

## **Colorado House Bill 12-1278 – South Platte River Alluvial Aquifer Study**

Scope of Work: July 1, 2012 – Dec 31, 2013

### **HB12-1278 states that the study's objectives are:**

- (i) to evaluate whether current laws and rules that guide water administration in the South Platte river basin achieve the dual goals of protecting senior water rights and maximizing the beneficial use of both surface water and groundwater within the basin;
- (ii) to identify and delineate areas within the basin adversely impacted by high groundwater levels and to conduct a feasibility-level evaluation of the causes of high groundwater levels in the affected areas;
- (iii) to provide information to use as a basis for implementation of measures to mitigate adverse impacts in areas experiencing high groundwater levels; and
- (iv) to provide information to the general assembly, the board, and the state engineer to facilitate the long-term sustainable use of South Platte water supplies.

**In addition**, and without expending additional funds, the institute shall evaluate and report its findings and conclusions to the board and the general assembly regarding:

- (i) to what extent augmentation plans are preventing injury to other water rights holders or potentially causing over-augmentation of well depletions;
- (ii) whether additional usage of the alluvial aquifers could be permitted in a manner consistent with protecting senior surface water rights; and
- (iii) whether, and to what extent, the use of water in the basin could be improved or maximized by affording the state engineer additional authority to administer water rights while ensuring protection of senior surface water rights.

### **Reporting**

The institute shall prepare a final report, including its conclusions, and present it to the general assembly no later than **December 31, 2013**. The institute shall prepare a progress report and present it to a joint meeting of the House of Representatives committee on agriculture, livestock, and natural resources and the senate committee on agriculture, natural resources, and energy, or their successor committees, during the first regular session of the sixty-ninth general assembly in 2013. The institute shall present the final report to a joint meeting of the House of Representatives committee on agriculture, livestock, and natural resources and the senate committee on agriculture, natural resources, and energy, or their successor committees, during the second regular session of the sixty-ninth general assembly in 2014.

### **Scope of Work**

HB-1278 calls for an investigation of high groundwater levels in the South Platte, in particular in several identified areas. The bill calls for review, analysis, evaluation, and conclusions using existing data. The study objectives necessitate well-calibrated and functioning models and a comprehensive network of groundwater observation wells to achieve the stated goals. However, new modeling and data collection is not envisioned under the auspices of HB1278; nonetheless, the study must be definitive enough to support future decisions, or at a minimum provide guidance on additional efforts that must be completed to support such decisions.

The need for good science and transparency cannot be understated, must remain fundamental goals throughout the study, and should be applied to the following:

- clear identification of data sources
- understanding of data quality and completeness (or incompleteness)
- data analysis processes
- presentation of results

Colorado's Decision Support Systems (CDSS) faced these and other challenges from inception and CDSS implementation has resulted in a data and analysis framework that can serve as the foundation for HB-1278. It is important to note that "CDSS" or "the DSS" does not automatically imply modeling. A significant part of the CDSS effort has been to establish the State of Colorado's HydroBase database as the center of the "CDSS data-centered approach". Although a primary goal of CDSS has been to establish baseline planning model data sets (and the science that supports these modeling efforts), data and tools increasingly are being used to more efficiently perform various studies beyond the initial focus of CDSS, such as the Colorado River Water Availability Study (CRWAS).

CWCB and DWR are currently performing a feasibility-level evaluation of the causes of high groundwater levels in two areas (Sterling and Gilchrest/LaSalle) with funding provided under the 2013 "Projects Bill." CWCB has developed a scope of the pilot project work envisioned for these areas, which will be invaluable to the Water Institute in its larger scale basin analysis. CWI will carefully coordinate with these pilot studies to ensure that no duplication occurs and that the two efforts derive maximum benefit from each other.

The following tasks summarize recommended activities necessary to successfully complete the project. It is recognized that there are significant personal interests in the outcomes of the project. Given the complexity of issues, data, and natural systems, there is risk that the outcome might be difficult to interpret and utilize. However, there is also the opportunity that the project can demonstrate the benefits of CDSS and objective knowledge of State of Colorado staff. Recognition of the past, current, and future SPDSS efforts (and limitations) will allow the HB-1278 project to dovetail with SPDSS efforts.

### **Task 1. Data Collection, Organization and Display**

HB 1278 specifies under item (c) The institute shall conduct the study independently using relevant, available, current, and historical hydrologic data and documents. The study must examine water use in Water Districts 1, 2, and 64 within Water Division 1. In conducting the study, the Institute is directed by HB1278 to consider the impacts to all water rights and interstate obligations in Water Division 1 and shall investigate, compile, and evaluate hydrologic variables and factors, including the following items specifically outlined in HB1278:

- (i) the number and location of alluvial wells that are currently withdrawing groundwater;
- (ii) the number and location of alluvial wells that are currently curtailed from pumping, either fully or partially;
- (iii) the number and location of existing artificial recharge facilities and the historical volume of water recharged;
- (iv) historical volumes of water pumped for each high-capacity irrigation, municipal, industrial, or other well not exempted under section 37-92-602;

- (v) historical amounts of water leaving the state in excess of the requirements of river compacts and of the "Platte River cooperative agreement" of 1997;
- (vi) historical water deliveries to surface water rights;
- (vii) groundwater level data available from existing observation wells and the historical fluctuations of groundwater levels based on the data;
- (viii) the South Platte decision support system's existing phreatophyte groundwater evapotranspiration module and, using available data, the relationship between high groundwater levels and nonbeneficial consumptive use by phreatophytes from 2001 through 2011;
- (ix) the number and size of augmentation plans in operation in the study area; and
- (x) the impact of transbasin supplies, reuse of fully consumable supplies, conservation practices, and the installation of lined storage facilities in the alluvium.

The purpose of Task 1 is to assist with addressing the following elements of HB12-1278:

- Identify and delineate areas within the basin adversely impacted by high groundwater levels
- Conduct a feasibility-level evaluation of the causes of high groundwater levels in the affected areas
- Provide information to use as a basis for implementation of measures to mitigate adverse impacts in areas experiencing high groundwater levels
- Provide information to the General Assembly, the Colorado Water Conservation Board, and the State Engineer to facilitate the long-term sustainable use of South Platte water supplies
- Examine water use in Water Districts 1, 2, and 64 within Water Division 1
- Use relevant, available, current, and historical hydrologic data and documents

### **1.1) Kickoff Meeting and Approach Confirmation**

Task 1 will begin with a thorough review of all available water resource data housed in HydroBase. To insure all relevant data is reviewed, interviews will be conducted with personnel within DWR, CWCB, CGS, USGS and both surface and groundwater users within the basin. A one-day kickoff meeting will be held between the State technical advisory group and project team to discuss and determine project outcomes and initiate project activities. It is envisioned that the technical advisory group from the DNR, CWCB and the CWI Project Team will confirm an understanding of the desired project outcomes, data sources and limitations, and technical approach. It is recognized that the focus of a kickoff meeting could vary depending on the attendees and intent. For the purpose of this document, it is assumed that the kickoff meeting will focus on technical issues and approach rather than overall stakeholder issues.

Most data that are relevant to the HB-1278 study effort are represented by the above individuals and the data representations for which they are responsible. A preliminary summary of important data include the following and will be discussed with the technical advisory group:

- Well levels, and depth – in HydroBase (1970's-1980's, gap, then 1990's and forward)
- Well pumping – in HydroBase diversion records; also in accounting workbooks, which DWR is trying to standardize so data can be imported into HydroBase
- Well locations – in HydroBase and associated spatial data layers

- Recharge – in HydroBase (via surface water diversions since 1970’s and more specifically as recharge since 1970’s)
- Streamflow data – in HydroBase and available from USGS and others using CDSS tools
- Climate data – in HydroBase and available from NCDC and others using CDSS tools
- Reservoir data – in HydroBase and available from others using CDSS tools

Members of the State technical advisory group noted above have in-depth knowledge about the data and can confirm data access, quality, and limitations. Ideally the required data will exist in HydroBase or are envisioned for inclusion in HydroBase (such as the augmentation plan workbook data); however, some external sources may need to be utilized (e.g., GASP, CCWCD, LSPWCD, USGS). Data sources and formats will need to be understood early in the project. The technical advisory group will provide feedback on the access, quality and limitation to using the data. The project team will coordinate with the State technical team on existing and ongoing state projects to insure duplication of effort is avoided and data and results are made available to the project team. We anticipate that during the project and following the kick-off meeting there will be a need for several short consultation meetings with specific DWR, CWCB and other staff to clarify aspects of the data.

At the kick-off meeting, the CWI project team will present an approach to using the data to analyze issues identified in HB-1278 and the technical advisory group will provide feedback on the approach. This approach will utilize CDSS, and as needed other, tools to automate data process, resulting in a repeatable, transparent process that can be utilized and enhanced in the future (for example to repeat the analysis with more years of historical data). Visual output products such as maps and graphs will be identified for outreach and to evaluate for presenting final results. Suitable milestones for State and peer review will be discussed in order to identify breakpoints in the project. The preliminary approach will serve as guidance for the following tasks and will be adapted as information is obtained.

### **1.2) HydroBase/CDSS Training for CWI Project Team**

Outcome: Ensure that the project team has an understanding of CDSS tool features related to HydroBase data access and processing.

HydroBase and related data such as spatial data layers will serve as the primary source of data. Members of the CWI Project Team may not have extensive experience with HydroBase and CDSS data tools; consequently, hands-on training will be provided early in the project to demonstrate data access and processing using TSTool, StateDMI, CDSS and DWR website and web services, GIS, and other tools. Limitations may be identified in this exercise, leading to a list of possible enhancements for the tools and technical approach. The CWI project team will document identified limitations and potential enhancements for consideration by CWCB and DWR staff. A pragmatic result of the training will be identification of resources within the team and State staff that can answer technical questions. A one-half to one day workshop is likely appropriate, with follow-up as needed. Participation by State staff may be beneficial.

### **1.3) Data Inventory and Preliminary Data Analysis**

Outcome: Produce a preliminary inventory of data necessary to perform the study and utilize the data to perform a preliminary analysis, in order to evaluate issues with data and the approach.

The project team will use CDSS tools to access data relevant to the project and produce inventory level data products. Suitable quality control checks will be established, such as period of record, outlier analysis, etc. Preliminary analysis will occur and visual products will be created, such as maps showing well locations, trends, and metrics. Products will be provided to the USGS and appropriate State staff for review, with time for review meetings budgeted appropriately. Additional effort may be needed if existing CDSS tools are limited. For example, the CDSS TSTool software currently is able to read all diversion “DivTotal” records from HydroBase; however, TSTool is not yet able to read diversion record classes (source/from/use/type) from web services and DWR has changed the diversion coding design in the past year. It is likely that several weeks of effort may be required to deal with these changes. Work product: data layers of all HB1278 required groundwater and related features to address HB1278 objectives (iii) and (iv).

### **Task 2. Groundwater mapping**

Objective (ii) of HB1278 requires CWI to identify and delineate areas within the basin adversely impacted by high groundwater levels and to conduct a feasibility-level evaluation of the causes of high groundwater levels in the affected areas. In order to understand spatial and temporal patterns of high water levels in the S. Platte basin, a GIS mapping component is needed to clarify the relationship between areas of high water levels, augmentation facilities, ditches and curtailed pumping. Fortunately, significant mapping of the S. Platte basin has already occurred in the process of developing the SPDSS, and these layers will be evaluated and used to develop maps of areas adversely impacted by high groundwater. Specifically, we anticipate using base layers defining areal extent of the alluvial aquifer, bedrock surfaces, surface water features and ditches, groundwater contours and others as appropriate. The CWI Project Team will review all existing SPDSS GIS data and incorporate into this effort as warranted. Additional GIS mapping generated under this effort will endeavor to meet the standards set under SPDSS.

It will be important to determine a working definition of “adverse impacts” and “high groundwater levels” as there is some subjectivity and judgment implied given this is site specific and has historically occurred due to natural hydrologic processes in various area of the basin. Working in conjunction with students and consultants under Task 1, a student GIS technician will be hired to work with CSU GIS faculty to develop map layers for the basin that include spatially referenced data related to groundwater levels and surface features. Work product: GIS maps of S. Platte groundwater and related features specifically needed for 1278 objective (ii).

### **Task 3. Evaluation of existing groundwater level analysis conducted by USGS**

HB1278 requires CWI to conduct a feasibility-level evaluation of the causes of high groundwater levels in the affected areas and to provide information to use as a basis for implementation of measures to mitigate adverse impacts in areas experiencing high groundwater levels. These objectives will be addressed by compiling existing information regarding well and augmentation locations and water volumes from the South Platte Decision Support System. In order to fully utilize the expertise and capacity of US Geological Survey scientists, modeling frameworks and data management capabilities, the data acquired in Task 1 will be compiled into USGS ESRI ARC geographic information system (GIS) software using geodatabases that can be made

publically accessible to other local, State, and Federal agencies. As this might appear duplicative of state funded efforts in Task 1, USGS matching funds will be used to resource this data transfer. Groundwater-level data available from existing USGS and other appropriate observation wells will be compiled from raw data sources into Microsoft Excel spreadsheets (if not already available), and the data will be uploaded to the U.S. Geological Survey National Water Information System (NWIS) database. The NWIS database is a web-based system that allows public access to the data, and it includes pre-programmed data-analysis tools that will provide summary statistics of the minimum, maximum, and mean water level for each well and by season. Once the data are entered into the NWIS database, they will be downloaded into ARC GIS files for temporal and spatial analysis. The analysis of when and where high groundwater levels have occurred will identify and delineate areas within the basin adversely affected by high groundwater levels to satisfy HB1278 and will provide information to use as a basis for implementation of measures to mitigate adverse effects in areas experiencing high groundwater levels.

Results from activities will be synthesized to (1) identify areas affected by high groundwater levels; (2) determine relations (or lack thereof) among the timing and locations of high groundwater levels and the timing and locations of pumping, well shut down, and augmentation; (3) develop hypotheses regarding the causes of high groundwater levels; and (4) develop a groundwater monitoring plan for the basin that accounts for the relations and tests the hypotheses. The resulting data sets also will support extending the SPDSS groundwater-flow model from year 2006 through water year 2011 and will be compatible with existing State tools and databases.

The USGS will provide quarterly written progress report to the Colorado Water Institute (CWI), and a draft USGS Scientific Investigations Report will be provided in November 2013 that documents the data compilation and interpretations and presents a draft groundwater monitoring plan. The funds planned for the project total \$304,231 with \$152,115 coming from CWI and \$152,115 coming from the U.S. Geological Survey Cooperative Water Program as indicated in the table below.

<b>Task</b>	<b>CWI</b>	<b>USGS FMF</b>	<b>Task Total</b>
GIS Data Compilation	\$ 26,136	\$ 26,136	\$ 52,272
Groundwater-level Data Compilation	\$ 32,262	\$ 32,262	\$ 64,525
Spatial and Temporal Data Analysis	\$ 47,922	\$ 47,922	\$ 95,843
Reporting	\$ 45,795	\$ 45,795	\$ 91,591
<b>Total</b>	<b>\$ 152,115</b>	<b>\$ 152,115</b>	<b>\$ 304,231</b>

**Task 4. Stakeholder involvement in data and groundwater problem area identification, mutual problem solving and public education**

HB1278 requires CWI to collect and organize a comprehensive array of data that are not all easily assessable or necessarily widely known to be reliable and acceptable for this analysis. For this reason alone, CWI must implement a process that facilitates stakeholders combining their collective knowledge toward shared agreements about data and mutual fact finding for agreeable

solutions required under the bill. We will do this by facilitating a robust dialogue and fact finding process in three distinct settings focused on finding information called for by HB1278. The activities envisioned under this Task may be conducted independent of CWCB and DWR but will include and coordinate with CWCB and DWR personnel as appropriate.

#### **4.1) Independent Scientific Panel**

In order to peer review the findings developed by the CWI Project Team under Tasks 1, 2 and 3 and to address the policy, institutional and administrative objectives specified in HB1278 an independent scientific panel of well-qualified and respected individuals will be convened to deliberate upon and address the questions outlined as the bill objectives. We expect the panel will be comprised of approximately 5 respected scientists/engineers with collective knowledge of groundwater, modeling and the S. Platte Basin to function similarly to a National Academies panel to provide peer review of data and develop hypotheses, conclusions and recommendations in a written report. The panel will specifically address these HB1278 objectives:

- to evaluate whether current laws and rules that guide water administration in the South Platte river basin achieve the dual goals of protecting senior water rights and maximizing the beneficial use of both surface water and groundwater within the basin;
- to what extent augmentation plans are preventing injury to other water rights holders or potentially causing over-augmentation of well depletions;
- whether additional usage of the alluvial aquifers could be permitted in a manner consistent with protecting senior surface water rights; and
- whether, and to what extent, the use of water in the basin could be improved or maximized by affording the state engineer additional authority to administer water rights while ensuring protection of senior surface water rights.

CWI will facilitate meetings in which this small panel of unbiased experts will discuss and carefully consider the data, maps and analyses conducted under Tasks 1, 2 and 3. We envision running this panel in the manner of a National Academies review panel that will ask for expert input and offer opportunity for public input as it reviews the available data and model output. The panel will also be afforded opportunity to conduct executive session if needed. Although CWCB, the Attorney General's Office and DWR personnel are not envisioned as members of the panel, it will be important to include selected state experts as staff to the panel as appropriate. CWI will be responsible for assisting the Independent Scientific Panel in coming to conclusions and recommendations, including agreement and lack of agreement. Panelists will be provided travel expenses and a modest honorarium for service. Work product: written interim and final reports.

#### **4.2) South Platte Roundtable Groundwater Committee**

CWI will work with the Roundtable groundwater committee to:

- Provide input to the CWI Director and CWI Project Team on study scope, research process, data suitability, maps, and specific questions from the CWI Project Team.
- Provide a forum for public input and discussion at the regular meetings of the Groundwater Committee.
- Advise the full S. Platte Roundtable on progress and concerns related to the HB1278 study. Make recommendations to the Roundtable as to when presentations from the CWI Project Team to the Roundtable are appropriate.

- Hear presentation of the interim and final CWI reports to the legislature and provide input on the reports.
- Help CWI develop an educational strategy for the public, elected officials and the media regarding factual information on groundwater in the Basin.

We envision meeting with the Roundtable groundwater committee at least on a quarterly basis and providing reports and presentations as requested by the Roundtable Execution Committee.

#### **4.3) Community Outreach and Education**

Working with the South Platte Roundtable's Public Participation and Public Education Committee, CWI will develop and implement a strategy for convening the public in communities along the river for education and facilitated dialogue via a series of public meetings. Work product: we will develop a website to organize and serve data, documents and educational factsheets for dissemination to the press and the public, both in printed and electronic form.

MaryLou Smith, Colorado Water Institute Policy and Collaboration Specialist and Reagan Waskom, CWI director, will facilitate meetings of the Independent Scientific Panel, the South Platte Roundtable Groundwater Committee, community outreach meetings and hold educational briefings with the press.

#### **Timeline for Work Completion**

We expect that Tasks 1-4 will all take the entire 18 months for completion, thus the deliverables under this Scope of work will be completed and final reports will be delivered by December 31, 2013.

#### **Budget**

On separate spreadsheet



## **Project Management structure**

Project Manager: Reagan Waskom  
Assistant to the Manager: Shannon Whittstock, esq.  
CWCB Liaison: Tim Feehan  
DWR Liaison: Kevin Rein  
Project Technical Adviser: Dick Stenzel  
Project Outreach and External communications: MaryLou Smith

### **Task 1: Data collection**

Technical oversight: Dr. Steve Malers, Riverside Technologies  
CSU lead: Dr. Ahmed Eldeiry  
Data collection technician: Takis Oikonomou  
Climate data preparation: Wendy Ryan, Colorado Climate Center  
CSU Faculty: Dr. Domenico Bau

### **Task 2: GIS mapping**

Technical oversight and CSU lead: Dr. Ahmed Eldeiry  
GIS technician: Roy Cook  
CSU Faculty: Dr. Luis Garcia

### **Task 3: USGS data collection and analysis**

Technical oversight: Dr. Suzanne Pashke, USGS  
Project Coordinator: Dr. Tristan Wellman, USGS

### **Task 4: Outreach, Communications, Education and Deliberation**

Task Oversight and Coordination: MaryLou Smith  
Assistants: John Bustos and Beth Plombon  
Advisors: CWI Advisory Committee, chaired by David Robbins  
Advisory and Public Process: S. Platte BRT Groundwater Com., chaired by Joe Frank  
Independent Scientific Panel: managed by Reagan Waskom

## **Proposed Independent Scientific Panel**

### **Panel Chair**

John C. Tracy, Director  
Idaho Water Resources Research Institute  
University of Idaho  
Boise, ID 83702

### **Panel Members**

Dr. Deanna Durnford  
Emeritus Professor  
Department of Civil and Environmental Engineering  
Colorado State University  
Fort Collins, CO

Dr. Eileen Poeter  
Emeritus Professor  
Department of Geology and Geological Engineering  
Colorado School of Mines  
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Dr. Geoff Delin  
Groundwater Specialist  
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Dr. Willem Schreuder,  
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