Eel River Valley Groundwater Basin Data Collection and Analysis Work Plan

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Contents

1 Introduction

Pursuant to the goals of California's Sustainable Groundwater Management Act of 2015 (SGMA), The Humboldt County Groundwater Sustainability Agency (Humboldt County GSA) uses robust and reliable data collection protocols to monitor groundwater conditions in the Eel River Valley groundwater basin (Basin). Use of the monitoring protocols contained within the Eel River Valley Groundwater Sustainability Plan (GSP) ensure data is consistently collected, thereby increasing the reliability of data used to evaluate GSP implementation. Overall there are five types of data that will be collected by Humboldt County GSA: groundwater elevations, groundwater extractions, groundwater quality, surface water flows, and saltwater intrusion. In addition, the Humboldt County GSA will monitor for annual change in climate conditions. Existing data is available for each data type needed and will be utilized. However, additional collection of new project data will be garnered through different means.

Several technical memorandums will be developed describing data collection efforts in support of the hydrologic modeling, hydrogeologic conceptual model, water budget, and the development of sustainable management criteria. These include:

- Land Use: A detailed inventory of land use types within the basin and potentially significant future land uses.
- Water Use: Presents the best available information to develop current estimates of groundwater extraction volumes for agricultural irrigation using direct flow measurements from representative irrigation systems in the basin and provide a review of other sources of estimated irrigation rates for the area. Other water use will be described in the Water Budget section of the GSP.

- Water Levels: Describes basin wide discrete groundwater level measurements as well as the installation of pressure transducers in monitoring wells for continuous groundwater level monitoring.
- Water Quality: Represents a comprehensive historical data review and discussion on groundwater quality in the Basin, as well as the collection of groundwater samples for analytical testing.
- Surface Water Flows: Details the collection of streamflow and stage measurements to support the development of the water budget and hydrologic model calibrations.
- Saltwater Intrusion: Describes the collection and analysis of chloride in groundwater within the vicinity of the freshwater-seawater transition zone to support delineation of saltwater intrusion.
- Terrain Data and Imagery: Provides a detailed summary of collected terrain data through Light Detection and Ranging (LiDAR) with spatial coverage over the entire basin and surveyed ground control for development of Digital Elevation Model (DEM) to accurately model the Basin topography.
- Aquifer Parameters: Gives a detailed account of pneumatic slug testing for the calculation of hydraulic conductivity and other aquifer parameters within the vicinity of groundwater monitoring wells.
- Groundwater Dependent Ecosystems: Provides an assessment of the extent and condition of groundwater dependent ecosystems in the basin.
- Surface Water Beneficial Uses: Represents an assessment of the flow needs for surface water beneficial uses identified in the Water Quality Control Plan for the North Coast Region (Basin Plan).

2 Data Collection and Analysis

2.1 Groundwater Elevations

Groundwater elevation monitoring will be conducted to evaluate Basin conditions relative to the sustainable management criteria for chronic lowering of groundwater levels, seawater intrusion, and depletion of interconnected surface water.

The 38 County monitoring wells (15 wells installed in 2017 and 23 wells to be installed in 2021) will provide the best opportunity for collecting high-quality, continuous groundwater elevation data as they have been properly designed and constructed for the purposes of monitoring groundwater levels. Continuous groundwater level data from this well network will provide the

most value as it will be strategically developed (locations, screened depths) to evaluate groundwater conditions relevant to the sustainability indicators.

Existing Data

As far back as the early 1950s, the California Department of Water Resources (DWR) has monitored groundwater levels biannually within nine (9) wells in the Basin. Of those wells, five (5) continue to be monitored as part of the California Statewide Groundwater Elevation Monitoring (CASGEM) program. These five (5) wells, all located within the lower Eel River Valley, provide the best long-term record of groundwater levels for the Basin.

As part of a Proposition 1 Sustainable Groundwater Management (SGM) Grant Program, two large-scale depth-to-water (DTW) measurement campaigns were carried out, one in Fall 2016 and one in Spring 2017. Additionally, pressure transducers were installed at multiple locations throughout the Basin—within five (5) newly developed County monitoring wells, four (4) locations within the Eel River, one (1) location within the Van Duzen River, and three (3) private wells—to continuously monitor the surface water and groundwater levels over the course of the 2017 after which transducers within two (2) of the County monitoring wells and two (2) river stations were left to continue monitoring indefinitely. Biannual DTW measurements were collected in 14 of the 15 County monitoring wells (nine [9] well locations, six [6] of which are paired wells) and in most municipal wells since Fall 2016 (SHN, 2016). Biannual DTW measurements have not been collected at MW-3s due to the well being dry during each monitoring campaign.

In addition to the 15 County monitoring wells (installed in 2016) and the municipal wells, which are currently monitored biannually, private irrigation and domestic wells were accessed through the efforts of the County and the Humboldt County Resource Conservation District (HCRCD), who coordinated with volunteer landowners. To maintain consistency with the previous groundwater level measurement campaigns (in Fall 2016 and Spring 2017), a special effort was made to include the wells that had been measured during those events.

Project Data Collection Methods

Additional private wells will be sought to fill data gaps in the monitoring well network and to obtain a greater variety of well depths, particularly wells screened below depths of 150 feet, where possible. All wells to be included in the Fall 2020, Spring 2021, and Fall 2021 sampling campaigns will be shown in the Water Levels Technical Memorandum.

Twenty-three new County monitoring wells (19 well locations, four [4] of which are paired wells) will be constructed in 2021. With the addition of the 23 new wells, the County will have a total of 38 groundwater monitoring wells throughout the Basin. One (1) of the 2016 County monitoring wells (MW-3d) is observed to remain dry much of the year, leaving 37 candidate wells for the continuous groundwater level monitoring program. Two (2) of the wells (MW-7s and -7d) have had transducers continuously monitoring groundwater levels since October 2019,

thus, those were left in place and the remaining 35 candidate wells will be outfitted with new transducers.

Groundwater levels in the Basin will be measured and recorded every 30 minutes using data loggers installed in each County monitoring well. All groundwater elevation measurements will be referenced to a consistent elevation datum, known as the Reference Point (RP). For County monitoring wells, the RP is on the top of the well casing on the north side. The elevation of each RP for each will be identified through 2020 LiDAR and accurate to 0.1 foot.

In addition, groundwater level measurements will be collected using an electronic DTW meter equipped with a sensor probe and flat measuring tape. Suspended by the flat tape, the probe is sent down the inside of the well casing; it sounds an alarm when water is registered. The DTW will be read and recorded (to the nearest 0.01 foot) on the flat tape at a measurement reference point typically on the top or side of the well casing (cutout). DTW measurement reference points will be described and the distance from the ground surface to the measurement reference point is recorded. Equipment will be operated and maintained in accordance with manufacturer's instructions, and all measurements will be in consistent units of feet, tenths of feet, and hundredths of feet.

Groundwater elevations will be recorded and reported using the Data Management System spreadsheets provided by DWR and uploaded to the SGMA Data Portal annually.

Groundwater elevations in municipal and community service district wells is provided annually by each water supplier.

2.2 Groundwater Extraction

Agriculture Irrigation Water Use

An Agriculture Water Use Estimate technical memo will be developed to estimate groundwater use for agricultural irrigation within the Basin utilizing representative monitoring data collected from eight flow meters in 2021. Readings of total cumulative water volume will be used as the basis for water use calculations.

Existing Data

An irrigated acreage geodatabase was created by the HCRCD in 2016 to assist the County of Humboldt (County) in the evaluation of irrigated lands and the quantification of estimated extracted groundwater within the Basin for agricultural irrigation use. The results were published as Technical Memorandum – Irrigation Water Use Study, dated December 8, 2016, and included in the County's Groundwater Sustainability Alternative Plan, 2016.

Project Data Collection Methods

The estimate for total irrigation groundwater use within the Basin will be based on an inventory of irrigated lands and the associated irrigation methods, estimates of irrigation season duration based on water year type, and direct measurement using flow meter data and will further be explained in the Agriculture Water Use Technical Memorandum.

Other minor sources for agricultural irrigation water in the Basin include surface water and reclaimed wastewater.

The HCRCD will update the inventory of irrigated land areas within the basin, following their initial inventory in 2016. The results from this analysis will be incorporated into the Land Use Technical Memorandum.

Seametrics AG3000 Series Flanged Magmeters (direct flow measurement meters) will be purchased and installed prior to the initiation of irrigation on six private wells to measure water use rates. The general goal is to select sites that are spatially distributed across the basin and represent the range of irrigation system types.

The AG3000 Series is a spool-type electromagnetic flowmeter for use in irrigation applications in two-inch to 12-inch diameter pipe. The flow meter has no moving parts, provides unobstructed flow, and is resistant to wear from debris found in ground or surface water (Seametrics 2021). The flow meter allows for direct download from the flow meters by staff using Flowinspector Version 2.5.0. Flow meters record the date, time, gallons per minute, and total gallons or acre-feet every minute or every hour. Data will be downloaded as recorded (minute or hour intervals) every 21 to 30 days during the irrigation season which is typically from April to October of each year.

Municipal, Industrial/Commercial, Domestic, and Cannabis Water Use

Consumptive groundwater use in the Basin water budget will include pumping from municipal, domestic, commercial, industrial, and cannabis water users. Agriculture groundwater use is described separately. It is noted that permitted cannabis water supply within the Basin is primarily from groundwater.

Existing Data

Basin groundwater use for municipal, industrial/commercial, domestic, and cannabis is estimated based on records provided by municipal water suppliers on a monthly or annual format for the past 10 years and by the County of Humboldt Planning Department through the Cannabis permitting process.

Project Data Collection Methods

Data collection methods will be described in detail in the Water Use Technical Memorandum and water budget section of the GSP. Municipal and Community Service Districts (CSD) will provide monthly or annual consumptive groundwater use for incorporation into the Basin's water budget. Those Municipalities and CSDs located within in the Basin include:

- Loleta CSD
- Palmer Creek CSD
- Bear River Band of the Rohnerville Rancheria
- City of Fortuna
- City of Rio Dell
- Hydesville Community Water District
- Del Oro Water Company (Ferndale)
- Riverside CSD

Total non-municipal domestic pumping will be estimated annually for parcels that are outside of municipal water supply systems. The amount of water pumped is based upon the number of dwelling units for the given parcels. Water use for a parcel is based upon data from several sources and includes land use zoning, parcel improvements, and parcel size.

Commercial and industrial users will be defined as public lands, schools, community buildings, motels, restaurants, heavy industry, wood products, miscellaneous commercial, and light industrial. The pumping for these parcels will be estimated annually. Water use for a parcel will be based upon land use zoning, parcel improvements, and parcel size. GIS analysis used to determine domestic groundwater pumping will also be applied to determine commercial and industrial pumping. As an exception, non-residential parcels shall be retained in the analysis and residential parcels excluded. Parcels identified as agriculturally irrigated parcels in the Humboldt County RCD irrigated acres databased will be excluded.

Water demand for cannabis irrigation is assumed to come from groundwater wells, developed by estimating the number of plants and irrigated areas based upon permitted cannabis cultivation sites within the Basin as provided by the Humboldt County Planning and Building Department. Water demand per plant estimates will be evaluated from several sources and noted in the Water Use Technical Memorandum. The demand for unpermitted cannabis sites will be estimated as an additional 30% of the permitted demand. This is based upon California Department of Fish and Wildlife (CDFW) estimates for other north coast basins (Bauer et al. 2015).

2.3 Groundwater Quality

Groundwater quality will be evaluated to determine whether known groundwater quality problems are under the purview of any agency and the current status of response plans. The Water Quality Technical Memorandum and the Water Quality Sampling and Analysis will include a detailed summary of the historical data review, description of the new data collection, results of laboratory testing, and an evaluation and discussion of any groundwater quality areas of concern in the context of SGMA regulations.

Existing Data

Existing data sources include historical groundwater quality studies completed by the U.S. Geological Survey (USGS) and the California Department of Water Resources (DWR), the Regional Salt and Nutrient Management Report published by the North Coast Regional Water Quality Control Board (RWQCB), as well as following California State Water Resources Control Board (SWRCB) resources:

- GeoTracker
- Safe Drinking Water Information System (SDWIS)
- GAMA program
- Dairy General Order
- Surface Water Ambient Monitoring Program (SWAMP)
- California Environmental Data Exchange Network (CEDEN)
- Dairy Representative Monitoring Program
- Irrigated Lands Regulatory Program

GAMA and SDWIS databases provide the most comprehensive water quality data for the Basin, which indicate that the groundwater in the Eel River Valley appears to be of high quality and suitable for the intended municipal and agricultural uses. The municipal raw water data retrieved from the SDWIS database suggest that concentrations of Total Dissolved Solids (TDS), iron, and manganese have been reported within the same ranges since the late 1980s. The municipal data and the data retrieved through GAMA do not show increasing trends of these constituents through time, including within the last decade. The findings presented in the RWQCB's staff report on salt and nutrients indicate that elevated levels of nitrate and TDS is an existing condition within portions of the Basin, which will be an important consideration in the development of the selection of wells for the 2021 water quality sampling campaign.

Project Data Collection Methods

The County has 14 active monitoring wells that were installed in Fall 2016 and an additional 23 wells scheduled to be installed in Summer 2021. These 37 wells form the primary network of dedicated monitoring wells for the GSP monitoring program. Unlike many other wells within the basin, the construction details and stratigraphy within which they were constructed is or will be known.

A subset of 15 wells from which annual water quality samples will be collected will be found in the Water Quality Technical Memorandum. Special consideration will be given to areas where groundwater use is concentrated and/or has the potential to impact water quality. A good distribution (both horizontally and vertically) is necessary to develop a good baseline of water quality conditions for use in the hydrogeologic conceptual model and groundwater conditions section of the GSP.

Groundwater quality samples will be collected in accordance with the U.S. Environmental Protection Agency "Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells" guidelines (EPA, 2017). Following this standard operating procedure ensures that data quality objectives will be reached and that each sample is collected in the same manner, allowing for direct comparisons of repeat measurements.

The groundwater quality samples are required to be analyzed for specific constituent groups outlined in the scope of work for the grant. At each location, samples will be tested for analytes within broad category groups, including metals, nutrients (nitrate), salts (TDS), organochlorine and organophosphorus pesticides, chlorinated herbicides, volatile organic compounds, semi-volatile organic compounds, polychlorinated biphenyls (PCBs), microbial contaminants, radioactive constituents, and physical parameters (pH, dissolved oxygen, redox potential, specific conductance, and temperature). Each broad category group contains many individual analytes.

Analyte lists and testing methods typically used by municipal water suppliers will be used as guides during the selection process. In some cases (metals, herbicides, salts) several analytical testing methods were selected in order to cover all of the individual analytes of interest. The broad category groups outlined in the grant and the specific analytical testing methods chosen to represent each group will be presented in the Water Quality Technical Memorandum.

Groundwater samples shall be collected in containers supplied by the analytical laboratory, placed in an iced cooler, and sent to the analytical laboratory under appropriate chain-of-custody documentation. Analysis is conducted by North Coast Laboratories, a State of California-certified analytical laboratory located in Arcata, California.

2.4 Saltwater Intrusion

The purpose of saltwater intrusion monitoring is to build upon previous studies, evaluate the current position of the freshwater-seawater transition zone, develop seawater intrusion isocontour lines, and gain a better understanding of the transition zone within deeper aquifers.

Existing Data

The United States Geological Survey (USGS) published the study "Groundwater Conditions in the Eureka Area, Humboldt County, California 1975," which included an assessment of the

freshwater-seawater transition zone in the Lower Eel River groundwater basin (defined as the 100 milligrams per liter [mg/L] iso-concentration line). The study concluded that the position of the freshwater- seawater transition zone in the alluvial aquifer in 1975 was approximately the same as the position of the transition zone as documented in 1952 (USGS, 1978).

In 2016, the County conducted two large-scale chloride sampling campaigns, one in the Fall of 2016 and one in the Spring of 2017. The results of those studies indicated that the freshwater-seawater interface had not moved significantly since 1975. As part of the commitments made in the 2016 Groundwater Sustainability Plan Alternative biannual chloride sampling was continued within two of the paired County monitoring well locations (MW-5s/d and MW-7s/d).

Project Data Collection Methods

Chloride sampling campaigns will be scheduled to coincide with the groundwater elevation field efforts and as closely as possible with the Department of Water Resources (DWR) field measurements of California Statewide Groundwater Elevation (CASGEM) wells. In preparation for the fieldwork, a tabulated list of wells will be developed that include information on location, ownership and contact information, access and coordination needs, and any known well attributes. Many of the locations had been sampled in previous campaigns and information from those efforts will be reviewed and included.

The geographic area of interest for data collection on saltwater intrusion will generally be focused on the western half of the lower Eel River Valley within the vicinity of the mapped 100 mg/L isoconcentration line from 2016. To maintain consistency with previous work, four municipal wells and seven County monitoring wells within the vicinity of the freshwater-seawater transition zone will be included in future monitoring.

County monitoring wells with open casing will be sampled using either a peristaltic pump or a downhole Grundfos pump and clean polyethylene tubing. Sampling will follow Low-flow sampling protocols outlined in the U.S. environmental Protection Agency (EPA) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. As described in the guidelines, temperature, pH, electrical conductivity, and turbidity will be measured every two to five minutes depending on the purge rate. Sampling methods and field parameter measurements are to be documented on “Groundwater Monitoring Forms” and “Daily Field Forms.” Samples shall be collected from a nearby spigot or hose following a flushing routine for any municipal or private wells that are sealed.

Equipment used during the field program consists of dedicated single-use disposable items, select hand tools, and mechanized equipment. Groundwater sampling equipment shall be cleaned prior to its use and between each monitoring well using the triple-wash system (a Liquinox® solution wash followed by two distilled water rinses).

Groundwater samples will be collected in containers supplied by the analytical laboratory, placed in an iced cooler, and sent to the analytical laboratory under appropriate chain-of-

custody documentation. Groundwater samples shall be analyzed for chloride using EPA method 300.0 Rev 2.1 (1993). Chloride analysis will be conducted by North Coast Laboratories, a State of California-certified analytical laboratory located in Arcata, California.

2.5 Surface Water Flows

Surface water flow data describes the surface water elevation and streamflow within the Eel and Van Duzen Rivers in the Basin.

Existing Data

Prior to the implementation of SGMA, no focused studies on the interaction of the surface water and the groundwater within the Eel River Valley Groundwater Basin (Basin) had been conducted. In 2016, several studies were initiated as part of a Proposition 1 Grant (DWR, 2016) to begin developing a baseline understanding of the groundwater exchanges associated with the Eel and Van Duzen Rivers. Some of the initial findings were included in the groundwater sustainability plan alternative submitted by Humboldt County in December 2016 (SHN, 2016) and in subsequent annual reports.

Throughout the fall of 2016-2019, pressure transducers have been maintained within stations in both the Eel and Van Duzen Rivers. River and well locations that have been part of the surface water/groundwater monitoring program to date are shown on Figures 1 through 4 of the Preliminary Analysis of Surface Water/Groundwater Interaction Monitoring Technical Memorandum (SHN, 2019).

Additional surface water information includes stage data from the Fernbridge United State Geological Survey (USGS) river gauging station (USGS Stream gage 11479560) and Scotia USGS river gauging station (USGS Stream gage 11477000) maintained in the Basin.

Project Data Collection Methods

A total of ten locations will be identified in the Eel and Van Duzen Rivers to record continuous water level by Thomas Gast and Environmental Consultants (TGAEC) and SHN. All sites will be equipped with HOBO U20L-04 pressure transducer data loggers to record water levels every 15-minutes. Three locations will also be equipped with a pressure transducer that is deployed in the air to measure atmospheric pressure. This barometric pressure record shall later be used to compensate data to determine the depth of water above the in-stream loggers. All loggers will be removed at the end of November 2021. Discharge will be calculated for each site using continuous water level data records and routine discharge measurements. The results for water year 2021-22 will be published in a Surface Water Flow Technical Memorandum.

Streamflow stage data from the Fernbridge United State Geological Survey (USGS) river gauging station (USGS Stream gage 11479560) and Scotia USGS river gauging station (USGS Stream gage 11477000) maintained in the Basin will continue to be used as a proxy.

In addition, streamflow monitoring methods as described in the Surface Water Flow Technical Memorandum and Preliminary Analysis of Surface Water/Groundwater Interaction Monitoring Technical Memorandum (SHN, 2019) will be implemented for future surface waterflow monitoring as appropriate.

3 References

Bauer et. al. 2015 *Impacts of Surface Water Diversions for Marijuana Cultivation on Aquatic Habitat in Four Northwestern California Watersheds*, PLOS ONE | DOI:10.1371/journal.pone.0120016 March 18, 2015

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