For intro Section only.

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Overarching Monitoring Methods - Overview

Project / Action Type	Overarching Monitoring Methods to apply to all projects/actions for understand projects/actions through benefit costs analysis and data management systems.
Similar / Related Project Types	All project types
Metric	Benefit-cost ratio. Cost effectiveness. Net benefits. All other metrics used in the Monitoring Methods.
Measurement Unit	Benefit-cost ratio of present US dollar value of the benefits divided by the present US dollar value of the project costs. Cost effectiveness in the US dollar cost per physical benefit achieved (based on project/action benefit, example is volume of recharge in acre-feet). Net benefits in the US dollar value of benefit minus US dollar cost of project. All other measurement units used in the Monitoring Methods.
Beneficial User	All beneficial users

Introduction

The Overarching Monitoring Methods outlined in this section are methods used to estimate and track metrics related to groundwater sustainability projects. Robust and standardized monitoring methods are necessary to provide the information needed to project and evaluate the impacts and benefits of projects on sustainability indicators and overall groundwater basin sustainability. To increase the likelihood that a groundwater sustainability project or action will successfully address sustainability indicators and not adversely affect beneficial users, water resource managers should review and apply the information in the applicable Monitoring Methods. This Monitoring Method provides specific standards to ensure project and economic integrity and facilitate sharing and transparency regarding the project's benefits and impacts to all relevant sustainability indicators.

KEY TERMS

Benefit Cost Analysis (BCA) compares a proposed project's costs and benefits.

Data Management System (DMS) are platforms capable of storing and reporting information relevant to the development and implementation of a monitoring plan.

The groundwater sustainability plan (GSP) Regulations that specify components of GSPs prepared pursuant to the Sustainable Groundwater Management Act (SGMA) require that Groundwater Sustainability Agencies (GSAs) provide explanations of project and management actions (23 CCR § 354.44). Nothing in these Monitoring Methods supersedes the GSP Requirements as related to the development and implementation of GSPs, alternatives to a GSP, coordination agreements, and annual reporting requirements under SGMA.

Types of Overarching Categories

Overarching Monitoring Methods apply to all project types and actions. These Overarching Monitoring Methods provide an overview of mechanisms to track and monetize the benefits/impact on the groundwater system using Benefit Cost Analysis (MM-11) and Data Management and Monitoring (MM-12).

1) **Benefit Cost Analysis (BCA) –** A standardized accounting for comparing a proposed project's costs and benefits, used to establish whether the project is economically feasible and justified i.e., whether the project is a good use of State.

   Monitoring – Benefit-cost ratio, Cost effectiveness, Net benefits.

2) **Data Management and Monitoring** – Refers to the requirement of project proponents and/or Groundwater Sustainability Agencies to develop and maintain a data management system (DMS) capable of storing and reporting information relevant to the development and implementation of a monitoring plan for the California Department of Water Resources (DWR) grant-funded projects.

   Monitoring – All relevant metrics are used within the DMS. See other Sustainability Indicator Monitoring Methods.

Implementation

The implementation of the Overarching Monitoring Methods will be applied to each project individually in the manner set forth in the project or sustainability indicator Monitoring Method. For example, the overarching Monitoring Methods for BCA and DMS, will apply to all project specific groundwater recharge projects and all projects and actions associated with the sustainability indicators as outlined in SGMA.

BCA is typically implemented at the project planning stage, but it can also be used retrospectively to assess the economic performance as costs and benefits are realized over time. DMS is applied at the end of a project or action with the objective of post-project monitoring and evaluation of the project benefits. Both of these methods are useful in meeting grant reporting to address the multi-benefit requirements of the grant funding.

Sustainability Indicators

The following Table MM11/12-1 provides the applicability of the Overarching Monitoring Methods toward the six sustainability indicators outlined in SMGA. The higher the applicability, the greater potential an action has towards providing a benefit to that indicator.

Table MM11/12-1. Overarching Monitoring Methods Benefit Levels to the Six Sustainability Indicators Outlined in SGMA

	Six Sustainability Indicators Outlined in SGMA	Benefit Cost Analysis	Data Management and Monitoring
	Depleted Interconnected Surface Water	★	★
	Lowered Groundwater Levels	★	★
	Water Quality Degradation	★	★
	Subsidence	★	★
	Reduced Groundwater Storage	★	★
	Seawater Intrusion	★	★

*Notes

★★★ = Primary Benefit (High Applicability)

★★ = Secondary Benefit (Medium Applicability)

★ = Situational Benefit (Applicability dependent on Location, Site Characteristics, and Aquifer Condition)

Monitoring Methods

The Overarching Monitoring Methods were separated into categories based on the mechanism used to understand and monitor the benefits of a project or action. The two categories are Benefit Cost Analysis (MM-11) and Data Management and Monitoring (MM-12).

Data Standards

Data standards for overarching methods are related to the respective project or action method. For example, if the project provides groundwater level benefits, appropriate data standards for monitoring groundwater levels would be applied and then carried through to the overarching methods.

Economic information and methods used to convert physical benefits into monetary benefits should follow the most recent guidelines and standards developed for state feasibility studies (currently, this would be the Technical Reference for the Water Storage Investment Program).

DMS information and methods should follow the example of DWR platforms such that data can be evaluated and compared across the State.

Source References

California Department of Water Resources. 2016. Best Management Practices for the Sustainable Management of Groundwater, six-part series (BMP 1 Monitoring Protocols Standards and Sites, BMP 2 Monitoring Networks and Identification of Data Gaps, BMP 3 Hydrogeologic Conceptual Model, BMP 4 Water Budget, BMP 5 Modeling, and BMP 6 Sustainable Management Criteria DRAFT). Sacramento (CA): California Department of Water Resources. California Natural Resources Agency. [Website] Viewed online at: https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents.

———. 2021. *California's Groundwater Update 2020. Bulletin 118. November 2021.* Sacramento (CA). California Natural Resources Agency. [Website] Viewed online at: https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118

Benefit Cost Analysis (BCA) Monitoring Method
MONITORING METHOD [MM-11]

SUSTAINABLE GROUNDWATER MANAGEMENT (SGM) GRANT PROGRAM

MONITORING METHOD [MM-11]

Benefit Cost Analysis (BCA) Monitoring Method

Project / Action Type	Benefit Cost Analysis (BCA) is a standardized method for displaying and comparing a proposed project's costs and benefits.
Similar / Related Project Types	BCA applies to all project types.
Metric	Benefit-cost ratio. Cost effectiveness. Net benefits
Measurement Unit	Benefit-cost ratio of present US dollar value of the benefits divided by the present US dollar value of the project costs. Cost effectiveness in the US dollar cost per physical benefit achieved (based on project/action benefit, example is volume of recharge in acre-feet). Net benefits in the US dollar value of benefit minus US dollar cost of project
Beneficial User	Applicable to all users.

Benefit Cost Analysis Overview

This Monitoring Method describes benefit cost analysis (BCA) of potential projects (and actions). BCA is a standardized method for displaying and comparing a proposed project's costs and benefits. For the purposes of Department of Water Resources (DWR) grant-funded projects, the appropriate perspective of the BCA is the State (i.e., benefits and costs to whomever they accrue in the State). BCA is used to examine whether the project appears to be economically feasible and justified – that is, whether the project is a good use of State (or other project proponent, as appropriate) funds. By its nature, BCA relies on monetized benefits and costs, some of which, especially effects on the environment and on third parties, can be quite challenging to quantify in physical and dollar terms. Therefore, the result of a BCA is generally not the sole criterion for whether a project represents a good investment or good public policy. BCA can be applied to all types of projects whose benefits and costs can be quantified.

The groundwater sustainability plan (GSP) Regulations that specify components of GSPs prepared pursuant to the Sustainable Groundwater Management Act (SGMA) require that groundwater sustainability agencies (GSAs) provide explanations of project and management actions (23 CCR § 354.44). Nothing in these Monitoring Methods supersedes the GSP Requirements as related to the development and implementation of GSPs, alternatives to a GSP, coordination agreements, and annual reporting requirements under SGMA.

Monitoring Objectives

The initial step in BCA is to define, quantify, and monetize, where possible, the benefits and costs associated with the project. Some form of BCA is typically implemented at the project planning stage, using estimates and projections of costs and benefits to assess the economic feasibility of a project. It can also be used retrospectively to assess the economic performance as costs and benefits are realized over time. In the context of monitoring project performance, BCA can be updated over time as data on actual costs and benefits are received.

Project costs are typically developed for planning purposes as part of initial project engineering design and assessment of technical feasibility. Project benefits depend on the type, location, and operation of the project. For example, a groundwater recharge basin would increase groundwater levels and store water for future uses. If the recharge basin is located near a groundwater dependent ecosystem, it might provide additional benefits to that ecosystem. Economic benefits are generally measured by the value that potential beneficiaries would be willing to give up to obtain the benefits. This basic foundation of economic benefits is called **willingness to pay**, but it need not rely on actual payment for a benefit. Many project benefits are not directly traded in a market (where a benefit value can be more readily observed as the price paid), and these require additional analysis to establish the value. General methods for monetizing benefits and costs are described in subsequent sections of this Monitoring Method.

Once costs and benefits of the project have been calculated, the next step in the BCA is to express those values on a consistent basis. Different types of costs are incurred over the life of the project: initial capital costs to build the project, annual costs to operate the project, and ongoing maintenance and replacement costs. These costs occur at different points in time during the life of a project. Project cost accounting should consider all project costs over its economic life (called lifecycle costs), in addition to any impacts caused by the project. Similarly, benefits of the project can be realized once the project is operational and may vary over time. All cost and benefits are expressed in present value terms to account for the time value of money using an appropriate inflation-free interest rate, the discount rate.

Willingness to pay describes how people value increases in a good or service, such as additional water supply or improved water or environmental quality. It is the amount of value that an individual or group would be willing to give up to obtain the good or service.

Once project benefit and costs are defined, monetized, and expressed on a consistent basis, typical outputs, or metrics, of a BCA can include:

- **Benefit-cost ratio**: The benefit-cost (B/C) ratio is the present value of the benefits divided by the present value of the project costs. A B/C ratio greater than 1 indicates that the benefits are greater than the project costs, or that the project is deemed economically feasible. All benefits and costs should be expressed in common units (normally present value in dollars) to calculate the B/C ratio.

- **Cost effectiveness**: This is the cost per unit of physical benefit achieved. A project is cost effective if it achieves a desired level of physical benefits (e.g., annual recharge volume) at the lowest present value cost among feasible alternatives. This measure does not ensure that benefits are at least as large as costs. Benefits are measured in physical units, so cost effectiveness comparisons are restricted to projects that produce the same physical benefit or set of physical benefits. As a result, cost effectiveness can be useful for single-purpose projects but is difficult to apply for multi-benefit projects.
- **Net benefit**: The net benefit of the project is the present value of benefits less the present value of costs (including and impacts of the project on other water users). A positive net benefit indicates project benefits are greater than project costs. All benefits and costs should be expressed in common units (normally present value in dollars) to calculate the net benefit.

Projects benefits for any sustainability indicator can be monitored, physically quantified, and monetized. The six sustainability indicators for SGMA are shown in Table MM11-1. BCA can be used to ensure projects implemented are economically feasible and/or cost effective.

Table MM11-1. Level of Benefit to the Six Sustainability Indicators Outlined in SGMA.

	Six Sustainability Indicators Outlined in SGMA	Applicability*
	Depleted Interconnected Surface Water	★
	Lowered Groundwater Levels	★
	Water Quality Degradation	★
	Subsidence	★
	Reduced Groundwater Storage	★
	Seawater Intrusion	★

*Notes:

★★★ = Primary Benefit (High Applicability)

★★ = Secondary Benefit (Medium Applicability)

★ = Situational Benefit (Applicability dependent on Location, Site Characteristics, and Aquifer Condition)

Potential Impacts

BCA is not a project or action. Rather, it is a method for evaluating and monitoring the economic performance of projects and actions. The BCA is developed to quantify and understand the potential impacts of the project or action. Therefore, it does not have adverse impact on any of the sustainability indicators.

The desired outcome of a BCA is a careful accounting of all lifecycle costs and benefits of the project. This gives the project proponent an understanding of whether the project is feasible, or whether it is cost effective (as appropriate).

Use and Limitations

A complete BCA can be challenging to implement due to the need for good cost information, physical benefits, and monetary evaluation, especially in the case of multi-benefit projects. Expertise in defining and quantifying benefits is required to provide reliable, useful information. In past grant programs, applicants' ability to prepare information for a BCA has varied widely across applicants. Also, during a competitive application process, applicants have an incentive to overstate benefits or understate costs, and DWR reviewers' ability to detect this can be limited due to time and staffing.

Ways to reduce the perceived problems and produce more consistent and comparable information on benefits and costs of projects include:

- Provide standardized benefit methods for applicants to use (see, for example, the Technical Reference for the Water Storage Investment Program, California Water Commission, 2005). These methods should include ways to describe accurately and, if possible, quantify effects that are indirect, accrue to third parties, or uncertain.
- Provide Excel® templates with appropriate calculations and perhaps default values for some assumptions such as discount rate (past grant programs have done this).
- Provide DWR staff to assist grant applicants/recipients in preparing information and BCAs. In the past, concern has focused on keeping the assistance equally available to all to avoid the appearance of unfair advantage to some in a competitive application process. This may not be as much of a concern for DWR assistance in updating information during project monitoring, because the competition for funds is no longer in play.

Finally, while BCA can provide usable, quantified comparisons of costs and benefits, it should not be the only criterion for evaluating the desirability or performance of a project. Water projects can have significant effects (positive and negative) that are difficult to quantify, difficult to monetize, and/or highly uncertain. Care is needed to avoid counting the costs and benefits that are easy to quantify and neglecting those that are difficult to quantify. Good project evaluation processes recognize this and treat a quantified BCA as one among a number of criteria to use for making decisions. For example, the California Water Commission's process for evaluating storage projects explicitly combines monetized benefits and costs, non-monetized benefits, environmental value, resiliency, and implementation risk into an overall score and rank (see California Code of Regulations, Title 23, Division 7, Chapter 1, Section 6009). Federal water project evaluation has for decades used four "accounts" to evaluate project alternatives – national economic development (BCA), environmental quality, regional development, and other social effects (U.S. Water Resources Council. 1983).

Relationship to Other Monitoring Methods

This Monitoring Method is related to all the other Monitoring Methods, as all projects have a cost and benefit component that can be evaluated using the BCA approach.

Benefit Cost Analysis Monitoring

BCA is a well-established method for the evaluation of public and private investments in potential projects. For water projects, there are federal and State guidelines for conducting BCA (see Resources section below). BCA has been widely applied for many decades, with a large body of supporting agency reports and peer-reviewed economic publications describing its application and advancing methods.

BCA is a standardized method for evaluating the investment of public funds in water projects. It should be applied at the initial planning stage of project development. However, it also can be applied for project monitoring after award of grant funds. As project benefits and costs are realized, these can be used to update the BCA and monitor project progress. Project monitoring could include periodic assessments of project cost-effectiveness to ensure grant funding is being used to support projects that generate the intended benefits at the least cost. Results of this monitoring could be used, for example, to update criteria for ranking and selecting projects in future grant solicitations.

Appropriate quantification of benefits is important for evaluating the economic feasibility of grant-funded projects. It also is important because costs can be allocated in proportion to project benefits. For example, a project may provide different types of benefits to multiple entities (e.g., groundwater level benefits to the broader subbasin and subsidence benefits to a specific area). Quantifying and monetizing project benefits allows multiple local project proponents to allocate costs in proportion to the benefits received. It also provides a basis of information for assigning and recovering local cost shares.

Background and Context

Groundwater sustainability plans require consideration of all beneficial uses and users of groundwater in the development and implementation of the plan. Groundwater sustainability is generally approached by developing projects and actions that improve groundwater management, develop new sources of supply, and in some regions reduce groundwater demand. Project actions are costly, and while some may be partially funded by State grants, a substantial share of their costs can be funded by local businesses and individuals in the subbasin. BCA provides important information for businesses and individuals about the costs, benefits, economic feasibility, and cost-effectiveness of project actions to achieve sustainability objectives specified in a sustainability play. All project effects (benefits and costs) should be included and quantified to the extent possible, including external, unintentional, and uncertain effects.

BCA is a standard method for evaluating project benefits and costs. It is an important consideration for ensuring that the sustainability plans are feasible and ensuring that stakeholders can achieve their sustainability objectives. For example, an implementation plan that includes some projects that are not economically feasible (i.e., have a B/C ratio less than 1) might not be able to achieve the desired benefits (e.g., groundwater recharge) and therefore might not achieve sustainability.

BCA is also justified as a method for project monitoring. It is a standardized approach to comparing project benefits and costs. As projects are implemented and become operational, costs and benefits can be updated, and the BCA can be refined. For example, this can be used to monitor the benefits received per dollar of state grant investment. If benefit categories are well defined (e.g., public and private benefits) then the return on the State's investment can be calculated and compared across different kinds of projects. Information gathered from ongoing monitoring of project benefits and costs could be used to refine future grant solicitations.

A Step-by-Step Guide to Applying the Benefit Cost Analysis Method

BCA is developed and applied according to the following general steps. These steps cover both planning-level BCA (when all costs and benefits should be estimated rather than observed) and post-implementation BCA (based on observations of actual costs and outcomes). All project effects (benefits and costs) should be included and quantified to the extent possible, including external, unintentional, and uncertain effects.

1. Describe and quantify the project in sufficient detail to provide a basis for cost and benefit estimates. This includes project design, construction, and operations and the resulting expected kind, location, and timing of physical benefits.
2. Describe and quantify conditions without the project. Project benefits can only be calculated by reference to a condition without the project.
3. For planning, estimate the project costs and when they are expected to occur. Uncertainty in costs can be addressed using probabilities of outcomes (such as costs by year type), scenario analysis, and sensitivity analysis. Revise with actual costs (including external or unexpected costs) after they are incurred for post-implementation BCA updates.
4. Quantify project physical benefits. For planning-level BCA, projected physical benefits may be based on modelling or other analysis of the without and with-project conditions. Uncertainty in benefits can be addressed using probabilities of outcomes (such as benefits by year type), scenario analysis, and sensitivity analysis. Post-implementation, monitoring and measurement of outcomes (including external or unexpected outcomes) is used to update benefits.
5. Use results from Steps 3 and 4 to calculate cost-effectiveness (if it is used as a metric).
6. If using net benefit and/or B/C ratio as a metric, calculate the dollar value of physical project benefits using appropriate monetizing methods.
7. Use the project benefits and costs from Steps 3 and 6 to calculate present values and metrics.
8. Continue to monitor project performance and update metrics when significant new cost or benefit information becomes available.

Data and Protocols - Fundamentals

Information / Data Requirements

Data requirements of BCA can be broken down into two fundamental components: project benefits and project costs. Project costs require defining the design, construction, and operation of the project. Some projects also may impose costs that are not included in the engineering costs – these typically require establishing the physical effects and then assigning a monetary value to them. Benefits require establishing the physical benefits of the project and monetizing those benefits. Benefits and costs caused by physical effects are calculated by comparison of a without-project and with-project condition. Physical benefits should be clearly defined so that appropriate monetization is applied. For example, recharge project yield can be expressed in terms of expected annual recharge, storage capacity, or net groundwater recharge. If yields vary by hydrologic condition (e.g., a project plans to extract yield in dry or critical years only) then monetizing needs should account for that. These different physical measures would be valued in different ways.

Cost estimates are critical for developing a BCA. Project costs depend on design and operating options and are typically split into design, construction, operations, maintenance, monitoring, replacement, and contingencies. Standard costing approaches are available that vary with project planning and design, ranging from preliminary estimates to more refined estimates as the project development progresses. More refined costs can be used to verify that the project is still feasible and cost-effective. Preparation of cost estimates follows standard approaches based on Association for the Advancement of Cost Engineering classifications and associated requirements for specific agencies. The Water Storage Investment Program Technical Reference (California Water Commission, 2015) provides an overview of the different approaches and requirements. After costs are estimated they can be expressed in current dollars using an appropriate index to escalate earlier estimates if needed and then converted to present value using an appropriate discount rate.

Once project physical benefits are established it is necessary to calculate the monetary value of those benefits. Monetizing project benefits can be a substantial effort. Benefits associated with water projects vary widely and the most appropriate method to monetize benefits can vary by project type and location.

California's Groundwater Update 2020 (California DWR, 2021) includes a summary section (see Chapter 2, page 2-16) describing the economic benefits of groundwater in California. That document provides a general overview of the different types of benefits associated with groundwater management. Different methods would be used to monetize the value of such benefits. A detailed treatment is beyond the scope of this initial summary document, but a brief summary of key approaches/considerations for groundwater sustainability indicators is briefly described in Table MM11-2.

In addition to the specific (example) benefits described above, projects can provide broader benefits that are shared across an entire subbasin. A project that benefits individual sustainability indicators means that the subbasin is more likely to meet its sustainability objective (achieve desired management objectives) and avoid more onerous state intervention, which is a benefit to all water users in the region.

Table MM11-2. Key Approaches/considerations from Project / Action on the SGMA Sustainability Indicators

SGMA Sustainability Indicators	Approaches/Considerations
Depleted interconnected surface water	Groundwater level benefits can be expressed in terms of the avoided cost of additional pumping lift and potentially avoided cost of well modification or replacement. This benefit may apply to the entire subbasin but benefits from projects typically have local effects.
Lowered groundwater levels	Projects that provide streamflow benefits can be valued in different ways. Additional flow may provide habitat benefits and compliance with minimum flow requirements. This can be valued at the avoided cost of a least-cost alternative project to improve flow and habitat (for example, idling agricultural land).
Water quality degradation	The benefit of water quality improvements depends on the water quality benefit in question. For example, municipal and industrial water quality improvement can be valued based on the avoided cost of water treatment. Other water quality improvements can be valued by the avoided costs on water users (for example avoided irrigation management costs and crop yield losses for agriculture).
Subsidence	Land subsidence can cause damage to and reduce the capacity of infrastructure such as roads and bridges, power transmission, canals, and flood control structures. Projects that reduce or prevent subsidence can be valued based on the avoided cost of these impacts, though few monetized estimates of avoided damages are available. At this time, it may not be possible to quantify changes in subsidence and changes in associated damages.
Reduced groundwater storage	Groundwater storage provides benefits because water is available for immediate and future uses. It also acts as an insurance policy against variability in surface water supplies in areas with multiple sources of supply. The economic benefits can be calculated based on the willingness to pay for the stored groundwater (e.g., for agricultural, environmental, municipal, or industrial uses).
Seawater intrusion	Seawater intrusion benefits can be valued based on studies of willingness to pay to avoid damage, and alternative or avoided costs can provide a useful lower bound benefit value.

Data Standards

Data standards for BCA include the standards for the physical benefits used in the BCA. For example, if the project provides groundwater level benefits, appropriate data standards for monitoring groundwater levels would be applied and then carried into the BCA. Other economic data standards are specified as part of the BCA guidelines (see accompanying Excel® summary workbook for examples). For example, a federal feasibility study has specific BCA requirements for discount rates and project economic life. Economic information and methods used to convert physical benefits into monetary benefits should follow the most recent guidelines and standards developed for state feasibility studies (currently the Technical Reference for the Water Storage Investment Program).

Key Protocols

Due to the wide variety of benefits, project types, and locations, no single protocol applies. The key is to follow the accepted practices for BCA. For example, for federal feasibility analyses, federal guidelines apply. For three decades, the standard for federal water resource development projects was the 1983 Principles and Guidelines (U.S. Water Resources Council, 1983). An updated principles document was developed in 2013 and implemented through more specific agency Principles, Guidelines, and Requirements (see for example U.S. Dept. of Interior, 2015). The national accounting perspective differs from the state perspective.

For state projects, the DWR guidelines –that are generally consistent with the federal feasibility guidelines— apply (California DWR, 2008). Other programs, such as the Water Storage Investment Program (California Water Commission, 2015), can have other specific requirements. The Technical Reference for the Water Storage Investment Program consolidated accepted practices from both federal and State guidelines and augmented them with specific recommended methods, data, and studies.

The general structure of the BCA does not change across all these guidelines. However, specific protocols may apply for certain purposes according to applicable statutes, regulations, or program guidelines. For example, a specific discount or cost accounting method may be required by federal or State law. The best methods for estimating the economic value of water-related benefits are often specific to the kind and location of the project or activity generating the benefits. As a result, a number of methods can potentially be used, and the analyst should be familiar with the methods and limitations to select and apply the proper methods. Young and Loomis (2014) provide a good description of general methods and their applications and limitations.

The attached Excel® workbook includes a summary of the different guidelines for water project BCA.

Examples of Benefit Cost Analysis Applications

Colusa Subbasin GSP Benefit Cost Analysis of Groundwater Minimum Thresholds

Location: Sacramento Valley

Year: 2021

Description and Relevance:

This is an example of a focused, simpler BCA. It was developed to evaluate the benefits and costs of setting Minimum Thresholds at different levels in the Colusa Subbasin GSP. The BCA was developed in terms of Groundwater Levels. Costs included the cost of replacing dewatered domestic wells if groundwater levels hit the minimum thresholds. Benefits included the avoided cost of additional pumping lifts and land idling to maintain groundwater minimum threshold levels at a higher elevation. All costs and benefits are expressed in present value terms and used to evaluate whether the benefits exceed the cost of increasing the minimum thresholds for each monitoring well.

Links to Resources: https://colusagroundwater.org/projects/groundwater-sustainability-plan/

Colusa Subbasin GSP, Draft. 2021. Appendix 5C. Economic Benefit Cost Analysis of Potential Groundwater Level Minimum Thresholds. November 2021.

Sites Reservoir Feasibility Study

Location: Sacramento Valley

Year: 2021

Description and Relevance:

This is an example of a relatively complex BCA for the proposed Sites Reservoir project. Project benefits include water supply (agriculture, municipal, and industrial), habitat, hydropower, flood control, and water quality. Project costs are similarly complicated, with various design and operation alternative under consideration. The project benefits considered SGMA implementation, and the water supply benefits that the project would provide in lieu of groundwater pumping in some areas. It is an example of a detailed BCA, and the BCA was developed under both State (Water Storage Investment Program) guidelines as well as federal feasibility guidelines.

Links to Resources: https://sitesproject.org/feasibilty-report/

Sites Reservoir Feasibility Report and Appendices. November 2021. Prepared by Sites JPA for the California Water Commission.

Chino Basin Program Feasibility Study

Location: Chino Basin, Southern California

Year: 2021

Description and Relevance:

Inland Empire Utilities Agency prepared a feasibility study of a project that includes Advanced Water Purification of wastewater, injection and extraction wells, groundwater treatment, and a water exchange with Metropolitan Water District of Southern California (MWDSC). Project benefits include water supply, ecosystem pulse flows on the Feather River (provided via exchange with MWDSC and agreement with the State Water Project), water quality, and drought emergency supply. The project is in an adjudicated groundwater basin and would provide additional purified water for recharge. The water can assist the basin in meeting its groundwater quality objectives and can be used to provide direct and in-lieu water supply benefits. MWDSC has agreed to accept water stored by this program in exchange for some of its State Water Project entitlement that would be left in Oroville Reservoir and released in pulse flows to benefit fishery habitat. It is an example of a complex and detailed BCA and was developed according to State (Water Storage Investment Program) guidelines.

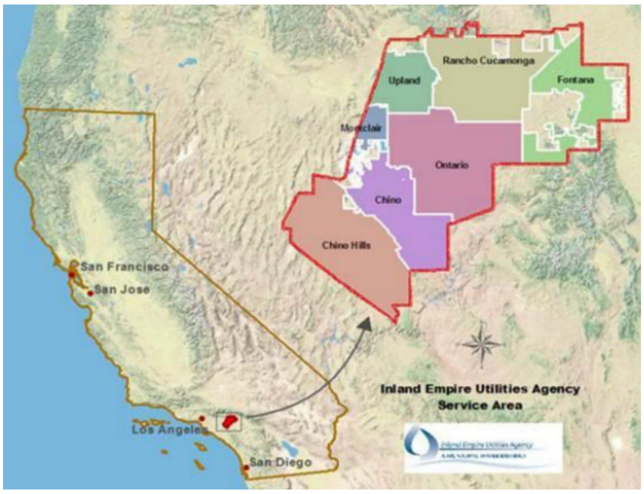

Figure MM11-1. Chino Basin Project Location Map (Inland Empire Utilities Agency. 2021)

Links to Resources: https://www.chinobasinprogram.org/how-it-works

Feasibility Study available on request to the California Water Commission, P.O. Box 942836 Sacramento, California 94236-0001

South County Recycled Water Feasibility Study

Location: Southern Sacramento County

Year: 2019

Description and Relevance:

Regional Sanitation District of Sacramento County (Regional San) prepared a feasibility study of its Harvest Water program that will provide tertiary treated wastewater for delivery to agricultural lands in lieu of groundwater pumping. Project benefits include water supply for agricultural use in southern Sacramento County, ecosystem enhancement from direct delivery to habitat lands near Cosumnes River and Stone Lakes Wildlife Refuge, and ecosystem restoration from the recovery of groundwater levels in the in-lieu delivery area. The project supports Regional San's efforts to meet its discharge water quality objectives. Project costs include conveyance and delivery facilities, ecological establishment and monitoring costs, groundwater monitoring, and operations & maintenance of the water delivery facilities. It is an example of a complex and detailed BCA and was developed according to State (Water Storage Investment Program) guidelines.

Links to Resources:

Feasibility Study at https://cwc.ca.gov/-/media/CWC-Website/Files/Projects/Harvest-Water-Program/Continuing-Eligibility/HarvestWater_2019TechMemo.pdf

Source References

Resources

Methods for Calculating Cost Benefits

DWR in Bulletin 118 includes a chapter on the economic value of groundwater (starting on Page 2-16 of Chapter 2) that lays out the different types of groundwater values and methods for calculating the benefits.

2021 California's Groundwater Conditions Report Update:

https://www.californiawaterviews.com/assets/htmldocuments/NewBlogs/CaliforniaWaterViews/Groundwater-Conditions-Report-Fall-2021.pdf

The Economic Analysis Guidebook by DWR provides a description of the approach to benefit-cost analysis with application to water projects.

https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/CDWA%20et%20al/SDWA%20273.pdf

For federal principles and guidelines for the economic analysis of water supply projects can be found in the Economics and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (1983). The document describes the general concepts for benefit cost analysis and additional details are provided in supporting agency documents.

https://planning.erdc.dren.mil/toolbox/guidance.cfm?Id=269&Option=Principles%20and%20Guidelines

References

California State Water Resources Control. 2021. *California Code of Regulations. Title 23 Waters. Division 7 California Water Commission. Chapter 1 Water Storage Investment Program. Article 3, Section 6009.* Sacramento (CA): California State Water Resources Control. [Website]. Viewed online at: https://cwc.ca.gov/-/media/CWC-Website/Files/Documents/2017/WSIP/RegulationsSubmitted.pdf

California Department of Water Resources. 2008. *Economic Analysis Guidebook*. Sacramento (CA): State of California Resources Agency. [Website]. Viewed online at: https://cawaterlibrary.net/wp-content/uploads/2017/09/EconGuidebook_Appendices_w-bookmarks_withcovers.pdf

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Data Management and Monitoring Method
MONITORING METHOD [MM-12]

SUSTAINABLE GROUNDWATER MANAGEMENT (SGM) GRANT PROGRAM

MONITORING METHOD [MM-12]

Data Management and Monitoring Method

Project / Action Type	Management and reporting of monitoring data is a key component of groundwater implementation projects, as they relate to all relevant sustainability indicators.
Similar / Related Project Types	All project types
Metric	Relevant metrics from project or action
Measurement Unit	Relevant units from project or action
Beneficial User	All beneficial users

Data Management and Monitoring Overview

This Monitoring Method summarizes data management related to project monitoring. Water resource managers and Groundwater Sustainability Agencies (GSAs) are required to develop and maintain a data management system (DMS) capable of storing and reporting information relevant to the development and implementation of a monitoring plan for the California Department of Water Resources (DWR) grant-funded projects. A DMS is necessary for managing and reporting data in a way that meets certain standards, ensures data integrity, and reduces data gaps, and facilitates data sharing and transparency regarding the monitoring of all relevant sustainability indicators.

Projects or actions that fall under the jurisdiction of a GSA will need to follow the requirements laid out in the GSA's Groundwater Sustainability Plan (GSP). Not all projects or actions will fall into that category, for those situations, a project proponent may apply the standards for reporting and management of data similar to a GSP with adaptations as needed to meet the specific goals of the project or action.

The GSP Regulations that specify components of GSPs prepared pursuant to SGMA require that GSAs provide explanations of project and management actions (23 CCR § 354.44). Nothing in these Monitoring Methods supersedes the GSP Requirements as related to the development and implementation of GSPs, alternatives to a GSP, coordination agreements, and annual reporting requirements under SGMA.

Monitoring Objectives

Water resource managers should develop a plan and system for collecting, managing, and reporting monitoring data to increase the likelihood that a groundwater project will successfully address sustainability indicators and not adversely impact beneficial users. A vital component of this plan is creating or updating an existing DMS (or database) to store data related to the project and relevant to sustainability indicators. Table MM12-1 below identifies the relative level of benefit of data management and monitoring on the six sustainability indicators included in the Sustainable Groundwater Management Act (SGMA). Data uploaded to the project’s DMS should first undergo a quality assurance and quality control (QA/QC) process to ensure data integrity. Data review and uploads should be completed in a timely fashion to address quality concerns and reduce data gaps. If applicable, project managers should coordinate with adjacent basins on data structures to facilitate data sharing. Monitoring data should be reported to DWR in annual reporting for the project.

Table MM12-1. Level of Benefit to the Six Sustainability Indicators Outlined in SGMA

	Six Sustainability Indicators Outlined in SGMA	Applicability*
	Depleted Interconnected Surface Water	★
	Lowered Groundwater Levels	★
	Water Quality Degradation	★
	Subsidence	★
	Reduced Groundwater Storage	★
	Seawater Intrusion	★

*Notes:

★★★ = Primary Benefit (High Applicability)

★★ = Secondary Benefit (Medium Applicability)

★ = Situational Benefit (Applicability dependent on Location, Site Characteristics, and Aquifer Condition)

Desired/Impacts Resulting from Data Management and Monitoring

If protocols are followed, data management should allow for the following:

– Effective monitoring of sustainability indicators addressed by a project.
– Identify quantifiable benefits.
– Provide data that can be transparent and be sharable.
– Allow for reporting of the data via the SGMA portal.

Data management is an overarching platform capable of storing and reporting information from a project or action, it is not a project or action item. Therefore, it does not have an adverse impact on any of the sustainability indicators. However, through data management and monitoring, impacts from a project to the sustainability indicators can be identified.

Use and Limitations

Data gaps may exist, and there are costs associated with developing and maintaining a DMS, conducting data quality assurance and control, and reporting monitoring data. Projects are unique and a general DMS may not always be applicable. Understanding the specific project and how to adapt a DMS to the project goals for monitoring are critical to addressing a project's overall effectiveness and allowing the DMS to link up to DWRs existing metrics for benefits and impacts to the SGMA sustainability indicators.

Relationship to Other Methods

This Monitoring Method is related to all other Monitoring Methods, as all projects require a data management and reporting component.

Data Management and Monitoring

The management and reporting of monitoring data are requirements for DWR grant-funded projects involving any sustainability indicators. While a general set of data management and reporting standards can be applied to all projects regardless of which sustainability indicators they address, specific data management and reporting standards based on the type of project should be used to evaluate a project.

Background and Context

The hallmark of successful projects, studies, and investigations is a planned data collection, management, and reporting process that meets standards established by DWR. Since successful data management increases the likelihood that a project will be successful, it therefore promotes groundwater basin sustainability.

With the passage of the SGMA, there is an increased need for local and state agencies and the public to easily access water data in order to make informed management decisions. The DWR provides data, tools, monitoring portals, and guidance to help GSAs and other grantees to develop projects for addressing sustainability and implement the requirements of SGMA. DWR has a long history of data collection, monitoring and reporting, and has developed the following data management platforms:

- **SGMA Portal:** Allows local agencies, GSAs, and watermasters to submit, modify, and view the information required by SGMA. It also enables you to view submitted information and provide comments, where applicable.
  - https://sgma.water.ca.gov/portal/#intro
- **Data & Tools:** Consists of a curated set of data, interactive mapping tools, and reports as resources to inform sustainable groundwater management decision-making.
  - https://water.ca.gov/Programs/Groundwater-Management/Data-and-Tools

As part of the funding requirements for DWR grant-funded projects, water resource managers and GSAs are required to develop and maintain a DMS capable of storing and reporting information relevant to the development and implementation of a monitoring plan. The requirement of a DMS is to support DWR role of regulatory oversight through the evaluation and assessment of grant-funded projects.

A Step-by-Step Guide to Applying the Data Management and Monitoring Method

Implementation of appropriate and effective data management and monitoring method for a project includes the following strategies and steps:

1. Develop DMS or adapt existing DMS developed for the GSP, considering information inputs needed to monitor sustainability indicators, data fields, and data format required for upload to SGMA portal.
2. Populate DMS with QA/QC'd data in a timely fashion.
3. Report monitoring data to DWR through SMGA Portal as part of initial submittal, annual reporting, or 5-year update, and submit project construction reports developed as part of the grant process.
4. Update DMS with QA/QC'd data based on established monitoring protocol.

Data and Protocols - Fundamentals

Information / Data Requirements

The data required for a project depends on which sustainability indicators the project addresses. In general, data requirements for a project should be sufficient to demonstrate the technical and economic feasibility of meeting project goals. The monitoring methods established for a project should provide the data needed to demonstrate project performance in terms of groundwater storage rates and volumes, groundwater levels, streamflow responses, sustainability criteria metrics, and avoidance of unintentional adverse impacts.

For long-term assessment of a project's capability to address sustainability indicators, the Monitoring Methods should link to the reporting on monitoring and evaluation of the sustainable management criteria, and project milestones reached. Annual reporting requires documentation and submittal of information to DWR regarding the project's benefits.

Data Standards

The data standards should be based on the sustainability indicators addressed by the project and are addressed in related project and sustainability indicator Monitoring Methods. The project-specific monitoring tracks specific impacts from the project. For compliance with the SGMA, the project should not allow impacts to groundwater levels or water quality that could cause undesirable results as defined by the basin's GSP.

Any recipient of state funds through a grant or contract for projects or research relating to the improvement of water or ecological resources must adhere to the protocols developed under AB 1755, the Open and Transparent Water Data Act.

Key Protocols

Data collection and management protocols should be specific to the sustainability indicators addressed by the project. In general, data should be collected, stored, and reported in a way that is operationally sound and compliant with grant requirements. Below are key protocols that should be followed:

- If the project is located in a basin with a GSP, the project should utilize the existing DMS developed as part of the GSP. The DMS can be adapted to include project information, and in general, should be capable of storing and reporting information relevant to the implementation of the project and monitoring of the sustainability indicators addressed by the project.

- Recommended types of databases for the DMS include a custom relational database, such as a Structured Query Language (SQL) database or Microsoft Access database. Two database examples are shown in Figures MM12-1 and MM12-2. The database may include data tables for basic information about groundwater, surface water, and subsidence monitoring sites, as well as related time-series data tables for groundwater levels, groundwater extraction, groundwater quality, subsidence, and surface water data collected during project implementation and monitoring.
- To develop a DMS for a project or a GSP, the following approach is typically used. These components can be adapted for project-specific data. DWR's SGMA GSP data upload templates, which are accessible through the GSP Reporting System at https://sgma.water.ca.gov/portal/ can be consulted for required data fields. In general, the monitoring site table should include site name, location data (coordinates and elevation), and construction data, including depth and screening intervals if appropriate. These tables may utilize the coded values from the SGMA templates for coordinate and elevation source and accuracy fields. Time-series data tables should include site names that can be related to the site tables, measurement date/time, and groundwater level, constituent, or flow data. Tables may utilize the code values from the SGMA templates for no measurement, questionable measurement, and measurement method fields.

KEY TERMS

Database platform allows the user to access and manipulate database, such as insert, update, delete, create, and create records and run queries against a dataset also able to generate figures and tables from the results of the query.

Microsoft has created the **Microsoft Access** database platform and there is also the **SQL** database, which stands for Structured Query Language.

- All data should be evaluated for validity and acceptable use prior to entry into the DMS. The data should comply with QA/QC protocols established for the project. Projects should incorporate the Data Quality Objective process following the United States Environmental Protection Agency Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA, 2006). Although strict adherence to this approach is not required, it does provide a robust method to consider for achieving the objectives of the project.
- Monitoring data should be uploaded to the DMS in timely fashion to address quality concerns and reduce data gaps.
- [Optional] If applicable, project should include coordination with adjacent projects on data structures to facilitate data sharing and transparency.
- Monitoring data should be reported using the DWR SGMA portal at required frequency. Any annual project construction reports related to the grant process should also be submitted through the SGMA portal.

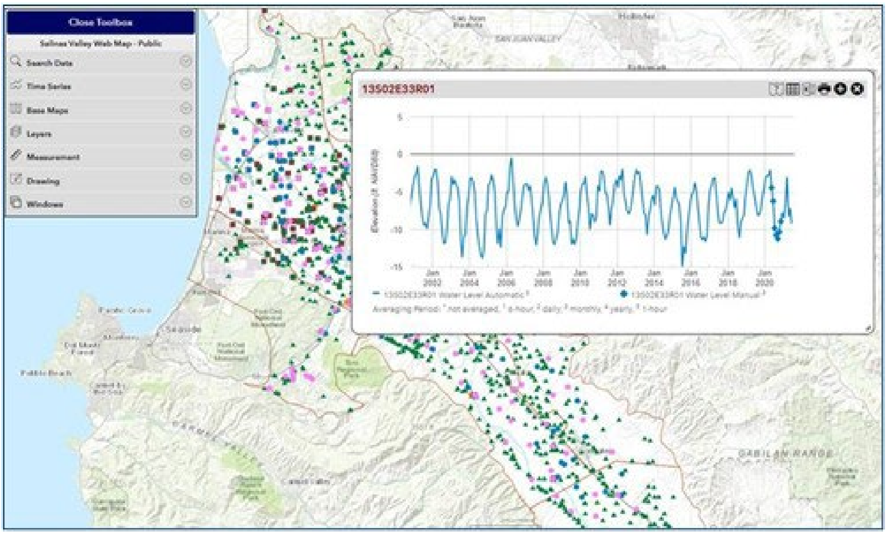

Figure MM12-1. Example DMS with Web Portal, developed for Salinas Valley Basin GSPs

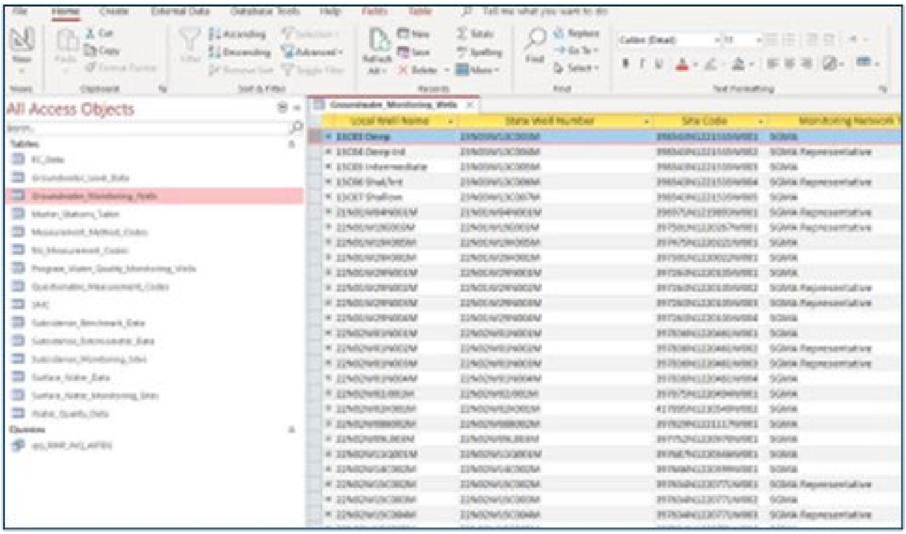

Figure MM12-2. Example Access Database, developed for Corning GSP DMS

Examples of Data Management and Monitoring Applications:

Salinas Valley Basin GSPs

Location: Monterey County, CA

Year: 2020-present

Description and Relevance: The Salinas Valley Basin Groundwater Sustainability Agency developed a DMS for its GSP. The DMS allows for timely upload of monitoring data and QA/QC of the data prior to upload. This system also links to a public web portal, which allows the data used to develop the GSP to be shared with stakeholders and the public. Data fields and data formats used in the DMS are based on SGMA portal templates, which facilitate the upload (reporting) of data relevant to the GSP and Annual Reports.

Links to Resources: Public web map is available at https://svbgsa.org/gsp-web-map-and-data/

Corning Subbasin GSP

Location: Tehama County and Glenn County

Year: 2020-present

Description and Relevance: An Access Database was developed as the DMS for the Corning GSP. The data tables and fields in this database closely mirror the SGMA GSP Data Upload Templates from DWR, allowing for seamless submittal of the GSP and Annual Reports.

Links to Resources: The Corning Subbasin GSP is available online at https://www.corningsubbasingsp.org/

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