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Colorado Water
Conservation Board

Department of Natural Resources

DRAFT

Project Management Plan for the Statewide Water Supply Initiative Update



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List of Abbreviations

BNDSS	Basin Needs Decision Support System
CDSS	Colorado's Decision Support Systems
CWCB	Colorado Water Conservation Board
IBCC	Interbasin Compact Committee
PM	Project Manager
PMP	Project Management Plan
SME	Subject Matter Expert
SWSI	Statewide Water Supply Initiative
TAG	Technical Advisory Group
WBS	Work Breakdown Structure



Section 1

Project Summary

1.1 Introduction and Background

Following the drought of 2002, the Colorado legislature authorized the Colorado Water Conservation Board (CWCB) to move forward with an in-depth technical study of Colorado's future water supplies and demands. The first Statewide Water Supply Initiative (SWSI) was approved by the CWCB in 2004, providing an analysis of current and future water needs, as well as a survey of potential approaches to meet those needs. The SWSI evolution continued with SWSI 2, which created four technical "roundtables" to explore needs identified in SWSI, as well as select potential solutions in more depth.

During this timeframe, the "Water for the 21st Century Act" created nine basin roundtables in each major drainage basin within the state, providing a forum for discussion on water issues. The Act also created the Interbasin Compact Committee (IBCC), consisting of representatives from the basin roundtables and other interest groups. This group would facilitate conversations on issues that reach across basins and on issues with statewide implications.

The basin roundtables were charged with developing a closer understanding of needs at the basin level, developing needs assessments, and proposing Projects and Methods by which to meet the enumerated needs. These needs assessments and the ongoing progress at the IBCC level would be the basis of SWSI 2010, informing the water supply planning at the state level with necessary grassroots input at the basin level.

The SWSI 2010 update included these updated local assessments, as well as an analysis of environmental and recreational needs, as informed by the basin roundtables. Other innovations included water availability analyses, more refinement of Projects and Methods, and baseline costs for implementation measures.

With Executive Order D 2013-005, Governor Hickenlooper directed the CWCB to commence work on Colorado's Water Plan. This effort would be the first of its kind, laying out the grassroots work of the basins through the Basin Implementation Plan process and the methods by which the State can assist basins in meeting their water needs. SWSI 2010 served as the technical foundation for the Basin Implementation Plan process and for Colorado's Water Plan.

SWSI 2017 will serve as the technical basis for water supply planning at the State level moving forward. Updates to SWSI include incorporation of the IBCC's work on scenario planning, climate change, development of an agricultural gap methodology, and analysis and incorporation of Basin Implementation Plans. SWSI 2017 will be prepared with an eye to future iterations and updates to Basin Implementation Plans and Colorado's Water Plan.

1.2 Vision for the PMP

The Project Management Plan (PMP) is a document that provides a roadmap for conducting the SWSI update and developing products and deliverables. The roadmap includes documentation and reporting guidance, communication tools, team coordination information, quality guidance, and descriptions of roles and responsibilities so that the team can be effective and efficient.

1.3 Purpose of the Project Management Plan

A basic requirement of the SWSI project (Project) is the development of a PMP that describes the overall project management approach. The plan must be soundly conceived with well-defined objectives, and it must be devised at the outset of the Project in order to provide the necessary and often critical direction required at every stage of the Project. A solid PMP lays out the boundaries within which the team works. It sets the stage for quality, consistency, usability and effectiveness of the products and deliverables. The PMP is adaptive and allows the various teams to make decisions that incorporate new technologies, decisions that are made or changed, new team members, and lessons learned.

1.4 SWSI Project Team Vision

SWSI will require extensive and effective communication, coordination and collaboration between and among the CWCB, prime and subconsultants. To further this end, the CWCB and consultants agree on the following vision statements as a blueprint for our commitment to partnering, and for how we wish to work together on the project:

- Vision for the SWSI product:
 - Key technical platform on which Basin Implementation Plans (BIPs) and the Colorado Water Plan (CWP) are built
 - Foundational to Colorado's water planning efforts and policies
 - As accurate as possible given limitations of budget, schedule and available data
 - Highly usable by the CWCB, roundtables and others
- Vision for *how* team will accomplish this goal:
 - Maintain a technical focus; extensive external input is not required for SWSI
 - Commitment to strong core team
 - Commitment to positive, team-oriented collaboration
 - Commitment to learning and adaptation

1.5 Roles, Responsibilities, and Contacts

1.5.1 CWCB Responsibilities

The overall SWSI project is managed by the CWCB Program Management Team. CWCB Program Management Team is composed of five members: Linda Bassi, Kevin Houck, Greg Johnson, Rebecca Mitchell, and Andy Moore. The CWCB Program Management Team will be assisted by a variety of CWCB Subject Matter Experts (SMEs) and some may also be SMEs. The CWCB SMEs will be assigned as Task Leaders for various components of the project or subject matters and will work with the Prime Consultant associated with the corresponding subject matter. The

following CWCB staff will perform the role as SME for the four main subject matters or work categories:

- ❖ Water Data Specialist
 - Environment and Recreation: Linda Bassi
 - Municipal & Self Supplied Industrial Needs and Demand Management - Rebecca Mitchell
 - Modeling, Gap, and Water Supply - Rebecca Mitchell
- ❖ Water Finance Specialist - Kirk Russell
- ❖ Water Economy Specialist - Craig Godbout

1.5.2 Consultant Responsibilities

The CWCB will use consultants to assist them in the SWSI update. The work to be conducted by consultants is described in general terms below (as stated in the Request for Proposals):

- ❖ **Project Integrator:** Advise the agency regarding all aspects of the project, provide project management support functions, perform quality control reviews (as described in Section 5), and integrate the technical work from other elements of this project into well-written and properly formatted deliverables. Additional work for this consultant or its subconsultants includes project integration with consultants working on Basin Implementation Plans and meeting facilitation as the agency deems necessary.
- ❖ **Water Data Specialist:** Update, quantify, prioritize, analyze, and integrate all relevant municipal, industrial, agricultural, environmental, recreation, and energy needs, projects, and supply-demand gaps. This work should build upon draft information in Colorado's Water Plan, the Basin Implementation Plans, the nonconsumptive toolbox, SWSI 2010, Colorado's Decision Support Systems (CDSS), scenario planning, needs assessments, and other available resources. The work performed under this role will also include an important focus on water conservation strategies, water quantity/quality issues, and land use patterns. Incorporation of information on climate change using available climate modeling and data plus information on adaptation and state action plans will be included.
- ❖ **Water Finance Specialist:** Quantify a range of financial needs and a justifiable total estimate for the planning horizon (currently set at 2050) in terms of actual dollar amount, based on the projected gaps and related information developed by the Water Data Specialist. The Water Finance Specialist will work with CWCB to identify and evaluate strategies for alternative financing mechanisms for long-term water project funding.
- ❖ **Water Economy Specialist:** Review, update, and refine population projections for the planning period (through 2050) based on best available data, and in close coordination with the State Demographer's Office. Develop a detailed explanation of water markets in Colorado and the West, and provide relevant water pricing information for various sectors of use across the diverse geographic and climatic areas in Colorado. Develop a compendium of information regarding public surveys, use trends, and value of water as perceived by customers and stakeholders.

1.5.3 Prime Consultant Responsibilities

Three consulting teams were chosen by the CWCB to assist with the SWSI update. Each consulting team is led by an engineering firm serving as the Prime Consultant. Each Prime Consultant will work with their team to conduct work associated with the subject matters described above. Prime Consultants selected to conduct work under the various subject matters as follows:

- ❖ Project Integrator - Brown and Caldwell
- ❖ Water Data Specialist
 - Environment and Recreation - CDM Smith, Inc (CDM Smith)
 - Municipal & Self Supplied Industrial Needs and Demand Management - CH2M Hill, Inc. (CH2M)
 - Modeling, Gap, and Water Supply - CH2M
- ❖ Water Finance Specialist - CDM Smith
- ❖ Water Economy Specialist - CH2M

Matt Lindburg will serve as the Integration Lead and the Brown and Caldwell project manager. Barbara Biggs (CDM Smith, Inc.) and Mark Bransom (CH2M Hill, Inc.) will serve as Prime Consultant project managers.

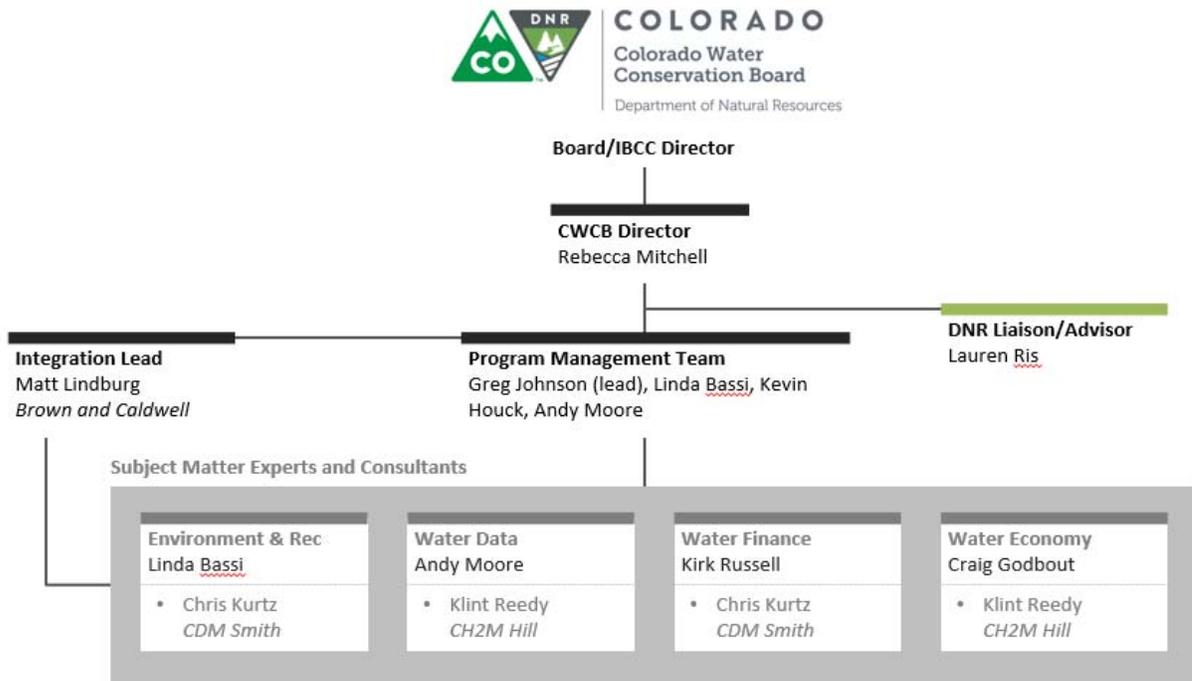
1.5.4 Subconsultant Responsibilities

Each Prime Consultant will work with several specialized Subconsultants to support the SWSI update. The following table describes the Prime Consultant and Subconsultant relationships and the types of work projected to be done by each Subconsultant

SWSI Consultant Teams		
Prime Consultant	Subconsultants	Subconsultant Responsibilities
Brown and Caldwell	CDR Associates	Facilitation (if needed)
	HDR Engineering, Inc.	Facilitation and public relations assistance (if needed), technical advisors related to general water resources
	Lynker Technologies, Inc.	Technical advisors related to general water resources and climate change
	The Open Water Foundation	Data visualization and management assistance
	University of Colorado - Denver Fine Arts Department	Data visualization and design of web-based content (if needed)
CDM Smith	Raftelis Financial Consultants	Research related to financing options
	The Nature Conservancy	Technical advisors related to environmental and recreational needs, gaps, etc.
CH2M	BBC Research & Consulting	Research and calculations related to population estimates and water-related values
	ELEMENT Water Consulting	Research and calculations related to municipal and self-supplied industrial water demands and water conservation
	The Open Water Foundation	Updates to Basin Needs Decision Support System (BNDSS) and gap calculations
	Southwest Water Resource Consulting	Technical advisors related to planning scenarios
	Wilson Water Group	Research and calculations related to water supplies, projects and methods, and gap analyses

1.5.5 Organizational Chart and Team Contacts

Below is an organizational chart showing CWCB staff/roles and Prime Contractor leads/roles described in Sections 1.5.1, 1.5.2, and 1.5.3.



Last Updated: 8/1/2017



Section 2

Consolidated Approach to SWSI

2.1 Purpose

The SWSI update will be conducted by the CWCB in harmony with the consulting teams selected by CWCB to perform various aspects of the project (as described in Section 1). At the proposal stage of the SWSI update, prospective consultants developed approaches to conduct components of the project. The CWCB awarded individual components of the project to consultants well suited to perform the work. The purpose of this document is to provide a consolidated approach to the SWSI update that reflects the strategies and work flow proposed by various consultants for their respective contracted tasks. **Note that this approach has changed since the beginning of the project and will continue to evolve as analysis methodologies are developed and refined.**

2.2 Overview

The work associated with the SWSI update will be conducted in three general phases. The phases are described below

Phase 1: During Phase 1, the consulting teams will develop methodologies for incorporating new analyses into SWSI such as effects of climate change and variability, evaluation of agricultural gaps, etc. In addition, methodologies used in previous versions of SWSI will be reviewed, updated (if necessary), and documented. The teams will work with Technical Advisory Groups (TAGs) on methodologies and seek to gain consensus on methodologies. Finally, data and information from new and existing sources such as Basin Implementation Plans, previous versions of SWSI, etc. will be collected and reviewed.

Phase 2: Technical evaluations related to the SWSI update will be conducted in Phase 2. Methodologies developed during Phase 1 will be used for the technical evaluations.

Phase 3: Draft and final SWSI update reports will be developed during Phase 3.

It is anticipated that the three phases of the SWSI update will overlap. For example, documentation of a methodology should occur once that methodology is finalized. It is not necessary to wait until Phase 3 to develop a technical memorandum or brief report on a methodology. Consultants should work fluidly and continuously through the work phases and collaboratively with others on the SWSI update team to complete the scope of work.

The current description of work associated with Phase 1 tasks includes both objectives and a proposed process for completion. Tasks associated with Phase 2 are described in more general terms and largely reflect the proposed approaches included in the proposals submitted by various consultants. As methodologies are developed and more detailed approaches for technical evaluations are established, this document will be updated.

2.3 Consolidated Approach

2.3.1 Phase 1a: Methodology Development and Documentation

Methodology development was identified as an initial activity for much of the analysis work proposed by consultants for the SWSI update. Several consultants proposed the formation and use of Technical Advisory Groups (TAGs) to provide advice and guidance in development of methodologies. In addition, the Brown and Caldwell Team proposed an initial task that included methodology development (where needed) and summarizing, evaluating, and improving (if necessary) methodologies used in prior versions of SWSI and documenting methodologies.

This phase of work focuses on developing new methodologies, reviewing and improving existing methodologies (if necessary), and planning future activities associated with data visualization and the refinement and use of the Basin Needs Decision Support System (BNDSS).

Task 1a.1: New Methodology Development and Existing Methodology Review and Improvement

The following is a list of focus area and proposed process for developing new analysis methodologies as well as reviewing and improving analysis methodologies used in previously versions of SWSI. These efforts are closely related, and therefore are presented in one process as described below.

List of Focus Areas:

Development of new analysis methodologies was identified as a needed step by various consultants in the following areas:

- ❖ Planning scenarios - The IBCC developed five planning scenarios to represent how Colorado's water future may look in the year 2050. While the actual future will likely be a mixture of the planning scenarios, the scenarios are a useful planning tool that recognizes the uncertainties of the future. The IBCC described the scenarios as Business as Usual, Weak Economy, Cooperative Growth, Adaptive Innovation, and Hot Growth. Three of these scenarios (Cooperative Growth, Adaptive Innovation, and Hot Growth) envision a future in which climate change has a significant impact on hydrologic and other drivers of water supply and demand. The characteristics of the five planning scenarios will impact nearly all of the analyses conducted in SWSI, including:
 - Climate change assumptions
 - Environment and recreation
 - Municipal and self-supplied industrial needs and potential demand reduction from future conservation measures (active and passive)
 - Agricultural needs and potential demand reduction from urbanization, water transfers, etc.
 - Potential success of Projects and Methods under various scenarios
 - Social values related to water
- ❖ Environmental and Recreational methodologies
 -
 - Evaluate the need to restructure the Nonconsumptive Needs Assessment Database (per the work conducted in the South Platte BIP)

- ❖ M&SSI analysis
 - Structural and shortage gaps under various scenarios
- ❖ Agricultural methodologies
 - Structural and shortage gap analyses in basins with and without surface water models (CDSS or otherwise) and under various scenarios
- ❖ Water supply analysis
 - Identify the tools that will be used and how they will be used
 - Wet, normal, and dry hydrologic conditions
 - Note: Consideration should be given to evaluating system reliability in terms of frequency rather than under wet, normal, and dry conditions
 - Basin firm yield
 - Note: Consideration should be given to evaluating yield in terms of frequency
- ❖ Population projections
 - The methodology will be developed with input from the Colorado State Demographer's Office

Process for Methodology Development:

This subsection describes the process that will be used to develop methodologies for the above areas and to review and improve existing methodologies. Specific areas of methodology development and review include planning scenario development, environmental and recreation, M&SSI, agricultural, and water supply (for water supply availability and shortage analyses). An overview of the methodology development process is illustrated below:



It is anticipated that the following consultants will lead the development and review of various methodologies. CWCB subject matter experts will be closely involved in all aspects of methodology development.

- ❖ Planning scenarios: CH2M Team
- ❖ Environmental and recreational methodologies: CDM Smith Team (assisted by the Nature Conservancy)
- ❖ M&SSI methodologies: CH2M Team (assisted by ELEMENT Water)
- ❖ Agricultural methodologies: CH2M Team (assisted by Wilson Water Group)
- ❖ Water supply methodologies: CH2M Team (assisted by Wilson Water Group)
- ❖ Water finance methodologies: CDM Smith Team (assisted by Raftelis Financial Consultants)
- ❖ Water economy methodologies: CH2M Team (assisted by BBC Research and Consulting)

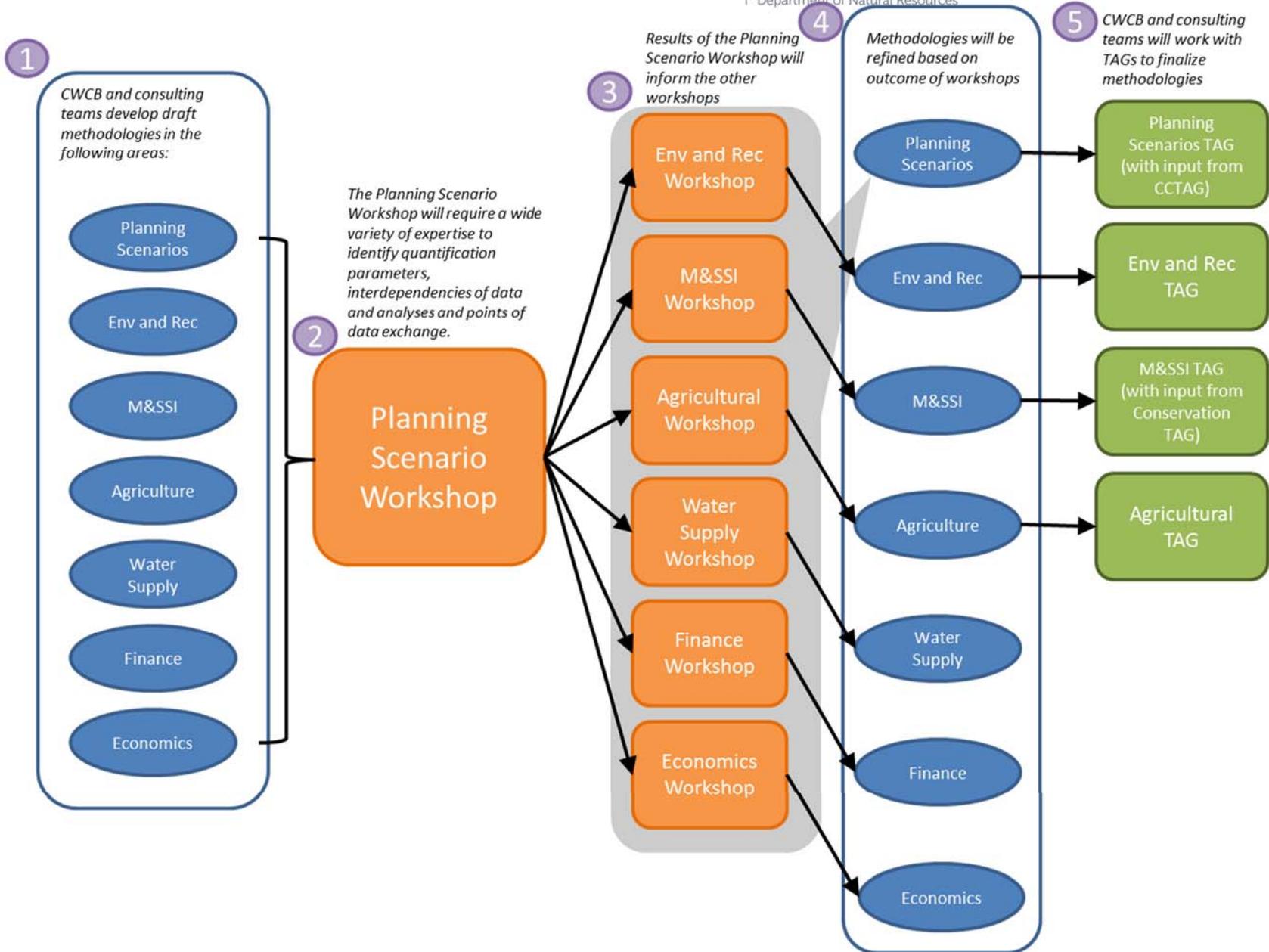
The process for developing methodologies will involve work by individual consultants and collaborative meetings that leverage multiple experts. The overall process is illustrated in the following graphic.



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The methodology development process illustrated in the above graphic is described in detail as follows:

1. CWCB and consultant staff will meet to kick off the methodology development and review process. Topics of discussion may include background on how previous methodologies were implemented, important questions that the methodology and results needs to answer, existing or planned studies and analyses proposed by Basin Roundtables that could inform or be incorporated into SWSI, potential technical advisory group (TAG) members, timeline for methodology development, available budget for conducting analyses, etc. The following are guiding principles and considerations for forming and working with the TAGs:
 - a. **Size of TAGs:** A TAG may be larger or smaller depending on the area of methodology development, but they should be small enough to be nimble in terms of scheduling meetings, efficiently gaining feedback, developing consensus, etc.
 - b. **Types of TAGs:** Four TAGs will be developed for the purposes of the SWSI update focusing on the following areas:
 - i. Planning scenarios
 - ii. Environment and recreation
 - iii. M&SSI
 - iv. Agriculture
 - c. **Use of existing TAGs:** TAGs focused on climate change and conservation already exist and should be utilized
 - i. Representatives from the climate change TAG should participate in the SWSI planning scenarios TAG
 - ii. Representatives from the conservation TAG should participate in the M&SSI TAG.
 - d. **TAG membership:** The TAGs should be scientifically focused and should consist of individuals from the CWCB, consulting team, and outside experts with relevant technical expertise.
 - e. **TAG objectives:** Given the need for expediency and budget limitations, the objective of TAG engagement will be to obtain review comments and recommendations on proposed methodologies. The TAGs will be provided with proposed methodologies that have been developed and refined by the CWCB and SWSI consulting teams, and the TAGs will comment on the methodologies and provide recommendations (if needed). Adoption of TAG recommendations for revisions or enhancements will be weighed in light of schedule and budgetary limitations.
2. CWCB will contact and coordinate with potential TAG members identified in Step 1.
3. Consultants will review methodologies used in prior versions of SWSI and develop an outline or briefing document that describes existing methods and highlights areas of potential improvement.
4. Consultants will develop a draft methodology for analyzing new concepts or components of SWSI (or methodology alternatives).
 - a. Draft methodology development may include a literature review.

8. CWCB staff and consultant will meet with the respective TAGs to discuss/refine the draft methodologies and methodology improvements.
9. Consultants will write draft technical memoranda describing methodologies.
10. CWCB staff and the Brown and Caldwell Team will review the draft technical memoranda.
11. The draft memoranda will be sent to the TAG for review.
12. If necessary, additional meetings will be conducted with the CWCB and the TAG to refine the methodology.
13. The methodologies and technical memoranda will be finalized based on input received from the CWCB and TAG.

Task 1a.2: Data Dissemination and Access Plan

The CWCB would like data and information developed in SWSI to be accessible and consumable by various user groups including the general public, Basin Roundtables, water professionals, etc. A plan will be developed describing how existing or new web-based tools could be used to communicate and disseminate SWSI datasets and deliverables.

1. Brown and Caldwell (including the Open Water Foundation) will work with the CWCB and representatives from the CH2M and CDM Smith Teams to identify individuals on the SWSI consultant team and others that should be included in this process.
2. Consultant team and CWCB will meet to discuss the types of data that could be made available to different user groups, existing tools for visualizing and disseminating SWSI data and information, additional tools that could be developed to enhance visualization and dissemination of data, etc.
3. The CWCB will coordinate with the Office of Information Technology to promote proper integration and coordination of database and related website technologies with state protocols.
4. The Brown and Caldwell Team will develop a draft data dissemination and access plan. The plan will include a description of data visualization and access tools that are needed (either existing tools or tools that should be created), information on how and where the tools will be hosted, and data standards that the SWSI consultant team will need to adopt to ensure compatibility between the tools and SWSI data sets.
5. The draft plan will be reviewed by CWCB, the SWSI consultant team, and others as recommended by the CWCB.
6. The plan will be finalized.

Task 1a.3: BNDSS Evaluation

The CH2M Team will evaluate the status and functionality of the Basin Needs Decision Support System (BNDSS) for data storage, collection, and gap analysis and identify structural refinements to ensure its readiness for SWSI analyses.

1. Review the BNDSS database and website design and functionality and engage with CWCB staff to ensure that the system meets the needs of staff, BRTs, IBCC, and interested parties. Also engage the CDM Smith team to identify ways the BNDSS can inform or incorporate Environmental and Recreation analyses.
 - a) Identify enhancements that can be effected within the task budget.

2. Meet with CWCB staff and the CDM Smith Team to discuss the enhancements to the BNDSS database and website design and gap analysis functionality.
3. Coordinate with the Office of Information Technology to promote proper integration and coordination of database and related website technologies with state protocols.
4. Finalize the list of enhancements and develop an approach for refining the BNDSS in Phase 2.

2.3.2 Phase 1b: Information and Data Collection

This phase can start while Phase 1a is in progress. The Prime Consultant Teams will likely collect data and information to support their work, and it will be a starting point for nearly all the tasks and subtasks in the scope of work. Some information and data collection could start immediately, but it is likely that the methodology development process will have some impact on the types and amount of information and data collection necessary.

Data collection, in some areas of analysis, could be a substantial effort (e.g. BNDSS project surveys). Teams should consider the level of effort needed to collect various types of data and work with the CWCB and Brown and Caldwell to balance the level of effort with available budget.

Task 1b.1: Catalog for Projects and Methods

Both the CDM Smith and CH2M Prime Consultant Teams will be reviewing and evaluating BIP Projects and Methods as a part of their respective analyses. To avoid inconsistencies in the Projects and Methods evaluated and considered in various analyses conducted by the teams, a framework will be developed for cataloging Projects and Methods. The catalog will be used by the CDM Smith and CH2M Prime Consultant Teams to help ensure that they are both considering and analyzing the same, consistent list of Projects and Methods.

The process for developing the framework is as follows:

1. The CDM Smith and CH2M Prime Consultant Teams, along with CWCB and Brown and Caldwell representatives, will meet to kick off the framework development process. During the meeting, it is anticipated that the group will discuss the following:
 - a) Existing sources of data and information describing various types of consumptive and nonconsumptive Projects and Methods used in previous versions of SWSI
 - b) Technologies or tools (i.e. database, spreadsheet, etc.) that could be used to develop the catalog given the types of existing data sources on describing Projects and Methods
 - c) Work assignments for developing the catalog. It is anticipated that the CH2M Team will develop the catalog given their team's expertise using the BNDSS.
2. The catalog will be developed based on decisions made during the kickoff meeting.

Task 1b.2: Data and Information Collection and Review

Data collection, organization, and metadata compilation in the following areas can begin concurrently with Phase 1a: Methodology Development and Documentation.:

- ❖ Environmental and Recreation

- The CDM Smith Team will review the BIPs to gain further understanding of each basin's goals and measurable outcomes as well as their environmental and recreational Projects and Methods.
 - When necessary, the CDM Smith Team will work directly with CWCB to gain clarity on the intention of specific goals, measurable outcomes, projects, and/or methods.
 - Develop an inventory of Projects and Methods from the BIPs.
- ❖ M&SSI Needs and Demand Management
 - The CH2M Team (ELEMENT Water) will review the BIPs and other data sources to supplement the summary of the current state of conservation in Colorado. This information will inform technical evaluations in Phase 2 associated with municipal and self-supplied industrial need and demand management. Data acquisition and review will include, but not be limited to the following:
 - Information from water providers collected under HB 10-1051 (1051) *Water Use and Conservation Reporting*
 - M&SSI needs and projections from the BIPs including the *Goals and Measurable Outcomes* and other local-level information such as municipal water efficiency plans, regional water use plans and comprehensive plans, and the *SWSI 2010 Conservation Levels and Strategies* will supplement information from 1051
 - Cost of water demand management measures and programs as reported by water providers in municipal water efficiency plans and other readily available references considering customer and provider-side costs
 - Other data and information identified during the development of methodologies
- ❖ M&I Projects and Methods
 - The CH2M Team will review BIPs and their proposed Projects and Methods with respect to a variety of SWSI related needs such as:
 - Estimated construction/implementation costs
 - Proposed location
 - Estimated water yields
 - Timeline for implementation
 - Degree to which these Projects and Methods have been studied or designed.
 - This will help the consulting team evaluate uncertainty with respect to estimated project or method costs, water yields under various hydrologic and climate change scenarios (if any), ability to model the Project and Methods, etc.
 - The CDM Smith Team will review, screen, and categorize cost estimates for Projects and Methods described in the BIPs. This information will be useful for water finance-related analyses in Phase 2.
 - Projects and Methods will be identified where a detailed cost estimating process is appropriate.
 - Projects need to have an adequate level of planning already completed, including a proposed amount of additional water supply to be provided and, where relevant, general locations of infrastructure identified.
 - Projects that have been identified as higher priority by the BIPs or SWSI 2010 will also be prioritized for detailed cost analysis.

- Methodologies used to develop costs in BIPs will be evaluated and summarized/categorized
 - For example, a project cost based on an engineering feasibility study will have a higher level of certainty than an estimate based on a conceptual project. The compiled information will be provided to the CDM Smith Team's Water Finance Specialist.
- The CH2M Team will gather additional information on Projects and Methods for the BNDSS
 - Based on the review of Projects and Methods from BIPs, the CH2M Team will identify additional data and information that should be collected.
 - The CH2M Team will work with CWCB to develop a process for gathering additional information on Projects and Methods. Lessons learned during the BIP process to acquire information from providers will be discussed, and process improvements will be adopted.
 - If schedule and budget allow, gather additional information on Projects and Methods based on the process developed in the prior step.
- ❖ Water Supplies
 - The CH2M Team will review existing hydrologic information that quantifies unappropriated surface water supplies from existing data, studies, BIP work, and the CRWAS.
- ❖ Water Economy
 - The CH2M Team will review data, information, and reports relevant to water markets, social values related to water (the Value of Water Survey), etc.

2.3.3 Phase 2: Technical Evaluations

Calculations and analyses in the various technical areas of the SWSI Update will be conducted in this phase. Methodologies developed in Phase 1 will determine the processes to be used during Phase 2. As methodologies are developed, the approach for Phase 2 will be refined.

The Phase 2 approach has been organized relative to the general Scope of Work provided by the CWCB in the RFP for this project.

Environment and Recreation

In this task, the CDM Smith Team will update the Nonconsumptive Needs Assessment (NCNA) database, evaluate nonconsumptive Projects and Methods from the various BIPs, and develop a tool for assessing flow conditions in each basin under the various Planning Scenarios.

- ❖ Update and enhance the NCNA database and incorporate the Projects and Methods inventory developed in Phase 1b.
- ❖ Develop an Environment and Recreation flow tool (Flow Tool) designed to assess flow conditions in each basin
- ❖ Use the Flow Tool to output from SWSI Update planning scenarios and a baseline/current conditions scenario to explore the projected sufficiency of current and future projects and protections.

Municipal and Self Supplied Industrial Demands Evaluation

The objective for the Statewide Water Supply Initiative (SWSI) Municipal and Self-Supplied Industrial (M&SSI) Demands Evaluation is to develop future demand forecasts under the umbrella of the State's planning scenarios that incorporate influences of a multitude of drivers including population, climate change, land use change, technology, regulations, and social values. The drivers will be combined according to the five planning scenarios that are further described in the Colorado Water Plan. The demand forecasts should employ consistency in methodology across the state and maximize use of available data.

Current and future municipal and self-supplied industrial water demands will be evaluated and quantified in this task.

- ❖ Update information on current state of conservation in Colorado
- ❖ Update self-supplied industrial (SS&I) information
- ❖ Investigate demand reduction potential
- ❖ Analyze water use and conservation scenarios

Agricultural Demand

The agricultural demand in each basin will be developed for current conditions and then increased or decreased based on drivers specific to each Planning Scenario. As discussed above, the agricultural demand is the amount of diversions and pumping required to meet the full crop IWR. Agricultural demand will be most impacted by climate and hydrological drivers; however they will also be impacted by socio-economic drivers captured in each Planning Scenario. As part of this assessment, the following items will be evaluated:

- ❖ Current irrigated acreage and irrigation water requirement.
- ❖ Potential future increases or losses of agricultural land.
- ❖ Potential impacts to agricultural demands due to climate change.
- ❖ Future crop irrigation water demand assessment.
- ❖ Non-irrigation water demand assesment.

Projects and Methods

As a part of the overall Modeling, Gap and Water Supply evaluation task, this work will focus on refining and updating the BNDSS and conducting supplemental analyses of certain types of Projects and Methods including alternative transfer methods, water reuse, and storage.

- ❖ Refine the BNDSS
 - Using the approach developed in Phase 1, the CH2M Team will refine the BNDSS.
- ❖ Input data on Projects and Methods to the BNDSS
 - The CH2M Team will input and update the data for projects included in the BIPs and acquired during Phase 1b into the improved BNDSS.
- ❖ Assess Alternative Water Transfer Methods (ATMs)
- ❖ Assess reuse potential
- ❖ Assess storage

Water Supply Evaluation

Unappropriated surface water supplies and groundwater availability will be evaluated and quantified through the following tasks.

- ❖ Analyze unappropriated surface water supplies
 - The CH2M Team will summarize existing hydrologic information that quantifies available surface water supplies from existing data, studies, BIP work, and the CRWAS. However, to quantify the amount of unappropriated surface water supplies under the different scenarios, existing model evaluations will need to be updated and new evaluations will need to be conducted.
 - Unappropriated surface water supplies will be analyzed for the planning scenarios and under dry, normal, and wet hydrology using agreed upon methods for characterizing various hydrologic conditions.
- ❖ Update groundwater supply availability
 - Available groundwater supplies in various aquifers in Colorado were described in SWSI 2004. The data and information used in SWSI 2004 will be reviewed and used to the extent that they are still current.
- ❖ Analyze storage
 - Basin firm yields and associated storage requirements will be analyzed using the agreed-upon methodologies developed at the early stages of the project.

Planning Scenarios Evaluation

The Planning Scenarios Evaluation will model water supply and demands based on the output from the above mentioned methodologies under the five planning scenarios described in Colorado's Water Plan (Business as Usual, Weak Economy, Cooperative Growth, Adaptive Innovation, and Hot Growth). Hydrologic gaps or shortages for M&I and agricultural water uses will be quantified as described in the following bullets.

- ❖ M&SSI gap analysis
 - CH2M Team members will collaborate on the M&SSI conservation component of the gap analysis, including demand-side increases due to climate change and other drivers reflected in the scenarios.
 - Hydrologic M&SSI gaps will be estimated using CDSS modeling tools (or other tools as determined during the "review and develop methodologies" step), configured for each planning scenario.
- ❖ Agricultural gap analysis
 - The models and tools described in the step above will also provide information about agricultural hydrologic gaps.

Water Finance

Work associated with the water finance component of SWSI will focus on estimating potential costs for Projects and Methods described in BIPs and are needed to meet future water needs and developing financial strategies to meet the goals and needs cited in Colorado's Water Plan.

- ❖ Develop cost estimates for Colorado's water needs

- Update the cost estimation tool
- Evaluate costs of Projects and Methods
- ❖ Develop financial strategies
 - Describe the economic effect of implementing Colorado's Water Plan versus the status quo
 - Determine the amount of financial support that may be needed from state sources
 - Describe and assess opportunities to fund Colorado's Water Plan

Water Economy

In the Water Economy component of SWSI, population projections will be updated, social values associated with water will be evaluated and incorporated into the planning scenarios, and water markets and pricing will be assessed.

- ❖ Incorporate social values into the scenario planning approach
- ❖ Update population projections through 2050
- ❖ Evaluate Water markets and water pricing information

2.3.4 Phase 3: Reporting

It is anticipated that reporting will occur at the end of Phases 1 and 2.

- ❖ The Brown and Caldwell Team will develop templates for technical memoranda, maps, figures, etc. The SWSI consulting team will use these templates when developing project deliverables to ensure consistency and facilitate integration of work products.
- ❖ Phase 1 reporting will document methodology development processes and results. It will also describe improvements made to existing methodologies.
 - Phase 1 reports will be in the form of technical memoranda. The format for the technical memoranda will be provided by the Brown and Caldwell Team. The process for developing Phase 1 reports is described below:
 - At the conclusion of methodology development and review, draft technical memoranda will be developed by various consultants.
 - The draft memoranda will be reviewed by the CWCB, TAG participants, and the Brown and Caldwell Team.
 - The various authors of the draft memoranda will update and finalize their reports based on comments provided during review.
 - The final technical memoranda will be uploaded to the SharePoint site.
 - The technical memoranda will be written in a way that allows for efficient incorporation into the final report.
- ❖ Phase 2 reporting will describe analysis inputs and results.
 - Phase 2 reporting will also be in the form of technical memoranda written by consultants working on various components of the SWSI study. The process for developing Phase 2 reports is described below:
 - At the conclusion of technical analyses, draft technical memoranda describing the analyses and results will be developed by various consultants.
 - The technical memoranda will be reviewed by the CWCB and Brown and Caldwell.

- The various authors of the draft memoranda will update and finalize their reports based on comments provided during review.
 - The final technical memoranda will be uploaded to the SharePoint site.
 - The technical memoranda will be written in a way that allows for efficient incorporation into the final report.
- ❖ SWSI report
- The Brown and Caldwell Team will assemble and integrate the various technical memoranda into a draft SWSI report.
 - The draft SWSI report will be distributed to the CWCB, SWSI consulting team, and BRTs for review.
 - Based on comments from CWCB, the SWSI consulting team, and BRTs, the final SWSI report will be developed.



Section 3

Project Controls

The following SWSI project controls are the tools and processes used to manage and monitor project documents, schedule, costs, and progress. The goals of these controls are to provide a means to evaluate and document that the project is meeting cost and schedule constraints and milestones and to provide timely information on the status and progress of the project.

3.1 SharePoint Site

BC will develop and maintain a secure Microsoft SharePoint® (SharePoint) site for this project. SharePoint is a Web-based environment with a scalable, searchable back end that is ideal for broad information sharing. It will be used as an online collaboration tool for sharing ideas, information, and documents among the SWSI project team members. Relevant data will be added to the SharePoint by SWSI project team members and will be available to team members.

3.2 Document Control

Document Control is the effective management of all documents and records associated with the Project. Document control encompasses the recording, control, storage, retrieval and reporting of all types of written documentation. Of primary importance, and the key to an effective document control system, is the easy retrieval of documents after they have been filed or archived.

The SharePoint site will be used as the collaboration and document storage/retrieval system for the Project. When a document is uploaded to the site, it will be characterized by a prescribed list of metadata (if required by the SharePoint site document library), which will vary based on the document's Content Type (e.g., meeting minutes, contract, presentation, etc.). The system is capable of sorting and filtering stored documents by any one or multiple attributes, as well as by keyword search. Filter and search tools will allow users to find documents on the site using any one of these attributes or using search terms describing the general subject of the desired document.

3.3 Task Order Scope of Services, Work Breakdown Structure, and Budgeting

It is anticipated that the Prime Consultants will submit task orders corresponding to the tasks and work described in the Consolidated Approach above (and as updated during the course of the Project).

The work breakdown structure (WBS) provides a framework for the manner in which work is executed and allows project managers to effectively evaluate task progress with respect to authorized budget. The WBS developed for the Project has three levels:

- ❖ Task Order
- ❖ Task or individual Subconsultant budget

❖ Subtask

Prime Consultants and Subconsultants will develop WBSs that include a sufficient number of tasks or subtasks to allow adequate monitoring of work progress, budgets, and schedules.

3.4 Change Management Process

Two types of scope of service changes are anticipated to occur as a part of the SWSI update: internal changes limited to individual Prime Consultant teams (including Subcontractors) and project approach changes made in conjunction with the CWCB, Project Integrator, and other Prime or Subconsultants. Prime Consultants will define and manage the scope of services within each task order, and any out of scope work will require written authorization from the CWCB.

3.5 Monthly Progress Reports

The purpose of preparing monthly progress reports is to communicate to the CWCB the status of the Project, including budget, earned value, schedule, monthly progress by task and/or subtask, accomplishments, and anticipated/needed changes. A detailed report (including components described in the following section) will be prepared by each Prime Consultant PM monthly.

Monthly progress reports are retrospective in nature, and will present project information as of the end of the reporting month. The monthly status reports will be prepared and posted as soon as possible after the end of the reporting month but no later than the end of the 3rd week of the month after the reporting month. For example, a monthly progress report delivered in April will provide information through the end of March.



Section 4

Communications Plan

SWSI team members are committed to positive and ongoing communication and coordination between and among themselves to complete the SWSI update. Team members have adopted the following guidelines to encourage productive and constructive partnering:

- ❖ Acknowledge and respect team members' assigned roles and responsibilities
- ❖ Give team members the benefit of the doubt and assume they are acting in good faith
- ❖ Courteous and respectful verbal and written communications
- ❖ Provide adequate information to make wise and informed decisions
- ❖ Communicate in a timely manner to keep team members informed about developments or changes

4.1 Nomenclature Bridging between this SWSI and past SWSI efforts

Consistent nomenclature should be used when communicating and writing about SWSI-related concepts, analyses, results, etc. The following are a list of terms that could potentially be inconsistently used and recommendations on how to reference these terms moving forward. Note that as the CWCB and consultants identify other needs for consistent nomenclature, the list below will be updated.

- ❖ Environmental and recreational: In prior versions of SWSI, water needs for environmental and recreational purposes were described as “nonconsumptive” needs. The SWSI update will use the term “environmental and recreational” when describing gaps, water needs, etc. for nonconsumptive purposes.
- ❖ Energy development: Water needs for energy development have sometimes described as needs for “oil and gas” development. The term “energy development” should be used to reflect a broader definition of these water needs.

4.2 E-mail and Written Communications

SWSI project team communication will occur through a combination of workshops, status meetings, emails, and formal written communications. Open communications are encouraged at all levels of the project team, and documentation is necessary to ensure the best project team communication.

While the use of email is encouraged, it should not be used for formal project communications. Due to the difficulties with archiving and sharing emails, all documentation of decisions, issues, and any impacts to scope, schedule or budget, will be in the form of project memos, letters, or reports. All formal project communications shall be routed through the Key Points of Contact (see below).

Copying the Key Points of Contact in all written communications, including emails is encouraged. However, communications strictly related to technical discussions between peers, or to procedural issues can be conducted without including the project managers in the communications at the judgment of the parties involved.

Key Points of Contact include:

- ❖ CWCB Program Management Team: Linda Bassi, Kevin Houck, Greg Johnson, Rebecca Mitchell, and Andy Moore
- ❖ Integration Lead - Matt Lindburg, Brown and Caldwell
- ❖ Environment and Rec/Water Finance - Barbara Biggs, CDM Smith
- ❖ Water Data/Water Economy - Mark Bransom, CH2M
- ❖ CWCB SMEs:
 - Environment and Recreation: Linda Bassi
 - Municipal & Self Supplied Industrial Needs and Demand Management - Becky Mitchell
 - Modeling, Gap, and Water Supply - Andy Moore
- ❖ Water Finance Specialist - Kirk Russell
- ❖ Water Economy Specialist - Craig Godbout

The following protocols are requested for emails:

- ❖ Strive to be clear concise as possible and refrain
- ❖ Utilize the "Bottom Line Up Front" idea of putting your request or "punch line" first
- ❖ Recipients listed under the "To" category are responsible for responding on the associated action item. Carbon Copy "CC" recipients listed are included for informational purposes only
- ❖ Use the subject line to identify the discussion topic

4.2.1 Memorialization of E-mail and Written Communications

As described in the Document Control section above, all SWSI project related documents, including email transmissions of a significant nature, must be converted to a portable document file (.pdf) format and uploaded to the appropriate document library on the Project's SharePoint site. Files should be named following the guidelines listed in Section 6.5.1. It is not necessary to upload and store e-mail transmissions of a general correspondence nature that do not provide critical technical direction or pertain to contractual matters. Critical technical changes in scope or contractual matters communications should be handled formally and utilize Prime Consultant or CWCB letterhead.

4.3 Meetings

Three types of regular project-related meetings (in-person or conference call) will be held during the SWSI Project, and are detailed as follows:

- ❖ Project Team meetings with CWCB staff, Prime Consultants, and subcontractors
- ❖ Prime Consultant Management Team progress meetings - held on the same day of each month at the CWCB office
- ❖ Technical Team coordination meetings (monthly or as the teams deem necessary)
- ❖ Technical Advisory Group meetings (to be determined)

4.4 External Communication Plan

The purpose of the External Communication Plan is to provide a proactive approach that seeks to provide appropriate information, timely notice, information on key decisions, and the early and continuous involvement of appropriate stakeholders in the development of the SWSI Project.

External communications with the Basin Roundtables will be an important aspect of the Communications Plan. Basin Roundtables should be informed of SWSI progress and results. Basin Roundtables input to SWSI will be sought at an appropriate level.

External communications and communication requests shall be handled as follows:

- ❖ **Informal information requests from the public or Basin Roundtables:** It is anticipated that SWSI team members will be approached by colleagues from the public or Basin Roundtables for information related to SWSI. Minor requests should be handled informally by team members and the results of these communications should be emailed to Key Points of Contact identified in Section 4.2. Requests for formal progress reports, discussions regarding methodologies, or other significant topics should be routed through the CWCB Program Management Team members or appropriate CWCB Subject Matter Expert.
- ❖ **Periodic progress updates to Basin Roundtables:** CWCB staff who sit on various Basin Roundtables will be informed of SWSI progress on a monthly basis prior to roundtable meetings so that they can provide regular progress reports to the Basin Roundtables.
- ❖ **Reporting to Basin Roundtables at project milestones:** It is anticipated that the project team will provide informational reports to Basin Roundtables at significant project milestones. For example, the project team may provide formal presentations to Basin Roundtables on new and improved methodologies that are developed. The project team will likely report preliminary gap analysis results to Basin Roundtables. The type and frequency of formal reporting will be identified in the Consolidated Approach.



Section 5

Quality Control Procedures

The deliverables described in the Consolidated Approach and subsequent task order contracts will be subjected to quality control review. In general, quality control (QC) for this project will consist of two levels of reviews.

- ❖ Prior to issuing any deliverable, a peer review will be performed. This is inherent in the day-to-day execution of the work and will be informal, ongoing, and will not be documented.
- ❖ Prior to issuing a final deliverable, an independent, senior-level review will be performed by knowledgeable senior staff persons not directly involved in the execution of the project (if possible). This review will be documented by the reviewers with responses to each comment.

Each Prime Consultant is responsible for ensuring that these reviews take place, and for identifying resources, scheduling and coordinating these reviews. All milestone quality control reviews will be logged in the Quality Assurance (QA)/QC Log spreadsheet and included with submittal.

The SWSI Project Integrator and CWCB will perform a tertiary QA/QC review and is responsible for reviewing and approving technical decisions made by the Prime Consultants. All deliverables are to be reviewed and approved by the SWSI Project Integrator prior to being incorporated into the final SWSI report.

5.1 Review Procedures and Formats

Prime Consultant reviewers and analysts/authors should be conferring during the course of the work, not just when it is done. This will be accomplished by engaging the appropriate reviewers prior to the commencement of an assignment and having them commit to being the reviewer and seeing the particular assignment through to review completion. The QA/QC Log spreadsheet (a template is available under the PM Documents folder) will also be used as a tracking sheet to keep track of comments and responses. QA/QC review comments will be categorized by the reviewer as **Major**, **Minor**, or **Preferential**. Major comments are the most important and preferential comments are the least.

The analyst or author will document responses to all comments in the QA/QC Log spreadsheet. Major comments or changes that could change the direction of the project will be kept and presented at SWSI progress meetings. The analyst or author will respond to Major comments in one of four ways:

1. Incorporated as-is
2. Incorporated with modifications (author explains the modifications)
3. Not incorporated (author explains why the recommendation was not incorporated)
4. Will be incorporated in a subsequent stage of the project

5.2 Review Philosophy

Quality is defined as meeting sound technical practice and requirements as completely and consistently as practicable. The purpose of the QC review is to identify errors, omissions, inconsistencies, and flaws that, if not corrected, would lead to an inadequate SWSI data set and report. The project team believes that QC reviews will minimize rework and produce higher quality deliverables.

5.2.1 Written Document Philosophies

All written documents, in addition to receiving editing and formatting review, must be given a quality review by the appropriate QC reviewer to verify:

- ❖ Technical correctness
- ❖ Technical adequacy
- ❖ Compliance with format requirements
- ❖ Clarity
- ❖ Completeness
- ❖ Courtesy, sensitivity
- ❖ Usage of standard and up-to-date SWSI nomenclature

General questions to be asked in reviewing all documents are:

- ❖ Is everything addressed that should be addressed?
- ❖ Is everything stated correctly?
- ❖ Is anything included that should not be included?

5.2.2 Technical Evaluation Review Philosophies

Sound technical evaluations depend upon carefully executed analytical work by qualified professionals:

- ❖ Work will be performed only by staff trained and qualified in the relevant technical discipline.
- ❖ The basis, assumptions, methodology, criteria, and reasoning must be stated clearly so that one unfamiliar with the work can follow the reasoning, formulas, calculations, and findings.
- ❖ Generic formulas must be fully stated, references identified, derivations complete, arithmetic setups shown, and units of measure clearly stated.
- ❖ All final spreadsheets must show or include a description of the calculation methodology, column by column.
- ❖ Where steps in reasoning are required, a statement or paragraph (or more if necessary) should be included. The entire calculation and process of reasoning must be documented and the level of documentation is dependent on the complexity of the calculation.
- ❖ All work will be checked thoroughly by the individual and compared against other studies, standards, or related project work products (if possible) for reasonableness.
- ❖ For model evaluation, calibration and prediction sensitivity/uncertainty analysis information should be requested and reviewed.

- ❖ Database reviews should incorporate statistical summaries and search for outliers by various graphical methods.

Section 6

Data Management Plan

This section describes data management procedures for SWSI. This data management plan (DMP) is intended to be a “living document”, incorporating changes as the project progresses. The DMP provides a comprehensive data management structure to support the accumulation of data to be used by the project team and as a reference for various stakeholders. As new datasets and processing procedures are developed and implemented, they will be incorporated into this document. The SWSI Project Integrator will be responsible for maintaining this document.

6.1 Objectives

The major objectives of this Data Management Plan are to:

- ❖ Provide a framework to manage and control data quality and to identify, manage and avoid risk arising from lack of control of the different versions of all data
- ❖ Describe and document procedures for sharing data with the project team
- ❖ Maintain data control, accessibility, consistency, reliability, and reproducibility throughout the life of the project
- ❖ Facilitate efficient understanding and use of data by software tools while avoiding unnecessary intermediate and derived versions
- ❖ Recognize data processing lifecycle including importing original sources, data management and processes, and publishing derived products
- ❖ Utilize unique identifiers across datasets to allow consistent and integrated use of data

6.2 Goals of Data Management

The data management activities for the SWSI update will be guided by six principles:

- ❖ **Quality:** Ensure that appropriate QA measures are taken during all phases of data development: acquisition, processing, summary and analysis, reporting, documenting, and archiving.
- ❖ **Interpretability:** Ensure that complete documentation accompanies each data set so that users will be aware of its context, content, source, applicability, and limitations.
- ❖ **Security:** Ensure that data are maintained and archived in a secure environment that provides appropriate levels of access to project leaders and team members.
- ❖ **Availability:** Ensure that the data and information from the SWSI update are made available and easily accessible to other project team members.
- ❖ **Accessibility:** Ensure that the data and information from the SWSI update are accessible in machine-readable formats that facilitate use and analysis.
- ❖ **Longevity:** Ensure that final data sets are submitted in an accessible and interpretable format, accompanied by sufficient documentation.

6.3 Data Types

This section identifies the data types that are anticipated to be generated and how these data will be managed and stored in various data repositories and ArcGIS Geodatabases at the Prime Contractor's or Subcontractor's local servers as well as the project SharePoint site. Generally, data are broken into the following categories, spatial data, modeling data, and analysis-specific data.

6.3.1 Spatial Data

It is anticipated that a wide variety of spatial data will be used for the SWSI project, in various formats and in some cases managed in a Geographic Information System (GIS) such as Esri ArcGIS. Spatial data consist of vector "features" represented by shapes (lines, polygons, points, etc.) and attributes (properties of the features) represented in a table. Raster data are grids of data that represent a value in each grid cell. To incorporate all potential types, spatial data is broken down into three categories Base data, Working data, and Project data. A geodatabase stores geographic data organized in datasets and can maintain both spatial and nonspatial data. Examples of the types of datasets that might be maintained in a geodatabase include:

- ❖ Object (nonspatial classes, for example water project data)
- ❖ Feature classes (spatial data)
- ❖ Relationship classes (to connect different data using a shared attribute)
- ❖ Topologies (spatial data relationships such as intersects, groups)
- ❖ Terrains (focus on three-dimensional representations)
- ❖ Raster datasets (such as digital elevation model to a certain resolution)
- ❖ Raster catalogs (lists of raster datasets)

To achieve the goals of data management, project team members are encouraged to use geodatabases rather than individual data and coverage files.

A Basemap Data Geodatabase, by definition, should not include data that will frequently change throughout the project. However, it is anticipated that over the length of the project, some base data may need to be updated. If project team members determine that basemap data set needs to be updated, and that data set is used by other Consultants, then notification should be posted on the project SharePoint discussion board and the new data set should be distributed by posting a copy to the SharePoint data page.

A Working Geodatabase includes data that is likely to change before the completion of the SWSI update. Some data originally located in the working geodatabase may move to the Project Data Geodatabase after a final analysis is complete. Retention of data within the Working Geodatabase or population of the Project Data Geodatabase will be decided by the Prime Consultant.

The Project Geodatabase includes final datasets that are used for an analysis, report figures, or are data that was prepared for other SWSI Prime Consultants. All datasets located in the Project Geodatabase will be documented in a readme file listing and describing the files included.

6.3.2 Modeling Data

It is anticipated that a variety of models will be used or developed for the SWSI project. Prime Consultant teams will be expected to establish a file structure that distinguishes

between source, working, and final model input and output data files. Data files used for analysis would be retained under the working file folder. Data originally located in the working file folder may move to the final file folder after a final analysis is complete.

It is anticipated that a variety of models will be used for the SWSI project, for example CDSS StateMod datasets. Models typically define a standard file structure and provide general documentation. Any modeling performed for SWSI will document the source of the data set, software version, and process to use or develop the dataset. Versions of model datasets will be tracked using timestamped folders or other approach. The requirements for modeling will be further defined as the need for modeling is identified.

6.3.3 Analysis-specific Data

The third category of data includes a broad range of data and information that are specific to the various analyses and evaluations to be included in the SWSI update. These datasets may consist of time series and other data that are used individually or integrated for analysis with Microsoft Excel, CDSS TSTool software, statistics programs such as R, database query tools, or other tools. Examples of analysis-specific data include the following:

- ❖ Climate change data
- ❖ Data and information from BIPs describing Projects and Methods
- ❖ Population forecast data
- ❖ Agricultural water use data
- ❖ Municipal and SSI water use data

Such data may exist in original form as provided by the author and may need to be manipulated to facilitate analysis. Different versions of the data files should be clearly identified, with documentation (README, etc.). Analysis processes should be documented within metadata as per Section 6.6.

6.4 Data Quality

Developing a data quality mindset among the SWSI project team is essential to ensure that appropriate quality assurance measures are taken during all phases of data evaluation and development. It is assumed that all project team members will have individual quality control plans and/or procedures that will ensure data quality during day-to-day efforts.

There are two critical times where quality control reviews will need to take place for the SWSI update. Data quality control reviews should be performed on external source data and final project data deliverables. If a data quality description is not provided with a third party data set, SWSI project team members should perform a quality control review of external data sets prior to manipulation, analysis and incorporation into working SWSI datasets. Quality control reviews on final SWSI project data will follow the guidelines described in Section 5.

6.5 Data Repositories and Sharing

Each Prime Consultant is responsible for management of the data collected or developed during the SWSI project, maintaining a repository of background information (such as source data) gathered to meet project goals, and QA/QC of project datasets.

During the life-cycle of the project, ArcGIS Geodatabases will be a repository of all spatial data generated or obtained over the course of the project. This will be the overall platform for GIS data transfer and sharing.

Non-spatial data repositories will consist of specified SWSI project folders on each Prime Consultant or Subconsultant's individual server. It is suggested that a data folder and file structures be developed based on specific SWSI-related tasks rather than by year or task order. Prime Consultants and Subconsultants should consider the submittal of data to the CWCB when developing folder organization structures.

Sharing of geodatabases non-spatial data will occur through the SWSI SharePoint project site. If spatial data needs to be shared, the current individual Prime Consultant geodatabases will be uploaded to the SharePoint site (rather than individual components). Similarly, non-spatial data will be shared in the same fashion and will include source data (if appropriate).

6.5.1 File Naming Conventions

A file name is the main identifier for an electronic record and provides initial metadata that places the record in context with the SWSI project and other project records. File naming conventions used for the SWSI project will be dependent on the data type. This is due to the wide variety of file types and software that will be used to perform project tasks. It is requested that all files contain the following file name components:

- ❖ Date of creation in ISO 8601 standard format of YYYY-MM-DD or YYYYMMDD
- ❖ Description of content (e.g., groundwater elevation [GWelev])
- ❖ Version Number:
 - 1) Version number by using 'v' or 'V' and the version number, e.g.:
 - a) ERgislayerfile_v1.0 = original document
 - b) ERgislayerfile _v1.1 = original document with minor revisions
 - c) ERgislayerfile _v2.0 = document with substantial revisions

The following guidelines should be followed when creating SWSI file names:

- ❖ Task Specific prefixes:
 - 1) PM for Project Management
 - 2) Water Data Specialist specific task prefixes:
 - a) ER - Environment and Recreation
 - b) MS - Municipal & Self Supplied Industrial Needs and Demand Management
 - c) MGW - Modeling, Gap, and Water Supply
 - 3) FS - Water Finance Specialist
 - 4) ES - Water Economy Specialist
- ❖ Creator or Company:
 - 1) First and Last initial of creator (e.g., Jim Smith - JS)
 - 2) Abbreviated name of Prime Consultant or Subconsultant associated with the record (e.g., Brown and Caldwell abbreviated to BC)
- ❖ Create unique file names. Duplicate file names will cause problems.
- ❖ Use underscores (_) and dashes (-) to represent spaces in GIS files.
- ❖ Use only alpha-numeric characters. Avoid using special characters such as: ? / \$ % & ^ # . \ : < > since their use can create problems and challenges for programming languages, databases, search engines, and hyperlinks.

- ❖ The use of "camel case" in filenames is encouraged. This method of condensing a string of text by removing the spaces has been in use for quite a while. The separation of words in a phrase is identified by using **UpperCaseLettersToRepresentTheBreaks**. This single simple practice can account for quite a few characters in a file path.
- ❖ Many common words are just as easily recognized when abbreviated: Accounting/Acctg, Department/Dept, Print/Prt, Construction/Const.

6.6 Metadata

The inclusion of metadata with every final data deliverables is essential for data interpretability and longevity. Metadata shall accompany all draft, draft final, and final data deliverables. The following are the metadata and other requirements based on data type.

GIS Metadata and other requirements:

- ❖ Completed metadata fields must include:
 - 1) Summary (include units of measurement if relevant)
 - 2) Description including data quality
 - 3) Credits
 - 4) Field descriptions for all fields (including attribute value descriptions if they are not in plain English and units of measurement if relevant)
 - 5) Point of contact
- ❖ Geodatabases and other data must be compatible with ArcGIS version 10.1.
- ❖ Projection: NAD83, UTM Zone13
- ❖ Do not tie any stream reach information to ComID in the NHD
- ❖ Working and final. mxd files will be delivered with relative path names stored for all data layers.

Modeling Metadata (as a README file):

- ❖ Model description (abstract, source/author, purpose, supplemental information, references, credits, version etc.)
- ❖ Status of model
- ❖ Time period (beginning and end dates)
- ❖ Data quality information
- ❖ Spatial Domain (not applicable to cost models)
- ❖ Point of contact
- ❖ In the case of StateMOD, StateCU or other state models, the version of Hydrobase used to develop modeling inputs.

Metadata for analysis-specific data sets:

- ❖ **Excel spreadsheets:** Every workbook has the first worksheet containing a description (abstract, purpose, supplemental information, references, credits etc.), data quality description, change log, point of contact, and notes.
- ❖ **Other data or analysis files:** Text files or data file collections will include a readme file containing a description (abstract, purpose, supplemental information, references, credits etc.), data quality description, change log, point of contact, and notes.

6.7 File Delivery

All final deliverable files produced on this project will be uploaded to the SWSI SharePoint site, with the exception of bulk datasets comprised of a large number of files or files that are large in size. Those final large datasets will be transferred to CWCB by external hard drive. If final data sets are saved in a format that can only be read by specific software, ensure that the same data sets are submitted in a machine-readable format can be processed using a standard process, accompanied by sufficient documentation.