor – all of which reduce the urban heat island effect and could reduce heat stress-related fatalities during extreme heat wave events. The projected cases of heat stress fatalities avoided can then be derived from value of statistical life (VSL) estimates.
- Water quality and aquatic habitat enhancements and values: Total willingness to pay (WTP) for Water Quality improvements was derived from a regression model based on existing studies that was used to predict what individual households would be willing to pay for improvements in Water Quality to a specified level.
- Wetland enhancement and creation: The monetization of added and enhanced wetland acres according to the range of services they are expected to provide in urban area watersheds used a benefits transfer approach based on the relevant published literature of wetland values.
- Poverty reduction benefits of local green infrastructure jobs: Green infrastructure projects creates the opportunity to hire unskilled – and otherwise unemployed – laborers for landscaping and restoration activities. The benefits of providing these jobs include the avoided costs of social services that the City would provide on behalf of the same people if they remain unemployed.
- Energy use and related changes in carbon and other emissions: Energy savings can be quantified in kilowatt hours (kWh) of electricity and British thermal units (Btus) of natural gas over a specified planning period. In addition to the direct expense of added energy consumed (or savings from use of less energy), the level of CO_2 (and other greenhouse gases) emissions added (or reduced or sequestered) can be evaluated. The net addition/savings in emissions can then be valued using a "social cost of carbon" estimate, which can be derived from the Intergovernmental Panel on Climate Change (IPCC) of the climate change damages contributed by each metric ton (MT) of CO_2 equivalent (CO_2e) emitted. The value used in the study was $12/MT.
- Air quality pollutant removal from added vegetation: A tool developed by the U.S. Forest Service, for application in Philadelphia, was used to evaluate the air quality impacts of added trees. Then, the Environmental Benefits Mapping and Analysis Program (BenMAP) was used to calculate the avoided health effects from the contribution of trees to reducing ozone and $PM_{2.5}$ concentrations, and to estimate the economic value of the avoided health effects. The software incorporates a database that includes concentration-response relationships, population files, and health and economic data needed to quantify these impacts. The avoidable air pollution-related health effects estimated in the analysis are: premature mortality (from ozone and $PM_{2.5}$); onset of irreversible chronic bronchitis ($PM_{2.5}$); heart attacks (non-fatal acute myocardial infarctions) ($PM_{2.5}$); hospital admissions (non-fatal) for respiratory and cardiovascular conditions (from ozone and $PM_{2.5}$); emergency room visits for asthma (from ozone and $PM_{2.5}$); respiratory symptoms (days of illness) (from ozone and $PM_{2.5}$); and work loss days ($PM_{2.5}$) and school absence (ozone).
- Construction- and maintenance-related disruption impacts: Both traditional and green infrastructure options will result in some level of disruption due to construction and program activities. Social costs of disruption can include traffic delays, limited access to places of business, increased noise and pollution, and other inconveniences. Travel time delays can be caused by: general traffic slowdowns associated with an increase in the number of trucks and construction equipment on the road; slowdowns from trucks entering and exiting construction or landscaping sites; and land or road closures associated with construction in the roadway or road right-of-way. In addition to "lost" time spent in traffic, there are increased costs associated with additional fuel used by vehicles as a result of slower speeds and occasional vehicle stops and idling. Standard methods and data for estimating traffic delays and associated fuel use and time loss were used to evaluate the 40-year present value of the external costs for each control option.

San Francisco Public Utilities Commission (SFPUC)

The SFPUC's Community Benefits Program partners with local residents, leaders, and community organizations to build strong, sustainable and vibrant communities through youth workforce development, educational outreach, land use programs, and an arts program.[23] The quantitative metrics used to illustrate the positive impact made in San Francisco communities are displayed on its website dashboard and **detailed in bold** below:

- **Youth workforce:** SFPUC's project learning grants provide funding to community organizations and offer education and employment programs to youth in San Francisco. These programs range from resume writing, video production, and water conservation techniques. The goal is for the youth to learn new professional skills, get hands-on work experience and explore career opportunities. Metrics of positive impact include: youth served by zip code; youth served by year; gender; age; and ethnicity/race.
- **Education programs:** SFPUC partners with community organizations, local school districts, and city departments to teach youth about science, technology, engineering, and math (STEM). Eco-literacy programs and field trips are provided for students to experience the outdoors and learn about STEM careers. Metrics of positive impact include: youth served by zip code; youth served by year; youth served by district; and youth served by each specific program.
- **Land use programs:** This program encompasses the Frontyard Ambassador and Sidewalk Garden programs where local residents and organizations can secure funding to transform the pavement near their homes into low-maintenance green spaces. Metrics of positive impact include: impervious surface removed (square feet per year); gardens planted; and stormwater diverted (volume per year).
- **Art programs:** The public arts projects embody the mission, vision, and values of local communities while inspiring them to respect natural resources. Metrics of positive impact include: artwork theme, artwork type, and artworks by year created.

3.3.4 Initial Metrics and Recommendations

Considering the comprehensive range of metrics related to Community Investment Benefits described above, the Technical Team proposes that metrics related to the following categories should be further considered by the Working Group and augmented by metrics raised by the Working Group or experts: conserving, enhancing, and restoring habitat, biodiversity, and floodplain functions; enhancing connectivity; create public spaces/recreational use and values; prevent gentrification-induced displacement; address homelessness; increase equitable community access and assets; promote wellness and physical activity; heat stress-related premature fatalities avoided; poverty reduction benefits of local green infrastructure jobs; energy use and related changes in carbon and other emissions; air quality pollutant removal from added vegetation; education programs; water management; urban regeneration; participatory planning & governance; and social justice & social cohesion. All considered metrics for this goal will need to be reconciled and/or deconflicted where they may overlap with other goals (particularly NBS, which yield many of the objectives and metrics listed above; DAC Benefits, which could be adversely impacted by "green gentrification," as described further under NBS; and Green Jobs). See Section 3.5.2 for additional Public Health and Community Investment metrics derived from NBS.

The Working Group prioritized this goal for expert consultation (albeit it was ranked lowest priority); the Technical Team strongly recommends engaging additional expert advice and stakeholders to determine what specific and/or additional factors are valued in specific communities throughout the District. Recommended academic experts include Jon Christensen and Gregory Pierce (UCLA).

[23] San Francisco Public Utilities Commission. https://sfwater.org/index.aspx?page=644

3.4 Multiple Benefits

The goal of providing multiple benefits was prioritized by the Working Group, although the current SCWP definition of a Multi-Benefit Project is relatively explicit; however, in reality, determining whether a project provides multiple benefits depends on determining the extent to which it achieves Water Quality, Water Supply, and/or community investment goals.

3.4.1 Current SCWP Guidance and Scoring Criteria

The SCWP Implementation Ordinance states that Regional Program projects submitted to the Scoring Committee must be Multi-Benefit Projects, and the current scoring criteria implicitly address this requirement by requiring projects to qualify for additional points beyond Water Quality Benefits in order to achieve the threshold score; however, as noted in the preceding sections, the determination of a Community Investment Benefit or a Water Supply Benefit can be subjective. This means that a project could technically be labeled a Multi-Benefit Project as a result of a relatively insignificant design element.

3.4.2 Initial Metrics and Recommendations

If the existing SCWP guidance is literally interpreted, then this goal could simply be measured as a derivative of the Water Quality, and Water Supply and/or Community Investment and Public Health goals. Once the appropriate metrics are defined for the other goals, then it is a binary check (yes/no) to determine whether the project meets two or more of the core SCWP Goals. However, that simplified method does not consider the magnitude of multiple benefits provided and does not set a minimum threshold of Water Supply or Community Investment Benefits for a project to qualify as a multi-benefit project. The existing SCWP scoring criteria do provide a unitless index for measuring the magnitude of Multiple Benefits, although other sections of this literature review discussed the potential limitations and subjectivity of the Community Investment and NBS Benefit scores.

The Technical Team therefore recommends that the Working Group explore criteria for measuring this goal by evaluating the results of the subsequent pilot modeling analysis (Pilot Analysis). Results will reveal the cost-benefit trade-offs of different portfolios of Multi-Benefit Projects to inform data-driven recommendations for scoring criteria adjustments that objectively benchmark and incentivize the highest-value projects.

The Working Group ranked this goal the third highest priority to seek external expert advice; the Technical Team suggests that the experts engaged for Public Health and Community Investment Benefits and NBS will provide the input and resources necessary to articulate recommended metrics for this goal.

3.5 Nature Based Solutions (NBS)

The SCWP seeks to prioritize NBS because they tend to provide a wide array of multiple benefits, ecosystem services, sustainable systems, and community investments per dollar spent.

3.5.1 Current SCWP Guidance and Scoring Criteria

The current scoring criteria help prioritize NBS by awarding additional points for projects that can demonstrate NBS; however, the criteria are relatively subjective, as shown in Table 10, which has prompted ample discussion and public comments.

According to the October 19, 2020, staff memo titled *ROC Input for potential FY 2021-2022 SIP Programming Guidelines* from the Flood Control District to the Regional Oversight Committee, the following issues and potential processes are anticipated to be clarified in the SIP Guidelines:[24]

[24] L.A. County Flood Control District. ROC Input for potential FY 2021-2022 SIP Programming Guidelines. https://safecleanwaterla.org/wp-content/uploads/2020/10/Staff-Memo-and-Attachment.pdf

1. What project elements count as "Nature-Based Solutions" and which do not: The memo recommends annotating the Nature-Based Solutions matrix (included in Fund Transfer Agreements and referenced in Projects module) to ensure consistent use of terminology and clarify categories to improve effective and standardized use of the matrix when crafting and discussing Projects. The memo also suggests developing an additional document that connects the problems that the SCWP was developed to address and "NBS project types" associated with each problem.
2. The process WASCs will use to consistently review and discuss NBS when considering recommendations: The memo recommends incorporating the NBS matrix (Figure 5) into WASC project evaluation. Project developers would be required to self-evaluate their Projects through an NBS filter using the NBS matrix in the Projects modules. However, the memo is also open to other long-term guidance to facilitate, point toward, and evaluate the prioritization of NBS.

Table 10. SCWP Scoring Criteria for Nature-Based Solutions.

D. Nature-Based Solutions	15 points max	The Project implements Nature-Based Solutions
	15 points	D1. Project: • Implements natural processes or mimics natural processes to slow, detain, capture, and absorb/infiltrate water in a manner that protects, enhances and/or restores habitat, green space and/or usable open space = 5 points • Utilizes natural materials such as soils and vegetation with a preference for native vegetation = 5 points • Removes Impermeable Area from Project (1 point per 20% paved area removed) = 5 points

METHODS	GOOD	BETTER	BEST
Vegetation/Green Space	Use of climate-appropriate, eco-friendly vegetation (groundcover, shrubs, and trees) / green space 5%-15% covered by new climate-appropriate vegetation	Use of native, climate-appropriate, eco-friendly vegetation (groundcover, shrubs, and trees) / green space 16%-35% covered by new native vegetation	Establishment of plant communities with a diversity of native vegetation (groundcover, shrubs, and trees) / green space that is both native and climate-appropriate More than 35% covered by new native vegetation
Increase of Permeability	Installation of vegetated landscape – 25%-49% paved area removed Redesign of existing impermeable surfaces and/or installation of permeable surfaces (e.g. permeable pavement and infiltration trenches)	Installation of vegetated landscape – 50%-74% paved area removed Improvements of soil health (e.g., compaction reduction)	Installation of vegetated landscape – 75%-100% paved area removed Creation of well-connected and self-sustained natural landscapes with healthy soils, permeable surfaces, and appropriate vegetation
Protection of Undeveloped Mountains & Floodplains	• Preservation of native vegetation • Minimal negative impact to existing drainage system	• Preservation of native vegetation • Installation of new feature(s) to improve existing drainage system	• Creation of open green space • Installation of features to improve natural hydrology
Creation & Restoration of Riparian Habitat & Wetlands	•Partial restoration of existing riparian habitat and wetlands •Planting of climate appropriate vegetation - between 11 and 20 different climate-appropriate or native plant species newly planted •No potable water used to sustain the wetland	• Full restoration of existing riparian habitat and wetlands • Planting of native vegetation - between 21 and 40 different native plant species newly planted •No potable water used to sustain the wetland	• Full restoration and expansion of existing riparian habitat and wetlands Planting of plant communities with a diversity of native vegetation – between 41 and 50 different native plant species newly planted •No potable water used to sustain the wetland
New Landscape Elements	Elements designed to capture runoff for other simple usage (e.g. rain gardens and cisterns), capturing the 85th percentile 24-hour storm event for at least 50% of the entire parcel	Elements that design to capture/redirect runoff and filter pollution (e.g. bioswales and parkway basins), capturing the 85th percentile 24-hour storm event from the entire parcel	Large sized elements that capture and treat runoff to supplement or replace existing water systems (e.g. wetlands, daylighting streams, groundwater infiltration, floodplain reclamation), capturing the 90th percentile 24-hour storm event from the entire parcel and/or capturing off-site runoff
Enhancement of Soil	Use of soil amendments such as mulch and compost to retain moisture in the soil and prevent erosion Planting of new climate-appropriate vegetation to enhance soil organic matter	Use of soil amendments such as mulch and compost that are locally generated to retain moisture in the soil, prevent erosion, and support locally-based composting and other soil enhancement activities Planting of new native, climate-appropriate vegetation to enhance soil organic matter	Use of soil amendments such as mulch and compost that are locally generated, especially use of next-generation design with regenerative adsorbents (e.g. woodchips, biochar) to retain moisture in the soil, prevent erosion, and support on-site composting and other soil enhancement activities Planting of new native, climate appropriate vegetation to enhance soil organic matter

Figure 5. NBS matrix as currently represented in the SCWP Transfer Agreement Municipal Template. Municipalities are required to include in each quarterly and annual report whether and how their project achieves a good, better, or best rating for each of the six NBS methods in accordance with the guidance above. If at least three methods score within a single class, the overall project can be characterized as that class.

On January 28, 2021, the ROC discussed the above issues surrounding prioritization of NBS, one of the SCWP's programmatic goals. The ROC acknowledges that NBS can, in turn, further other programmatic goals listed in Ordinance Section 18.04. Thus, the application of NBS in Program implementation should emphasize the multiple benefits provided using NBS, rather than simply the presence of NBS strategies.

In addition, the ROC led a discussion asking the following questions, prompted by a *workbook* prepared by the District:

1. To what extent do the potential processes provide a workable approach in the short-term and/or long-term?
2. What are options to ensure that NBS projects advancing Program Goals are competitive for funding in current decision-making processes?
3. What additional approaches to advance NBS could advance Program Goals?
4. How can the District cultivate a robust pipeline of NBS projects while recognizing that there may also be cases where a non-NBS alternative may be preferential, if justified?
5. What other methods can/should the District employ to prioritize NBS?

3.5.2 Nature-Based Solutions Frameworks

Looking internationally, the European Union (EU) has positioned itself as a leader in innovating with nature to achieve more sustainable and resilient societies through its ambitious research and innovation policy. Nature-Based Solutions support major EU policy priorities, such as the European Green Deal, EU Biodiversity Strategy, and EU Adaptation Strategy, to foster biodiversity and make Europe more climate-resilient. The European Commission EKLIPSE's framework for evaluating the impacts of using NBS is discussed in the next section.

European Commission EKLIPSE Project

The European Commission requested the EKLIPSE project to build an evidence and knowledge base on the benefits and challenges of applying NBS.[25] The document reports on the following three objectives: (1) to develop an impact evaluation framework with a list of criteria for assessing the performance of NBS in dealing with challenges related to climate resilience in urban areas; (2) to prepare an application guide for measuring how NBS projects fare against the identified indicators in delivering multiple environmental, economic, and societal benefits; and (3) to make recommendations to improve the assessment of the effectiveness of NBS projects, including the identification of knowledge gaps according to the criteria presented in the impact evaluation framework.

The EKLIPSE report defines Nature-Based Solutions as "*solutions to societal challenges that are inspired and supported by nature, which are cost-effective, provide simultaneous environmental, social and economic benefits, and help build resilience*." The expert working group selected 10 challenges for Nature-Based Solutions to address climate resilience in urban areas at different scales (macroscale, mesoscale, and microscale):

1. Climate mitigation and adaptation
2. Water management
3. Coastal resilience
4. Green space management
5. Air quality
6. Urban regeneration
7. Participatory planning & governance
8. Social justice & social cohesion
9. Public health & well-being
10. Economic opportunities & green jobs

[25] Raymond, C.M., Berry, P., Breil, M., Nita, M.R., Kabisch, N., de Bel, M., Enzi, V., Frantzeskaki, N., Geneletti, D., Cardinaletti, M., Lovinger, L., Basnou, C., Monteiro, A., Robrecht, H., Sgrigna, G., Munari, L. and Calfapietra, C. (2017) An Impact Evaluation Framework to Support Planning and Evaluation of Nature-based Solutions Projects. Report prepared by the EKLIPSE Expert Working Group on Nature-based Solutions to Promote Climate Resilience in Urban Areas. Centre for Ecology & Hydrology, Wallingford, United Kingdom

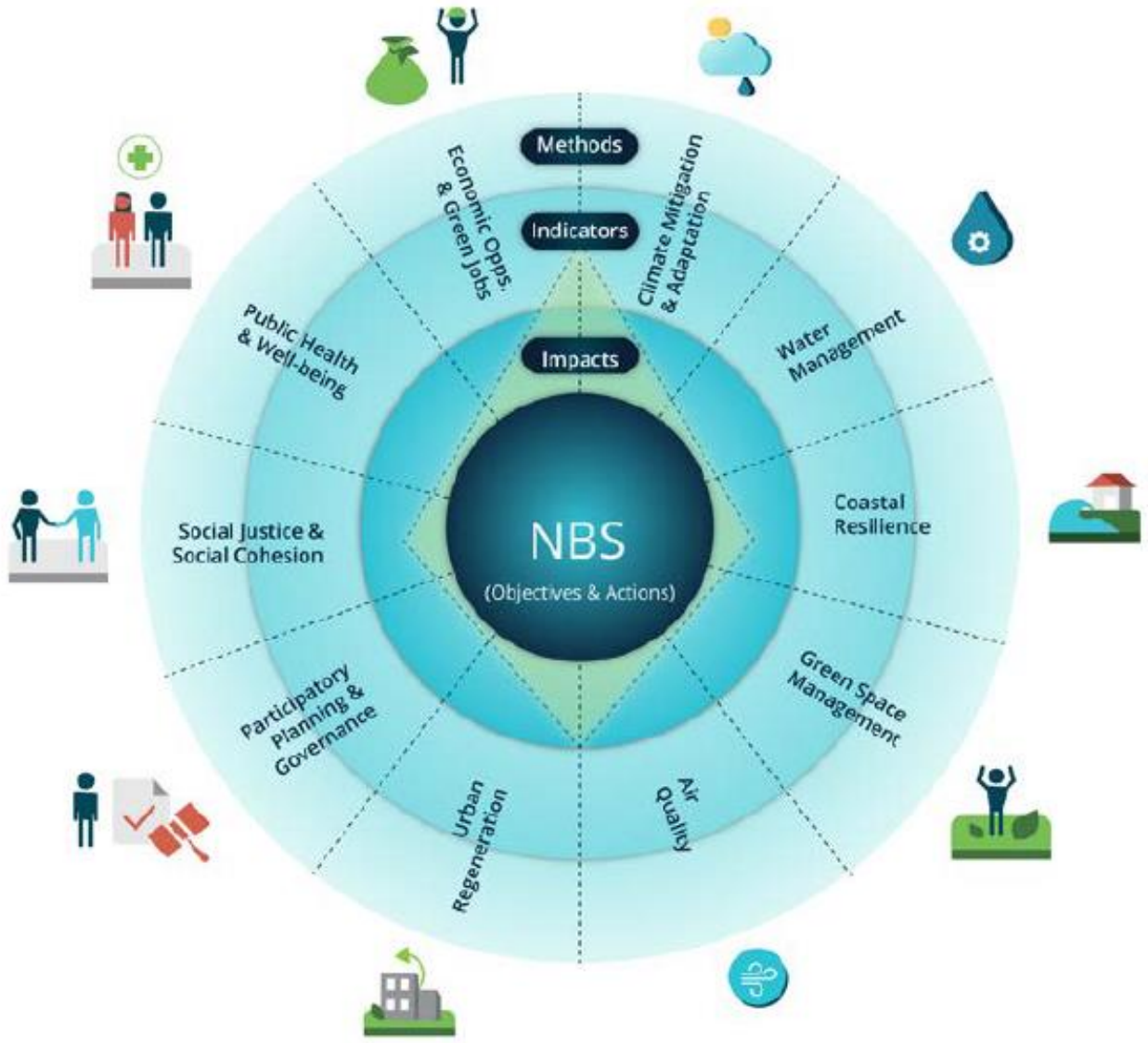

Figure 6. The 10 climate resilience challenges considered in the EKLIPSE project's impact assessment framework.

The macroscale corresponds to the global and international level, the mesoscale represents the regional through to metropolitan and urban scales, and the microscale coincides with the scales ranging from the neighborhood and street to the single building. For the purposes of this literature review, focus will be given to the mesoscale and microscale. It is important to note that due to the multi-functionality (capacity to perform different functions and present a range of benefits simultaneously and over time) of NBS, any NBS is likely to have co-benefits (and costs) in other challenge areas and to benefit biodiversity.

The EKLIPSE project provides comprehensive examples of indicators for assessing the impacts of each challenge area at the meso- and micro-scale, all of which can be accessed in Section 8. Appendix 1 of the EKLIPSE report contains detailed descriptions of indicators for each category, the type of indicator (which determines the way it can be used for assessments), unit of measurement, and example of method(s) of assessment for measuring the indicator.

Insights from Australian Researchers and Practitioners

While interventions that are labeled "Nature-Based Solutions" have been integrated into policy and practice in Europe, the term has not been as extensively developed or adopted in Australian or the United States policies. The International Union for Conservation of Nature (IUCN) in Europe defines NBS as "…actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits…" while the European Commission defines NBS as "…actions which are inspired by, supported by or copied from nature. Some involve using and enhancing existing natural solutions to challenges, while others are exploring more novel solutions, for example mimicking how non-human organisms and communities cope with environmental extremes." In fact, according to Moosavi et. al. (2021), the origin of the NBS concept from two European-based agencies (IUCN and the European Commission) exemplifies its Eurocentricity, with 46% of the 112 NBS publications on Web of Science and Scopus (as of May 2018) focusing on Europe. In particular, there is a need to clarify the NBS criteria with regards to the role and contribution of 'nature' and defining which interventions qualify as NBS, and which do not. In addition, there is a need to resolve what "solutions" we see NBS providing. Moosavi et. al. (2021) interviewed 27 Australian water professionals from research and practice and examines how they understand, conceptualize, and use the concept "Nature-Based Solutions" in addressing urban water challenges.[26] The thematic analysis of the transcripts resulted in three broad key themes: core ideas embedded in the term NBS, the use of the term in water practices, and critiques of the term.

The first theme involves the conceptualization of NBS, specifically core ideas and related concepts. Most interviewees acknowledged that NBS uses ecological principles to reinstate ecologies for their protective properties and to improve the performance of infrastructure; rather than acknowledging the value of, or capitalizing on natural processes, for something to be called NBS, it must physically contain living organisms. Interviewees also pointed out that Nature-Based approaches should be an adaptive solution, with the capacity to self-repair and adapt with changes in climate. The authors noted that most interviewees discussed broader natural and ecological systems, as opposed to focusing solely on water, emphasizing that natural and hydrological systems cannot be considered in isolation, rather a systems thinking approach is necessary. When interviewees were asked about what "nature" means to them, a common thread highlighted the necessity of shaping a new relationship with a novel and emerging nature–one that was shaped unintentionally, or deliberately by human interventions, that now has to be urgently reimagined with adaptability, humility, and compassion. Upon reflection of what the term "solutions" means in NBS, a number of interviewees highlighted the risk of jumping too quickly to solutions, without examining the nature of the problems these Nature-Based approaches were meant to solve. Therefore, it is necessary for stakeholders to have a shared understanding of the problem(s) that need to be addressed and come to a consensus on the primary and secondary opportunities to be addressed with NBS. The effectiveness of NBS should be measured by what they set out to achieve. Finally, most interviewees highlighted the multi-functionality of NBS in their responses; however, the article notes that the provision of multiple functions, including ecological, hydrological, recreational, and social, should not lead to the assumption that NBS can provide co-benefits in all situations and at all scales as this can place unreasonably high expectations on proposed NBS.

The second theme uncovered the practices that were characterized as NBS to address urban water challenges. The interviews revealed three broad levels of natural processes' contribution to what is perceived as NBS: (1) direct incorporation of nature elements such as plants (i.e. revegetation of urban waterways), (2) direct use of natural processes (i.e. enabling natural water infiltration in soil); and, (3) indirect use or inspirations from natural processes (i.e. sand nourishment) and structures (i.e. artificial reefs to mimic natural reefs). Figure 7 and Figure 8 color-codes natural, Nature-Based Solutions, and Gray Infrastructure solutions to urban water challenges in dark green, green, and grey, respectively.

The third theme presents critiques of the "Nature-Based Solutions" term. Most interviewees criticized the word "solutions" in the term, stating that they were uncomfortable with the implication that any ecological 'problem' can ever be 'solved' in

[26] Moosavi, S., Browne, G. R., & Bush, J. (2021). Perceptions of Nature-Based Solutions for Urban Water challenges: Insights from Australian researchers and practitioners. *Urban Forestry & Urban Greening*, *57*, 126937.

a way that the phrase implies—there is no “lock and leave” solution. Other interviewees brought up the fact that many natural systems are dynamic and influenced by processes such as sedimentology and geomorphology.

Therefore, expecting that NBS can fully and permanently resolve problems is unreasonable; rather NBS should be adaptive and responsive to evolving needs and characteristics of living systems, organisms, and processes.

Example	Problem/s	Supporting quote/s	Coastal /Inland
Revegetation of urban waterways targeting charismatic species	Habitat loss	*So, we were generally trying to improve the environmental value of water ways [by proposing a whole lot of vegetation]. We, more often than not, came up against opposition to nature-based solutions because of their impact on floods.* [PS1]	Inland
Allowing space for saltmarsh retreat	Sea level rise (SLR)	*So this one [enabling salt marsh retreat] .... this is really important in terms of natural responses to climate change because we probably don't have to do anything.* [AS6]	Coastal
Biomimicry	Poor water quality. Unattractive built areas	*Your classic is your water sensitive urban design and ... But you can see it right down to bio-mimicry and bio-philia.* [PP1]	Inland
Planting trees to mitigate heat	Urban heat island	*Trees in an urban forest canopy make a lot of sense. That is a natural climate solution to the heat island effect* [PS2]	Inland
Coastal wetland as barrier to SLR	SLR, coastal flooding Habitat loss	*Enhancing a (coastal) wetland, and keeping a wetland ... even building it up ... and maintaining a dune system and trying to stop erosion with vegetation, I would definitely say is nature-based* [PP3]	Coastal
Wetlands for water quality	Poor water quality	*Bio-treatment systems; wetlands ... that are able to use natural processes to remove pollutants from urban waters so that we can release it less polluted or reuse it in our urban areas for a potable water supply substitution.* [AE2]	Inland
Allowing water to flow through floodable easment	Inland flooding Poor water quality	*Living with water, any system that lets the water flow, because 'water is truth'* [PD2] *Precinct scale wetlands to allow water to be held within the catchment when it rains and then just slowly infiltrate into the ground* [PE1]. *Maribyrnong River waterfront - what we did was set up a whole site relationship that allowed the river to come in and flood the site, and to use that as a positive, ecological, spatial and liveability outcome* [PD4]. *Retreat of development from the waterway to allow the appropriate flood width for floods when they come through.* [PP2]	Inland
'Daylighting' a creek or drainage line	Drought Insufficient water for a park Water quality and flooding	*We altered flow from underground pipes to a surface creek and asked ourselves, 'it's not natural because we're actively irrigating [the landscape]. But we thought, 'We're not in a natural environment anymore because we've urbanised it.'* [PP1]	Inland
Returning a drainage line to a more natural state	Unattractive urban areas Poor water quality	[Edinburgh Gardens, Fitzroy, Melbourne] *was essentially taking a main drain that ran through the site and opening it up. It wasn't daylighting it even, it was just breaking it up and making that pipe more porous, and creating a surface drainage system, a shallow trench and then planting it with Isolepsis.* [PD7]	Inland

Figure 7. Examples from the interviews illustrating a spectrum of solutions, from 'natural' (coded dark green), through 'Nature-Based' (coded light green), to 'grey solutions (coded grey).

	Raingardens	Urban runoff Drought Insufficient water for irrigation	Melbourne, an old school site: *Captured all the storm water from the streets and from the development site townhouses, designed a system that takes all the water from the streets and the townhouses, brings all that water into a series of rain gardens in the park, and that treated water gets then stored underground in a one hundred thousand litre tank - a sustainable water supply, a green park* [PD6]	**Inland**
	Use of dunes to manage SLR	Sea level rise Loss of biodiversity	Netherlands*: Making blowouts in foredunes to a) increase sand transfer landward and b) create greater ecological diversity. both mimicking what natural dunes would do.* [AS3]	**Coastal**
	Salt marsh and blue carbon	GHG emissions	*Salt marsh per unit area is far better at sequestering atmospheric carbon than forest.* [AS2]	**Coastal**
	Revegetating with exotic species	Sea level rise / erosions	*… stabilising [dunes] with Marram and pine forest. But that IS a 'nature-based solution' to a landscape problem, albeit done with invasive species* [AS2]	**Coastal**
	Artificial reefs and textured seawalls	Coastal erosion Sea level rise Habitat Loss	*Things like oyster reefs and artificial reefs of other types that can help dampen wave energy and things like that to protect coastlines* [PS1]. *Wave attenuation, but with … better ecological outcomes* [AS1]	**Coastal**
	Geobag, fencing & renourishment	Coastal erosion Sea level rise	*… a buried geobag wall (small section) with major sand nourishment over the top; I guess a hybrid solution … for say a 30-year period, then Council can reassess* [PE2]	**Coastal**
	Rainwater tanks	Urban runoff / flooding	*Rain tanks are a way of trying to recreate storage. They're not natural, but they certainly work extremely effectively to create a dispersed and sort of homogenous storage across the landscape.* [AS4]	**Inland**
	Sand replenishment	Coastal erosion	*And I probably would have put sand replenishment in that [hard engineering] bucket. But now after talking to the engineers last night, I'd probably put it hybrid. Because it is using the natural sand movement process and intervening in it and redirecting it.* [PP4] *Although, I think sand renourishment is a bit of a fine line* [AS7]	**Coastal**
	House on stilts	Storm surge	*I can't see a house on stilts as a nature-based solution. It's an adaptation to nature, but I don't think it's a nature-based solution because there's no implementation of nature in it.* [AS1]	**Coastal**

Figure 8. Examples from the interviews illustrating a spectrum of solutions, from 'natural' (coded dark green), through 'Nature-Based' (coded light green), to 'grey solutions (coded grey).

Finally, the article acknowledges how NBS could be considered an umbrella term, encompassing specific technical solutions (structural and non-structural), as well as concepts and broad principles to inform practices and policies. Figure 9 highlights the intersections and differences between NBS and other water-related concepts commonly used in practice.

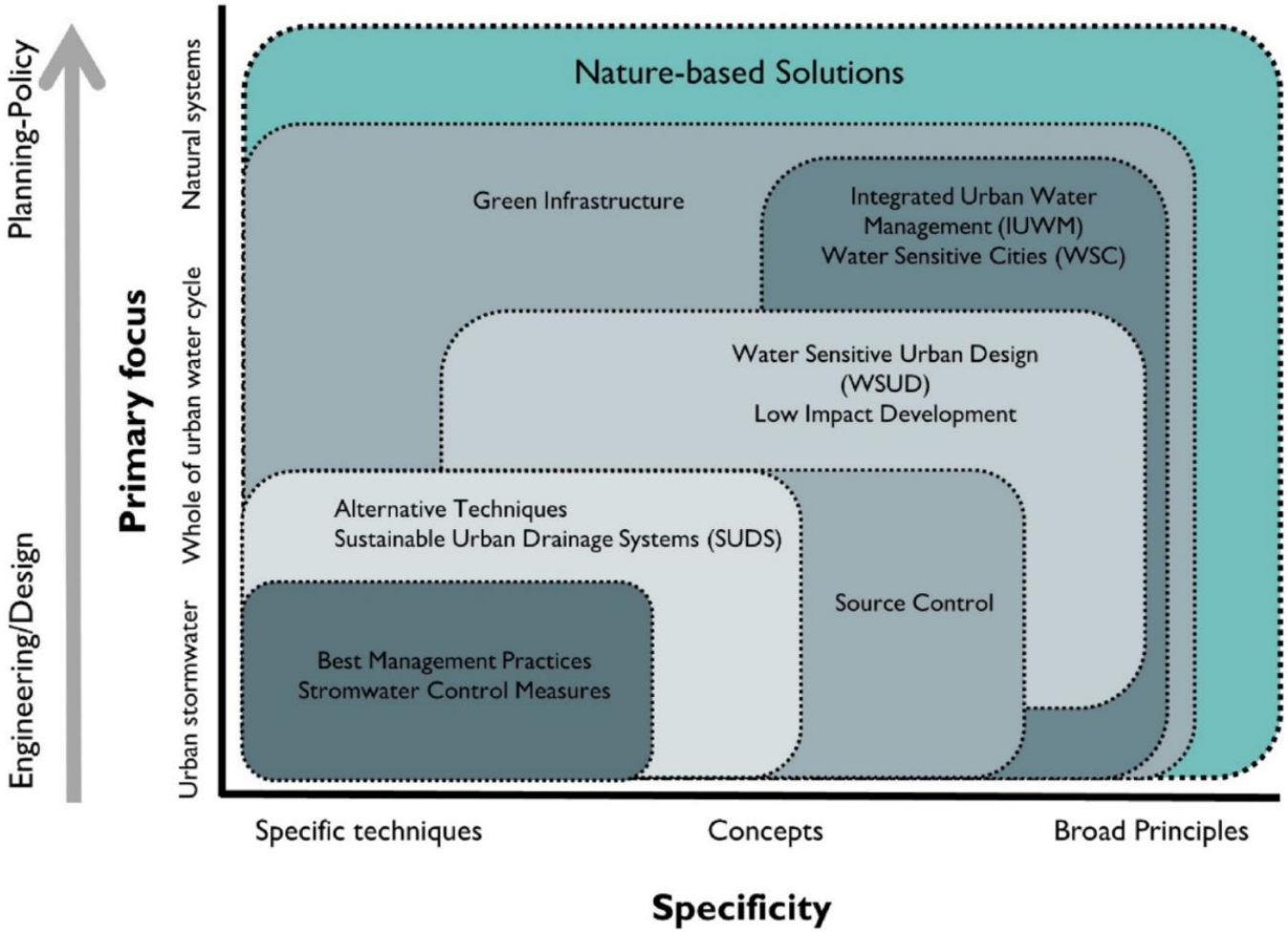

Figure 9. How NBS as an umbrella concept is positioned in comparison to other classifications of terminologies related to water management.

3.5.3 National Examples

Environmental and Energy Study Institute

The Environmental and Energy Study Institute gives examples of Nature-Based Solutions and places where they have been implemented across different problem areas, such as coastal storms, sea level rise, and erosion; inland flooding; and extreme heat.[27] Examples of Nature-Based Solutions that address coastal storms, sea level rise, and erosion include: restoration of wetlands, mangroves, marshes, and oyster reefs, and the installation of living shorelines. Current projects include:

- Along Alabama's Gulf Coast, The Nature Conservancy and its partners worked to install more than nine miles of oyster reefs and marshes. The project aims to limit erosion, compensate for sea level rise, and manage wave energy, while providing habitat for native species.
- In Tampa, Florida, the Army Corps of Engineers built oyster reefs to reduce wave energy and accumulate sediment, and restored previous salt marsh and mangrove systems along the coast, creating habitat.

[27]Bertrand, S. (2021). Fact Sheet | Climate Environmental, and Health Impacts of Fossil Fuels. https://www.eesi.org/papers/view/fact-sheet-nature-as-resilient-infrastructure-an-overview-of-nature-based solutions#:~:text=Nature%2Dbased%20solutions%20includes%20both,%2C%20and%20social%20co%2Dbenefits

- The San Francisco Bay Living Shorelines Project established native eelgrass and oyster beds to protect and stabilize the coast.

Examples of Nature-Based Solutions that address inland flooding include green roofs, rain gardens, bioswales, urban tree canopies, permeable pavements, protecting and/or restoring wetlands and marshes, and protecting and/or restoring riparian buffers. Current projects include:

1. In Wisconsin, The Conservation Fund's Greenseams program has protected over 3,600 acres of natural, flood-prone landscapes throughout Milwaukee and nearby counties, including watersheds and rural counties. The protected area, which is being restored to native wetlands, prairies, and forest habitats, can store 1.3 billion gallons of water to help lower river water levels and slow flows.
2. Green City, Clean Waters is a 25-year green infrastructure retrofit project in Philadelphia to reduce flooding and pollution from Gray Stormwater Infrastructure. The project installs permeable pavement, green roofs, rain gardens, and other NBS.

Examples of Nature-Based Solutions that address extreme heat include green roofs, tree cover, gardens, and any solutions that convert built environments to natural environments such as forests, wetlands, and vegetation. Current projects include:

- In Nashville, Root Nashville is planting trees across the city in areas experiencing warmer temperatures. Since October 2018, 5,300 trees have been planted, lowering temperatures between 1-4°F on hot summer days.
- In Utah, TreeUtah works to educate youth about stewardship and sustainability, while also planting trees to help clean the air and water and lower local temperatures. Since its 30-year anniversary in 2019, 370,000 trees have been planted.
- In Kansas City, Missouri, there have been over 450,000 square feet of green roofs installed between 1999 and 2015 to mitigate the urban heat island effect.

3.5.4 International Examples

Urban Forest Strategy in Melbourne, Australia

The City of Melbourne, Australia faces significant challenges from climate change, population growth, and urban heating, which is placing pressure on the infrastructure, services, and people of the city. Melbourne's Urban Forest Strategy seeks to manage this change and protect against future vulnerability by providing a robust strategic framework for the evolution and longevity of Melbourne's urban forest.[28] The intended outcomes of Melbourne's Urban Forest strategy are to create resilient landscapes, community health and wellbeing, and a livable, sustainable city. The strategy's guiding principles are to mitigate and adapt to climate change; reduce the urban heat island effect; become a 'water sensitive' city; design for health and wellbeing; design for livability and cultural integrity; create healthier ecosystems; and position Melbourne as a leader in urban forestry.

[28] City of Melbourne (2011) Urban Forest Strategy. https://www.melbourne.vic.gov.au/community/greening-the-city/urban-forest/Pages/urban-forest-strategy.aspx

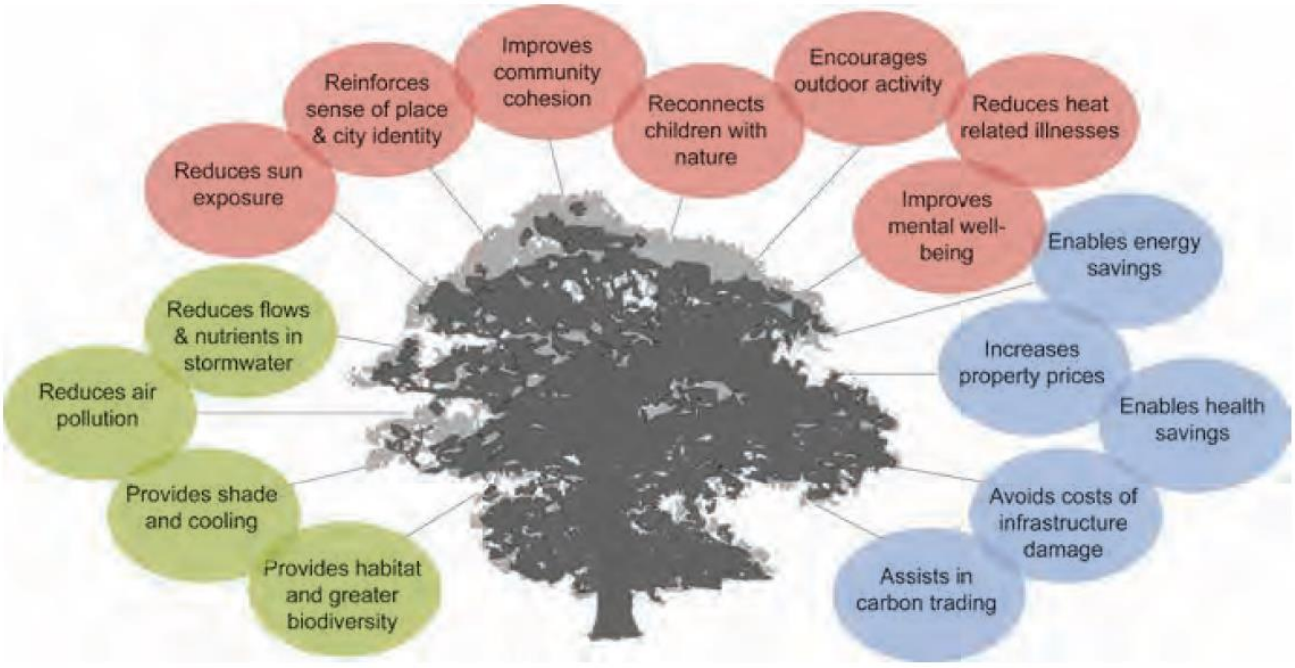

Figure 10. Summary of the broad array of benefits offered by urban trees [adapted from the Woodland Trust, UK].

In order to achieve this vision, the specific strategies and targets proposed are:

- Increase tree canopy cover by increasing public canopy cover from 22 percent at present to 40 percent by 2040.
- Increase urban forest diversity: The urban forest will be composed of no more than 5 percent of any single tree species, no more than 10 percent of any single genus, and no more than 20 percent of any single family.
- Increase tree health: 90 percent of the City of Melbourne's tree population will be healthy by 2040.
- Improve soil moisture and Water Quality: Soil moisture will be maintained at necessary levels to provide for the healthy growth of vegetation. Tree canopies and root systems reduce stormwater flows and nutrient loads. Specifically, tree canopies can intercept and mitigate the impact of heavy rainfalls, and healthy tree roots help reduce the nitrogen, phosphorus, and heavy metal content in stormwater.
- Improve urban ecology: Biodiversity that contributes to a healthy ecosystem will be protected and enhanced.
- Inform and consult the community: The community will have a broader understanding of the importance of the urban forest, increase their connection to it, and engage with its process of evolution.

Melbourne's Urban Forest strategy details a comprehensive list of environmental, community, and economic benefits associated with urban forestry, as described below:

- Environmental: providing shade and cooling cities; reducing stormwater flows and nutrient loads; reducing air pollution; and providing habitat and enhanced levels of biodiversity
- Community: the creation of local identity; improving community cohesion; encouraging outdoor activity; reconnecting children with nature; reducing sun exposure; reducing heat related illnesses; and improving mental wellbeing
- Economic: reducing energy costs, increasing property values, avoiding costs of infrastructure damage and renewal; decreasing health costs; marketing the city; and storing and sequestering carbon

3.5.5 Initial Metrics and Recommendations

As mentioned previously, NBS can address a variety of problems, such as coastal storms, sea level rise, erosion, inland flooding, and extreme heat. It is recommended that the Working Group first define the problems that NBS should be addressing in accordance with the SCWP Goals to inform specific metrics for success. The Technical Team further recommends that NBS prioritization be customized to each WASC's identified problems, and that stakeholders have a shared understanding of the problems to be addressed with NBS.

For example, the problems identified in Central Santa Monica Bay may be different than those identified in the Upper Los Angeles River, and thus, different types of NBS may be needed to address them. The examples of NBS provided in Section 3.5.3 can be used as a foundation for identifying what types of NBS may be used to tackle which specific problems. It is also important to note that NBS are not the only solutions that should be considered to help communities adapt to climate change; rather NBS can be thought of as key assets in a diversified portfolio of solutions.

Although NBS are a goal of the Program, they are also a tool to accomplish a variety of other Program goals. The NBS matrix in Figure 5 shows an example of qualitative metrics for evaluating how "good" a Nature-Based Solution is. It is recommended that the Working Group use this matrix as a starting point for defining the minimum requirements that would qualify a solution as a "Nature-Based Solution," and consult with experts to better define the term. The Technical Team specifically recommends consulting with The Nature Conservancy.

As with the goal of Multiple Benefits, the Working Group must also work to define an appropriate, data-driven mechanism to benchmark and confirm that NBS have been prioritized Program-wide, acknowledging that traditional cost-benefit analyses may not necessarily capture the multiple benefits of NBS over time. The Working Group—informed by the modeling analysis to be conducted in this study—will need to evaluate the spectrum of benefits provided by NBS compared to those provided by non-NBS projects to determine how the balance achieves SCWP Goals at a project- and Watershed-area scale, while using taxpayer dollars wisely.

3.6 DAC Benefits

The SCWP Goals are relatively explicit that the Program shall "Provide DAC Benefits, including Regional Program infrastructure investments, that are not less than one hundred ten percent (110%) of the ratio of the DAC population to the total population in each Watershed Area." However, this prescription seems to imply that benefits are proportional to investments, which is certainly not always the case. As such, additional guidance is warranted to define and determine the magnitude of DAC Benefits in each Watershed Area.

3.6.1 Current SCWP Guidance and Scoring Criteria

As discussed earlier, a DAC is defined in the Implementation Ordinance as "a Census Block Group that has an annual median household income of less than eighty percent (80%) of the Statewide annual median household income" (as defined in Water Code section 79505.5; see Figure 11).

The scoring criteria currently do not consider DACs.

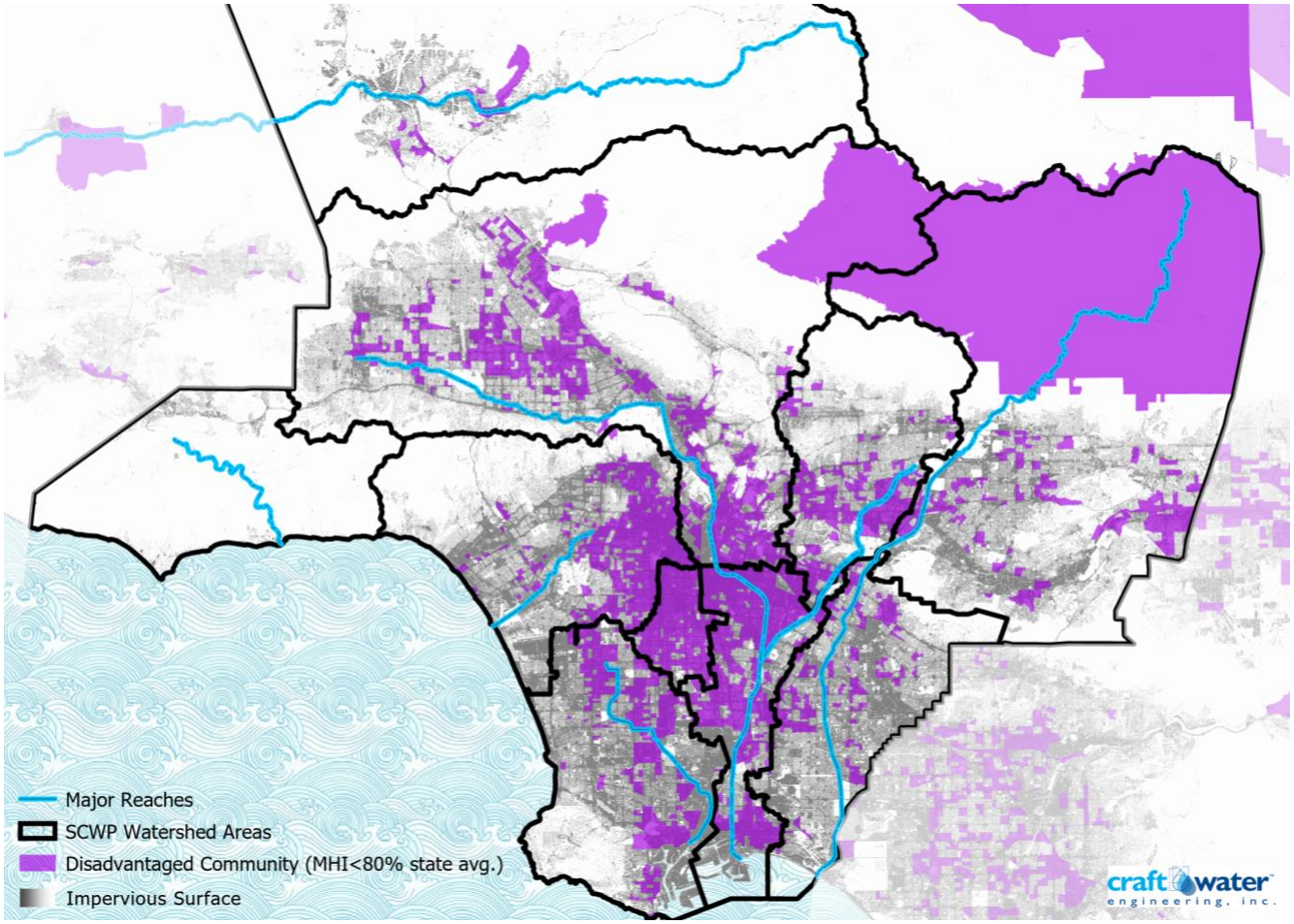

Figure 11. DACs based on median household income (MHI) less than 80 percent of the statewide median (as defined by the State Water Code; US Census Bureau 2018).

3.6.2 The "Urban Green Paradox" & Green Gentrification

As adaptation investments are planned, complex equity issues can arise. While green infrastructure can provide multiple benefits and redress existing inequities, they can also introduce new inequities at the same time; this is known as the "urban green paradox."[29] Poor initial site conditions underlying existing inequities in minority- and lower-income neighborhoods can give rise to intense price and development pressure when these areas are revitalized by urban greening, causing risks of exclusion and displacement to these vulnerable communities. This results in green gentrification, which describes the occurrence or exacerbation of gentrification in vulnerable communities where green infrastructure, such as parks, have been implemented or revitalized.[30]

According to Kulper et. al., there appear to be two approaches to addressing the risks of gentrification during urban greening projects. The first approach is the "just green enough" strategy, which focuses on participatory processes and using small-scale interventions that would fly under the radar of large developers while still bringing some benefits to residents. This approach raises the question of what constitutes "just green enough." It will be crucial to improve areas of historical environmental injustices to a point at which the environmental health hazards are addressed, but not to the point where existing, long-term residents are pushed out of their homes due to increased property values and rent prices. Balancing this concept will be crucial to ensuring that the benefits intended for Disadvantaged Communities rightfully belong to them. The second approach, which is not necessarily in the scope of this project but is worth mentioning, is designing and implementing anti-gentrification policies. There is a wide range of policies that could be used to stabilize property values and limit turn-over of residences and local businesses in large-scale urban greening projects.

3.6.3 Local Examples

CalEnviroScreen 3.0

CalEnviroScreen 3.0 is the latest version of the California Communities Environmental Health Screening Tool.[31] The purpose of the tool is to assist California communities by directing state and local government resources toward a common purpose: the revitalization of Disadvantaged Communities and the pursuit of environmental justice. Californians are burdened by environmental problems and sources of pollution in ways that vary across the state. Some Californians unfairly face more pollution and historical inequities; thus, they are more vulnerable to the effects of pollution than others. CalEnviroScreen uses a science-based method for evaluating multiple pollution sources in a community while accounting for a community's vulnerability to pollution's adverse effects. As opposed to risk assessments, which are primarily designed to quantify health risks from a single pollutant or source at a time, often in one specific medium, CalEnviroScreen aims to assess the impacts of pollution in communities with respect to factors that are not routinely included in risk assessments, due to the recognition that people in real life are simultaneously exposed to multiple contaminants from multiple sources and also have multiple stressors based on their health status and living conditions. In addition, methodologies do not exist to fully integrate geographic factors, intrinsic factors (health status), and extrinsic factors (socioeconomic status); hence CalEnviroScreen aims to fill this gap with its tool as seen in Figure 12.

The map in Figure 13 depicts the relative scoring of California's census tracts using the CalEnviroScreen methodology. Regions such as Los Angeles, San Francisco, San Diego, the San Joaquin Valley, Sacramento, and the Coachella and Imperial regions contain a high number of Disadvantaged Communities. Identifying the specific disadvantaged census tracts in the Los Angeles region will be crucial to ensuring that DAC Benefits are specifically realized in those communities.

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[29] Kuiper, J. F., & Hamin Infield, E. (2019). Greenways for Climate Adaptation: Avoiding the 'Green Paradox' while Improving Urban Resiliency. In *Proceedings of the Fábos Conference on Landscape and Greenway Planning* (Vol. 6, No. 1, p. 39).

[30] Yudelevitch, E. (2019) Green Gentrification: A Study of Revitalized Parks in Los Angeles. https://www.oxy.edu/sites/default/files/assets/UEP/Comps/2019/emma_yudelevitch_green_gentrification.pdf

[31] Rodriquez, M. & Lauren, Z. (2017) CalEnviroScreen 3.0 https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf

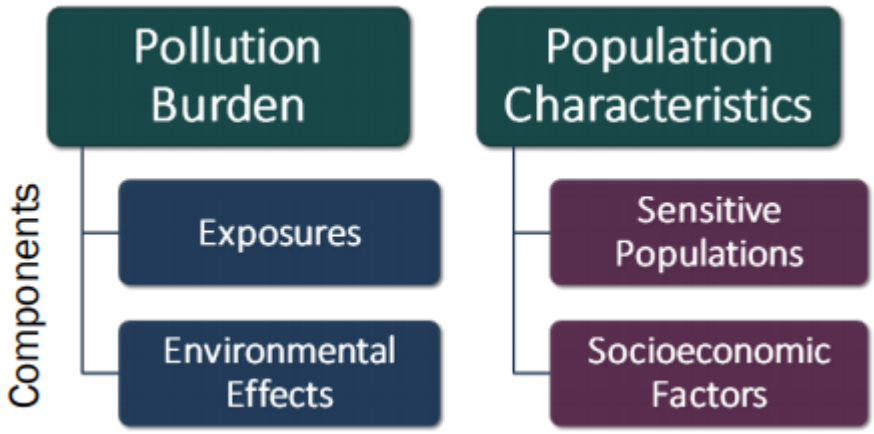

Figure 12. The model includes two components representing pollution burden (exposures and environmental effects) and two components representing population characteristics (sensitive populations and socioeconomic factors).

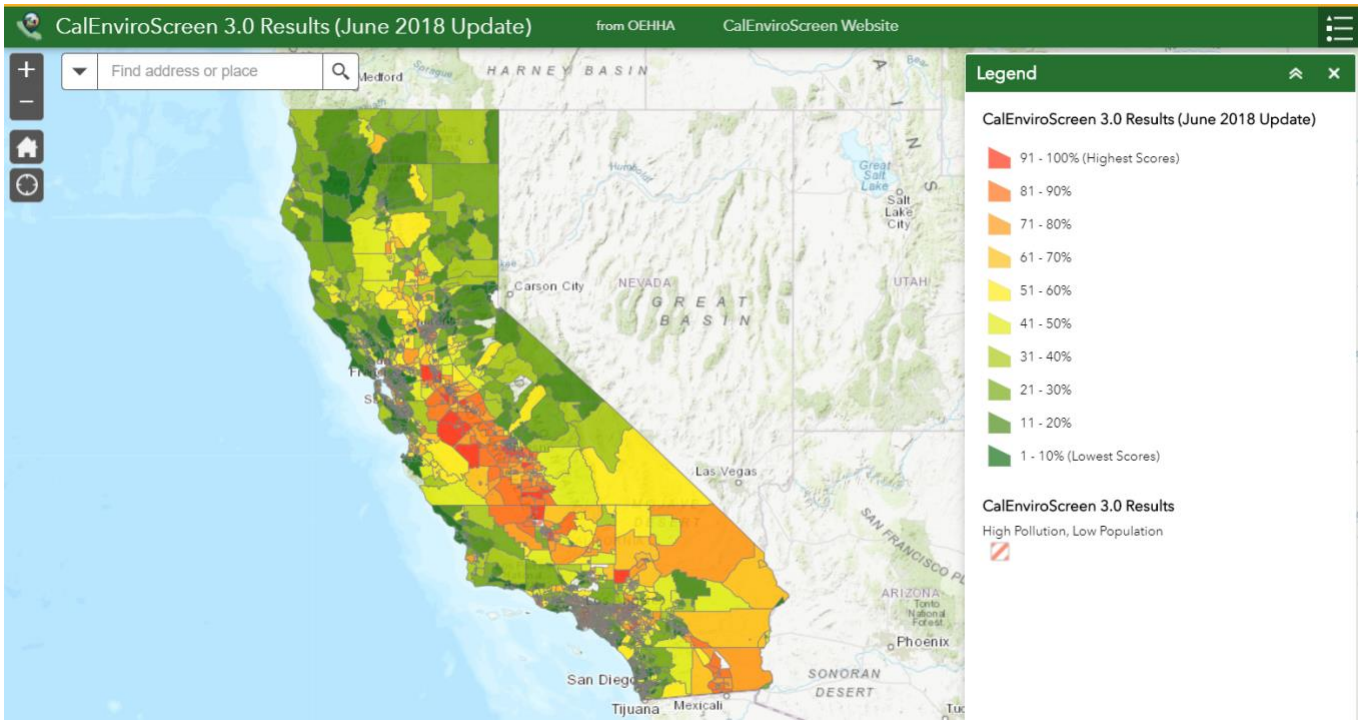

Figure 13. Relative scoring of California's census tracts using the CalEnviroScreen methodology. Census tracts with darker red colors have the higher CalEnviroScreen scores and therefore have relatively high pollution burdens and population sensitivities.

Measures Matter Report by the University of Southern California (USC) Equity Research Institute.[32]

The purpose of the *Measures Matter* report is to help the County, through its related agencies, use public policy to help close equity gaps instead of widening them. This report was written with particular context to Measures M and A, which address transportation and parks, respectively. Both parks and transportation are major advocacy issues for stakeholders working for health equity, environmental justice, workforce development, housing for all, racial equity, decriminalization of people of color, and more.

The framework proposed by the USC Equity Research Institute includes the following eight points:

- Drive with equity from the start;
- Support grassroots groups and leadership development;
- Share decision making among residents, cities, and agencies;
- Take a collaborative approach to training and technical assistance;
- Attach equity guidelines to government dollars;
- Advance a broad regional economic and health equity platform;
- Integrate and lead across silos; and
- Conduct ongoing outcomes and process evaluation.

The report emphasizes that capturing both transactional and transformational metrics matters; transactional metrics are straight forward (e.g., did community engagement impact project plans?) while transformational metrics assess the quality of the engagement (e.g., was trust built, the number of CBO representatives sitting on decision-making entities, community engagement processes changing the course of projects, etc.). In addition, these metrics should be adaptive to match the adaptive processes that reflect the changing equity landscape. Process and outcome metrics will help hold agencies accountable and measure progress toward shared goals to ensure that equity is both centered and achieved in the implementation process.

3.6.4 National Examples

Green Gentrification.[33]

The study covers 10 cities—New York, Los Angeles, Chicago, Houston, Philadelphia, Seattle, Denver, Austin, Albuquerque, and Portland—and tracks the role of parks in the gentrification of the cities over 15 years, from 2000 to 2015. The study identifies gentrifying neighborhoods in these cities by tracking changes in median income, housing values and rents, and the number of resident college graduates. Neighborhoods or census tracts that start out with median incomes lower than that of the city overall are labeled as "gentrification-eligible." The key characteristics of parks that are identified as potential causes for gentrification include size, overall quality, whether they are new, proximity to downtown, and whether or not they are linear "greenway parks" (longer than a mile and include an active transportation component like bike lanes).

The study found that long greenway parks, like the New York High Line or Atlanta's BeltLine, are the biggest culprits in gentrification; in fact, being located within a half-mile of a new greenway park increases the odds that a neighborhood will gentrify by more than 200 percent, because long linear parks provide opportunities for new real estate development. In addition, the study found that parks located closer to downtown played a larger role in gentrification, such as new parks in L.A. near the Los Angeles River. There is no statistical evidence that park size is a driver of gentrification; rather, parks of any size trigger gentrification when they are located close to downtown.

Overall, the study suggests that planners and policymakers should strive to address deep rooted inequities in accessible park acreage by adding substantial amounts of new green space in park-poor, low-income communities of color, while also

[32] Carter, V., Pastor, M., Wander, M., Chlala, R., Hernandez, N., Muna, E. (2018) Measures Matter. https://dornsife.usc.edu/assets/sites/1411/docs/2018MeasuresMatterPERE.pdf

[33] Rigolon, A., & Németh,, J. (2019). Green gentrification or 'just green enough': Do park location, size and function affect whether a place gentrifies or not? *Urban Studies* (Vol. 57, Issue 2, p. 402-420). https://doi.org/10.1177/0042098019849380

providing and protecting nearby affordable housing. Ultimately, cities need to ensure that initiatives for parks and green space are integrated with broader strategies for inclusive development for all neighborhoods and residents.

3.6.5 Initial Metrics and Recommendations

The most straightforward method to evaluate the DAC Benefits goal could be to define metrics for all of the other SCWP Goals (i.e., Public Health and Community Investments, Water Supply, Water Quality, Green Jobs, etc.) and then model those metrics for proposed projects in each Watershed Area to validate whether the benefits achieved are 10 percent higher in DACs.

However, the preceding goals and benefits may not necessarily translate into what specific DACs need. In the survey completed prior to its first meeting, the Working Group collectively prioritized the need to consult external experts for Disadvantaged Community Benefits. The Technical Team recommends engaging Dr. Manuel Pastor, or one of his colleagues, to further articulate key issues related to DACs (such as the definition of equity, green gentrification, and anti-displacement policies) and advice on how DAC Benefits should be measured, tracked, and potentially customized to specific communities throughout the District, using tools such as CalEnviroScreen 3.0 or the Los Angeles County Parks and Recreation Needs Assessment. This could ultimately result in the tabulation of other SCWP Goals (as quantified through metrics agreed upon by the Working Group) achieved in DACs, or benefits could potentially be aggregated into an index to measure the proportion of benefits realized in DACs versus non-DACs.

3.7 Summary of Initial Metrics and Recommended Next Steps

The following potential metrics should be considered and discussed by the Working Group to initially agree upon which appropriately and defensibly measure progress toward SCWP Goals. It is important to note that this is not a static list of metrics; rather, this list is dynamic and can be augmented by metrics raised by the Working Group or experts during discussions.

Table 11. Initial list of example metrics for prioritized goals.

ID	Paraphrased Goal	Current SCWP Criteria/Metrics	Alternative Metrics Identified Through Literature Review

A	**Water Quality**	• Reduction in Stormwater or Urban Runoff pollution, such as improvements in the chemical, physical, and biological characteristics of Stormwater or Urban Runoff (no metric specified)
		• Project pollutant removal efficiency (%)
		• Dry weather urban runoff elimination (%)
		• Tributary area managed for dry weather (acres)
		• Cost-effectiveness (as measured by dividing the 24-hour BMP capacity by the construction cost in $ millions)
			Project-Scale
			• Pollutant load captured/reduced
			  ○ Percentage of baseline load captured (%)
			  ○ Total long-term pollutant load captured (pounds)
			Outfall- or Subwatershed-scale:
			• Frequency that discharges exceed Water Quality objectives (%)
			• Decreased concentrations in outflows (%)
			Receiving Water- or Watershed Area-scale:
			• Improved California Stream Condition Index (CSCI) score (reference the proposed Basin Plan amendment in San Diego) or improved Algal Index of Biotic Integrity (IBI) score (unitless)
			• Decreased number of beach closures/improved grade on Heal the Bay's Beach Report Card (count, or % of days)
			• Decreased concentrations under applicable critical conditions (e.g., metals consider chronic and acute CTR conditions, nutrients consider annual and summer averages and typical algal growth conditions, bacteria consider high-flow suspension (HFS) days) (%)

ID	Paraphrased Goal	Current SCWP Criteria/Metrics	Alternative Metrics Identified Through Literature Review
			• Decreased concentration levels in fish tissue samples (mostly focused on mercury, selenium, PCBs, DDT, and Chlordane) (%) • Decreased number of exceedance days, shortened exposure periods of exceedances (%, days) • Receiving water removed from the 303(d) list (i.e., meeting Basin Plan objectives) (count, or % of total currently listed)
		Recommended Next Steps Technical Team should customize Water Quality metrics to each receiving water.	
C	**Public Health & Community Investments**	Projects are awarded points based on how many of the following Community Investment Benefits are accrued:	Metrics related to the following public health challenge areas include:[34] Climate resilience: Decrease in mean/peak daytime local temperatures; measures of human comfort; heatwave risks; kWh/y and t C/y saved; etc.

[34] For a more comprehensive list of metrics to consider within these challenge areas, please refer to the European Commission EKLIPSE Project section and Public Health and Community Investments section.

ID	Paraphrased Goal	Current SCWP Criteria/Metrics	Alternative Metrics Identified Through Literature Review
		• Improved flood management, flood conveyance, or flood risk mitigation; • Creation, enhancement, or restoration of parks, habitat or wetlands; • Improved public access to waterways; • Enhanced or new recreational opportunities; • Greening of schools; and • Improved public health by reducing heat island effect and increasing shade or planting of trees or other vegetation that increase carbon reduction/sequestration and improve air quality	Water management: Flood peak reduction; increase in time to peak; absorption capacity of green surfaces, bioretention structures and single trees; reduction of inundation risk for critical urban infrastructures (probability); etc.
			Coastal resilience: Shoreline characteristics and erosion protection; avoided damage costs; recreation and public access; number of students benefiting from education and research about coastal resilience/amenity; estimates of spec, individual, and habitat distribution; etc.
			Habitat creation: Area within project footprint covered by native grasses/herbs and/or native shrubs/trees immediately after project is completed and after plantings have grown to maturity (in ft^2 or m^2); layers of vegetation (in ft^2 or m^2)
			Energy use: Energy savings measured by kilowatt hours (kWh) of electricity and British thermal units (Btus) of natural gas over a specified planning period; level of CO_2 (and other greenhouse gases) emissions reduced or sequestered (valued using a "social cost of carbon" estimate)
			Increasing access to green space and providing additional recreational activities: Distribution of public green space per capita (or capita in Disadvantaged Communities); recreational or cultural value (number of visitors, number of recreational/cultural activities); accessibility (measured as within a half-mile or a specified time) of urban green spaces for population; park pressure (measures the park size in relation to population density), park amenities; etc.
		Recommended Next Steps	Air quality: Annual amount of pollutants captured by vegetation; premature deaths and hospital admissions averted per year; etc.
		Working Group to engage additional expert advice and stakeholders to determine what specific and/or additional factors are valued in specific communities throughout the District. Recommended academic experts include Jon Christensen and Gregory Pierce (UCLA)	Urban regeneration: Reclamation of contaminated land; reclamation of building materials; distribution, configuration, and diversity of green space and land use changes; etc.
			Participatory planning and governance: Openness of participatory processes; perceptions of citizens on urban nature; social values for urban ecosystems and biodiversity; policy learning concerning adapting policies and strategic plans by integrating ecosystem services and possibly their valuation; etc.

ID	Paraphrased Goal	Current SCWP Criteria/Metrics	Alternative Metrics Identified Through Literature Review
			Social justice and social cohesion: Availability and distribution of different types of parks and/or ecosystem services with respect to specific individual or household socioeconomic profiles and landscape design; being able to move freely from place to place; etc.
			Public health and well-being: Number and share of people being physically active; reduced autoimmune diseases and allergies (potentially); proximity measures (green space of a specified size within a specified distance); Normalized Difference Vegetation Index (NDVI); etc.
			Economic opportunities and green jobs: Number of jobs created; gross value added per employee based on full-time equivalent jobs in the green sector
E	**Multiple Benefits**	All projects submitted to the Scoring Committee must demonstrate a Water Quality Benefit, and a Community Investment Benefit or a Water Supply Benefit, or both. Recommended Next Steps Working Group to explore criteria for measuring this goal by evaluating the results of the Pilot Analysis performed by the Technical Team. Results will reveal the cost-benefit trade-offs of different portfolios of Multi-Benefit Projects to inform data-driven recommendations for scoring criteria adjustments that objectively benchmark and incentivize the highest-value projects.	• Binary criteria (yes/no) • Multi-benefit score/index accounting for magnitude and distribution of benefits, benchmarked with modeling results
B	**Water Supply**	• Cost-effectiveness (as measured by dividing the life-cycle cost by the annual stormwater capture amount) • Annual amount of stormwater captured	• Project or Program-Scale: Acre-feet of water—that would have otherwise been discharged to the ocean, infiltrated to unmanaged or unused aquifers, or lost to evaporation—captured to replenish or augment local supply • Program-Scale: percentage of local water demand augmented/offset

ID	Paraphrased Goal	Current SCWP Criteria/Metrics	Alternative Metrics Identified Through Literature Review
		Recommended Next Steps Technical Team to collaborate closely with the BoR study to leverage the best available models and tools for predicting deep percolation of runoff to managed and usable groundwater aquifers	
F	**Nature-Based Solutions**	• Implements natural processes or mimics natural processes to slow, detain, capture, and absorb/infiltrate water in a manner that protects, enhances, and/or restores habitat, green space and/or usable open space • Utilizes natural materials such as soils and vegetation with a preference for native vegetation • Removes Impermeable Area from project site Recommended Next Steps • Working Group to define what problems should be solved with NBS • Working Group to agree on definition/qualifying criteria for NBS projects • Working Group to consult with expertise at The Nature Conservancy • Technical Team to conduct modeling analysis to articulate the spectrum of benefits from various NBS	The Working Group should define the minimum qualifications for a NBS. Subsequent modeling analyses will better articulate the goals achieved by prioritizing a range of NBS versus non-NBS. Examples of Nature-Based Solutions that address coastal storms, sea level rise, and erosion include: restoration of wetlands, mangroves, marshes, and oyster reefs, and the installation of living shorelines. Examples of Nature-Based Solutions that address inland flooding include green roofs, rain gardens, bioswales, urban tree canopies, permeable pavements, protecting and/or restoring wetlands and marshes, and protecting and/or restoring riparian buffers. Examples of Nature-Based Solutions that address extreme heat include green roofs, tree cover, gardens, and any solutions that convert built environments to natural environments such as forests, wetlands, and vegetation.
J	**DAC Benefits**	Not less than one hundred ten percent (110%) of the ratio of the DAC population to the total population in each Watershed Area	DAC Benefits may be derived from other goals; define metrics for all other goals and ensure they are achieved at least 10 percent higher in DACs

ID	Paraphrased Goal	Current SCWP Criteria/Metrics	Alternative Metrics Identified Through Literature Review
		Recommended Next Steps	
		The Technical Team recommends engaging Dr. Manuel Pastor, or his colleagues, to further articulate key issues related to DACs (such as the definition of equity, green gentrification, and anti-displacement avoidance policies[2]) and provide advice on how DAC Benefits should be measured, tracked, and potentially customized to specific communities throughout the District, potentially using tools such as CalEnviroScreen 3.0 and the Los Angeles County Parks and Recreation Needs Assessment.	

4 Additional Working Group Prioritized Goals

Additional goals that require research and analysis to inform measurement of Program success include:

- Green jobs
- Other funding
- Spectrum of project sizes
- Proportionally benefiting municipalities
- Operations and Maintenance

These goals are key elements of the Program, but do not necessarily inform the programming of projects into SIPs. Additional guidance would be valuable to quantify progress toward achieving each goal. Brief commentary is provided for each goal below, and additional research will be separately performed to inform modeling approaches.

4.1 Green Jobs

Green jobs could potentially be considered a component evaluated under the Community Investments prioritized goal. Jobs resulting from the implementation of stormwater projects are typically thought to include occupations in landscaping, groundskeeping, maintenance, and repair and require skilled craftspeople and scientists, hydrologists, engineers, botanists, and horticulturalists.[35] During the first Working Group meeting, a question about the distinction between "jobs" and "green jobs" was brought up, particularly with relation to stormwater infrastructure solutions under the SCWP. It is recommended that the Working Group consult with subject matter experts and stakeholders to form a consensus about the definition of "green jobs" and its distinction, if any, from "jobs."

As discussed in Sections 3.3.4 (Philadelphia case study), 3.5.2 (NBS framework from the EKLIPSE project), and the T.R.E.E.S. (Transagency Resources for Economic and Environmental Sustainability) Project Cost-Benefit Analysis, some potential quantifiable metrics that could be used for measuring the impacts of green job creation are:

- Net additional jobs in the green sector enabled by NBS projects (related to construction and maintenance)
- Avoided costs of social services that the City would provide on behalf of the same people if they remain unemployed
- How many of the jobs created by BMP implementation would be long-term jobs with livable wages for a typical family (i.e. job-years).[36]

[35] Los Angeles Alliance for a New Economy (2018) Liquid Assets: How Stormwater Infrastructure Build Resilience, Health, Jobs, & Equity. https://laane.org/wp-content/uploads/2018/03/LAANE_Liquid-Assets_Stormwater-Report.pdf

[36] Product Specification for the T.R.E.E.S. (Transagency Resources for Economic and Environment Sustainability) Project Cost-Benefit Analysis

In order to model green job creation (in job-years), control measure maintenance hour estimates for specific tasks, employee types, and frequencies can be found from several published references. For example, the hours per unit of control measure can be converted to job-years by the following formula:

$$\left(LH\left(\frac{hr}{yr}\right) \times SL(yr)\right) \div FTL\left(\frac{hr}{yr}\right) = Job\ Years$$

Where LH denotes the control measure's total maintenance labor hours per year; SL equals service life of the control measure; and FTL equals 1904, the amount of labor hours assumed in a full-time labor year. Total maintenance labor hours accounts for all employee types involved in maintaining a given control measure, as maintenance crews differ by type. Service life is estimated to be 20 years for all control measures for consistency.

In addition to considering quantitative metrics such as the number of job-years, it is important that all projects that receive funding comply with additional equity guidelines that ensure more inclusive job opportunities and high job standards.

4.2 Other Funding

The SCWP *Feasibility Study Guidelines* state that project feasibility studies must include "a discussion of how other funding sources are being leveraged to finance the project, including documentation of such other funding sources (e.g., existing agreements, MOUs, grant awards).[37] Other funding sources could include funds from the SCW Municipal Program." A portion of a Project's score depends on its ability to secure additional funding other than Regional Program funding from the SCWP; therefore, it is crucial to assess the availability of other funding programs that can fund the Project to completion (and O&M after completion), should a Project not receive its requested funding from the SCWP. The Working Group should consider if additional guidance should be provided to adjust scoring based on a city's financial position and ability to cost share.

Table 12. Infrastructure Program Project Scoring Criteria for Leveraging Funding.

E. Leveraging Funds and Community Support	10 points max	The Project achieves one or more of the following:
	6 points max	E1. Cost-Share. Additional Funding has been awarded for the Project. • >25% Funding Matched = 3 points • >50% Funding Matched = 6 points
	4 points	E2. The Project demonstrates strong local, community-based support and/or has been developed as part of a partnership with local NGOs/CBOs.

4.3 Spectrum of Project Sizes

The distribution of project sizes across the Program can be easily measured, although currently there are no guidelines to suggest an appropriate target for this goal. Note that this goal is subjective, because there is currently no evidence that providing a spectrum of project sizes results in maximum benefits to the environment and communities in every Watershed Area. The Working Group should consider whether any quantitative targets or ratios should be established to measure this goal, or if this goal is inherently addressed by prioritizing NBS.

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4.4 Proportionally Benefiting Municipalities

This goal is generally enforced by the allocation of tax revenue in the Program, but could be measured by tallying and comparing the benefits achieved in each jurisdiction. Note that some benefits are realized at a watershed-scale, though, and cannot be clearly parsed along jurisdictional boundaries.

4.5 Operations and Maintenance

This goal is generally enforced by the *Feasibility Study Guidelines,* which require a plan for long-term operations and maintenance. The Working Group should consider if additional recommendations are warranted.

5 Working Group Supplemental Goals

The remaining SCWP Goals govern overall Program implementation and do not necessarily impact measurement of success at the Watershed Area or project-scale. These goals will not be explicitly researched or analyzed as part of this study, but any related recommendations will be tracked, documented, and submitted to the District for consideration. Supplemental goals include:

- Innovation
- Scientific Research
- Adaptive Management

6 Next Steps and Expert Consultation

During Working Group meetings in March 2021 and June 2021, the ARLA and the Technical Team brought in technical experts to discuss nuances related to the prioritized goals to better inform the Working Group's background knowledge related to each prioritized goal. The Technical Team will continue coordinating with the District's ongoing efforts to adapt the Program guidance. Listening sessions were held with key decision makers between February 2021 and April 2021 to gain additional input and feedback on the measurement of goals. Information distilled from these activities will be deliberated with the Working Group to reach consensus on initial metrics for measuring Program success, and those metrics will then be tested by modeling a spectrum of projects within a pilot area of L.A. County. Metrics and recommendations will be iteratively updated in collaboration with the Working Group on the basis of the scientific findings, and ultimately recommended to the District for consideration.

7 Additional Related References

1. Autocase (https://sustainable-infrastructure-tools.org/tools/green-growth-indicators/)
2. Los Angeles Regional Water Quality Control Board (LARWQCB) Basin Plan (https://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/)
3. L.A. County Basin Study, Bureau of Reclamation and the District (2016) (https://www.usbr.gov/watersmart/bsp/docs/fy2017/LABasinStudySummaryReport.pdf)
4. Center for Neighborhood Technologies (CNT) (https://cnt.org/publications)
5. CIRIA (https://www.ciria.org/CIRIA/Topics/Building_and_construction_technology/Topic_overviews/Building_and_construction_technology.aspx?hkey=5859d78d-429e-4fd5-bfff-48c5fca52bf2)
6. Enhanced Watershed Management Plans (EWMPs) (https://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/watershed_management/)
7. FRAGSTATS (1995) (https://doi.org/10.2737/PNW-GTR-351)
8. Green Infrastructure Leadership Exchange's Co-Benefits Valuation Tool (https://giexchange.org/wp-content/uploads/2019/05/Green-Infrastructure-Valuation-Tool-User-Guide-Version_1.01.pdf)
    a. http://greenvalues.cnt.org/national/downloads/methodology.pdf
    b. https://giexchange.org/wp-content/uploads/2019/05/Green-Infrastructure-Valuation-Tool-User-Guide-Version_1.01.pdf
9. Integrated Decision Support Tool (iDST) (https://idst.mines.edu/)
10. Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) (https://naturalcapitalproject.stanford.edu/software/invest)
11. Los Angeles Countywide Parks and Recreation Needs Assessment (https://tpc.maps.arcgis.com/apps/MapJournal/index.html?appid=6f8962df9e9446babb35f28fa8d1c23a)
12. Los Angeles Urban Cooling Collaborative (https://www.treepeople.org/rx-for-hot-cities-climate-resilience-through-urban-greening-and-cooling-in-los-angeles/)
13. Lower LA River Revitalization Plan (https://lowerlariver.org/volume-i/)
14. Living Waterways – Version 3 (https://waterbydesign.com.au/living-waterways)
15. National Research Council. (2005). *Valuing ecosystem services: toward better environmental decision-making*. National Academies Press.
16. Pacific Institute Multi-Benefit Resource Library (https://pacinst.org/multi-benefit-resource-library/)
17. Rigolon, A., & Németh, J. (2020). Green gentrification or 'just green enough': Do park location, size and function affect whether a place gentrifies or not?. *Urban Studies*, *57*(2), 402-420.
18. Stormwater Capture Master Plan (https://www.ladwp.com/cs/idcplg?IdcService=GET_FILE&dDocName=OPLADWPCCB421767&RevisionSelectionMethod=LatestReleased)
19. Susdrain (https://www.susdrain.org/resources/best.html)
20. Upper LA River and Tributaries Revitalization Plan (https://upperlariver.konveio.com/)
21. Water Research Foundation Community-enabled Lifecycle Analysis of Stormwater Infrastructure Costs (CLASIC) (https://www.waterrf.org/community-enabled-lifecycle-analysis-stormwater-infrastructure-costs-clasic)
22. Water Sensitive Cities Index (https://watersensitivecities.org.au/solutions/wsc-index/)

8 Appendix: Comprehensive Examples of Indicators & Metrics Related to NBS and Community Investment Goals from the European Commission EKLIPSE Report

Table 13. Examples of indicators for assessing the impact of climate adaptation actions.

Indicators	Metric
• Temperature reduction	• Decrease in mean or peak daytime local temperatures (°C) (Demuzere et al., 2014). • Measures of human comfort e.g. ENVIMET PET — Personal Equivalent Temperature, or PMV — Predicted Mean Vote. • Heatwave risks (number of combined tropical nights (>20°C) and hot days (>35°C)) following Fischer, Schär, 2010, cited by Baró et al. (2015).
• Energy and carbon savings from reduced building energy consumption	• kWh/y and t C/y saved.

Table 14. Examples of indicators for assessing the impact of water management actions.

Indicators	Measurement scale				
	mesoscale			microscale	
	Regional*	Metropolitan	Urban	Street	Building
Physical indicators					
• Run-off coefficient in relation to precipitation quantities (mm/%) (Armson et al., 2013; Getter et al., 2007; Iacob et al., 2014; Scharf et al., 2012).	•	•	•	•	•
• Flood peak reduction (Iacob et al., 2014), Increase in time to peak (Iacob et al., 2014) (%).	•	•	•	•	
• Reduction of drought risk (probability).	•	•			
• Increasing ground water availability, (depth to groundwater) (Feyen and Gorelick, 2004).	•	•			
• Absorption capacity of green surfaces, bioretention structures and single trees (Armson et al., 2013; Davis et al., 2009).				•	•
• Nutrient abatement, abatement of pollutants (%, nutrient load, heavy metals).	•				
• Ground water quality (nutrient load, heavy metals).	•				
• Increased evapotranspiration measured/modelled (Litvak and Pataki, 2016).	•	•	•	•	•
• Temperature reduction in urban areas (°C, % of energy reduction for cooling) (Demuzere et al., 2014).	•	•	•	•	
Economic indicators					
• Economic benefit of reduction of stormwater to be treated in public sewerage system (€) (Deng et al., 2013; Soares et al., 2011; Xiao and McPherson, 2002).	•	•	•		
• Reduction of inundation risk for critical urban infrastructures (probability) (Pregnolato et al., 2016).			•	•	
• Stage-damage curves relating depth and velocity of water to material damages (€) (de Moel et al., 2015).		•	•		

Table 15. Examples of indicators for assessing the impact of coastal resilience actions.

Indicators	Measurement scale				
	mesoscale			microscale	
	Regional	Metropolitan	Urban	Street	Building
Physical indicators (Fagherazzi, 2014; Gedan et al., 2011; Grabowski et al., 2012; Stark et al., 2016).					
• Shoreline characteristics and erosion protection	•	•			
• Soil, temperature, drainage			•		
• Flooding characteristics	•	•			
Economic indicators (Gedan et al., 2011; Narayan et al., 2016; Shuster and Doerr, 2015).					
• Avoided damage costs			•	•	•
• Changes in property value				•	•
Social and education indicators (Piwowarczyk et al., 2013; Schuster & Doerr, 2015).					
• Recreation and public access		•	•		
• Number of students benefiting from education and research about coastal resilience/amenity	•				
Biological indicators (Bell, 1997; Yepsen et al., 2016).					
• Estimates of species, individuals and habitats distribution	•	•			
• Invasive and planted species	•	•	•		
• Algal bloom	•				
Chemical indicators (Grabowksi et al., 2012; Yepsen et al., 2016).					
• Concentration of nutrients			•	•	
• Salinity, pH			•	•	

Table 16. Examples of indicators for assessing the impact of green space management actions.

Indicators	Measurement scale				
	mesoscale			microscale	
	Region	Metropolitan	Urban	Street	Building
• Distribution of public green space – total surface or per capita (Badiu et al., 2016; Gómez-Baggethun and Barton, 2013; La Rosa et al., 2016).	•	•	•		
• Recreational (number of visitors, number of recreational activities) or cultural (number of cultural events, people involved, children in educational activities) value (Kabisch and Haase, 2014).	•	•	•	•	
• Accessibility (measured as distance or time) of urban green spaces for population (Tamosiunas et al., 2014).	•	•	•	•	
• Changes in the pattern of structural and functional connectivity (Iojă et al., 2014).	•	•	•		
• Species richness and composition in respect to indigenous vegetation and local/national biodiversity targets (Cohen et al., 2012; Krasny et al., 2013).	•	•	•	•	•

Table 17. Examples of indicators for assessing the impact of air quality actions.

Indicators	Measurement scale				
	mesoscale			microscale	
	Regional	Metropolitan	Urban	Street	Building
• Non-spatial indicators of gross quantities: annual amount of pollutants captured by vegetation (Bottalico et al., 2016).	•	•	•	•	
• Non-spatial indicators of net quantities: net air quality improvement (pollutants produced – pollutants captured + GHG emissions from maintenance activities) (Baró et al., 2014).		•	•	•	
• Non-spatial indicators of shares: share of emissions (air pollutants) captured/sequestered by vegetation (Baró et al., 2014).		•	•	•	
• Spatial indicators: pollutant fluxes per m2 per year (Manes et al., 2016; Tallis et al., 2011).		•	•	•	
• Monetary values: value of air pollution reduction (Manes et al., 2016); total monetary value of urban forests including air quality, run-off mitigation, energy savings, and increase in property values (Soares et al., 2011).		•	•		
• Other indicators: health impact indicators such as premature deaths and hospital admissions averted per year (Tiwary et al., 2009).	•	•	•		

Table 18. Examples of indicators for assessing the impact of urban regeneration actions.

Indicators	Measurement scale				
	mesoscale			microscale	
	Regional	Metropolitan	Urban	Street	Building
Urban green indicators					
• Urban green: Index of biodiversity, provision and demand of ecosystem services.	•	•	•	•	•
• Ecological connectivity (Pino and Marull, 2012).	•	•	•		
• Accessibility (Schipperijn et al., 2010): distribution, configuration, and diversity of green space and land use changes (multi-scale; Goddard et al., 2010).	•	•	•		
• Ratio of open spaces to built-form.				•	•
• Reclamation of contaminated land: percentage of contaminated area reclaimed.			•	•	•
Building efficiency and environmental design indicators					
• Reclamation of building materials: percentage reclaimed from existing buildings.					•
• Energy efficiency: building materials/ construction methods based on points awarded according to energy efficiency checklist.					•
• Incorporation of environmental design: percentage of total building stock.					•
• Land devoted to roads: percentage of site area occupied by roads.	•	•	•	•	
Socio-cultural indicators					
• Conservation of built heritage resources: percentage of built form retained for culture.					•
• Land dedicated to pedestrians: percentage of road network.	•	•	•	•	
• Public transport links: walking distance to nearest facilities.			•	•	
• Access to open space: average journey time for residents/employees by foot or average distance to sports centre, recreation area, or green space.		•	•	•	
• Access to cultural facilities: average journey time for residents on foot or average distance to cultural centre.		•	•	•	
• Access to housing: affordability and choice.	•	•	•		
• Level of devices contributing to the safety of users in the neighbourhood: lighting of common areas, access control, presence of technical, or specialized staff, etc.					•

Table 19. Examples of indicators for assessing the impact of participatory planning and governance actions.

Indicators	Measurement scale				
	mesoscale			microscale	
	Regional	Metropolitan	Urban	Street	Building
• Openness of participatory processes (Frantzeskaki and Kabisch, 2016; Luyet et al., 2012; Uittenbroek et al., 2013).	•	•	•	•	
• Legitimacy of knowledge in participatory processes (Frantzeskaki and Kabisch, 2016; Luyet et al., 2012).	•	•	•		
• Social learning concerning urban ecosystems and their functions/services (Colding and Barthel, 2013).	•	•	•	•	
• Policy learning concerning adapting policies and strategic plans by integrating ecosystem services and possibly their valuation (Crowe et al., 2016; Uittenbroek et al., 2013; Vandergert et al., 2015).	•	•	•	•	•
• Perceptions of citizens on urban nature (Buchel and Frantzeskaki, 2015; Colding and Barthel, 2013; Gerstenberg and Hofmann, 2016; Scholte et al., 2015; Vierikko and Niemelä, 2016).	•	•	•		
• Social values for urban ecosystems and biodiversity (Brown and Fagerholm, 2014; Kenter et al., 2015; Polat and Akay, 2015; Raymond et al., 2014, 2009; Scholte et al., 2015).	•	•	•		

Table 20. Examples of indicators for assessing the impact of social justice and social cohesion actions.

Indicators	Measurement scale				
	mesoscale			microscale	
	Regional	Metropolitan	Urban	Street	Building
Social justice (informed by the capability framework of social justice (Comim et al., 2008; Nussbaum, 2011; Sen, 2005).					
• The availability and distribution of different types of parks and/or ecosystem services with respect to specific individual or household socioeconomic profiles and landscape design (Cohen et al., 2012; Ernstson, 2013; Ibes, 2015; Kabisch and Haase, 2014; Raymond et al., 2016b; Shanahan et al., 2014).		•	•	•	
• Access to financial resources, including indicators of income per capita in a given neighbourhood, or urban area (Klasen, 2008).			•	•	
• Bodily integrity: being able to move freely from place to place; to be secure against violent assault, including indicators of crime by time of day (Felson and Poulsen, 2003).				•	•
• Senses, imagination and thought: being able to use the senses, to imagine, think, and reason about the environment, informed by indicators of levels of literacy, mathematics and science knowledge (Chen and Luoh, 2010; Elliott et al., 2001).				•	•
• Emotions: being able to have attachments to things and people outside ourselves; to love those who love and care for us, including indicators of place attachment, empathy and love (Lawrence et al., 2004; Manzo and Devine-Wright, 2014; Perkins et al., 2010; Raymond et al., 2010).			•	•	•
• Being able to participate effectively in political choices that govern one's life, including indicators on level and quality of public participation in environmental management (Reed, 2008; Reed et al., 2009).	•	•	•	•	•
Social cohesion					
• Structural aspects: indicators of family and friendship ties; participation in organised associations; integration into the wider community (Cozens and Love, 2015; Stafford et al., 2003).				•	•
• Cognitive aspects: indicators of trust, attachment to neighbourhood, practical help, tolerance and respect (Mihaylov and Perkins, 2014; Uzzell et al., 2002).				•	

Table 21. Examples of indicators to assess the impact of public health and well-being actions.

Indicators	Measurement scale				
	mesoscale			microscale	
	Regional	Metropolitan	Urban	Street	Building/ Park
Psychological indicators (Relaxation and restoration, sense of place, exploratory behaviour, socializing).					
• Reduction in chronic stress and stress-related diseases measured through repeated salivary cortisol sampling (Roe et al., 2013; Ward Thompson et al., 2012) and hair cortisol (Honold et al., 2016); use cortisol slope and average cortisol levels as an indicator of chronic stress.			•	•	•
• Cognitive and social development in children: indicators related to improvement in behavioural development and symptoms of attention deficit/hyperactivity disorder (ADHD) related to green space use; questionnaire indicators on socio-demographic and household characteristics, the time spent playing in green and blue spaces, ADHD symptom criteria, such as emotional symptoms, inattention, conduct problems, hyperactivity/inattention, and peer relationship problems; and a strengths subscale for prosocial behaviour (Amoly et al., 2014).			•	•	•
• Mental health changes measured through Mental Well-being scales asking participants how they have felt over the previous four weeks in relation to a number of items (e.g., feeling relaxed, feeling useful), with responses rated on a 5-point scale from "none of the time" to "all of the time" (Roe et al., 2013).			•	•	•
Health indicators related to physical activity (Sports and leisure activities including e.g. walking, cycling).					
• Number and share of people being physically active (min. 30 min 3 times per week).			•		
• Reduced percentage of obese people and children; reduced overall mortality and increased lifespan.			•		
• Reduced number of cardiovascular morbidity and mortality events (Tamosiunas et al., 2014).			•		
Health indicators related to ecosystem service provision (Buffering of noise and air pollution, reduced heat, exposure to microflora).					
• Reduced autoimmune diseases and allergies (potentially) (Kuo, 2015).			•		
• Reduced cardiovascular morbidity and mortality (Tamosiunas et al., 2014).			•		
• GIS related indicators: NDVI, proximity measures (green space of min. 2 ha within 300m, (Maas et al., 2006; Vries et al., 2003)), percentage of green space (Kabisch and Haase, 2014; van den Berg et al., 2010).	•	•	•	•	•

Table 22. Examples of indicators to assess the impact of economic opportunity and green job actions.

Indicators	Measurement scale				
	mesoscale			microscale	
	Regional	Metropolitan	Urban	Street	Building
• Number of subsidies or tax reductions applied for (private) NBS measures (Meulen et al., 2013).	•	•	•	•	•
• Number of jobs created (Forestry Commission, 2005); gross value added (Forestry Commission, 2005).	•	•	•		
• Change in mean or median land and property prices (Forestry Commission, 2005).	•	•	•	•	•
• New businesses attracted and additional business rates (Eftec, 2013).	•	•	•		
• Resource efficiency in the urban system (CO2 emissions per capita, CO2 emissions for transportation per capita, etc.) (OECD, 2013).	•	•	•		
• Public-sector cost per net additional job (Tyler et al., 2013).	•	•	•		
• Net additional positive outcomes into employment (Tyler et al., 2013).	•	•	•		
• Net additional jobs (Tyler et al., 2013) in the green sector enabled by NBS projects.	•	•	•		
• Gross value added per employees based on full-time equivalent jobs (Tyler et al., 2013) in the green sector.	•	•	•		
• Production benefit: earnings uplift arising from skills enhancement (Tyler et al., 2013) in the design and implementation of NBS.	•	•	•		
• Consumption benefits: property betterment and visual amenity enhancement (Tyler et al., 2013) resulting from NBS.	•	•	•		