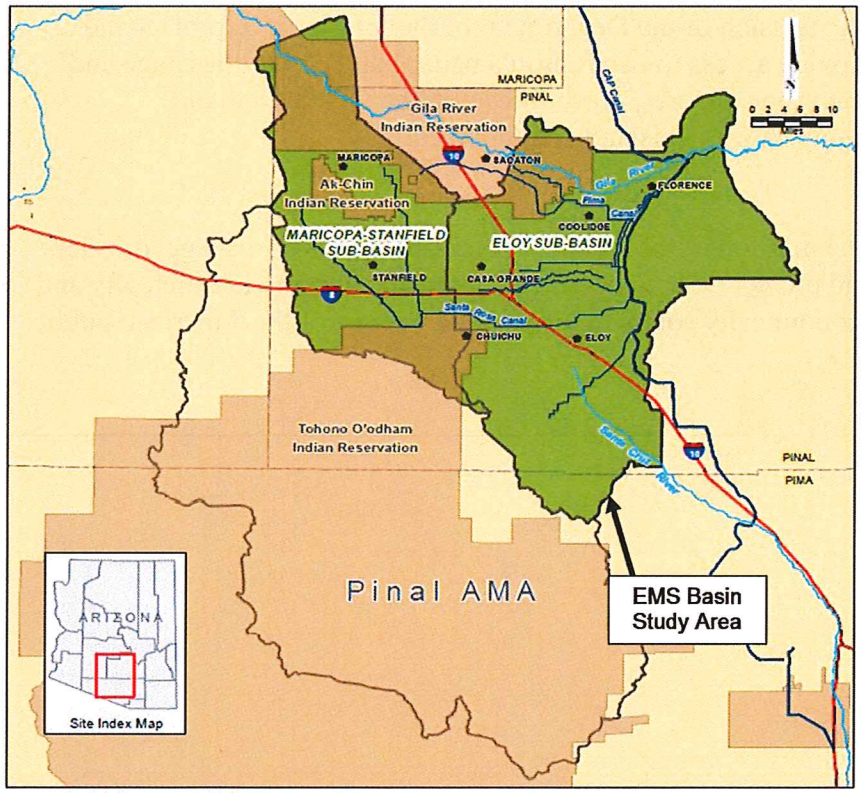
RECLAMATION

Managing Water in the West

Plan of Study

Eloy and Maricopa-Stanfield Basin Study



U.S. Department of the Interior
Bureau of Reclamation
Phoenix Area Office
Glendale, Arizona

Pinal Partnership
Florence, Arizona

September 2018

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

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

Plan of Study

Eloy and Maricopa-Stanfield Basin Study

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September 2018

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Acronyms and Definitions

ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
AFY	Acre-Feet per Year
AWSA	Arizona Water Settlements Act of 2004
Basin	The contributing watershed of a major river or tributary. For the purposes of this Study, the Basin coincides with the five sub-basins of the ADWR Pinal Active Management Area.
Basin Study	A comprehensive study, or update of an existing study, that identifies imbalances between water supply and demand and includes the development of mitigation and adaptation strategies in direct response to current or future water supply and demand imbalances resulting from climate change and other stressors. In this Plan of Study, the Eloy and Maricopa-Stanfield (EMS) Basin Study is referred to as the 'Basin Study', the 'Study', or the 'EMS Basin Study'.
CAP	Central Arizona Project
CAP:SAM	Central Arizona Project Service Area Module
CMIP	World Climate Research Programme's Coupled Model Intercomparison Project
Cost-Share Partner	Federal and non-Federal entities who share basin study costs.
CRSS	Colorado River Simulation System
DCP	Drought Contingency Plan
EMS	Eloy and Maricopa-Stanfield
ft, bls	feet, below land surface
GCM	Global Climate Model

GRIC	Gila River Indian Community
ICUA	Intentionally Created Unused Apportionment (Colorado River water)
LID	Low Impact Design
Non-Federal Cost-Share Partner	A non-Federal entity or entities, approved by the eligible applicant and Reclamation, that will cost-share, either through in-kind services or cash contributions, with Reclamation, the eligible applicant, and other basin study stakeholders to develop and conduct a basin study.
MOA	Memorandum of Agreement
Pinal AMA	Pinal Active Management Area
PPWRC	Pinal Partnership Water Resources Committee
POS	Plan of Study – a fully developed scope of work describing the specific study tasks and how each task will be carried out, including the responsible party, cost, schedule, and approach.
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
SNWA	Southern Nevada Water Authority
Stakeholders	All Federal, State, tribal, regional, and local government entities (including cost-share partners), customers, nongovernmental organizations, and the public who are present and actively involved or interested in a basin study.
Study Partners	All Stakeholders, cost-share partners and Reclamation staff who are present and actively involved or interested in a basin study.

About this Plan of Study

This Plan of Study (POS) delineates the responsibilities and scope of work scheduled for completion by the Bureau of Reclamation (Reclamation) and the Non-Federal Cost-Share Partners for the Eloy and Maricopa-Stanfield (EMS) Basin Study (Study). This POS describes each specific Study task, the responsible party assigned to the task, and the associated cost, schedule and proposed method to complete each task.

This POS was developed by using the recommended guidelines in the Reclamation Manual – Directives and Standards WTR 13-01, dated December 16, 2016, and is intended to be a "living document." Therefore, this document may require revisions to support future research and documentation that may be acquired during the three-year Basin Study. If Reclamation and the Non-Federal Cost-Share Partners agree that a modification to any of the activities described in this POS is required, then the POS may be modified without amending the Memorandum of Agreement (MOA).

1.0 Introduction

1.1 Study Purpose, Objectives and Constraints

1.1.1 Study Purpose

The State of Arizona Groundwater Management Act established Active Management Areas (AMA) for groundwater management. The Pinal AMA is one of five basins designated as an AMA in Arizona. Each AMA carries out its programs in a manner consistent with its individual goals, while considering the unique character of the basin and its water users. The Arizona Department of Water Resources (ADWR) established the Pinal AMA with a statutory management goal to preserve existing agricultural economies for as long as feasible, consistent with the necessity to preserve future water supplies for non-irrigation uses. The 1980 Groundwater Management Act does not specify the quantity of water that must be preserved for non-irrigation uses, nor does it list any criteria by which to determine how long agricultural economies should be preserved.

The Eloy and Maricopa-Stanfield (EMS) Basin Study area includes two of five sub-basins within the Pinal AMA (Figure 1). The EMS sub-basins are the dominant watersheds and are represented in ADWR's Pinal Regional Groundwater Model. Pumped groundwater is the primary water source in the region which has been historically dominated by the agricultural sector. Pumped groundwater continues to be a significant water source in addition to Colorado River water deliveries to the region via the Central Arizona Project (CAP) which began in 1987. Groundwater for municipal, industrial and tribal use has continued to increase over time, and intensive groundwater pumping has greatly exceeded natural recharge. Subsequent groundwater level declines have resulted in land compaction and subsidence, leading to the formation of earth fissures.

Excess CAP supplies, primarily utilized for agricultural irrigation and groundwater recharge in the EMS sub-basins, will diminish as CAP allocations are fully utilized. In addition, deliveries of CAP allocations to the EMS Basin Study area would be significantly reduced under a Colorado River water shortage. According to the Arizona State Climate Office, Arizona is in its 21st year of a long-term drought. To meet ADWR's statutorily established water management goals, it is necessary to reduce dependence on groundwater and to identify additional water management and surface water supply augmentation strategies for the EMS sub-basins.

The EMS Basin Study will enable Non-Federal Cost-Share Partners and stakeholders to evaluate future water supply and demand imbalances and develop potential strategies to meet future demands.

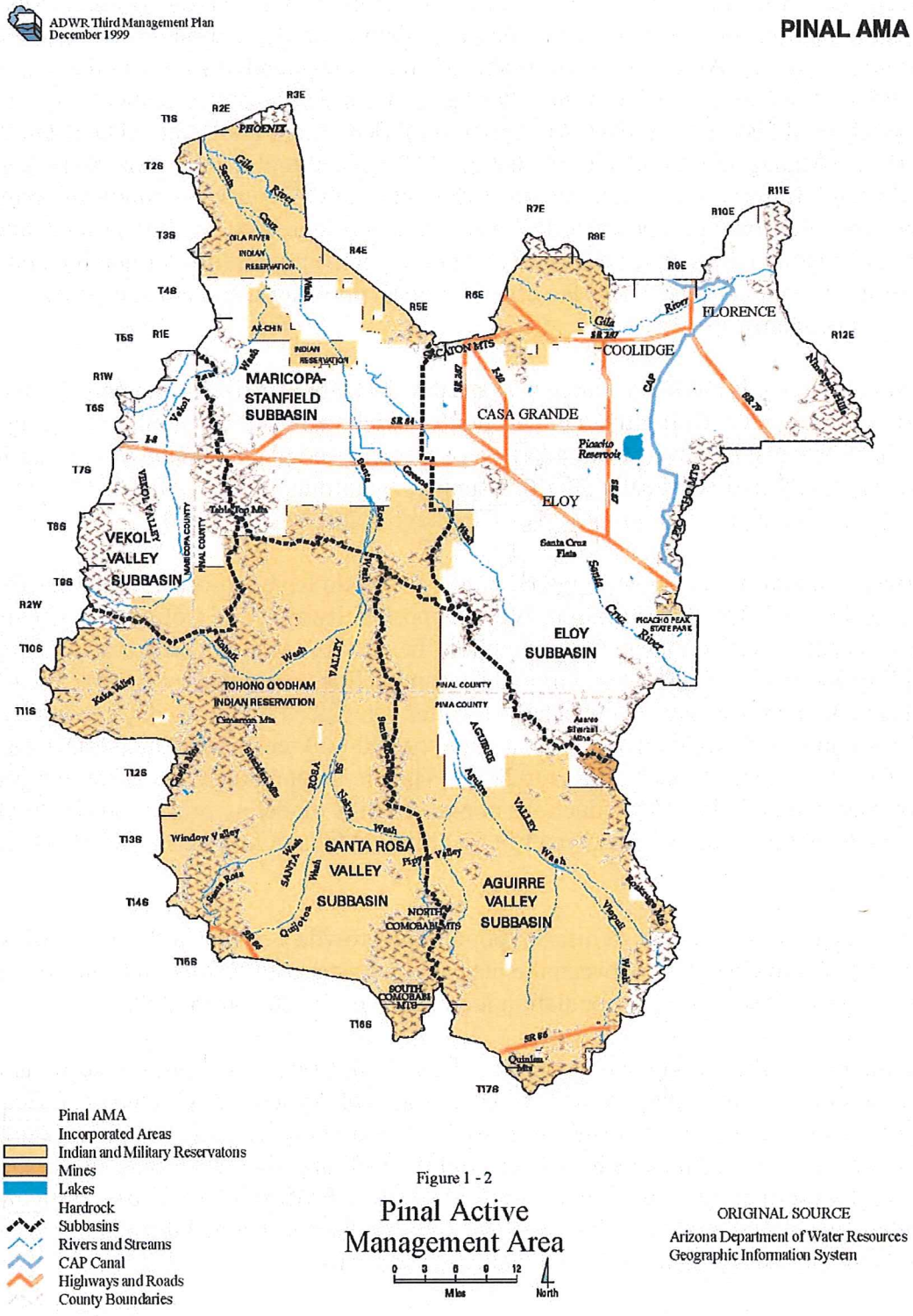

Figure 1: Pinal Active Management Area

A convergence of factors necessitated the need for the EMS Basin Study. These factors include imminent reductions in surface water availability, significant population growth, and a thriving agricultural economy. All these issues combined create the potential for water demand to outpace water supply. If a Colorado River water shortage is declared, Arizona's reduction in Colorado River water would come from the CAP Agricultural Settlement Pool. The ADWR Draft Pinal AMA Fourth Management Plan reports that in 2015, agricultural demand was 80 percent of Pinal AMA demand. If there is a reduction in the availability of CAP water, groundwater pumping will increase, and additional groundwater declines will occur. Increased depth to groundwater will exacerbate existing land subsidence issues, negatively impact groundwater quality, and increase groundwater pumping costs. These factors will impact all water use sectors, especially the agricultural economy.

The Colorado River is a critical source of water for the state of Arizona and particularly for the EMS Basin Study area. Currently, a big portion of Arizona's CAP water entire is being used in the EMS sub-basins; however, Colorado River shortages and planned reductions in agricultural supplies are likely to dramatically alter that supply. According to the CAP's 2015 Annual Report, "there is a significant probability of shortage in 2018 and beyond."

A shortage declaration would be triggered on the Colorado River if surface water levels in Lake Mead drop below 1,075-foot elevation. With the possibility of future Colorado River shortages and the subsequent reductions in water supplies, the need for accurate projections of groundwater availability and quality is essential. Groundwater modeling completed by ADWR in 2014 indicates that under a scenario in which CAP water is replaced by pumped groundwater, the depth to groundwater could change from a range of 500-600 feet below land surface (ft, bls) to a range of 1,101 – 1,533 ft, bls by the year 2059. While it is not realistic to expect pumped groundwater to match the CAP reductions one-to-one, the modeling projections highlight the need to understand depth to groundwater in the Pinal AMA and long-term availability of this resource.

The EMS region is also facing significant population growth. Located at the center of what is known as the "Sun Corridor" between the metropolitan areas of Phoenix and Tucson, Pinal County has experienced a rapid population increase of over 120% from 2000.

Even with the significant population growth within Pinal County, agriculture has remained a prominent industry. According to the U.S. Department of Agriculture Census of Agriculture Data, there were 223,626 acres irrigated in 2012. Due to many reasons, including changing economic factors, irrigated lands have been slightly declining since that time. While the irrigated agricultural sector has been the primary water user in the EMS sub-basins, beginning in 2004, residential and commercial growth in the EMS sub-basins has changed the demographics significantly thus resulting in increased municipal water use.

Additionally, there are two subsidence areas within the EMS sub-basins. These subsidence areas are known as the Maricopa-Stanfield Land Subsidence Feature and the Picacho-Eloy Land Subsidence Feature. If the depth to groundwater increases, land compaction and associated land subsidence would likely increase in these areas, resulting in decreased aquifer storage, damage to infrastructure, and potentially other structural and environmental issues.

The EMS Basin Study will evaluate current and future water supplies in this area. The operation of existing water and power infrastructure will be analyzed to evaluate how it will function under various water supply scenarios. Additionally, adaptation and mitigation strategies will be developed and evaluated to assess their effectiveness in addressing the imbalance between supply and demand within the Basin Study area. Partners and stakeholders will also evaluate mitigation strategies to assess institutional requirements and costs.

The results of this Study will provide vital information for future water resources planning and economic development in the EMS Basin Study area.

1.1.2 Study Objectives

The EMS Basin Study objectives will be accomplished by compiling water supply and demand data for all water sources, climate data, current infrastructure information, and social and economic data. Data will be used to assess future water demand requirements based on population projections. A range of scenarios will be developed for potential future water demands in the EMS sub-basins. The results of the scenarios will be used to develop strategies to plan for potential water supply vulnerabilities. The EMS Basin Study will provide Partners and Stakeholders with information for water resource planning for future residential and commercial growth while preserving the agricultural economy. A final EMS Basin Study report will be submitted to the Bureau of Reclamation's (Reclamation) Policy Office within three years of signing a Memorandum of Agreement (MOA).

1.1.3 Study Constraints

The EMS Basin Study shall provide technical assessments of the EMS sub-basins; it will not provide recommendations or represent a statement of policy or position of Reclamation, the Department of the Interior, or the Non-Federal Cost-Share Partners. The EMS Basin Study will not propose or address the feasibility of any specific project, program, or plan and will not represent a commitment for any future provision of Federal funds.

1.2 Authority (Bureau of Reclamation)

Reclamation's authority to enter into this Agreement is based on:

- Reclamation Act of June 17, 1902 (ch. 1093, 32 Stat. 388; 43 U.S.C. 372, et seq.) and acts amendatory thereof and supplementary thereto.
- Title IX of the Omnibus Public Land Management Act of 2009 (P.L. 111-11, 123 Stat. 991).

1.3 Study Area Description

The EMS Basin Study is located in Pinal County in central Arizona. The ADWR Pinal AMA consists of five sub-basins; the EMS Basin Study boundary represents two of the sub-basins incorporating a majority of groundwater and surface water usage in Pinal County (Figure 2). The statutory management goal of the Pinal AMA is to preserve the agricultural economy for as long as feasible, while considering the need to preserve groundwater for future non-irrigation uses.

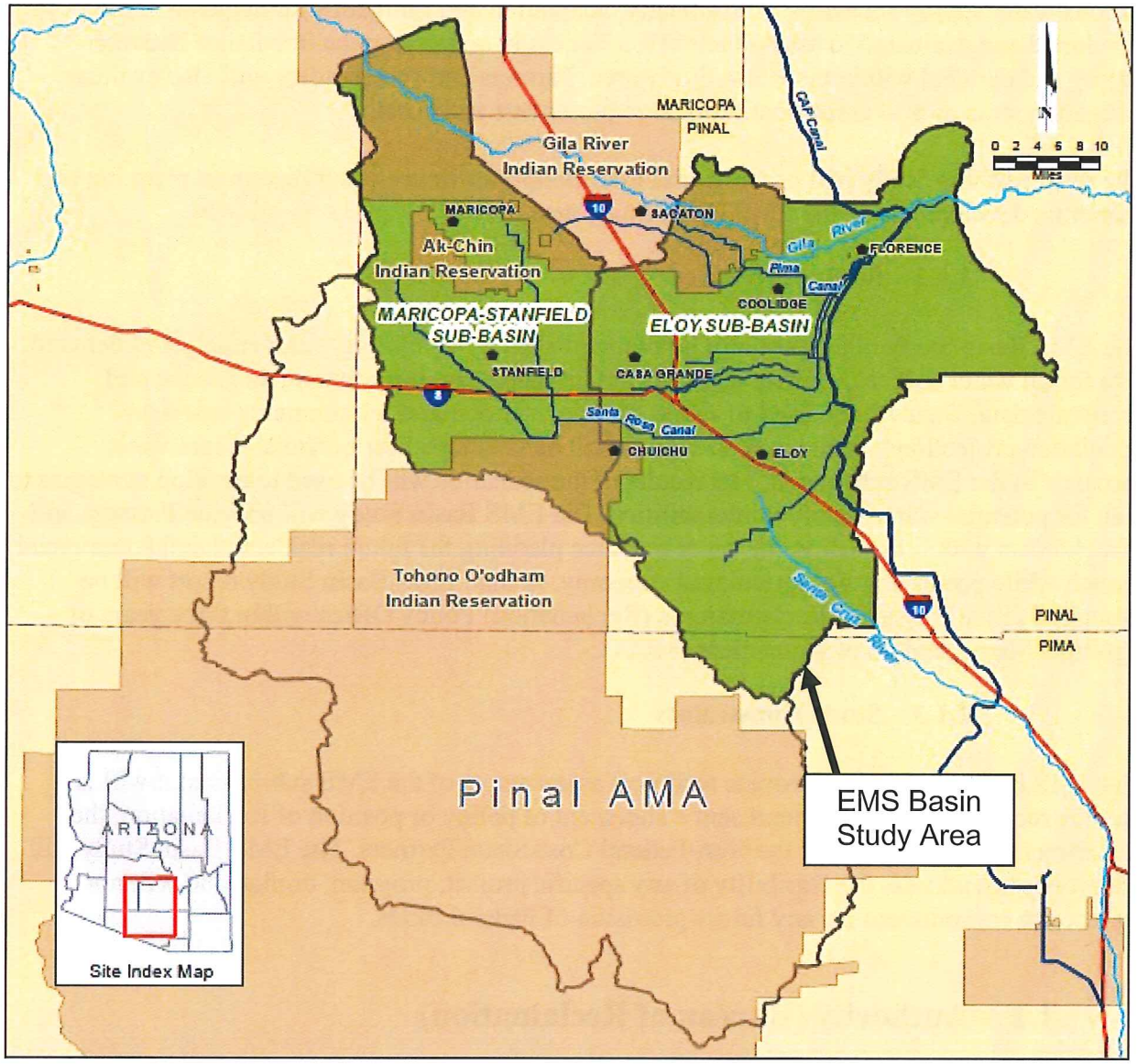

Figure 2: EMS Basin Study Area

Major surface water drainages in the Pinal AMA are the Gila and the Santa Cruz Rivers. The Gila River is located in the northern portion of the EMS Basin Study area and flows east to west. Coolidge and Ashurst-Hayden dams regulate Gila River flow. The Santa Cruz River flows northwesterly through the area.

The EMS sub-basins follow a groundwater divide, and groundwater underflow between the sub-basins is limited. The total underflow entering the Pinal AMA is between 45,000 and 55,000 acre-feet per year (AFY) (Source: ADWR Pinal AMA Draft Fourth Management Plan). Groundwater underflow leaves the EMS sub-basins flowing northwest between the South Mountains and Sierra Estrella Mountains at about 16,300 AFY and north between the Santan and Tortolita Mountains at about 3,500 AFY.

1.3.1 Organization of the Plan of Study

This Plan of Study (POS) follows the requirements listed in Reclamation's Directives and Standards (WTR 13-01), dated 12/16/2016.

2.0 Study Description

2.1 Needs and Opportunities

The EMS sub-basins consist of limited groundwater and surface water supplies that are utilized by a large historic agricultural community and an ever-increasing municipal population. Limited water supplies and the potential for a Colorado River water shortage declaration require that water management be a high priority. Groundwater supplies in the EMS sub-basins were heavily pumped for agricultural purposes through history, resulting in large groundwater declines. CAP surface water supplies were first delivered to Pinal County in 1990, resulting in reduced groundwater pumping and partial recovery of aquifers. However, potential increases in pumped groundwater would further overdraft groundwater aquifers and exacerbate existing land compaction and subsidence, resulting in negative impacts to agricultural and municipal water supplies, groundwater quality degradation, and an increase in pumping and treatment costs.

The Colorado River is a significant source of water for the State of Arizona and particularly the EMS Basin Study area. Currently, approximately one-third of the entire Colorado River supply delivered through the CAP is utilized in the EMS Basin Study area; however, Colorado River shortages and planned reductions in agricultural supplies will dramatically alter that proportion. According to Bureau of Reclamation January 2018 projections, there is no projected shortage condition in 2019 and a 57% chance of a Level 1 shortage in 2020. [1] If a Colorado River water shortage is declared, Arizona's reduction in Colorado River water would be at least 320,000 AFY. Of the 320,000 AFY of water that Arizona would not receive, 145,000 AFY of the

[1] Source: https://www.usbr.gov/lc/region/g4000/riverops/crss-5year-projections.html

reduction would come from the CAP Agricultural Settlement Pool, further reducing surface water supplies to the EMS Basin Study area. According to ADWR, in Pinal County from 2001-2005 "approximately 96% of the average annual demand was agricultural" of which 45% was met with groundwater and 55% was supplied by renewable surface water supplies and the CAP Agricultural Settlement Pool.

Even without a declared shortage, the volume of Colorado River water may be reduced. The Lower Colorado Basin Drought Contingency Plan (DCP) is a proposal currently under consideration that aims to protect Lake Mead's elevation from dropping to critical levels. It specifies voluntary reductions for each Lower Basin state – Arizona, California and Nevada – to protect the water level in Lake Mead. The DCP proposes earlier and deeper reductions to Colorado River supplies for Arizona and Nevada beyond those agreed-upon limits set forth in 2007 in the Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead. The DCP could result in reduced CAP deliveries and subsequently more groundwater pumping.

Additionally, the Southern Nevada Water Authority (SNWA) presently has approximately 601,000 acre-feet of water stored in Arizona's aquifers. Under the Storage and Interstate Release Agreement among SNWA, the Arizona Water Banking Authority, and the U.S., SNWA can recover up to 100,000 acre-feet of this 'intentionally created unused apportionment (ICUA)' each year. When SNWA wants to take delivery, it requests that a certain amount of ICUA be created by Arizona. ICUA is created when a CAP contractor takes delivery of storage credits (pumped groundwater) and CAWCD leaves an equal amount of water on the system. This water is then available to Nevada for SNWA to divert from the river.

Prior to CAP water deliveries to the EMS sub-basins in 1987, groundwater overdraft was significant. ADWR's Draft Pinal AMA Fourth Management Plan reports that through 1996 the region experienced years of water surplus related to flood events and high volumes of agricultural incidental recharge. After 1996, regional overdraft averaged 120,000 AFY. Cumulative overdraft for the historical period of record for the Pinal Regional Groundwater Model is about 1.9 million acre-feet. ADWR projects groundwater overdraft to be 105,000 AFY in 2025. Decreased CAP deliveries could also result in increased overdraft of the EMS sub-basin aquifers.

Groundwater overdraft has resulted in two subsidence areas within the EMS Basin Study area known as the Maricopa-Stanfield and the Picacho-Eloy Land Subsidence Features. If groundwater overdraft continues, depth to groundwater will increase and land subsidence may be magnified in these areas, resulting in damage to infrastructure and other structural and environmental issues within these regions.

Groundwater pumping that results in overdraft can negatively impact water quality. A study completed by the Arizona Department of Environmental Quality (ADEQ) in 2005 – 2006 revealed that 70% of the sites sampled within the Pinal AMA had groundwater that exceeded the Environmental Protection Agency's Safe Drinking Water Standards Primary Maximum Contaminate Level concentration for at least one constituent. The ADEQ also found that, in

general, Pinal AMA groundwater is generally alkaline with high Total Dissolved Solids concentrations (2017 ADWR, Pinal Active Management Area Fourth Management Plan).

ADWR noted that changes in groundwater levels may result in degraded aquifer conditions. Rising water levels may promote contaminant migration and declining water levels can negatively impact aquifer water quality. ADWR recommends identification of groundwater quality and development of area-specific plans to match water quality with intended uses.

The Gila River drains an area encompassing 60,000 square miles and flows through the EMS sub-basins on its way to the Colorado River. Historically, long stretches of the Gila River flowed year-round and the River was utilized by the Gila River Indian Community (GRIC) for irrigation purposes. Subsequent to the construction of dams, including Coolidge Dam and the Ashurst-Hayden Diversion Dam, and surface water diversions over the last 100 years, the Gila River became ephemeral along most of its reach between Ashurst-Hayden Dam and Pima Butte. As a result of the decreased flows and following many years of litigation, the Arizona Water Settlements Act (AWSA) was passed in 2004. The AWSA provided the GRIC with a water budget of 653,500 AFY, comprised of CAP, Gila River, Salt River, and groundwater sources, and funding to construct infrastructure to utilize the CAP allocations.

The Santa Cruz River has a poorly defined channel within the Basin Study area. It flows only in response to intense rainfall and is designated as effluent dependent water by ADEQ in some locations. The confluence of the Santa Cruz River and the Gila River is located in the northwest corner of the EMS Basin Study area.

2.1.1 Needs

In 2015, agriculture comprised 80 percent of the water use in the Pinal AMA, reflecting the strong historic agricultural economy that continues to thrive. Historic agriculture relied on pumped groundwater that resulted in overdraft and land subsidence, reducing the storage capacity of the aquifers. In 1987, the CAP began surface water deliveries to the Pinal AMA which reduced pumped groundwater amounts. In addition, surplus CAP supplies were recharged in the Pinal AMA for the state of Nevada and for the Arizona Water Banking Authority. Despite the increased use of surface water and recharge, groundwater levels in the EMS sub-basins have not fully recovered. In order to conduct comprehensive water resource management planning, detailed analyses of available surface water, treated effluent and groundwater supplies, and the potential for aquifer recharge are needed.

With the possibility of forthcoming Colorado River shortages and subsequent reductions in CAP allocations, the need for accurate assessments of groundwater availability and quality is essential. Increasing depth to groundwater can negatively impact groundwater wells, pumping equipment, increase power requirements, damage or require modifications to infrastructure, and degrade water quality. Further groundwater modeling will help refine and assess depth to groundwater in the Pinal AMA and long-term availability of this resource.

2.1.2 Opportunities

The EMS sub-basins will likely continue to experience demand and supply imbalances that will be compounded over time. These challenges provide an opportunity to develop a collaborative, integrative and sustainable regional water management plan.

Opportunities exist to address these concerns, including potential changes to regulations for indirect and direct potable use of recycled water. As the population within the Study area increases, the availability of recycled water also increases, creating an opportunity to offset water demands.

2.2 Previous Work and Available Data / Models

Data / Model	Significance / Importance	Source
ADWR Assured and Adequate Water Supply data	Estimated water demands for planned development of specific lands	https://gisweb.azwater.gov/waterresourcedata/AAWS.aspx
ADWR subsidence data	Maps showing magnitude of land subsidence in response to past groundwater pumping	http://www.azwater.gov/AzDWR/Hydrology/Geophysics/PicachoEloySubsidence.htm http://www.azwater.gov/AzDWR/Hydrology/Geophysics/MaricopaStanfieldSubsidence.htm
ADWR Underground Storage Facility and Groundwater Savings Facility permit data	Permit documents and annual reports of artificial recharge and in-lieu	http://www.azwater.gov/azdwr/WaterManagement/Recharge/documents/ALLAMAUSFList5.25.16.pdf http://www.azwater.gov/azdwr/WaterManagement/Recharge/documents/ALLGSFList05.25.16.pdf et al
ADWR well data, groundwater levels, and pumpage history	Well registry and Groundwater Site Inventory database of measured water level data, reported annual pumping volumes by well.	https://gisweb.azwater.gov/waterresourcedata/WellRegistry.aspx https://gisweb.azwater.gov/waterresourcedata/GWSI.aspx
Ak-Chin Indian Community Tribal Water Uses in the Colorado River Basin	Overview of water sources, quantity, Settlement Act and uses	http://www.tribalwateruse.org/?page_id=153
Ambient Groundwater Quality of the Pinal Active Management Area	ADEQ, 2005-2006 Baseline Study	http://legacy.azdeq.gov/environ/water/assessment/download/pinal_ofr.pdf

Data / Model	Significance / Importance	Source
Indian Firming Study Commission Final Report - 2006	States volumetric obligation for Indian Firming, describes an overview of the modeling efforts completed by ADWR, and summarizes solution elements to meet the demand	http://www.azwaterbank.gov/documents/2006/Indian_Firming_Study_Commission_Final_01_06.pdf
ASARCO 2009 Bankruptcy Settlement	Settlement agreement for cleanup cost associated with the Sacaton mine site near Casa Grande	https://www.epa.gov/enforcement/asarco-bankruptcy-case-summary-custodial-trust-settlement-information-sheet
Assessment of Climate Change in the Southwest U.S. - 2013	University of Arizona publication assessing climate change effects on sectors including water. Various climate change models are reviewed to determine the optimum model to be used to assess water supply and demand in the region.	http://www.swcarr.arizona.edu/sites/all/themes/files/SW-NCA-color-FINALweb.pdf
Availability of Renewable Water Resources in Pinal County, December 2010	Investigation of renewable supplies and opportunities to acquire additional supplies in Pinal County.	Westland Resources and Montgomery & Associates, 2010
Central Arizona Project Service Area Model (CAP:SAM)	Model developed using GoldSim software to simulate water demands and supplies for major water users in the CAP Service Area, including the Pinal AMA.	http://www.goldsim.com/Web/Solutions/Showcase/EnvironmentalExamples/CAPSAM/
Colorado River Basin Water Supply and Demand Study, December 2012	Examination of water supply and demands for States that receive Colorado River water including projections under varying climatic conditions using Reclamation's Colorado River Simulation System.	http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/index.html
Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections, May 2013	Climate and hydrologic projections for analysis of potential hydrologic effects to climate change.	http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/
West-Wide Climate Risk Assessments Bias-Corrected and Spatially Downscaled Surface Water Projections, March 2011	Provides future projections of water supplies, water demands, and river system operations, characterized in a consistent manner within the eight major Reclamation river basins, including the Colorado River.	https://www.usbr.gov/watersmart/docs/west-wide-climate-risk-assessments.pdf
DRAFT Demand and Supply Assessment 1985-2025 Pinal Active Management Area, May 2011	Historical water demand and supply characteristics for 1985 - 2006 and projections to 2025. Evaluates possible scenarios for future groundwater overdraft using low, medium and high reasonable water demand.	http://www.azwater.gov/AzDWR/WaterManagement/Assessments/documents/PinalAssessmentFinal5-23-2011.pdf

Data / Model	Significance / Importance	Source
Draft Pinal Active Management Area Fourth Management Plan, May 2017	The management plan serves as a tool to assist in achieving the management goal of the Pinal AMA.	http://infoshare.azwater.gov/docushare/dsweb/Get/Document-10127/PAMA%204MP%20draft%20Combined%20with%20TOC.pdf
Earth Fissure Maps of Pinal County, Arizona	Arizona Geological Survey maps of fissures throughout Pinal County including the Basin Study area.	http://repository.azgs.az.gov/facets/results/og%3A779%20taxonomy%3A68
GRIC Department of Public Works Annual Water Quality Report 2016	Provides information on sources of tribal water and water quality data.	http://www.gricdeq.org/view/download.php/water-quality-program/2016-annual-water-quality-reports
Hydrogeologic Conditions and Groundwater Related Permitting, Santa Cruz In Situ Copper Mining Research Project, Pinal County, Arizona, 1994	Extensive investigations at the Santa Cruz test site that provide data on the chemical quality of groundwater, and assessment of hydraulic parameters for the multilayered hydrogeologic system.	https://portal.azoah.com/oedf/documents/12-005-WQAB/SWVP-0005-%201992%20Hydrogeologic%20Conditions-Santa%20Cruz%20ISL%20Mine.PDF
Hydrologic map series Report No. 36 showing Groundwater Conditions in the Pinal AMA, and Maricopa, Pinal, and Pima Counties, Arizona, Nov. 2002 - February 2003	Regional water level data and trends to support modeling efforts.	http://www.azwater.gov/AzDWR/Hydrology/BasicDataUnit/documents/HMS_No_36.pdf
Phase II Environmental Assessment for the Cyprus Tohono Mine and Wetlands Restoration	Restoration Plan and Environmental Assessment to present alternatives to restore natural resources, ecological services and migratory birds injured from the release of hazardous substance by the Cyprus Tohono Mine.	https://www.fws.gov/southwest/es/arizona/Documents/ECReports/Cyprus_Tohono_RP-EA_FINAL.pdf
Pinal Active Management Area Groundwater Quality Survey, June 2014	Water quality database used to evaluate regional patterns in water quality and pinpoint localized areas where constituents may exceed drinking water standards or be unacceptable for certain uses without treatment.	Montgomery and Associates, 2014
Public Law 108–451 108th Congress, Arizona Water Settlements Act, December 2004	Provides adjustments to the Central Arizona Project to authorize the Gila River Indian Community water rights settlement, to reauthorize and amend the Southern Arizona Water Rights Settlement Act of 1982, and for other purposes.	https://www.gpo.gov/fdsys/pkg/PLAW-108publ451/pdf/PLAW-108publ451.pdf
Reclamation Environmental Assessment of CAP water Option and Lease from GRIC to Apache Junction's Water Utilities, 2011	Environmental Assessment of proposed 100-year lease of 1,000 acres of CAP water from GRIC to Apache Junction Water Utilities Community Facilities District.	https://www.usbr.gov/lc/phoenix/reports/gricajwucfd/GRICWUCFDea.pdf

Data / Model	Significance / Importance	Source
Recovery of Water Stored by the Arizona Water Banking Authority, 2014	An analysis for recovering water storage credits that uses two models, the CRSS and a custom recovery model developed to calculate the probability of specific recovery volumes, based on a range of conditions.	https://www.cap-az.com/documents/departments/planning/recovery/Joint-Recovery-Plan-FINAL4-14-14.pdf
Pinal Regional Model reports and documents	Provides historic publications related to groundwater modeling in the area.	http://www.azwater.gov/azdwr/Hydrology/Modeling/Pinal_Home.htm
Regional Groundwater Flow Model for the Pinal Active Management Area, Arizona, Model Update and Calibration, Model Report No. 26, February 2014	Comprehensive update to the groundwater flow model for the primary aquifers in the Pinal AMA.	http://www.azwater.gov/azdwr/Hydrology/Modeling/FINAL_PINAL_MODEL_REPORT_ALL_02_24_2014.pdf
Report, maps, basic data of hydrogeologic conditions, historic water levels, stratigraphy of the basin sediments, 1977.	Hydrogeologic characterization of the Pinal AMA and Basin Study area	Geology and Groundwater Resources Report, Maricopa and Pinal Counties, Arizona. Bureau of Reclamation, U.S. Department of the Interior. Volumes 1 and 2.
Tohono O'odham Utility Authority 2016 Water Quality Report	2016 Consumer Confidence Report	https://toua.net/wp-content/uploads/2016-Combined-CCR.pdf
Estimated Depth to Bedrock in Arizona. Arizona Geological Survey Digital Geologic Map 52 (DGM-52), version 1.0, April 2007	Update of the depth to bedrock in the Basin Study area, including the bottom of the regional aquifer and subsequent aquifer saturated thickness.	http://www.azgs.az.gov/publications_online/dgm/dgm52.pdf

2.3 Current Activities

ADWR developed the Regional Groundwater Flow Model of the Pinal Active Management Area, Arizona using the U.S. Geological Survey's modular finite-difference groundwater flow modeling code (MODFLOW) in 1980. The model area encompasses approximately 1,575 square miles. Updates to the model began in 2007 and were completed in 2010. In 2014, ADWR included subsidence simulations in the model. ADWR is currently working to modify the structure and recalibrate the model. ADWR plans to complete updates to the model in 2018 and will provide updated model files for use in the EMS Basin Study.

The CAP maintains a model that simulates water demands for more than 100 major water users in the CAP service area, and 16 different supply types are used to meet their demands. The Central Arizona Project Service Area Model, also known as CAP:SAM, can be used to simulate a wide range of future conditions, including variable rates and patterns of growth, shortage impacts, effluent reuse, aquifer recharge and recovery, and complex supply portfolio management decisions. The model performs a large number of interrelated calculations, broadly

organized into four conceptually simple steps: (1) Project Demands; (2) Determine Available Supplies;

(3) Request Supplies; and (4) Fulfill Demands. The CAP:SAM model provides a tool for collaborative discussion among partners and stakeholders and is currently being used on the West Salt River Valley and Lower Santa Cruz River Basin Studies. It will also be utilized for the EMS Basin Study.

2.4 Potential Alternatives

The Study will identify strategies to address water supply and demand imbalances. Adaptation and mitigation strategies may include but are not limited to: changes to water supply systems operations, modifications to existing facilities, development of new facilities, or non-structural changes. Some examples are:

- Hydrological models and other decision support systems
- Water conservation and demand reduction strategies or projects
- Regional underground water storage facility
- Indirect and Direct Potable Reuse of recycled water
- Water treatment facility for poor quality water
- Non-Indian Agricultural priority CAP water purchase
- Lease arrangements to acquire and use renewable water sources
- Management agreements between entities
- Integrative planning for surface and groundwater resources

3.0 Study Approach and Interested Parties

3.1 Study Approach

The goal of this Study is to develop a foundation for future water management within the EMS Basin Study area using a collaborative and holistic approach. The Basin Study will use current hydrologic data, climate models, and growth projection data to provide a basis for a cohesive vision for both near and long-term water management in the Basin Study area.

This Study will seek to identify current and future water demands based on the existing and future population projections, agricultural demands, tribal demands, and other demands for water within the Basin Study area. The Study will assess current and future water supplies, incorporating analysis of climate change scenarios and their potential impact on future water supplies.

A large part of this Study will focus on the groundwater model. Input files of the groundwater model will be developed based on recent water demand trends, recent infrastructure projects affecting pumped groundwater and climate change projections, which will affect stream flows and evapotranspiration, as well as mountain front recharge. The Study will also incorporate information on potential CAP shortages and DCP reductions developed by the system operator, the Central Arizona Water Conservation District.

Based on the range of scenarios developed, an infrastructure analysis will be conducted based on existing operations, future demand and supplies. Infrastructure needs will be assessed based on identification of mitigation strategies and development of augmented water supplies. Following development of mitigation strategies, a trade-off analysis will be completed to evaluate cost, environmental impact, risk, and stakeholder impact.

Regional stakeholders, including those representing municipal, agricultural, environmental, industrial, and tribal water providers, and water users will be engaged in the Study process. This collaboration will be promoted by information sharing and by requesting input from Partners and Stakeholders.

3.2 Interested Parties

3.2.1 Non-Federal Cost-Share Partners

Arizona Water Company
Central Arizona Project
City of Casa Grande
City of Eloy
Global Water Resources, Inc.
Maricopa-Stanfield Irrigation & Drainage District
Pinal County
Pinal County Water Augmentation Authority
Pinal Partnership (Acting as Fiscal Agent)

3.2.2 Stakeholders

Ak-Chin Indian Community
Arcus Private Capital Solutions
Arizona Department of Environmental Quality
Arizona Department of Water Resources
Arizona Public Service Company
Arizona State Land Department
Arizona State University
Central Arizona Irrigation & Drainage District
City of Apache Junction
City of Coolidge
City of Maricopa
El Dorado Holdings
Electric District No. 2 (Casa Grande)
Electric District No. 3 (Maricopa)
Electric District No. 4 (Eloy)
Environmental Defense Fund
Gila River Indian Community
Hilgart-Wilson
Langley Properties
LeSueur Investments
Northern Arizona University
Maricopa Agricultural Center
Pinal County Water Augmentation Authority
Rose Law Group
Saint Holdings
Salt River Project
Sif Oidak District, Tohono O'odham Nation
Strand Associates
Sunrise Engineering
The Nature Conservancy
United Dairymen of Arizona
University of Arizona

4.0 Study Management Requirements

4.1 Project Management Plan

4.1.1 Study Management Structure

4.1.1.1 Co-Study Managers

Reclamation and the Non-Federal Cost-Share partners will provide Co-Study Managers who shall act as the primary points of contact and oversee the coordination for the Basin Study. They will conduct and carry out the duties and responsibilities required under this Plan of Study. The Co-Study Managers will pursue the work diligently, with an objective of completing the tasks and meeting the schedule requirements.

The Co-Study Managers are authorized to incur costs, liabilities, and obligations up to the amounts approved and funded by the Parties to the MOA and to conduct or arrange for the conduct of Study investigations.

Non-Federal Co-Study Manager:

Jake Lenderking
Director of Water Resources
Global Water Resources, Inc.
Pinal Partnership Fiscal Agent
21410 N 19th Ave., Suite 220
Phoenix, AZ 85050
480-719-6977

Federal Co-Study Manager(s):

Valerie Swick
Water Resources Planner
Bureau of Reclamation
6150 West Thunderbird Rd.
Glendale, AZ 85306
623-773-6272

Marcia Nesby
Water Resources Planner
Bureau of Reclamation
6150 West Thunderbird Rd.
Glendale, AZ 85306
623-773-6226

4.1.1.2 Project Team

The Co-Study Managers will steer and guide the Basin Study efforts to ensure the Study is conducted efficiently and consistently in accordance with program requirements. The Basin Study Stakeholders will identify a Project Team who will ensure the Basin Study tasks are completed in a cost-effective and timely manner and are technically sound.

Members of the Project Team will provide the expertise, experience and knowledge relative to the Study's scope and objectives. Members of the team shall include staff from Reclamation and staff from the Non-Federal Cost-Share Partners. A sufficient number of team members shall be determined by the Co-Study Managers as required to perform the Basin Study tasks.

4.1.1.3 Sub-Teams

Sub-Teams will be identified for Basin Study tasks on an as needed basis to collect and compile data for water supply and demand, infrastructure assessments, groundwater modeling updates, adaptation strategies, economic analyses, report preparation, and to review memorandums and reports. Sub-Team members are intended to provide specific expertise, information, and knowledge to support or complete tasks. Sub-teams may be comprised of Project Team members, Reclamation staff, Non-Federal Cost-Share Partners, contracted staff, and representatives from stakeholder groups.

4.1.1.4 Stakeholder Advisory Group

The Basin Study Stakeholders consist of all Federal, State, tribal, regional and local government entities, customers, nongovernmental organizations and the public who are present and actively involved or interested in the EMS Basin Study. Stakeholders may include, but are not limited to, the parties listed above in Section 3.2 – Interested Parties.

4.1.2 Decision-Making Process

This Study is a collaborative effort between the Non-Federal Cost-Share Partners and Reclamation. Therefore, the Co-Study Managers, supported by the Project Team, will make the day-to-day and strategic decisions required to complete the Study. In making decisions, they will also consider feedback provided by the Basin Study Stakeholders. Important decisions will be made on a consensus/consent basis.

Every effort will be made to achieve consensus among Cost-Share Partners and Basin Study Stakeholders for key decisions required for the successful completion of the Study. If, after significant effort, the Partners are unable to reach consensus on critical decisions for the Study, Reclamation will make the final determination; in doing so, Reclamation shall give appropriate consideration to technical assessments, Cost-Share Partner input, and budget constraints. Final Study assessments will be solely a product of local Cost-Share Partner input. If there are differences in opinion among the local Cost-Share Partners regarding final Study assessments, the Final Report will document those differing opinions.

4.1.3 Roles and Responsibilities

Reclamation and the Non-Federal Cost-Share Partners will assume major roles and responsibilities for the EMS Basin Study.

The Non-Federal Cost-Share Partners will contribute staff time and in-house data to the Study. They will compile pertinent references, compile water supply and demand data, analyze and summarize EMS sub-basin infrastructure and reliability metrics, and will work collaboratively with Reclamation to develop adaptation and mitigation strategies. Work products prepared by Non-Federal Cost-Share Partners will be summarized in Technical Memorandums for review by Study Partners and incorporate review comments in preparation for inclusion in the final report.

Non-Federal Cost-Share Partners will work collaboratively with Reclamation to prepare the final report.

Reclamation will be the primary source of climate change data and the economics analysis and will work closely with the Co-Study Managers to compile required information. Reclamation will provide climate change data to the Co-Study Managers for use in the groundwater modeling update. Reclamation will collaborate with Non-Federal Cost-Share Partners and ADWR to identify necessary updates and will hire a contractor to incorporate the updates into the Pinal AMA Regional Groundwater Flow Model. Reclamation will produce periodic progress reports and financial status reports to monitor progress.

Reclamation will prepare draft reports for technical work products that Reclamation completes, including climate change modeling and economic analyses, incorporating the views of the Non-Federal Cost-Share Partners and other stakeholders. The final report will document the selection of scenarios, and adaptation and mitigation measures assessed by the Study Partners, with input from the public contributed through the Communications and Outreach Plan (Appendix I). Reclamation will be responsible for the formatting and publication of Study documents. Where necessary, Reclamation and the Non-Federal Cost-Share Partners will consult outside experts. Reclamation will coordinate with the Non-Federal Cost-Share partners in all aspects of the Study.

4.1.4 Study Team Coordination

The Co-Study Managers will be responsible for coordination between the Sub-Teams and Stakeholders. The Co-Study Managers will set dates and locations for meetings for the Sub-Teams. The Co-Study Managers will also be responsible for outreach activities as necessary, including development of appropriate forums for public and stakeholder interaction. Co-Study Managers will also field inquiries from the general public on the Study as appropriate.

4.1.5 Administrative Record

Reclamation will maintain the Administrative Record for this Study. Data to be retained include:

- Meeting summaries
- Contract documentation
- Public comments received in writing
- Basin Study Technical Memorandums
- Cost-share documentation
- Final report
- Other Basin Study documentation

4.1.6 Schedule and Cost Control

The Basin Study will be conducted over a 3-year period, beginning when the Memorandum of Agreement is executed. Descriptions of the Basin Study tasks are provided in Section 5.0. Specific costs are identified in Section 6.0 Milestones, Schedule and Costs.

Schedule and cost control measures will be monitored by the Co-Study Managers to ensure that project tasks stay on track and within budget. Co-Study Managers will collaboratively prepare Basin Study Performance Reports summarizing accomplishments to date and progress toward completion of the Study every six months.

4.1.7 Deliverables and Projects Documentation

4.1.7.1 Basin Study Performance Reports

Co-Study Managers will collaboratively prepare Basin Study Performance Reports every six months and include:

- Accomplishments to date.
- Progress toward completion of the Basin Study.
- A description of any issues, concerns, or problems.

4.1.7.2 Basin Study Financial Status Reports

Financial Status Reports will be prepared to document all components of the non-Federal cost-share specifically identifiable to the Basin Study. Financial Status Reports will be submitted to the Basin Study Program Coordinator every six months and upon completion of the Basin Study.

4.1.7.3 Final Report

The Final Basin Study Report will contain, at a minimum, the following five elements:

- Projections of water supply and demand, including an assessment of risks to the water supply relating to climate change as defined in §9503(b)(2) of the SECURE Water Act.
    - Changes in snowpack
    - Changes in the timing and quantity of runoff
    - Changes in groundwater recharge and discharge
    - Any increase in the demand for water as a result of increasing temperatures
- Analysis of how existing water and power infrastructure and operations will perform in the face of changing water realities.

- Descriptions of options to improve operations and infrastructure to supply adequate water in the future.

- A trade-off analysis of the options identified, and findings and assessments as appropriate. Such analysis shall examine all proposed alternatives in terms of their relative cost, environmental impact, risk, stakeholder response, or other attributes common to the alternatives.

- Findings and conclusions prepared by the Cost-Share Partners.

4.1.8 Internal and Technical Sufficiency Reviews

Technical Sufficiency Reviews will be completed to ensure that technical information, data, models, analyses, and conclusions developed during the EMS Basin Study are technically supported and defensible. Details for the Technical Sufficiency Review are described in Appendix II, the Technical Sufficiency Review Plan (Plan). The Plan will include the following items:

- Review timing
- Review products
- Review conduct
- Reviewer information

4.2 Project Communication and Outreach Plan

See Appendix I.

5.0 Study Tasks

The Basin Study tasks include the following:

5.1 Develop Climate Projections

5.1.1 Development of Climate Scenarios

Climate change projections for the United States have been developed for hydrologic and water demand analyses by Reclamation's Technical Service Center (TSC). A set of climate scenarios will be derived using an approach referred to as the 'ensemble informed hybrid delta method (HDe)'.

This task will also consider how potential climate changes in natural recharge, which will be reflected in (1) modeled discharge rates to shallow groundwater areas in each of the water accounting areas, (2) the magnitude of discharge rates, and (3) the direction of flow under each scenario. It will address how, based on existing literature, the effects of higher temperatures and longer growing seasons may affect water demands for riparian vegetation, streams and springs, as well as agricultural operations.

The Study Partners will select the climate modeling scenarios to be considered in water supply and demand projections.

5.1.2 Documentation of Selection Process

Reclamation will provide a technical memorandum on the selected scenarios in collaboration with the Study Partners.

5.2 Conduct Supply and Demand Assessment

5.2.1 Conduct Assessment of Current Water Supply

Study Partners and Reclamation will update the quantity, location, and timing of current water supplies. Supplies will include CAP water, surface water, recycled water, stormwater and groundwater. Data sources will include ADWR's Draft Fourth Management Plan, ADWR annual reports and Long-Term Storage Credit accounts, water delivery records from CAP, and other locally available supply data. Groundwater conditions will also be assessed from ADWR's Groundwater Site Inventory database, Assured Water Supply evaluations, and the groundwater flow model.

5.2.2 Develop Future Water Supply Projections

Study Partners and Reclamation will conduct a future water supply assessment considering the potential effects of:

- Changes in legal and physical availability of surface water supplies, including changes in the availability of CAP Agricultural Settlement Pool Water and reductions in CAP water from shortages on the Colorado River
- Availability of CAP water from partners, including the Arizona Water Banking Authority and Central Arizona Groundwater Replenishment District
- Availability of tribal water supplies within the Study area
- Availability and use of effluent and reclaimed water
- Availability and use of stormflows
- Changes in streambed and mountain-front recharge, including effects of climate variability

5.2.3 Conduct Assessment of Current Water Demand

Study Partners and Reclamation will update the quantity, location, and timing of current water demands of municipal, industrial, agricultural, tribal and other uses. Data sources will include ADWR's draft Fourth Management Plan, ADWR Annual Reports and other available demand data. Data on irrigated crops will be obtained from the U.S. Department of Agriculture's National Agricultural Statistical Service, including cropping data from the CropScape GIS layer, and the University of Arizona's Cooperative Extension Service. Related socioeconomic data from the U.S. Census Bureau, Central Arizona Association of Governments, Pinal County Assessor, and the State of Arizona will also be incorporated into the assessment of current demand.

5.2.4 Develop Future Water Demand Projections

Study Partners and Reclamation will conduct an assessment of future water demand in the Study area using a scenario planning approach. A range of potential water demands will be projected through 2060 for municipal, industrial, agricultural, tribal, and other uses. The potential effects of climate variability and climate change on future demand will be considered, including effects on evapotranspiration, crop consumptive use, and municipal demand from outdoor water use. The CAP Service Area Model (CAP:SAM) will be used to develop multiple demand projections, with consideration and input from each of the water sectors. Among the factors that will be considered when developing scenarios are the rates and patterns of population growth and housing unit construction, changes in per capita usage, cropping patterns and efficiency factors, urbanization of agricultural land, and anticipated industrial uses. These demand factors will be matched with a range of future supply projections. Specific demand scenarios will be developed by the partners and model variable values representing these model scenarios will be selected. Study Partners and Reclamation will prepare a technical memorandum summarizing the current and future water supply and demand assessments.

5.3 Update Groundwater Model

In consultation with Study Partners and ADWR modelers, a Reclamation contractor will update the Pinal AMA Regional Groundwater Flow Model to include current and future water supply and demand assessments. The model update will include a review of surface water and groundwater conditions in the EMS sub-basins including changes in surface flow and underflow conditions due to water management modifications upstream of the EMS sub-basins, and other water use, and availability concerns identified during the EMS Basin Study. The updated model will be used to make projections about the watershed based on operation of existing and near-term projects and potential mitigation strategies.

5.4 Run Groundwater Model with Climate Model Scenarios

The supply and demand scenarios incorporating climate projections developed by Reclamation and the Study Partners will be translated into inputs for the Pinal AMA Regional Groundwater Flow Model. Climate related variables will include mountain-front recharge, stream recharge and evapotranspiration components. Other model inputs sensitive to temperature and precipitation may also be included in simulations.

The Study Partners and Reclamation will prepare a technical memorandum summarizing the current and future water supply and demand assessments, indicating the status of the Pinal AMA groundwater resources. Projected water supply and demand imbalances for the 2060 planning horizon under a suite of scenarios will be identified in ten-year increments.

5.5 Conduct Infrastructure Analysis

The Study Partners will evaluate the existing and proposed near-term regional water supply and transmission infrastructure and its ability to meet current and future water demands. This analysis will focus on current and future supply conditions and will include an evaluation of the impact on future groundwater levels within the Basin Study area for each set of future supply conditions that may be anticipated. This effort will include a compilation of information from the various municipalities, tribes, and water providers throughout the Basin Study area, including information on existing infrastructure and proposed near-term improvements. The infrastructure evaluation will include identification of challenges and opportunities for effective water supply and delivery within the Basin Study area.

5.5.1 Identify Model and System Reliability Metrics

The Study Partners will determine metrics to be used in evaluating the ability and reliability of the regional water supply infrastructure to meet current and future demands. The System Reliability Metrics may include availability of groundwater across the Study area, well capacity, delivery capacity, groundwater elevation limits, groundwater rates of decline, recharge and storage capacity, transmission system reliability, stormwater management, and aspects of regional water infrastructure.

5.5.2 Conduct Baseline Reliability Analysis

The Study Partners and Reclamation will provide input on the assumptions made for the reliability analysis and will help in establishing a baseline scenario to be used for the analysis of various future system conditions.

5.5.3 Projections of Future Reliability

The Study Partners and Reclamation will evaluate how the assumptions made and the reliability metrics used for the analysis may vary in the future depending on different groundwater and infrastructure conditions.

5.5.4 Evaluate Supply Risks for the Following Sectors

The Study Partners will evaluate what determines "system reliability" for the Basin Study, especially as it relates to the various sectors to be served. Sub-teams will be formed for the sectors as needed. Various concepts of system reliability may be evaluated as the Study Partners work to reach consensus in defining this quality. Questions that may be posed for evaluation include, but are not limited to, the following:

- What determines if the groundwater supply is reliable?
- What does "reliable system infrastructure" mean?
- What timeframes should be used to evaluate system reliability?
- Will the near-term municipal, industrial, and agricultural demands continue to be met with existing delivery infrastructure? And if so, for how long?
- If the supply or delivery system is found to be unreliable, what would it take to make it reliable again?
- If recovery of long term storage credits is necessary, how will this be accomplished and is the system infrastructure in place to deliver this water to the end users?
- Who are the potential end users?
- How will environmental resources be impacted?
- How is stormwater managed?
- Should the reliability metrics vary from sector to sector?
- How will any impacts identified in the Study be distributed throughout the Study area?
- What are the effects of not meeting reliability metrics?
- How significant are the effects of not meeting reliability metrics for each of the sectors?

5.5.4.1 Municipal

The Study Partners will evaluate the sources, and their respective quantities, of water supply and capacity of water delivery infrastructure used by the municipal sector in the EMS Basin. This analysis will include an evaluation of the availability and reliability of the water infrastructure to adequately supply and deliver water to customers. The various supplies of municipal water in the EMS Basin will be identified and evaluated for reliability.

Risks to municipal water supply may be dependent on availability of groundwater, groundwater quality, availability of surface water, shortages in surface water supply, agreements for the use of surface water, the use of long term storage credits to meet the supply, recovery water, and the use of reclaimed water for indirect and direct potable water use.

A municipal sector Sub-Team will provide input on the following:

1. Geographical areas that are expected to depend on groundwater supply.

2. Availability of surface water for use as primary or backup water supply.
3. Availability of stormwater supplies to augment water supply.
4. Availability of treated effluent to augment water supply.
5. How shortages of surface water will impact municipal water delivery and the cost of surface water under different supply and demand scenarios.
6. Current conditions and available capacities of water delivery systems.
7. Geographical areas expected to depend on pumped groundwater for recovery of long term storage credits.

5.5.4.2 Industrial

The Study Partners will evaluate the sources, and their respective quantities, of water supply and the capacity of water delivery infrastructure used by the industrial sector in the EMS Basin. This analysis will include an evaluation of the availability and reliability of the water infrastructure to adequately supply and deliver water to industrial users. The various supplies of industrial water in the EMS Basin will be identified and the following discussions will be included:

1. Geographical areas that are expected to depend exclusively on groundwater supply.
2. Availability of surface water for use as primary or backup supply.
3. The use of reclaimed water for direct and indirect reuse.
4. How shortages of groundwater and/or surface water will impact industry.

5.5.4.3 Agricultural

The Study Partners will evaluate the sources, and their respective quantities, of water supply, and the capacity of water delivery infrastructure used by the agricultural sector in the EMS Basin. This analysis will include an evaluation of the availability and reliability of water infrastructure to adequately supply and deliver water to agricultural users. The various supplies of agricultural water in the EMS Basin will be identified and the following discussions will be included:

1. Current uses of water from various sources of supply.
2. Impacts to agriculture based on a shortage of Colorado River water supply.
3. The use of reclaimed water for direct and indirect reuse.
4. Impacts to agriculture based on climate variations and changes (e.g., longer growing seasons).

5.5.4.4 Cultural

Cultural water use includes consumptive (agricultural and municipal) water use and non-consumptive water use (ceremonial, social, habitat, aesthetic, etc.) necessary to maintain Tribal cultures. The Study Partners will consult with Tribal representatives and other Tribal experts on the water supplies required to serve the cultural water demands of Tribes within the EMS Basin Study and will evaluate the reliability risks, and how loss of water supply could affect these uses.

A cultural sector Sub-Team will provide input on the following:

1. Current uses of water from various sources of supply.
2. Impacts to cultural water use based on a shortage of water supply.
3. Types of water and water quality needed.
4. Additional elements as identified by the cultural sub-team.
5. Potential development of Tribal water agreements.

5.5.4.5 Environmental

The Study Partners will evaluate the sources, and their respective quantities, of water supply, and the capacity of water delivery infrastructure to supply environmental water in the Pinal AMA. This analysis will include an evaluation of the availability of water for environmental use and how losses of renewable supplies and projected groundwater levels could affect environmental water demands, including:

1. Impacts to aquatic and terrestrial ecosystems dependent on surface water within the Pinal AMA.
2. Impacts to ecosystems dependent on groundwater resulting from declining groundwater levels.
3. Financial impacts to the cost of water for environmental uses due to Colorado River water shortages.
4. How projected water demands in the Pinal AMA may affect the availability of recycled water and stormwater for environmental purposes.
5. How stormwater flows may be used to support and create habitat and maintain current habitat to support ecosystem interconnectivity.

5.5.5 Summary of Findings

Reclamation and the Non-Federal Cost-Share Partners will prepare a Technical Memorandum summarizing potential risks to water supplies and projections of future reliability.

5.6 Adaptation and Mitigation Strategies

5.6.1 Develop Strategies to Meet Future Supply Needs

The Study Partners, in consultation with members of the Sub-Teams, the Stakeholder Advisory Group, and the public, will identify preliminary adaptation strategies to address supply and demand imbalances. These adaptation strategies may include, but are not limited to:

WATER
- Augmentation
- Conjunctive use
- Conservation and efficiency
- Desalination
- Long term storage
- Recovery of stored supplies
- Recycling and reuse

MANAGEMENT
- Collaborative opportunities
- Demand management
- Land fallowing and retirement
- Operational changes
- Urban runoff management
- Vegetation management
- Weather modification
- Wheeling agreements

INFRASTRUCTURE
- Desalination
- Importation projects
- New conveyance and storage facilities
- Groundwater recharge facilities
- Rehabilitation or replacement of existing facilities

LEGAL AND INSTITUTIONAL
- Legal and institutional changes
- Legislative changes
- Policy changes

ECONOMICS
- Mitigation Scenarios
- Social
- Ecosystem Services
- Market and non-market water values

5.6.2 Refine Strategies for Further Evaluation

The Study Partners will refine strategies and identify candidates for analysis based on effectiveness, feasibility and cost to address a range of future scenarios.

5.6.3 Analysis of Strategies

The Study Partners will identify strategies to be analyzed and develop a trade-off matrix for viable strategies that includes criteria such as performance measures, costs, ability to implement, and institutional issues.

Each of the Adaptation and Mitigation Strategies developed by the Basin Study Partners will be analyzed and evaluated by Reclamation technical staff to determine the approximate cost and

effectiveness in addressing system reliability issues. If applicable, Reclamation staff will provide conceptual-level cost estimates and designs.

The strategies may include methods to address declines in groundwater levels, stream and spring flows, and riparian and aquatic habitats to restore and to reduce vulnerability to future water demands and climate change. Infrastructure will be assessed, and future needs identified. Potential changes to groundwater pumping practices may be analyzed to reduce impacts of groundwater demands on shallow groundwater areas, streams, springs, and riparian and aquatic habitats.

5.6.3.1 Technical Analysis

Reclamation will conduct a technical evaluation including a uniform cost comparison, environmental impacts, and permitting requirements. Risk and uncertainty will be assessed. An assessment of effectiveness in addressing future supply-demand imbalances will be conducted.

5.6.3.2 Legal and Institutional Analysis

Reclamation, with input from the Study Partners, will conduct an analysis of legal and institutional implementation issues associated with each mitigation and adaptation strategy. This will include a high-level analysis of the potential environmental and cultural impacts of the alternative. The analysis will be conducted in enough detail to allow the Partners to rate each alternative against their selection criteria and choose one or more alternatives to incorporate into a basin plan.

5.6.3.3 Social and Economic Analysis

Reclamation, in partnership with the Study Partners, will conduct an analysis of social and economic impacts of each strategy. If possible, this will include an evaluation of changes to ecosystem services.

5.6.4 Summary of Analyses

Reclamation and the Non-Federal Cost-Share Partners will prepare a technical memorandum summarizing the results from the analyses of strategies.

5.7 Conduct Economic Analysis of Strategies

5.7.1 Conduct Economic Analysis

An economic analysis of quantified benefits will be used to evaluate the magnitude of potential benefits of each selected mitigation alternative, recognizing that many additional benefits may exist that are not accounted for in a traditional benefit analysis. After completing the evaluation

and comparison of the various adaptive alternatives, the alternatives will be further evaluated to assess both the quantitative and qualitative benefits and costs. Quantifiable benefits and costs will be evaluated using a standard economic analysis of the estimated present value of benefits and costs over a 50-year planning period. Qualitative benefits and costs will be evaluated using a trade-off analysis. A trade-off analysis will provide a methodology for comparing different types of benefits and costs, including economic, financial, environmental, and social effects.

5.7.2 Prepare Report – Summary of Economic Analysis

Reclamation and the Non-Federal Cost-Share Partners will prepare a Technical Memorandum summarizing potential risks and projections of future reliability.

5.8 Prepare Basin Study Report

5.8.1 Draft Final Report

Reclamation and the Study Partners will prepare a draft final report summarizing all work completed for the EMS Basin Study. The draft report will include the Study purpose, general methodology for each model, economic tools, and water management strategies.

5.8.2 Review Draft Final Report

The Study Partners and Reclamation will develop a peer review plan to guide development of federal and non-federal peer review teams to review the draft final report. The peer review teams will provide input and comments to Reclamation and the Non-Federal Cost-Share Partners.

5.8.3 Publish Final Report

Reclamation and the Study Partners will address and incorporate review comments and publish the final report. The final report and its findings will be presented to the Stakeholder Advisory Group (see definition in Communications and Outreach Plan), Study Partners, and the public upon completion of the project.

5.9 Conduct Technical Sufficiency Review

A technical sufficiency review will be conducted for each of the key tasks, as described in Appendix II. The Study Partners and Reclamation will identify technical reviewers.

5.10 Conduct Communication and Outreach

The Study Partners and Reclamation will conduct communications and outreach to allow and work with input from interested parties who are not Non-Federal Cost-Share Partners, as described in the Communications and Outreach Plan (Appendix I). Throughout the Study, the Non-Federal Cost-Share Partners will make information available to basin stakeholders and request their input.

5.11 Administer Study

The Study Partners and Reclamation will administer the Study throughout the Study period. The Co-Study Managers will be primary points of contact and will oversee the coordination for the Basin Study to complete the tasks and meet the schedule requirements. The Study Project Team will ensure the Basin Study tasks are completed in a cost-effective and timely manner and are technically sound.

5.12 Federal Contracting

Reclamation will obtain non-federal contractors to conduct key Study tasks and sub-tasks as agreed upon by both the Study Partners and Reclamation.

6.0 Milestones, Schedule and Costs

6.1 Study Schedule

The EMS Basin Study will be conducted in the order as indicated in the table below, with estimated durations as noted.

Task	Description	Year 1				Year 2				Year 3			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
5.1	Climate Change Analysis		X	X									
5.2	Supply and Demand Assessment	X	X	X	X								
5.3 & 5.4	Groundwater Model			X	X	X	X			X			
5.5	Conduct Infrastructure Analysis				X			X	X				
5.6	Adaptation & Mitigation Strategies								X	X			
5.7	Conduct Economic Analysis									X	X		
5.8	Basin Study Report			X	X		X		X		X	X	X
5.9 - 5.12	Project Management / Admin	X	X	X	X	X	X	X	X	X	X	X	X

Note: This Schedule will be updated to reflect actual start dates after the MOA is signed.

6.2 Cost Table

The table below includes budget estimates and cost-share for the federal and non-federal participants in the Basin Study.

Task	Task Description	Cost	Cost Share Partners		Reclamation	
			Cost-Share	%	Cost-Share	%
5.1	**Develop Climate Projections**	100,000	30,000	30%	70,000	70%
	Development of Climate Scenarios					
	Prepare Report - Documentation of Selection Process					
5.2	**Conduct Supply and Demand Assessment**	200,000	160,000	80%	40,000	20%
	Conduct Assessment of Current Water Supply					
	Develop Future Water Supply Projections					
	Conduct Assessment of Current Water Demand					
	Develop Future Water Demand Projections					
	Report Preparation					
5.3 & 5.4	**Update and Run Groundwater Model**	360,000	95,000	26%	265,000	74%
	Review Existing ADWR Model Info					
	Assess Model Supply/Demand Figures					
	CAP:SAM Demand Information					
	Incorporate Subsidence Package					
	Run Mitigation Scenarios					
	Groundwater Well-Depth Assessment					
	Prepare Report					
5.5	**Conduct Infrastructure Analysis**	90,000	60,000	67%	30,000	33%
	Identify Model and System Reliability Metrics					
	Conduct Baseline Reliability Analysis					
	Projections of Future Reliability					
	Evaluate Supply Risks by Sector					
	Prepare Report					
5.6	**Adaptation and Mitigation Strategies**	210,000	145,000	69%	65,000	31%
	Develop Strategies to Meet Future Supply Needs					
	Refine Strategies for Further Evaluation					
	Analysis of Strategies					
	Prepare Report - Summary of Analyses					
5.7	**Conduct Economic Analysis**	100,000	40,000	40%	60,000	60%
	Conduct Economic Analysis					
	Prepare Report - Summary of Economic Analysis					
5.8	**Prepare Basin Study Report**	100,000	50,000	50%	50,000	50%
	Draft Final Report					
	USBR Technical Sufficiency Review					
	Review Draft Final Report					
	Publish Final Report					
5.9 - 5.12	**Project Management / Administration**	200,000	100,000	50%	100,000	50%
	Conduct Technical Sufficiency Review					
	Conduct Communication and Outreach					
	Administer Study					
	Federal Contracting					
	Task Management					
	STUDY TOTAL	**$1,360,000**	**680,000**	**50%**	**$ 680,000**	**50%**

Appendices

Appendix I – Communication and Outreach Plan

Appendix II – Technical Sufficiency Review

Appendix I Communication and Outreach Plan

Reclamation and the Non-Federal Cost-Share Partners agree that the EMS Basin Study tasks cannot be fully successful without input, comments and consideration by Stakeholders. The Pinal Partnership will engage technical experts, professionals and interest groups through its Water Resources Committee (WRC).

The Pinal Partnership is a non-profit organization consisting of members from about 94 organizations including: member governments of the Cities of Apache Junction, Coolidge, Casa Grande, Eloy, Maricopa, and Mesa, the Towns of Florence and Marana, Pinal County, and the Gila River Indian Community, Ak-Chin Indian Community, and Tohono O'odham Nation Sif Oidak District. Interest groups, State and Federal entities, and water delivery or management authorities are also represented in the PP.

Coordination with Partners and Stakeholders will be conducted through monthly meetings and strategic planning meetings of the PPWRC. Meetings will be held primarily at the Global Water Resource office in Pinal County, Arizona. EMS Basin Study updates, requests for information, and reviews and presentations will be communicated via these meetings, email notification lists, and the PPWRC website.

As the Study progresses, the Co-Study Managers will assess the effectiveness of the EMS Basin Study public involvement, based on the level of public response and feedback from Partners and Stakeholders, and, if necessary, will identify other potential methods of communication that would be beneficial.

1.0 Stakeholder Information Meetings

Co-Study Managers will identify potential stakeholders of the Basin Study to include municipalities, Indian communities, private water providers, and environmental and academic entities. In addition, regulatory agencies will be notified of the EMS Basin Study, including the Arizona Department of Water Resources, Arizona State Land Department and the U.S. Geological Survey.

At the start of the EMS Basin Study, the Co-Study Managers will schedule a meeting to inform Stakeholders about the Study tasks and schedule, and to invite them to participate in the EMS Basin Study process. Annual stakeholder meetings will be scheduled to provide updates about the EMS Basin Study progress and to provide an opportunity to receive stakeholder comments and/or feedback.

2.0 Basin Study Meetings

Coordination with Partners will be conducted through a minimum of 10 monthly PPWRC meetings during the course of the project and strategic planning meetings. EMS Basin Study updates, requests for information, and reviews and presentations will be communicated via these meetings, email notification lists, and the PPWRC website.

Meetings will be open to the public and information about their scheduling will be widely distributed through the PPWRC mailing list. Efforts will be made to invite key Stakeholders.

3.0 Regional Managers and Decision Makers

This Basin Study will develop adaptation and mitigation strategies to address potential water supply and demand imbalances. In order to move into future implementation and collaboration, it is essential that management and political decision makers be well informed and have opportunity to provide input during the evaluation. The PPWRC will ensure that jurisdictional managers are informed about the EMS Basin Study through its top policy advisory committee, the Pinal Partnership.

During the Study process, key elected officials will be kept abreast of project progress and results through information provided to the Pinal Partnership governing board.

4.0 Responses to Comments

Comments and responses received by Basin Study Stakeholders or interested parties will be discussed and considered to be integrated, when possible, into the Basin Study process.

Reclamation will prepare a response for all comments received. Responses will be posted on the project website established the Pinal Partnership. All information received regarding technical aspects of the Study will be considered and feedback regarding that consideration will be provided.

5.0 Records

All meetings with Stakeholders, interested parties, or Basin Study participants will be documented with sign-in sheets for attendees and meeting notes. This information will be maintained by Reclamation and will be utilized by the Non-Federal Cost-Share Partners to document as cost-share for the EMS Basin Study.

As the Study progresses, Reclamation will periodically assess the effectiveness of the public involvement outreach, and adjustments will be made as necessary to ensure that appropriate communication and feedback is occurring.

6.0 Other Types of Communications

Website

PPWRD will manage a Basin Study website at pinalpartnership.com/ems-basin-study/. Website content will provide up-to-date information and will be used as a tool for soliciting input from stakeholders.

Email

EMS Basin Study email communications may be sent to EMSBasinStudy@usbr.gov.

News Releases and Informational Mailings

As key information is developed or as milestones are accomplished, Reclamation and the Partners will collaborate to develop news releases or informational mailings.

Email List

A Stakeholder email contact list will be maintained by the Pinal Partnership and Reclamation for the EMS Basin Study. This contact list will be the primary method of communication between the EMS Basin Study and stakeholders. Individuals will be added to the email list when requested through the Study email address or through attendance at a public meeting captured on the sign-in sheet.

Additional Meetings with Interested Stakeholder Groups

There will be times when it will be important to meet with interested Stakeholder groups as identified by the Co-Study Managers. All Stakeholder meetings will be open to the public. Email notification of the meetings will be sent by the Pinal Partnership.

As appropriate, representatives of Stakeholder groups may participate and provide input through ad hoc groups formed for specific Study tasks or through the public participation venues described in the Communication and Outreach Plan.

Appendix II – Technical Sufficiency Review Plan

This Technical Sufficiency Review Plan outlines the approach and method for reviewing technical information, data, models, analyses, and conclusions developed during the EMS Basin Study. Technical sufficiency reviews ensure that technical information resulting from the EMS Basin Study are technically supported and defensible. A technical review of each work product from the Basin Study will be conducted before it is made final. Work products that will require technical sufficiency reviews include: supply and demand data compilation and analyses; climate-change model description and results; groundwater model updates; identification and analyses of mitigation strategies; economic analyses; and the final report.

1.0 Coordination, Timing and Scope

The Co-Study Managers will manage and coordinate the timing and scope of the technical sufficiency reviews. Reviews will be scheduled based on availability of draft products as shown in the Plan of Study, Section 6.1 Study Schedule. Co-Study Managers will coordinate with Reclamation and Non-Federal Cost-Share Partners to schedule two to four technical reviewers to review each draft technical memorandum and report as the documents become available. At the start of the EMS Basin Study, Co-Study Managers will develop a review schedule for comprehensive review of the draft EMS Basin Study final report, taking into consideration review times for technical reviews and special review times for policy and management reviews. The review schedule will be reflected in the EMS Basin Study project timeline.

2.0 Selection of Reviewers

At the start of each technical task, the Co-Study Managers will coordinate with Reclamation staff and Non-Federal Cost-Share Partners to identify two to four potential reviewers. Potential reviewers will be contacted with a request and a placeholder date to schedule start of the anticipated review. Co-Study Managers will notify selected reviewers one month prior to the scheduled due date of the draft document and coordinate and manage the review process. The technical sufficiency reviews will be conducted for each work product by reviewers who have not been directly involved with preparation of the work product and who have scientific and technical background and expertise relevant to the review content. The Co-Study Managers will identify management staff who will review the draft EMS Basin Study final report following technical reviews and will notify management of pending reviews.

3.0 Documentation of the Results

The Co-Study Managers will prepare a written response to all comments and suggestions submitted by reviewers. Technical uncertainties identified by reviewers will be identified and characterized in the Final Basin Study Report. Technical sufficiency review results will be made available to the public.

All reviewer comments will be considered and incorporated where relevant and appropriate. The Co-Study Managers will prepare a response to all comments and suggestions submitted by reviewers. Technical uncertainties identified by reviewers will be identified and characterized in the Final Basin Study Report.