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Site Name: South Metro Water Supply Authority Regional ASR Groundwater Model Scope of Work (August 17, 2022)

Location: Aurora, Colorodo

Operator: South Metro Water Supply Authority (SMWSA)

Permitting Agency: USEPA, Region 8, 1595 Wynkoop Street, Denver, Colorado 80202

Current MAR Status: Planning

Year Constructed: N/A

Costs: Project costs for Phase I estimated to be $184,035

Project Contact Information:

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Project Website/Publication Links: N/A

Purpose of MAR:

- Sustainable water supply

Source Water:

- Rivers/streams/lakes/reservoirs

Water Quality:

- Pretreatment required

Recharge Technology(s):

- Aquifer storage and recovery well

Project Description

South Metro Water Supply Authority (SMWSA) is a partnership of 14 water providers in the South Metro region of Denver, Colorado. SMWSA members and other regional providers (for example, Denver Water and Aurora Water) have had numerous conversations on the value of a South Metro ASR Regional Model. Such a model will support informed decision-making, particularly on the use of ASR to store Water Infrastructure and Supply Efficiency (WISE) Partnership deliveries and other renewable surplus supplies when deliveries exceed demands, and then to draw upon the stored reserves when needed. The model could serve as a tool to evaluate ASR operational scenarios; better understand ASR-related infrastructure needs; and address geologic, operational, and accounting questions. A South Metro ASR Regional Model will be an asset for water providers throughout the region. As a result of these conversations, a scope of work document has been prepared and is presented below.

East Cherry Creek Valley Water and Sanitation District (ECCV), Centennial Water and Sanitation District (Centennial), and the Town of Castle Rock (Castle Rock) have been identified as ASR “hubs” for incorporation into the South Metro Regional ASR Model. Centennial has an operational ASR program, and Castle Rock has initiated their ASR program. ECCV has developed a local ASR model to evaluate ECCV-specific ASR operational scenarios. These providers are geographically well positioned to serve most of the South Metro region, with ECCV serving as an “eastern hub,” Centennial serving as a “western hub,” and Castle Rock serving as a “southern hub.” They also have access to key conveyance infrastructure necessary for transporting water throughout the South Metro region.

The South Metro ASR Regional Model will be designed to assist in investigating the feasibility, opportunities, and limitations of an integrated three-hub regional ASR system. This entails the following suite of critical questions identified by SMWSA members and regional providers:

- How conducive are the three hubs in meeting regional demand and storage needs?
- What sort of peak and optimum injection and extraction rates could we anticipate with an integrated multi-hub ASR system?
- What are the dynamics related to groundwater mounding resulting from ASR? This is related to anticipated

groundwater levels and gradients during and post injection/extraction periods, lateral extent of the mounding effect, and duration of the mounding effect in relation to extractions and injections.
- How many wells and what other accompanying infrastructure are necessary for a multi-hub ASR system and what are the costs?
- How can the individual hubs be integrated to operate on a systemwide level?
- Are there critical limitations in injections and extractions (bottlenecks) that need to be addressed before a regional ASR system could be optimized?
- What sort of interactions with nearby wells outside of the hub water providers' service area should be anticipated?
- How do systemwide regional ASR operational scenarios influence groundwater levels and are there favorable ways ASR could be managed to mitigate groundwater level declines?
- Could a South Metro Regional ASR Model be the initial steppingstone for a suite of tools needed to operate and integrate a multi-hub South Metro regional ASR system?

Project Planning/Implementation

The South Metro Regional ASR Model includes two phases:

- Phase 1: Development of a conceptual model—The South Metro conceptual model will include the compilation of a broad spectrum of technical data. Such data will entail groundwater levels; aquifer properties, including transmissivity, hydraulic conductivity, pumping/slug tests, and well yields; location of wells and neighboring wells (as feasible); operational capacity; delivery limitations; and any water quality concerns. These data will form the technical platform necessary to develop and calibrate a numerical South Metro Regional ASR Model (to be developed in Phase 2).
- Phase 2: Development of the numerical South Metro Regional ASR Model—The numerical model will be constructed to simulate ASR operations in the three designated hubs. Modeling scenarios will be developed to address the questions listed above, empowering stakeholder participants to assess how ASR may be integrated at a multi-hub regional level within the South Metro area.

Project Objectives

Specific objectives for Phase 1 of this project include:

- Develop a comprehensive compilation of available data specifically pertaining to the application of ASR in the three identified hubs (ECCV, Centennial, and Castle Rock).
- Develop a robust South Metro conceptual model that will inform development of the South Metro numerical model in Phase 2.
- Work closely with the stakeholder technical committee in collecting data and input on key project components as the project progresses.
- Develop an easily digestible technical report summarizing the available data; conceptual model development approach; key findings; and constructive recommendations for Phase 2.

Phase 1 will involve three tasks:

Task 1: Project and Grant Administration. Task 1 includes routine calls/meetings every 6 weeks with the technical committee to convey results and receive feedback, coordination with SMWSA to implement the project, project invoicing by INTERA to SMWSA, and activities necessary for Colorado Water Conservation Board (CWCB) grant administration.

Task 2: Data Collection and Identification of Data Gaps. The purpose of Task 2 is to collect the data necessary to develop a comprehensive common understanding of the hydrogeology within each hub and a suite of hydrogeologic data necessary to conduct the ASR modeling. Most relevant are the hub-specific data that have been collected by each hub. Such data entails: groundwater levels; stream and lake locations; aquifer properties and tests, including transmissivity, hydraulic conductivity, pumping/slug tests, well yields; lithology logs, geophysical logs from boreholes; location of wells and neighboring wells (as feasible); operational capacity and delivery limitations; any water quality concerns; and data gaps. Data from the USGS, state, well driller logs, and local studies will also be assessed. In addition, data collected as part of the USGS Denver Basin Aquifer System Model (DBASM) development will be included. The DBASM model will serve an important role during the development of the numerical South Metro ASR Regional Model in Phase 2, where the model will be converted into a MODFLOW 6 to allow for the numerical integration of the three proposed local hubs.

Task 3: Develop Conceptual Model. The purpose of Task 3 is to develop a conceptual model that establishes the system framework and the range of parameters required to construct a numerical model. It is foundational in identifying sources, sinks, and pathways associated with an aquifer. The conceptual model also defines unknowns and uncertainties in a system and identifies gaps in data. A well-constructed conceptual model identifies additional data needs, supports site quantifications, and generates preliminary answers to complex questions. It focuses on the stratigraphic and physical position as well as the characteristics of the aquifers.

The conceptual model developed for this task will provide the foundational information and input data necessary to develop the numerical model in Phase 2. Such information will include a regional and local hub-specific overview on the following: geologic and hydrogeologic maps and cross sections and description of key geologic and hydrogeologic features, including key aquifers; regional relationships between surface water, recharge, and groundwater; subsurface formations that influence groundwater movement and storage; visuals showing seasonal groundwater contour maps and regional and local groundwater flow depictions; well extractions; hydrographs depicting changes in groundwater levels over time; general characterization of groundwater quality; and parameters that will be included in the numerical model (for example, local hub transmissivities, and aquifer boundaries). Data collected in Task 2 will be used to inform the conceptual model, primarily focusing on the three local hubs. Information collected from the recent previously conducted ECCV conceptual and numerical modeling effort will provide the basis for the conceptual modeling of the ECCV Hub.

Task 3.1: Castle Rock Hub and Task 3.2: Centennial Hub. These tasks include the evaluation of geologic and geophysical data from the producing aquifers within the Castle Rock Hub boundary and the Centennial Hub boundary. As described above, a variety of geologic and groundwater data will be assessed to provide a conceptual model of the underlying subsurface. This includes key numerical modeling parameters, such as aquifer transmissivity, hydraulic conductivity, and storage, that will be directly incorporated into the Phase 2 numerical modeling effort. Core data results from the drilling of wells will also be examined to determine appropriate specific yields of the aquifers for numerical modeling purposes. Additionally, hydrographs showing groundwater level fluctuations and available potentiometric data will be evaluated to inform the numerical modeling calibration in Phase 2. It is assumed that Castle Rock and Continental will provide the data necessary to inform the hub conceptual model along with additional data sources cited in Task 2. Data from neighboring provider wells may also be incorporated where readily available.

Regional data from the DBASM study/USGS model will also be collected and compared with the local hub-specific data to ensure data compatibility. This is an important step in preparing the conceptual model for numerical development because, as mentioned in Task 2, it is anticipated that the regional USGS model from the DBASM study will be converted into MODFLOW 6 as a component of the Phase 2 numerical modeling effort. This conversion will be critical in integrating the three local hubs from a regional perspective and will further offer the ability to add additional local hubs if desired in the future. (Essentially the three local hub numerical models will be “insets” in the newly developed regional MODFLOW 6 model). Since the DBASM study/USGS model will inform the converted MODFLOW 6 regional model, data evaluated for the Castle Rock Hub and Continental Hub conceptual models in this task will be compared with data from the DBASM study/USGS model. Comparison of the Castle Rock Hub–specific data and Continental Hub–specific data and DBASM data will focus on the hub boundaries where the coarser scale MODFLOW 6 regional model will “connect” with the refined smaller scale local Castle Rock Hub numerical model inset.

Task 3.3: ECCV Hub. INTERA developed a conceptual and numerical model of the Arapahoe Aquifer within the ECCV service area as part of ECCV’s previously conducted ASR numerical modeling efforts. While the focus of that effort was on the Arapahoe Aquifer, additional data were collected and reviewed for the Denver and Laramie Fox-Hills Aquifers to assess the hydraulic connectivity between these two aquifers and the Arapahoe Aquifer. This task includes further refinement of the ECCV conceptual model for the ECCV Hub to characterize and enhance the additional aquifers. It also includes the addition of ECCV’s Willows Wellfield (pending ECCV’s approval).

Task 3.4 Consolidation of Data and Synthesis of Results. A critical factor to the success of this project is developing materials and data that are easily digestible and useful to the South Metro regional providers. INTERA will work with the technical committee in organizing the conceptual model into a comprehensive set of materials that 1) informs the numerical model and 2) can be utilized by stakeholders for additional studies and/or decision-making purposes. Such materials will consist of spreadsheet database(s) of collected data and informative visual aids, including maps of key geologic formations, groundwater-level contours, and well locations. INTERA will receive feedback from stakeholders on these draft materials as they are being presented during the technical committee meetings.

Task 4: Documentation. This task entails the development of a report documenting the data synthesis and evaluation conducted in Tasks 1–3. The report will focus on the conceptual model, providing detailed narratives on the regional and local hub geologic and groundwater characteristics discussed in Task 3. The main goals of the report are to: (1) provide a foundational understanding of the groundwater dynamics regionally and within each hub, (2) inform the Phase 2 numerical

groundwater modeling effort, and (3) serve as a reference to stakeholders when developing modeling scenarios and interpreting model results during the Phase 2 numerical modeling effort. The initial draft report will be developed for review by SMWSA followed by a second draft reviewed by the technical committee. The final draft will be provided to the Colorado Water Conservation Board and be available to the public.