

Groundwater Sustainability Plan Alternative Annual Report 2018 Water Year (October 1, 2017 to September 30, 2018)

Eel River Valley Groundwater Basin
Humboldt County, California



Prepared for:

Humboldt County Public Works Department

SHN

in collaboration with:

County of Humboldt Public Works Department

and

Humboldt County Resource Conservation District

April 2019

016219

Reference: 016219

Groundwater Sustainability Plan Alternative Annual Report 2018 Water Year (October 1, 2017 to September 30, 2018)

Eel River Valley Groundwater Basin Humboldt County, California

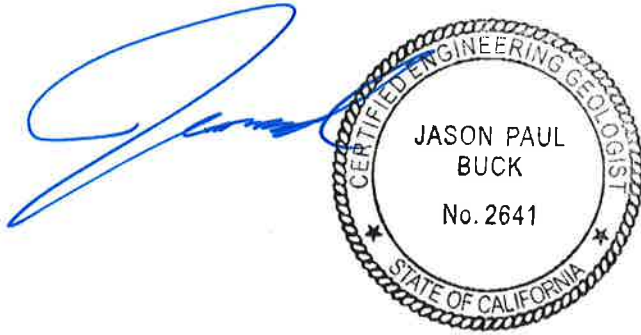
Prepared by:

SHN

812 W. Wabash Ave.

Eureka, CA 95501-2138

707-441-8855



In Collaboration with:

County of Humboldt Public Works Department

1106 Second Street

Eureka, CA 95501

and

Humboldt County Resource Conservation District

5630 South Broadway

Eureka, CA 95503

April 2019

QA/QC:GDS *gds*

Executive Summary

The groundwater sustainability plan alternative (GSP Alternative) submitted to Department of Water Resources (DWR) in December 2016 (SHN, 2016) showed that groundwater levels within the Eel River Valley Groundwater Basin (Basin) (Figure 1 in Appendix 1) have a relatively narrow range of fluctuation and have remained generally stable over time, including during the droughts of 1976-1977, 1987-1992, and the most recent drought of 2013-2015. The 2018 Water Year (WY) from October 1, 2017, through September 30, 2018, was a relatively dry year based on total precipitation (33.7 inches) measured at the Scotia climate station (048045), but was a normal irrigation season with irrigation beginning generally around May 15, 2018. Groundwater level measurements collected over the course of the 2018 WY indicate that the levels are consistent with the historical fluctuations as observed in the wells associated with the California Statewide Groundwater Elevation Monitoring (CASGEM) program. A system of transducers collecting continuous water level data remains in place within select wells and river locations within the Basin.

Groundwater extraction within the Basin continues to be primarily associated with irrigation and municipal use. Studies carried out to support the preparation of the GSP Alternative (HCRCD, 2016; PECG, 2016) indicated that the total volume of groundwater use represents a very small percentage of annual recharge within the Basin. There is very little growth of the agricultural sector or the general population within the Basin. Further, there are no ongoing or anticipated future changes to the conditions of use within the Basin that would significantly change the conclusions in the GSP Alternative. One of the external factors that could affect conditions within the Basin is the ongoing regulatory changes associated with cannabis cultivation (which was legalized in California in January 2018). Changes in groundwater and/or surface water use associated with the continued development of the cannabis industry may have an impact on the overall water balance within the Basin. Enforcement actions, water use regulations, and adherence to regulatory requirements will likely facilitate an overall reduction in upstream water taking. Cannabis cultivation has long been a part of the Eel River watershed; however, it is not yet clear how the increase in cultivation will affect water use within the Eel River and Van Duzen watersheds.

The fate of Pacific Gas and Electric's Potter Valley Project hydroelectric facility may affect the overall water balance within the Basin. The facility is located on the Eel River in Lake and Mendocino Counties, approximately 150 miles upstream of the Basin. The Potter Valley Project diverts water from the Eel River at Cape Horn Dam into the Russian River watershed. Recently, PG&E has abandoned its effort to relicense the facility and, at this time, it is unclear what changes may occur to the facility and if/how the flows to the Eel River Valley Groundwater Basin may be affected.

The Eel River Valley Groundwater Basin is a coastal basin and seawater intrusion is a potential undesirable condition. As reported in the GSP Alternative, chloride sampling conducted in Fall 2016 within the lower Basin indicated the position of the seawater/freshwater transition zone is comparable to the position mapped in 1975 (USGS, 1978). In Spring 2018, additional sampling was conducted, selected wells, the results for which indicate no significant changes have occurred.

Based on the data reviewed in this 2018 annual report, we submit that the conclusions presented in the GSP Alternative remain applicable and appropriate. In our opinion, the GSP Alternative is still the most appropriate compliance option for achieving the goals of the Sustainable Groundwater Management Act (SGMA) for the Eel River Valley Groundwater Basin. The GSP Alternative provides for a monitoring plan and commitments for annual reporting that are appropriate and effective for monitoring changing conditions.

Combined with the five-year assessment due to be completed and submitted with the annual report in 2021, we anticipate that no project or additional management action is needed to maintain the Basin's sustainability goal as defined in the GSP Alternative.

Table of Contents

	Page
Executive Summary.....	i
Abbreviations and Acronyms.....	iv
1.0 Introduction	1
2.0 2018 Water Year	1
3.0 Groundwater Elevation Data	2
3.1 CASGEM Program	2
3.2 Groundwater Elevation Contour Maps.....	2
3.3 Freshwater-Seawater Transition Zone.....	3
3.4 Surface and Groundwater Monitoring using Pressure Transducers.....	3
4.0 Groundwater Use for WY 2018.....	4
4.1 Irrigation Water Use	4
4.2 Municipal Water Use	5
4.3 Rural Domestic Water Use.....	6
4.4 Total Water Use	7
5.0 Changes in Groundwater Storage.....	7
6.0 Plan Implementation Progress–Projects and Management Actions.....	7
7.0 References	8

Appendices

1. Figures
2. Groundwater Monitoring Data Tables
3. Hydrographs

List of Illustrations

Tables	On Page
1. Monitoring Network and Sampling Program.....	1
2. Irrigation Groundwater Use Rate by Water Year (2007-2018).....	5
3. Municipal Water Use, 2007-2018 (Acre-Feet per Year)	6

Abbreviations and Acronyms

mg/L	milligrams per liter
Basin	Eel River Valley Groundwater Basin
CASGEM	California Statewide Groundwater Elevation Monitoring
CCR	California Code of Regulations
CSD	Community Service District
DWR	Department of Water Resources
g	sourced from groundwater
GSP Alternative	groundwater sustainability plan alternative
HCRCD	Humboldt County Resource Conservation District
MW-#	monitoring well-number
N/A	not available
NAVD88	North American Vertical Datum, 1988
NR	no reference
PECG	Palmer Environmental Consulting Group
s	sourced from surface water
SGMA	Sustainable Groundwater Management Act
SGWP	Sustainable Groundwater Planning
USGS	U.S. Geological Survey
Working Group	Eel River Valley Groundwater Basin Working Group
WY	Water Year

1.0 Introduction

As a result of Sustainable Groundwater Management Act (SGMA) regulations approved in 2014, the County of Humboldt Public Works Department (County) took the lead role in organizing the local response to SGMA for the Eel River Valley Groundwater Basin (Basin; Figure 1). In October 2015 the Eel River Valley Groundwater Basin Working Group (Working Group) was formed. The Working Group includes stakeholders representing agricultural, municipal, and environmental interests and is instrumental in facilitating compliance with the SGMA. From 2015 through December 2016, the County and Working Group conducted several meetings to discuss compliance and data needs to meet requirements of the SGMA and implemented a groundwater assessment with funding from a Proposition 1 Sustainable Groundwater Planning Grant.

The County submitted to the Department of Water Resources (DWR) a groundwater sustainability plan alternative (GSP Alternative) in December 2016 for the Eel River Valley Groundwater Basin in collaboration with the Working Group. The GSP Alternative was prepared in accordance with the regulations in California Code of Regulations (CCR), Title 23, §350 et seq. and provides information demonstrating that the Basin has operated within its sustainable yield over a period of at least 10 years. The monitoring network and sampling program proposed in the GSP Alternative is shown on Figure 2 and summarized in Table 1.

**Table 1. Monitoring Network and Sampling Program
Eel River Valley Groundwater Basin**

Location	Analysis	Frequency	Responsible Agency
CASGEM ¹ Wells	Depth-to-Water (feet)	Bi-annually	DWR ²
USGS ³ River Stations	River Stage (feet)	Continuous	USGS
Temporary River Stations	River Stage (feet)	Continuous	County
County Monitoring Wells (9 total)	Depth-to-Water (feet)	Bi-annually	County
	Chlorides (mg/L) ⁴	1X/5 Years	County
MW-2	Depth-to-Water (feet)	Continuous	County
MW-5/MW-7	Chlorides (mg/L)	Bi-annually	County
1. CASGEM: California Statewide Groundwater Elevation Monitoring 2. DWR: State of California Department of Water Resources 3. USGS: U.S. Geological Survey 4. mg/L: milligrams per liter			

Based on the requirements contained in the CCR, Title 23, §350 et seq. an annual report must be submitted to the DWR by April 1st of each year. This annual report provides a discussion and the results of studies conducted during the 2018 Water Year that weren't included in the GSP Alternative. Also included is an update on water use and groundwater storage for the preceding water year, and a description of progress toward implementing the measures identified in the GSP Alternative. This submittal will be processed through the SGMA Portal–Alternative Reporting System monitored by DWR.

2.0 2018 Water Year

Precipitation totals for the 2018 water year as measured at the Scotia Station 048045, and reported by the Western Regional Climate Center totaled 33.72 inches (Figure 3), whereas the mean yearly precipitation is 47.87 inches. The rain season started late with significant rains not picking up until mid-November and

ending early around mid-April. Rainfall in March 2018 (8.9 inches) was significantly above average. There were three storm events over the season with generally moderate river flows and no significant flooding events. River discharge and gage height data for the U.S. Geological Survey (USGS) stations at Scotia (11477000) and Bridgeville (11478500) on the Eel and Van Duzen Rivers, respectively, are provided as Figures 4 and 5.

3.0 Groundwater Elevation Data

The principal aquifers within the Basin have been loosely defined based on the primary stratigraphic units of the Basin; the shallow alluvial aquifer and the underlying aquifer associated with the Carlotta Formation. Groundwater use in the Basin is primarily sourced from the alluvial aquifer, which is on the order of 100 to 200 feet thick. Most wells within the valley have been installed at a depth of less than 100 feet. Due to the scarcity of wells screened within the deeper Carlotta aquifer, and the lack of historical data, the discussion and presentation of groundwater elevation data provided in this report is focused on the shallow alluvial aquifer.

Groundwater elevation data for the 2018 water year (WY) included in this annual report (Appendix 2) has been made available from the following sources:

1. Two rounds of groundwater elevation measurements conducted by DWR as part of the California Statewide Groundwater Elevation Monitoring (CASGEM) Program
2. Two groundwater elevation measurement campaigns, one conducted in Fall 2017 and one in Spring 2018
3. A transducer study conducted within selected wells adjacent to the Eel and Van Duzen rivers

3.1 CASGEM Program

The seasonal groundwater elevation measurements collected as part of DWR's CASGEM program provide the best opportunity to evaluate long-term groundwater elevation trends. Groundwater elevations were measured by DWR staff in six wells in Fall 2017 and five wells in Spring 2018. The groundwater elevations recorded are observed to be consistent with historical values. The locations of the CASGEM wells and their associated hydrographs are shown on Figure 6. Individual hydrographs are also included in Appendix 3.

3.2 Groundwater Elevation Contour Maps

In Fall 2017, and again in Spring 2018 groundwater elevations were recorded in wells throughout the Van Duzen and Eel River valley bottoms. There were 20 wells measured in Fall 2017 and 17 wells measured in Spring 2018, some of which are made up of a shallow/deep well pairs. Wells included municipal wells, private wells, and County monitoring wells.

Depth-to-water measurements within the private and County wells were collected by staff from SHN, whereas depth-to-water measurements in the municipal wells were provided by municipal staff. Groundwater elevation contour maps and the locations of the wells used to develop them for the Fall 2017 and Spring 2018 sampling events are shown as Figures 7 and 8, respectively, and details of the monitoring are included in Tables 2-1 and 2-2 (Appendix 2).

Groundwater contours in both fall 2017 and spring 2018 indicate that flow is consistently toward the ocean (westward) with gradients and directions mimicking the topography of the valley floors. Flow gradients within the Eel River Valley are generally shallow with fall elevations ranging from approximately 30 feet along the eastern edge of the valley floor to 5 feet nearest the ocean. A much steeper groundwater gradient is observed within the Van Duzen watershed with elevations ranging from 120 feet within the Yager Creek down to 30 feet at the intersection with the Eel River Valley. In general, the elevation change between the spring and fall seasons is on the order of 5 feet or less.

3.3 Freshwater-Seawater Transition Zone

Chloride sampling was conducted during the Spring 2018 groundwater elevation measurement campaign discussed above. Chloride sampling and testing were conducted in 2 wells, MW-5 and MW-7, which were installed within the vicinity of the freshwater-seawater transition zone previously mapped by the USGS in 1975 (USGS, 1978). These wells were identified in the GSP Alternative as indicator wells used to monitor for changes in the position of the freshwater-seawater transition zone. The 1975 study used a chloride concentration of 100 milligrams per liter (mg/L) as an indicator of poor-quality water. More specifically, the study applied the 100 mg/L concentration limit as an indication of the landward edge of the freshwater-seawater transition zone. This transition zone is shown on Figure 9 along with results from both the 2018 spring sampling event and the more comprehensive spring 2017 sampling campaign. The spring 2018 chloride values are consistent with historical data and confirm that the location of the freshwater-seawater as mapped in 1975 remains appropriate.

3.4 Surface and Groundwater Monitoring using Pressure Transducers

To monitor the surface water and groundwater levels over the course of the 2018 WY, pressure transducers were maintained within stations in both the Eel and Van Duzen rivers. River and well locations that were part of the monitoring program for the 2018 water year are shown on Figure 10. Transducers were installed within temporary installations at two locations within the major rivers (R-3 and R-4), and two County monitoring wells (MW-2 and MW-9). Additional transducers were installed in late October 2018 in MW-7, results for which will be reported in the 2019 WY Annual Report. Transducers will be left in place at select locations to continue monitoring water levels for an indefinite period, as part of the ongoing monitoring commitments outlined in the GSP Alternative. Hydrographs of locations monitored during the 2018 WY are provided in Appendix 3.

A review of the hydrographs through the course of the winter season shows close interconnection between the river and the adjacent alluvial aquifer. The fluctuation of river flows associated with winter storms is clearly affecting the aquifer, with groundwater elevations tracking those fluctuations closely. This is consistent with the relatively high hydraulic conductivity of the granular alluvial material that was encountered when installing the wells.

The water levels observed in the Eel River and the adjacent aquifer at the location of MW-2 are very closely tied, with peaks in the river flows very tightly mimicking the peaks in aquifer fluctuations (see Appendix 3). Rain events and associated rises in the river generally produced losing stream conditions (flow gradients toward the aquifer) and periods between rain events produced gaining stream conditions (flow gradients toward the river). The gradients are very gentle with maximum elevation differences of less than 6 inches. The profile of both the Eel River and the aquifer remained closely tied during the course of the dry season with the gaining stream conditions changing to a losing stream condition in early July, and remaining that way until late November when the initial storm systems of the 2018/2019 wet season begin. The river

elevation profile over the course of the 2018 dry season was similar to the profile of the 2017 dry season, with water levels stabilizing at an approximate elevation of 19 feet. The hydrographs of both the river and MW-2 water levels exhibit a smooth transition into the dry season, typical of a standard recession curve. There does not appear to be an influence on water levels associated with nearby pumping or the starting and ending of the irrigation season, which generally occurred between May 15 and October 1.

Monitoring of the Van Duzen River and adjacent aquifer was facilitated with monitoring well MW-9 and the River 4 installation (R-4), situated approximately 1,300 feet apart from each other within the central portion of the Van Duzen valley floor. The hydrographs of MW-9 and R-4 indicate that the aquifer gets recharged by the river relatively quickly during the initial peak river flows of the wet season. Water elevations within the aquifer are relatively slow to recede following these peak flows, and result in consistent gradients toward the river in all but the earliest parts of the wet season. Over the course of the dry season, the relative water elevations of MW-9 and R-4 indicate a transition from gaining to losing stream conditions in late-June. Water elevations of the aquifer remain below the surface water elevations (up to 1.3 feet) until the wet season begins again in late November. Similar to the surface water elevations in the Eel River, the water elevations in the Van Duzen River appear to generally stabilize during the months of August and September at similar elevations as noted in the 2017 dry season. The water levels at the MW-9 location appear to have been affected by nearby pumping during the irrigation season. Between May 24 and September 27, the hydrograph shows daily fluctuations on the order of 0.1 to 0.2 feet, interpreted to represent daily irrigation of the surrounding fields, likely from an active well located approximately 500 feet southwest of MW-9. Based on the apparent deviations from a smooth recessional curve, an overall lowering of the aquifer in the vicinity of MW-9 on the order of 0.5 to 0.8 feet may be interpreted to have occurred during the course of the irrigation season.

Table 2-3 (Appendix 2) provides details on the locations, including the timeframes for which continuous water level data was being collected over the course of the 2018 WY. The hydrographs from stations monitored through most of the 2018 WY are provided within Appendix 3.

4.0 Groundwater Use for WY 2018

Groundwater use within the Eel River Valley Groundwater Basin supports agricultural irrigation, municipal distribution, and rural domestic water use. Historically, there has been no comprehensive program for yearly measurement or quantification of total groundwater use in the Basin. In 2016, the Humboldt County Resource Conservation District (HCRCD) carried out an empirical study to estimate irrigated acreage and annual irrigation volume estimates (HCRCD, 2016). The nine municipal entities that extract and distribute water within the Basin coordinated with County staff to provide volumes used over the course of the year. Rural domestic use (private domestic wells) is conservatively estimated at this time. Below, the three primary water use sectors are discussed and the quantification of their extraction volumes for the 2018 water year is provided.

4.1 Irrigation Water Use

The GSP Alternative presented a technical memorandum completed by the HCRCD that estimated the irrigation water use rates of irrigated lands within the Basin. The estimated water use for a given year is based on the general start date for irrigation and precipitation received during the irrigation season. Estimated volumes of water use have been developed for each of three “Irrigation Season Types”: dry, normal, and wet (see Table 2).

From information contained in the technical memorandum and personal communication with HCRCD in March 2019, the estimated total acre-feet of groundwater used for irrigation during the 2018 season is 13,600 based on a “normal” irrigation season determination, with irrigation starting around May 15, 2017, based largely on the relatively wet spring. The estimated irrigated acreage for WY 2018 remained the same as that presented in the GSP Alternative and technical memorandum (13,558 acres). Approximately 73% of the irrigated land is situated in the Ferndale area, with the remainder distributed within several geographic areas (Alton, Carlotta, Fortuna, Hydesville, Loleta, Rio Dell, Rohnerville, and Scotia). Figures 11a, 11b, and 11c show the distribution of irrigated acres within the Basin. Table 2 summarizes irrigation water use.

**Table 2. Irrigation Groundwater Use Rate by Water Year (2007-2018)
Eel River Valley Groundwater Basin**

Irrigation Season Type	Water Use Estimate (Acre-Feet)	Associated Years
Dry Irrigation Season (April 15-October 1)	16,680	2008, 2009, 2013, 2014, 2015
Normal Irrigation Season (May 15-October 1)	13,600	2007, 2012, 2016, 2018
Wet Irrigation Season (June 1-October 1)	10,265	2010, 2011, 2017

4.2 Municipal Water Use

There are nine identified municipal users in the Basin. They are made up of Community Service Districts (CSDs), cities/towns, and one tribal nation, all of which collect and distribute water within a larger community. Most extraction is facilitated with source wells, though in the case of the towns of Scotia and Rio Dell, water is primarily sourced from infiltration galleries below the Eel River bed, considered to be a surface water source. Del Oro CSD has both wells and shallow collection systems near springs within the hill slopes south of the Eel River Valley. Figure 12 shows the location and service area extent of the municipal water users.

Eight of the nine water suppliers have cooperated in providing extraction volume data covering the past 10 years. A summary of historical (past 10 years) and current municipal water use associated with the eight users is provided in Table 3 below. Record-keeping has varied between entities and not all years were made available. The 2006 to 2015 entries are reported as annual volumes, whereas the 2017 and 2018 entries are for their respective water years.

Although not considered significant to the overall water balance, it should be noted that there are some adjustments made to the reporting for 2017 WY and the 2018 WY that were not included in the information submitted in the GSP Alternative.

Specifically the following corrections in reporting were made for the 2017 WY values:

- The Town of Scotia previously reported only water from the town’s use of treated water, it did not account for raw water that went to the mill operations.
- Del Oro Water Company was only reporting the volumes associated with extraction from its well, not the data for extraction from near its springs.
- Loleta CSD and Palmer Creek CSD reported volumes in million gallons and cubic-feet, respectively instead of acre-feet.

The water use reported for Scotia and Rio Dell for the 2018 WY includes a breakdown of water derived from infiltration galleries below the Eel River (now reported as surface water), whereas in prior years, this distinction was not broken out.

Table 3 summarizes municipal water use (domestic, commercial, industrial).

**Table 3. Municipal Water Use, 2007-2018 (Acre-Feet per Year)
Eel River Valley Groundwater Basin**

Supplier	Measuring Device	Accuracy	2018 ¹	2017 ¹	2015 ²	2014	2013	2012	2011	2010	2009	2008	2007
City of Fortuna	McCrometer flow meter	99-101 %	1,252	1,262	1,445	1,595	1,654	1,540	1,333	1,399	1,423	1,439	N/A ³
City of Rio Dell	Electromagnetic flow meter	to 0.5% (+or-)	7(g) 343(s)	264	254	294	351	315	304	305	327	330	365
Town of Scotia	Sparling flow meter	to 2% (+or-)	872(s)	693	346	363	325	362	422	432	421	430	471
Del Oro Water Co.	Propeller meter	95%	171	177	46	41	33	29	12	11	19	26	44
Loleta CSD ⁴	Water Specialties mag meter	to 2% (+or-)	93	73	23	23	21	20	20	20	20	19	21
Riverside CSD	Siemens Mag flow meter	to 5% (+or-)	21	24	24	N/A	35	32	32	33	32	N/A	26
Palmer Creek CSD	Sensus turbo meter	to 1.5% (+or-)	24	23	3	3	3	3	3	3	4	N/A	N/A
Hydesville CSD	Electromagnetic meter	to 1 cubic foot	107	97	97	107	118	124	161	153	126	138	148
Bear River	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	---	---	2,890	2,613	2,238	2,426	2,540	2,425	2,287	2,356	2,372	2,382	1,075
1. 2017 and 2018 are reported in Water Year Totals (October of previous year to September of noted year) 2. 2006 to 2015 are reported in Annual Totals (January to December) 3. N/A: not available 4. CSD: Community Services District 5. Includes groundwater and surface water g: sourced from groundwater s: sourced from surface water													

4.3 Rural Domestic Water Use

No targeted study for the Basin has been completed to quantify the volume of groundwater extracted by users outside the municipal service areas other than for irrigation purposes. These users would include residential, agricultural, or commercial uses that supply their water from private wells. For the purposes of capturing the volume of extraction associated with these miscellaneous or otherwise minor uses in the Basin, a conservative estimate is used. An estimate of 1,000 acre-feet was included in the water balance prepared by Palmer Environmental Consulting Group (PECG, 2016), which was included with the GSP Alternative. Until further evaluation of this use sector has been completed, we maintain this value as part of the 2018 WY extraction estimates.

4.4 Total Water Use

Agricultural Water Use:	13,600 Acre-feet (estimated)
Municipal Water Use:	2,890 Acre-feet (measured)
Groundwater	1,675 Acre-feet
Surface Water.....	1,215 Acre-feet
Rural Domestic Water Use:.....	1,000 Acre-feet (estimated)
Total Water Use:.....	17,490 Acre-Feet

5.0 Changes in Groundwater Storage

Within the Basin, the most reliable long-term data set available to evaluate change in storage over time are the hydrographs for the CASGEM wells. For this reason, our evaluation is focused on the alluvial aquifer of the Lower Eel River Valley. Because use is concentrated in the Lower Eel River Valley, we conclude that the alluvial aquifer underlying it is a good proxy for the Basin as a whole.

For the purposes of evaluating trends in the change in groundwater storage, the Eel River Valley was broken into representative polygons based on position within the Basin and general compositional variations in the aquifer material. Each polygon was assigned to a representative CASGEM well within its area. The polygons and their representative CASGEM wells are shown on Figure 13. It should be noted that the CASGEM well representative of the area north of the Eel River (ID 23182) was recently destroyed and the CASGEM well nearest this well (ID 23181) to the south is now being used as representative of the aquifer fluctuation. Sea level was used as a basal boundary to define the storage capacity. This is a practical lower limit as it relates to seawater intrusion and it simplifies the volume calculation. The area within approximately 1.5 miles of the coast was not considered as it is within the intertidal zone, the fluctuation is small, and the water quality is poor. The height of the spring groundwater elevations in each respective well was multiplied by the area of the associated polygon to derive a bulk volume. This volume was then multiplied by a specific yield estimated for each area to develop a quantity of water in storage. Figure 14 shows the change in storage year to year from 1989 to 2018 plotted with the yearly precipitation totals (water year) as measured in Scotia. As expected, the precipitation and storage track very closely with each other. Figure 15 plots the cumulative change over the same period with a net negative shown in 2018.

6.0 Plan Implementation Progress—Projects and Management Actions

The monitoring network that was expanded in 2016 with support from the Proposition 1 Sustainable Groundwater Planning Grant and volunteer participation is sufficient to monitor Basin parameters into the future. Ongoing monitoring will provide relevant, high-quality data and information to support a continuously improving understanding of groundwater conditions and verification of sustainable groundwater management. Humboldt County will develop a data management system to compile the data and make it publicly available, and will continue to share information at meetings of the Working Group.

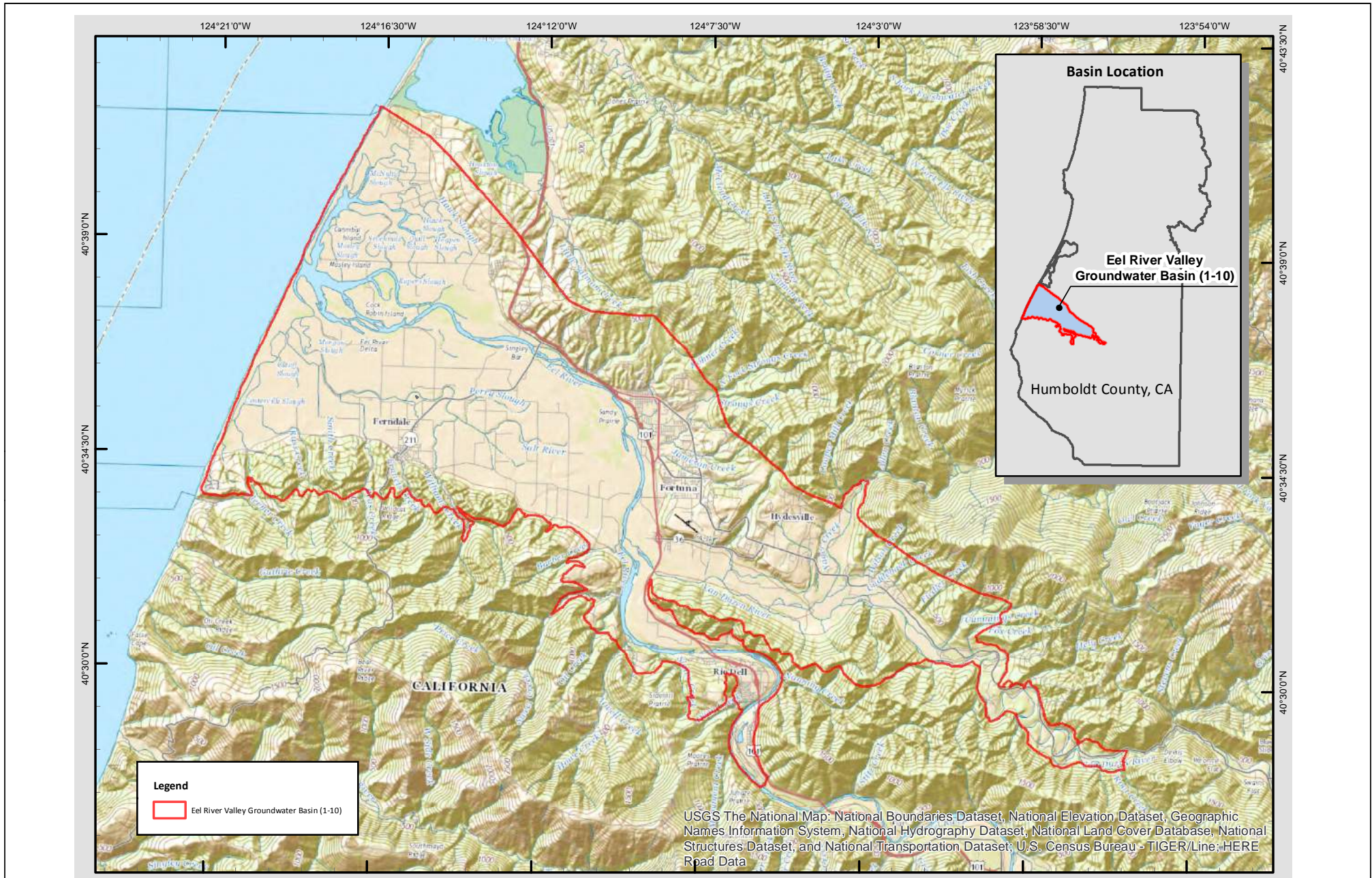
Based on the evaluation presented in the previously submitted GSP Alternative, and the updated information presented herein, the sustainability goal for the Basin is being met and is projected to continue to be met with a high confidence level for at least the next five years. The monitoring network and program outlined in Section 4.5 of the GSP Alternative remains appropriate after our review of 2018 water year data. In addition to the monitoring summarized in Table 1, we will maintain transducers at both the River 4 and

MW-9 locations (Figure 10) to provide surface water-groundwater monitoring along the Van Duzen River as well as transducers in the paired wells at the MW-7 location (started on August 30, 2018). No additional monitoring network components are considered necessary at this time. Therefore, Humboldt County concludes that periodic monitoring, and the submittal of annual reports is sufficient, and that projects or additional management actions are not needed to achieve the Sustainability Goal.

7.0 References

- Humboldt County Resource Conservation District. (December 8, 2016). Evaluation of Irrigated Acres and Irrigation Water Use Rates in the Eel River Valley Groundwater Basin; Technical Memorandum prepared for Humboldt County Public Works. Eureka, CA:HCRCDC.
- Humboldt County Resource Conservation District and Cheryl Laffranchi. (March 13, 2018). Personal Communication regarding irrigation water use information (water year type and acreage amounts)
- Multiple Water Suppliers. (February 6, 2018 –March 14, 2018). phone and email communication regarding municipal water use
- Palmer Environmental Consulting Group, Inc. (December 30, 2016). Eel River Valley Groundwater Basin GIS-Based Water Budget V2. Arcata, CA: PECG.
- SHN Consulting Engineers & Geologists, Inc. (2016). Eel River Valley Groundwater Basin, Humboldt County, California; Groundwater Sustainability Plan Alternative, prepared for Humboldt County Public Works. Eureka, CA:SHN.
- United States Geological Survey. (1978). "Ground-water Conditions in the Eureka Area, Humboldt County, California, 1975." U.S. Geological Survey Water Resources Investigations 78-127. NR:USGS.

Figures 1



BASEMAP FROM HUMBOLDT COUNTY PUBLIC WORKS (DECEMBER, 2016)



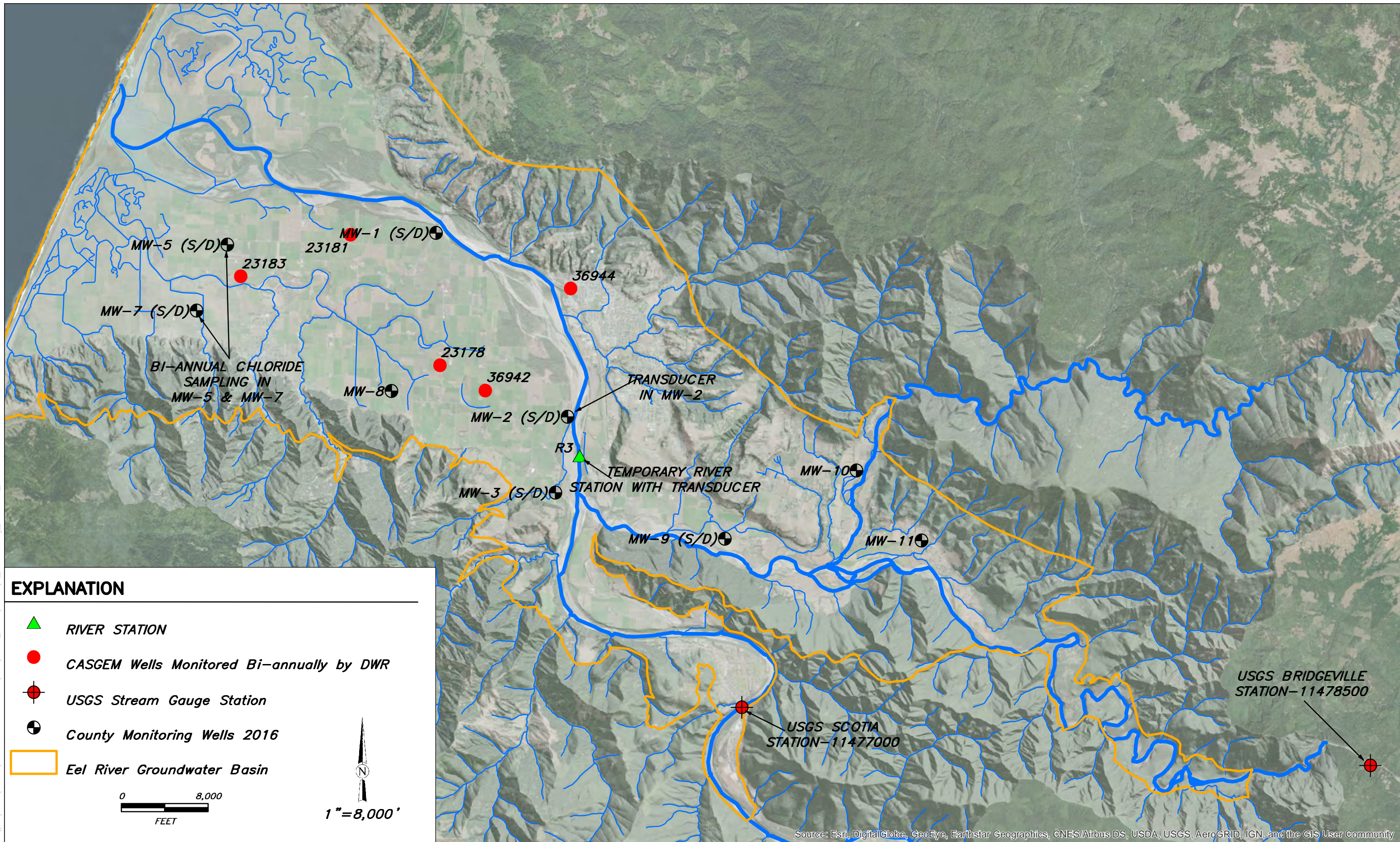
Humboldt County Public Works
 Eel River Groundwater Assessment
 Humboldt County, California

Site Location
 Map
 SHN 016219

March 2019

1_SiteLocationMap.ai

Figure 1



EXPLANATION

- RIVER STATION
- CASGEM Wells Monitored Bi-annually by DWR
- USGS Stream Gauge Station
- County Monitoring Wells 2016
- Eel River Groundwater Basin

0 8,000
FEET

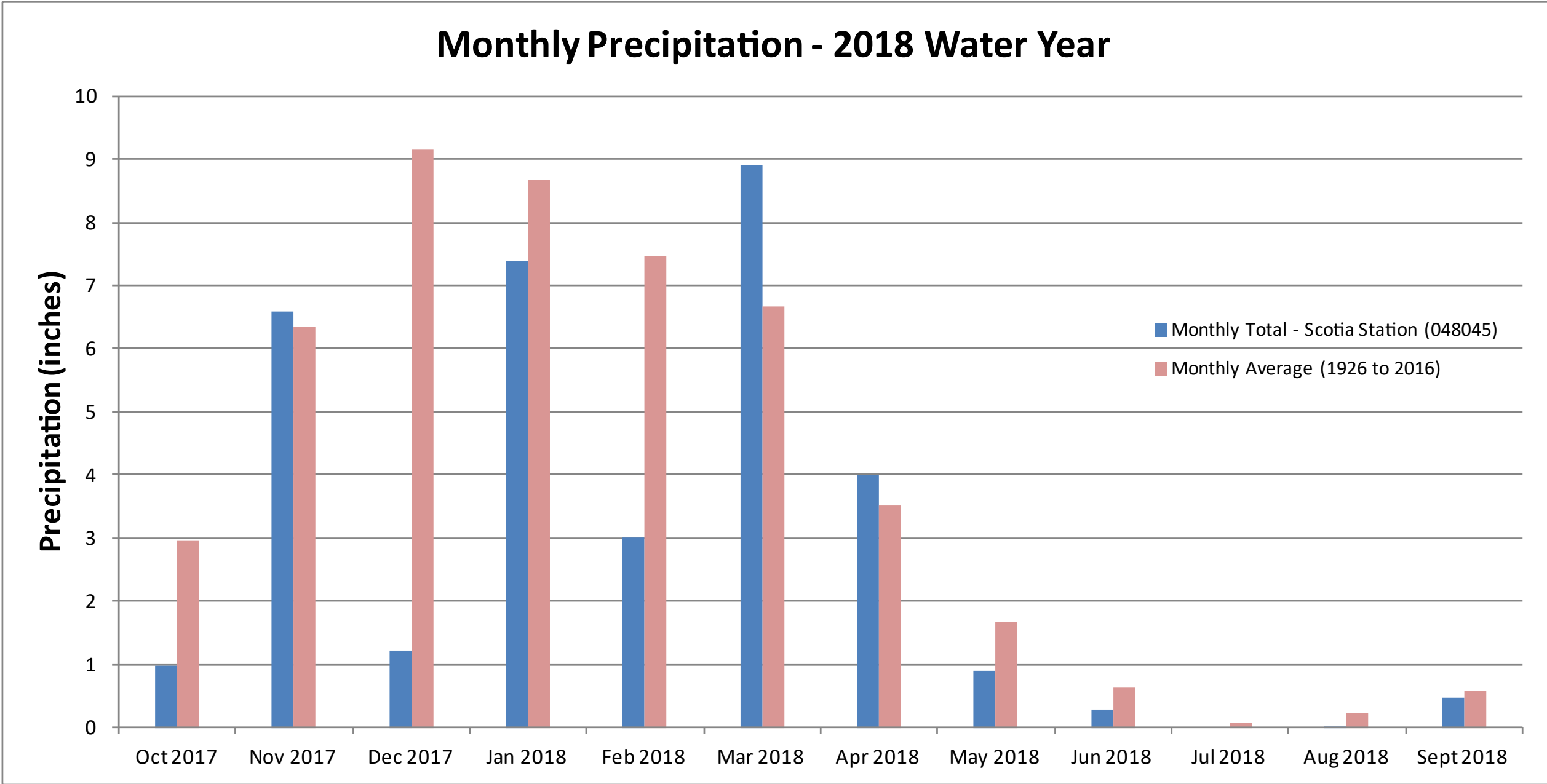
1" = 8,000'

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Humboldt County Public Works Eel River Groundwater Assessment Humboldt County, California		Monitoring Network Locations SHN 016219	
March 2019	2_Monitoring_Network_Locations	Figure 2	

Path: \\eureka\projects\2016\016219-EelRiverGW\GIS\PROJ_MXD\2019\2_Monitoring_Network_Locations.mxd

Monthly Precipitation - 2018 Water Year



Path: \\Eureka\Projects\2016\016219-Eel River\GIS\FIGURES\2019\A\3_Precipitation.ai



Humboldt County Public Works
Eel River Groundwater Assessment
Humboldt County, California

Monthly Precipitation
Totals
SHN 016219

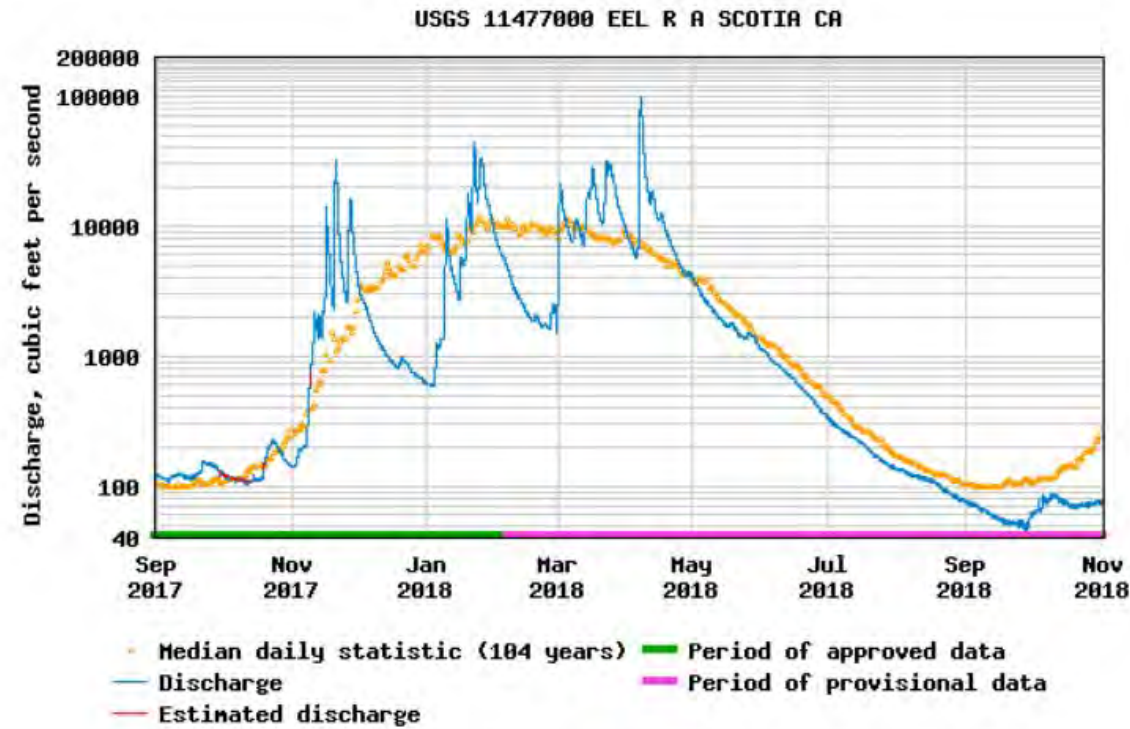
March 2019

3_Precipitation.ai

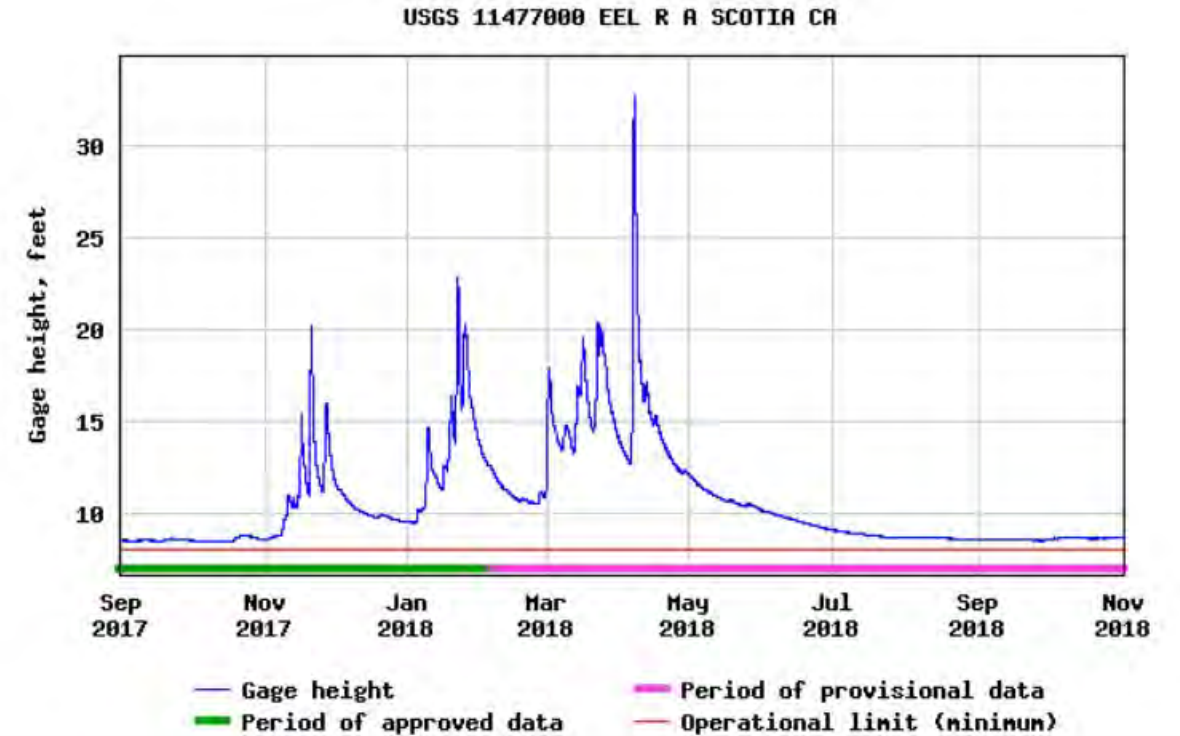
Figure 3



USGS 11477000 EEL R A SCOTIA CA



USGS 11477000 EEL R A SCOTIA CA



Path: \\Eureka\Projects\2016\016219-EelRiver\GWS\FIGURES\2019\A\4_ScotiaStationData.ai



Humboldt County Public Works
Eel River Groundwater Assessment
Humboldt County, California

Flow and Gage Data
USGS Scotia Station 11477000
SHN 016219

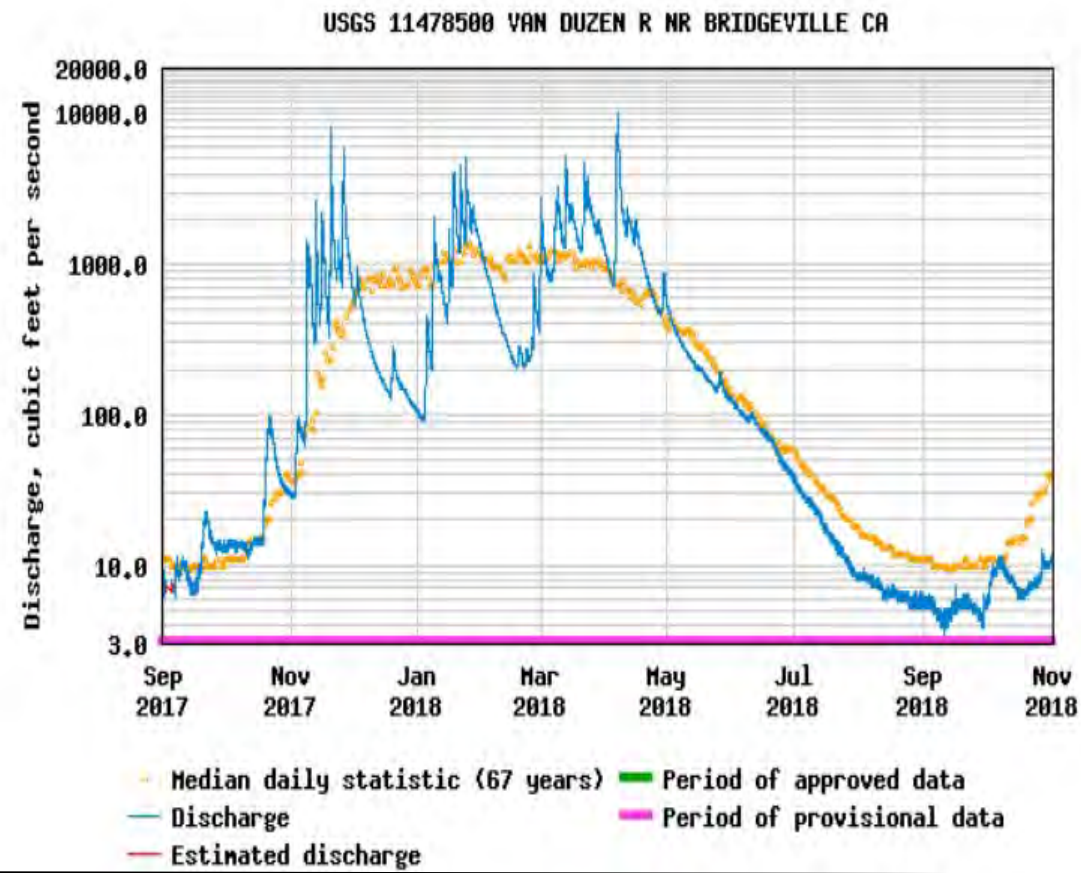
March 2019

4_ScotiaStationData.ai

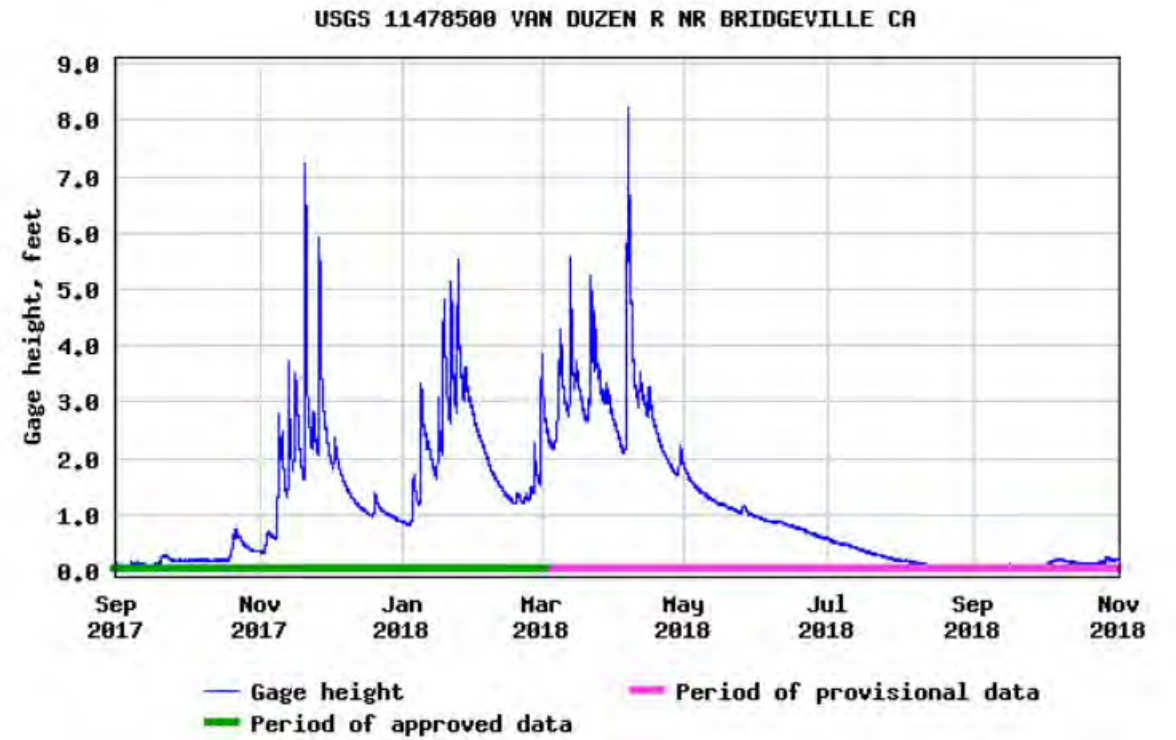
Figure 4



USGS 11478500 VAN DUZEN R NR BRIDGEVILLE CA

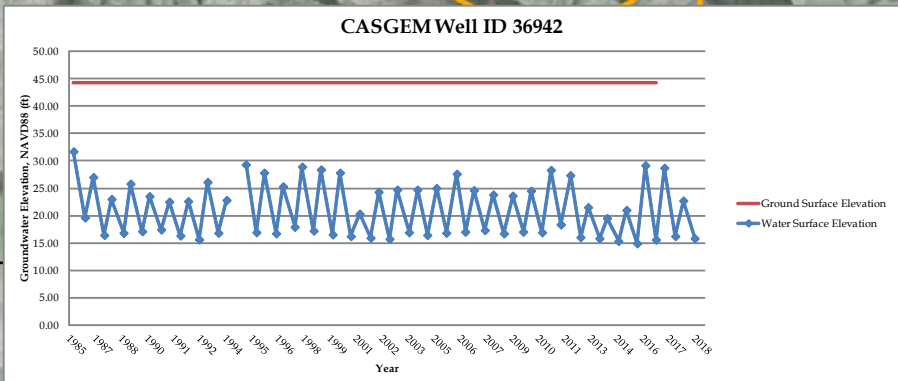
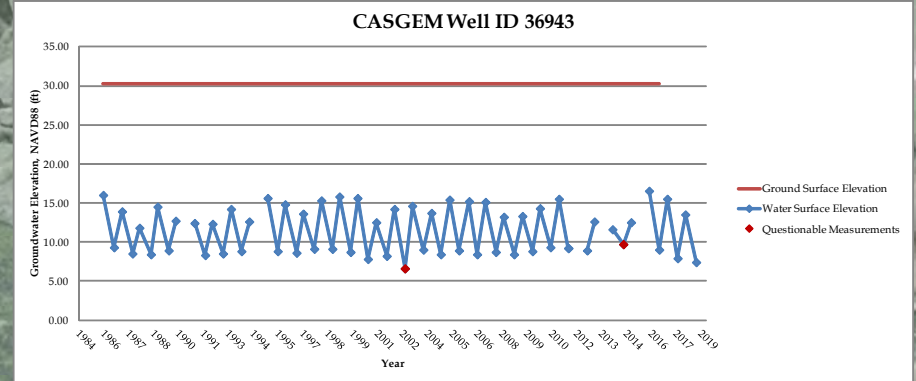
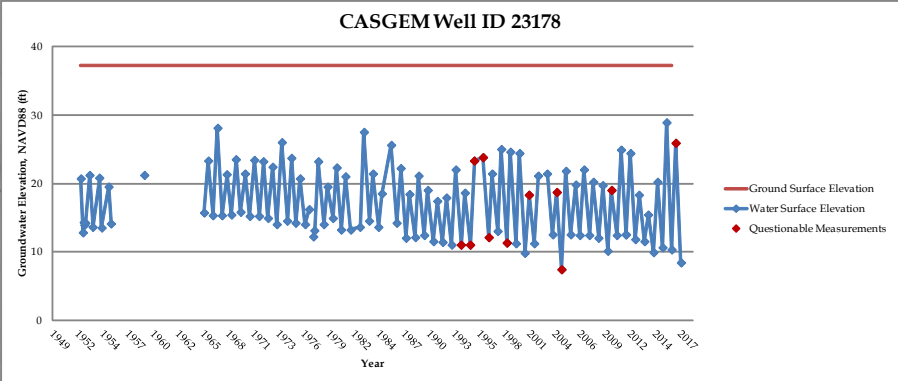
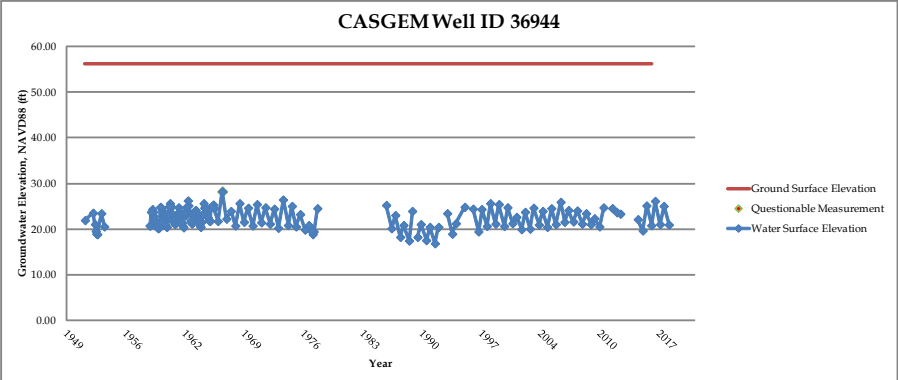
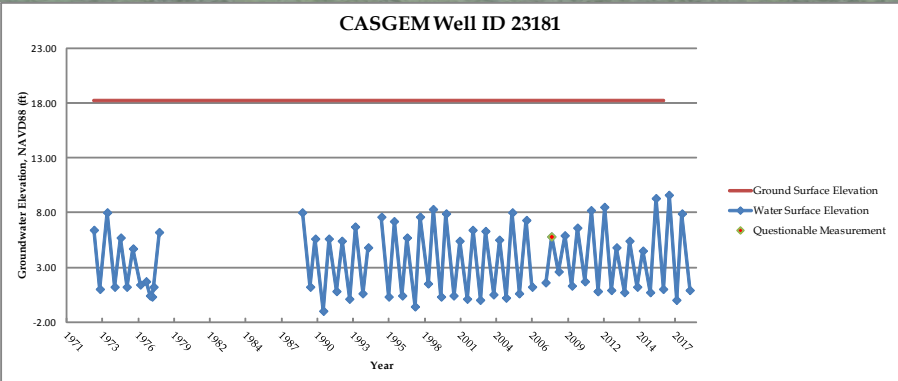
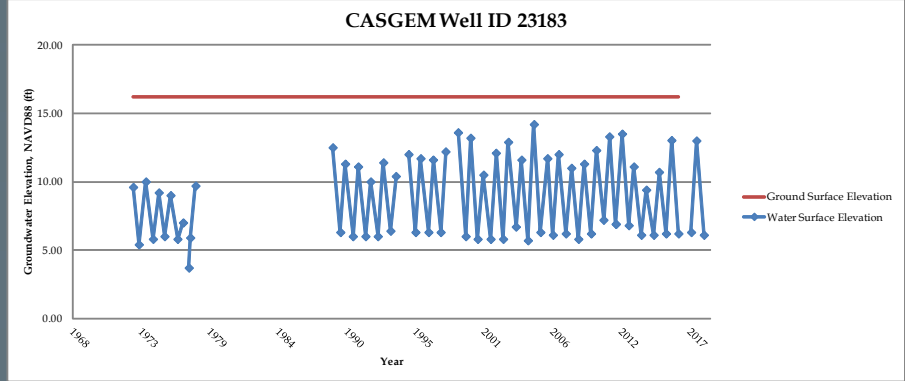
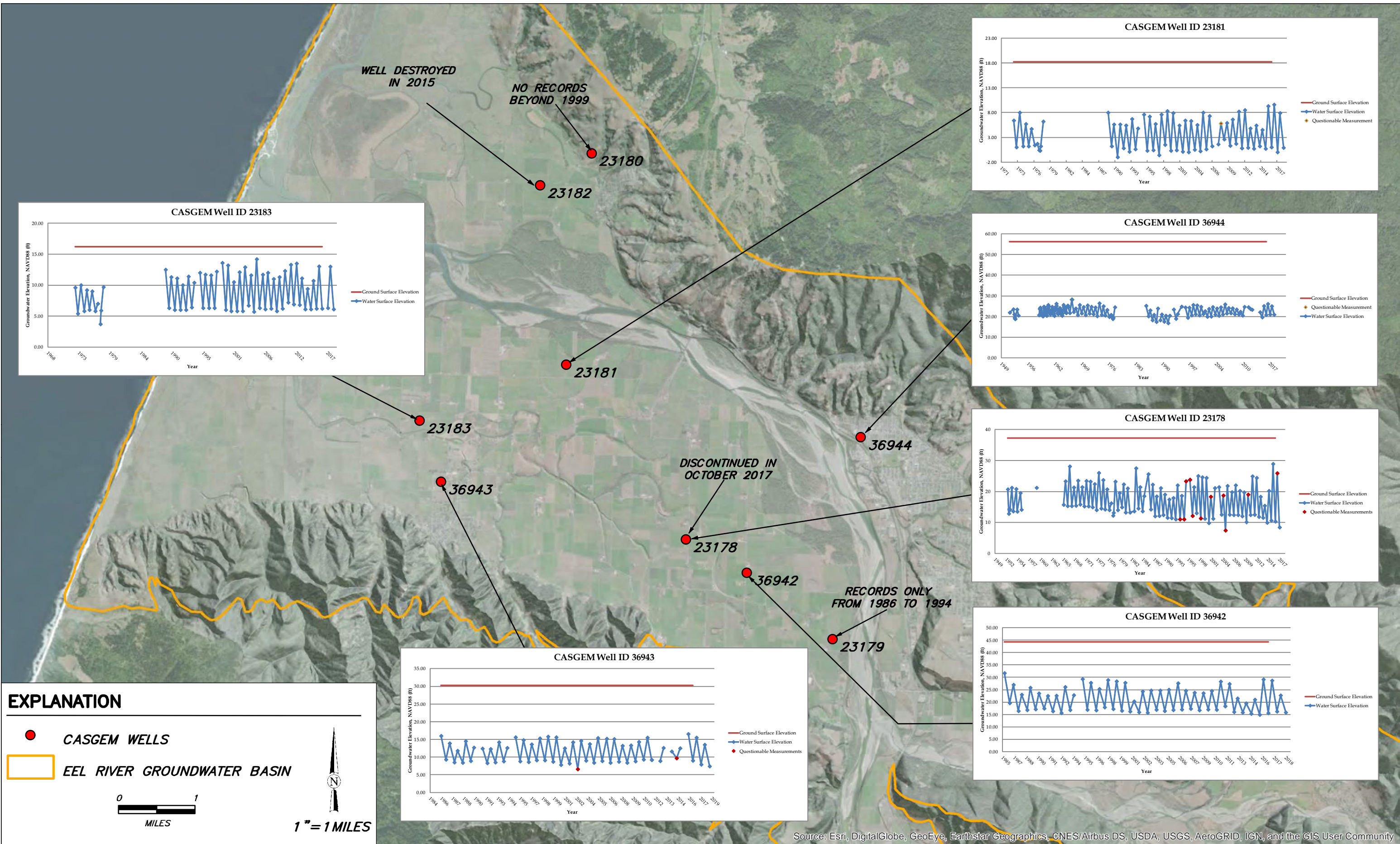


USGS 11478500 VAN DUZEN R NR BRIDGEVILLE CA



Path: \\Eureka\Projects\2016\10-16219-EelRiverGW\GIS\FIGURES\2019\A\5_BridgevilleStationData.ai

Path: \\eureka\projects\2016\016219-EelRiverGW\GIS\PROJ_MXD\2019\CASGEMWell_Locations.mxd



EXPLANATION

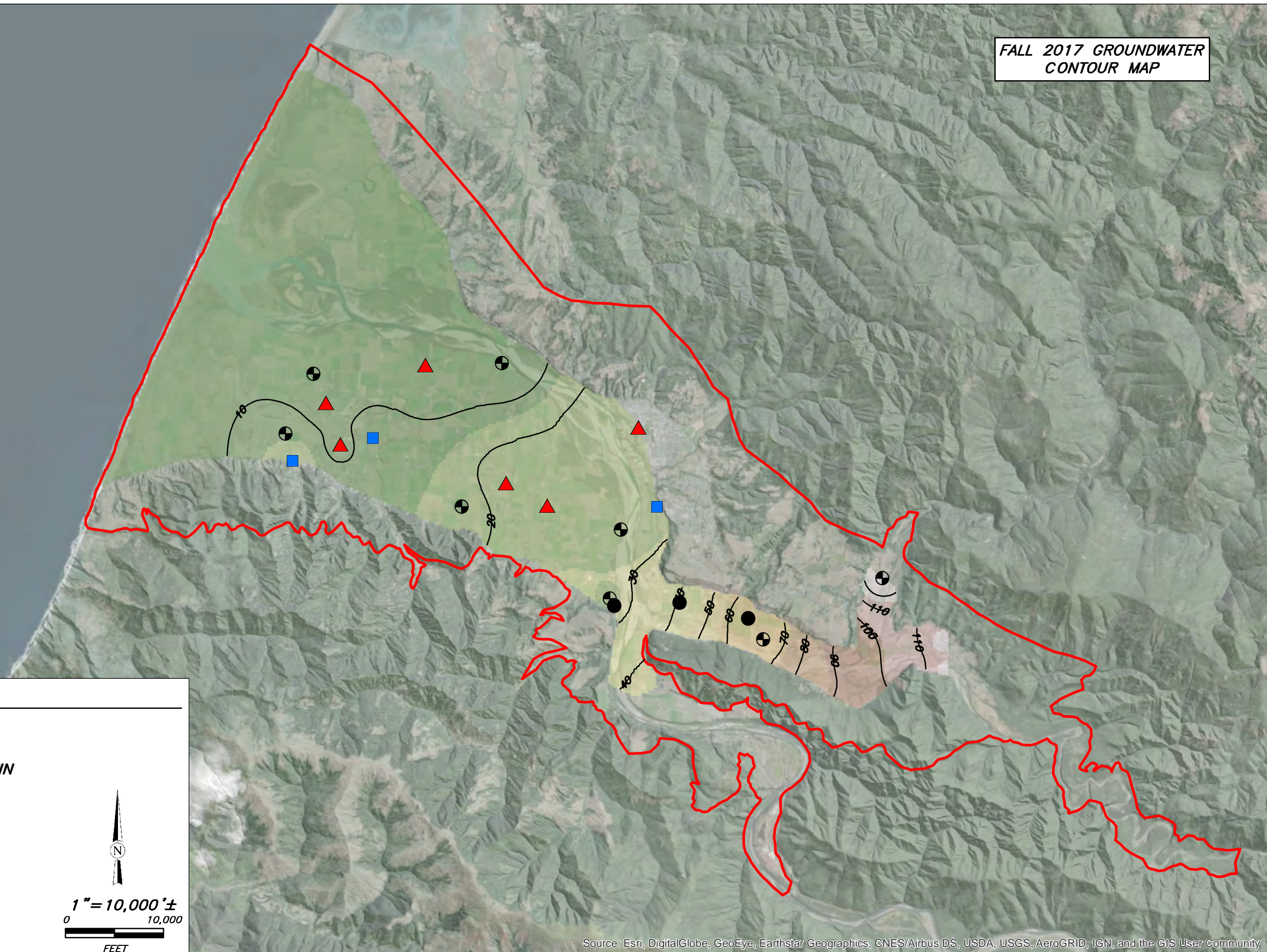
- CASGEM WELLS
- EEL RIVER GROUNDWATER BASIN

0 1
MILES

1" = 1 MILES

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





FALL 2017 GROUNDWATER
CONTOUR MAP

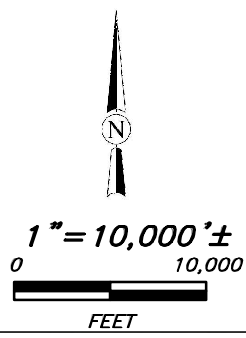


EXPLANATION

 EEL RIVER GROUNDWATER BASIN

WELLS

-  CASGEM WELLS
-  MUNICIPAL WELLS
-  PRIVATE WELLS
-  COUNTY MONITORING WELLS



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Humboldt County Public Works
Eel River GW Assessment
Humboldt County, California

Groundwater Elevation
Map - Fall 2017
SHN 016219

March 2019

GW_Elevations_Fall2017


Figure 7

Path: \\eureka\projects\2016\016219-EelRiverGW\GIS\PROJ_MXD\2019\GW_Elevations_Fall2017.mxd


**SPRING 2018 GROUNDWATER
CONTOUR MAP**


Path: \\eureka\projects\2016\016219-EelRiverGW\GIS\PROJ_MXD\2019\GW_Elevations_Spring20182019.mxd


EXPLANATION


 **EEL RIVER GROUNDWATER BASIN**

WELLS


 **CASGEM WELLS**

 **MUNICIPAL WELLS**

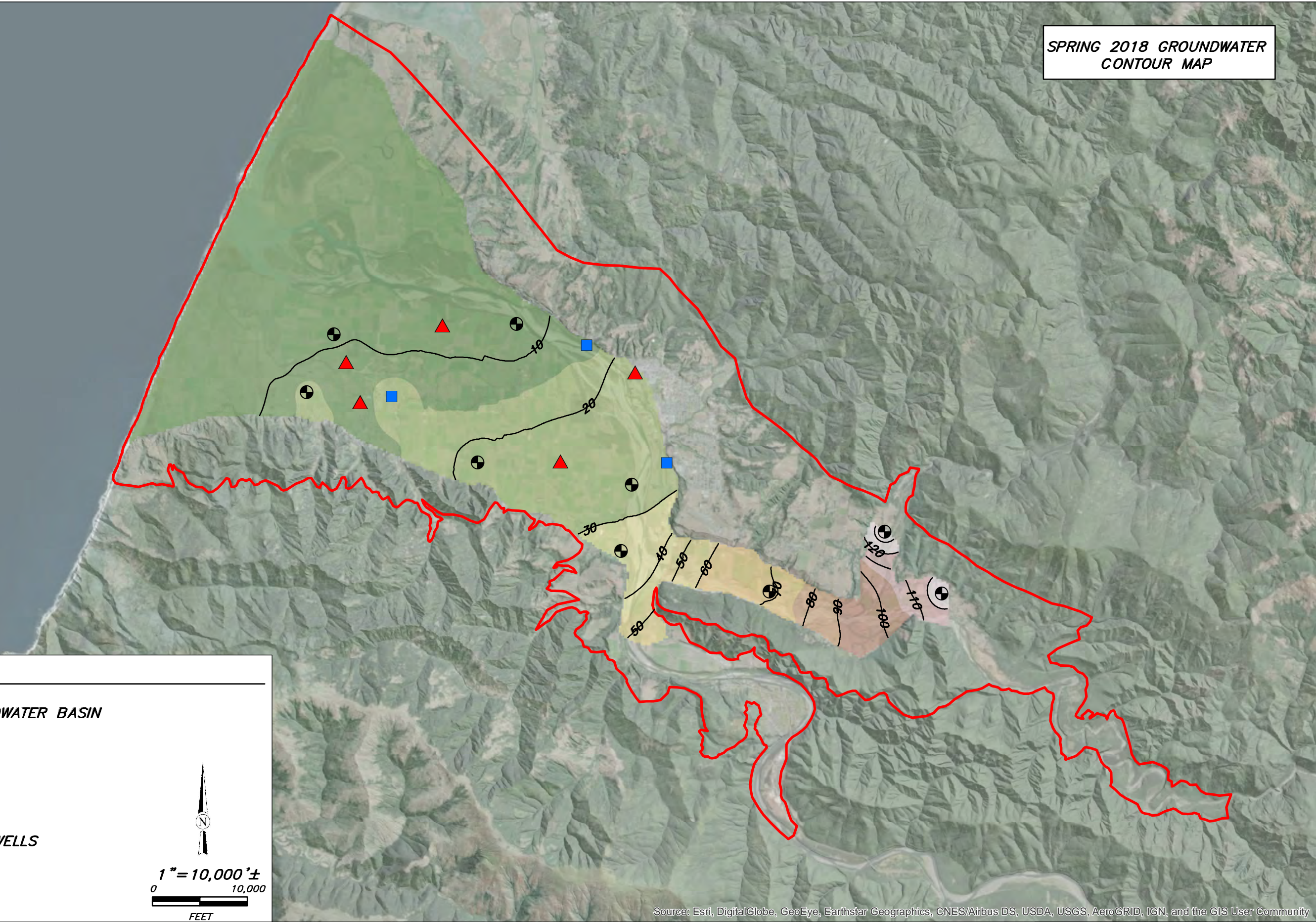
 **SHN MONITORING WELLS**



1" = 10,000' ±



FEET



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

<p>Humboldt County Public Works Eel River GW Assessment Humboldt County, California</p>		<p>Groundwater Elevation Map - Spring 2018 SHN 016219</p>	
<p>March 2019</p>	<p>GW_Elevations_Spring20182019</p>	<p>Figure 8</p>	

EXPLANATION

100 mg/l line of equal chloride concentration (Johnson, 1975)

— Certain

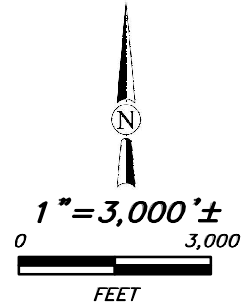
- - - Approximate

● 2018 CHLORIDE SAMPLE LOCATIONS

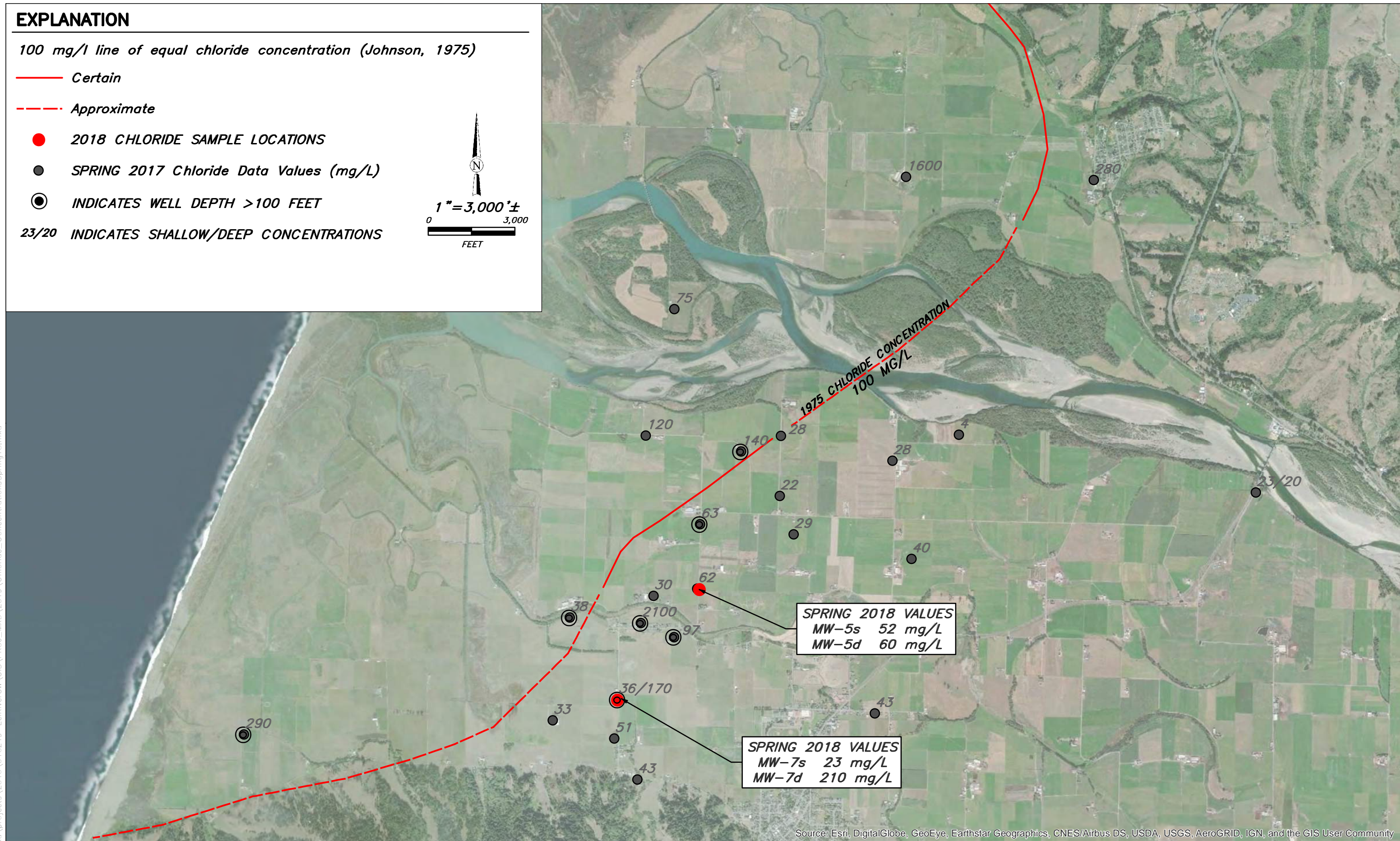
● SPRING 2017 Chloride Data Values (mg/L)

⊙ INDICATES WELL DEPTH >100 FEET

23/20 INDICATES SHALLOW/DEEP CONCENTRATIONS



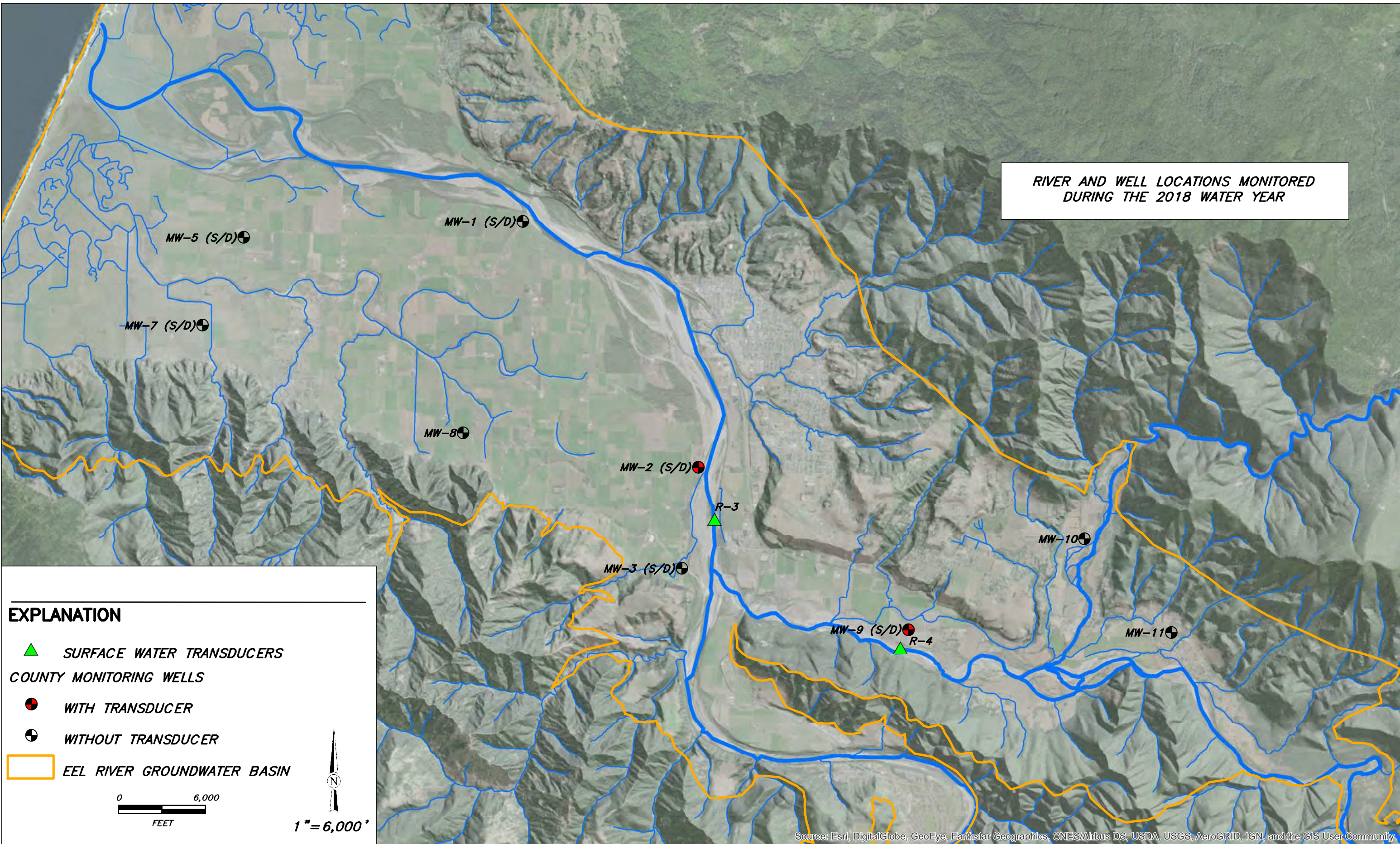
Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ_MXD\2019\Chloride_ConcentrationsSpring18.mxd



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Humboldt County Public Works Eel River Groundwater Assessment Humboldt County, California		Spring 2018 Chloride Concentrations Map SHN 016219	
March 2019	Chloride_ConcentrationsSpring18	Figure 9	

RIVER AND WELL LOCATIONS MONITORED DURING THE 2018 WATER YEAR



EXPLANATION

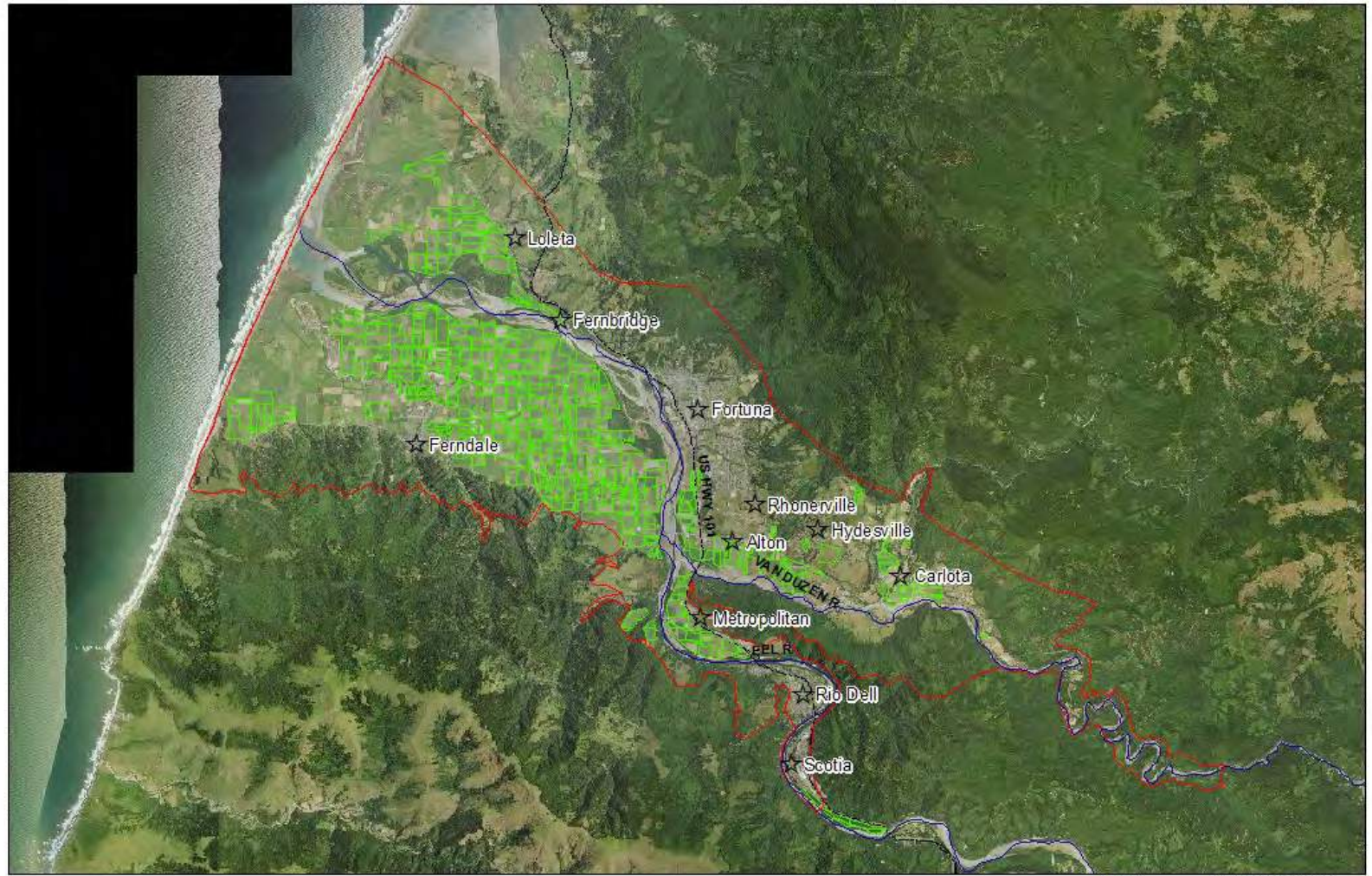
- ▲ SURFACE WATER TRANSDUCERS
- COUNTY MONITORING WELLS**
- WITH TRANSDUCER
- ⊕ WITHOUT TRANSDUCER
- EEL RIVER GROUNDWATER BASIN

0 6,000
FEET

1" = 6,000'

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ_MXD\2019\10_CWSW_Monitoring_Locations.mxd



Irrigated Acres

Irrigated Acres

Eel River Valley Groundwater Basin 1-010

— Major Waterways

--- Highways

☆ City

Humboldt County



0 2.5 5 Miles

Maps are for graphical purposes only. They do not represent a legal survey. While every care has been taken to prepare this map, the HCRCD makes no representations about its accuracy, reliability or completeness for any particular purpose, and thus cannot accept any liability or responsibility of any kind which may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable.

Date: 12/7/2016
2014 NAIP Imagery





Irrigated Acres

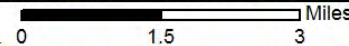
Irrigated Acres

Eel River Valley Groundwater Basin 1-010

Major Waterways

Highways

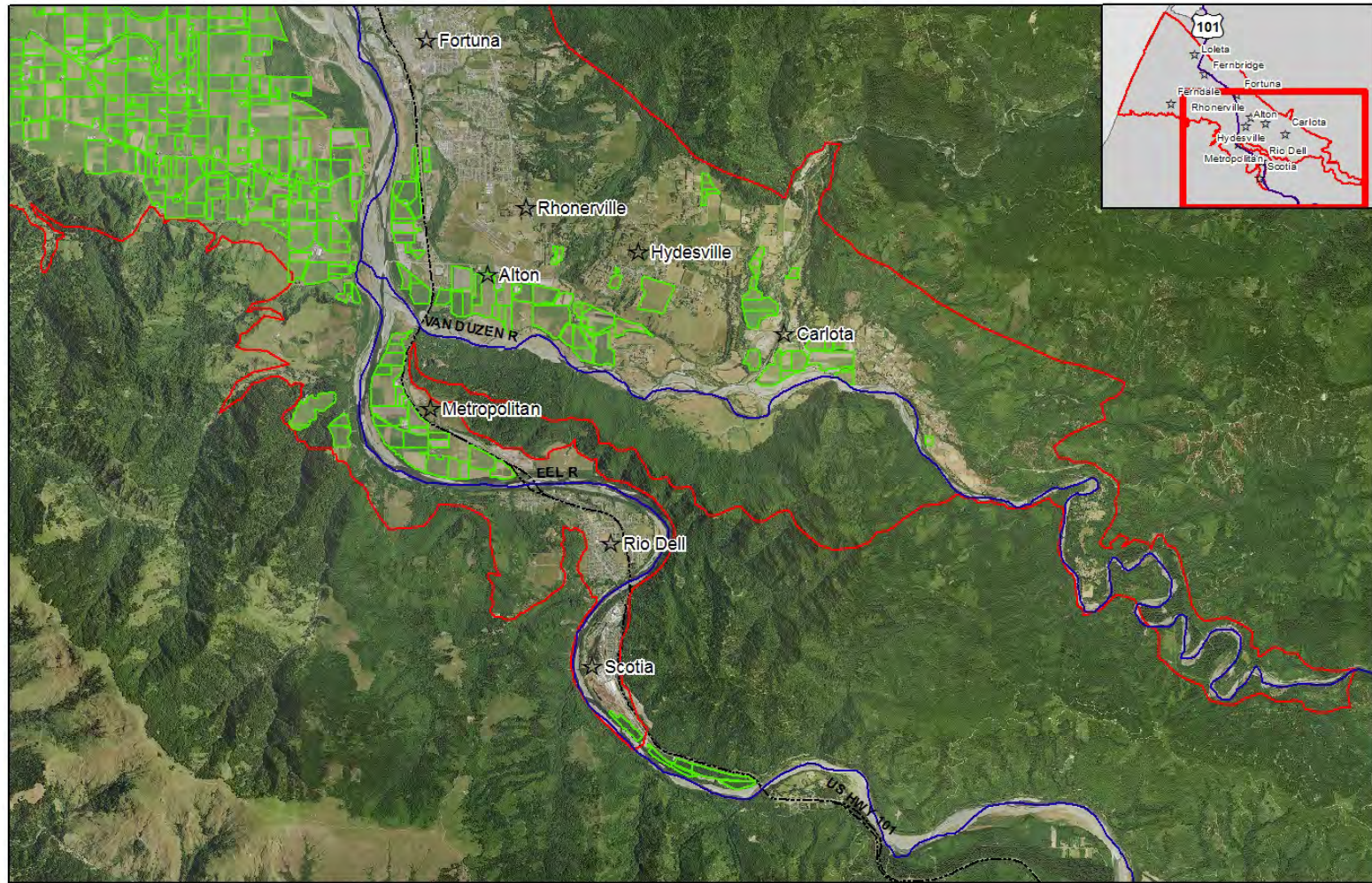
☆ City



Date: 12/7/2016
2014 NAIP Imagery

Maps are for graphical purposes only. They do not represent a legal survey. While every care has been taken to prepare this map, the HCRCD makes no representations about its accuracy, reliability or completeness for any particular purpose, and thus cannot accept any liability or responsibility of any kind which may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable.





Irrigated Acres

Irrigated Acres

Eel River Valley Groundwater Basin 1-010

Major Waterways

Highways

City

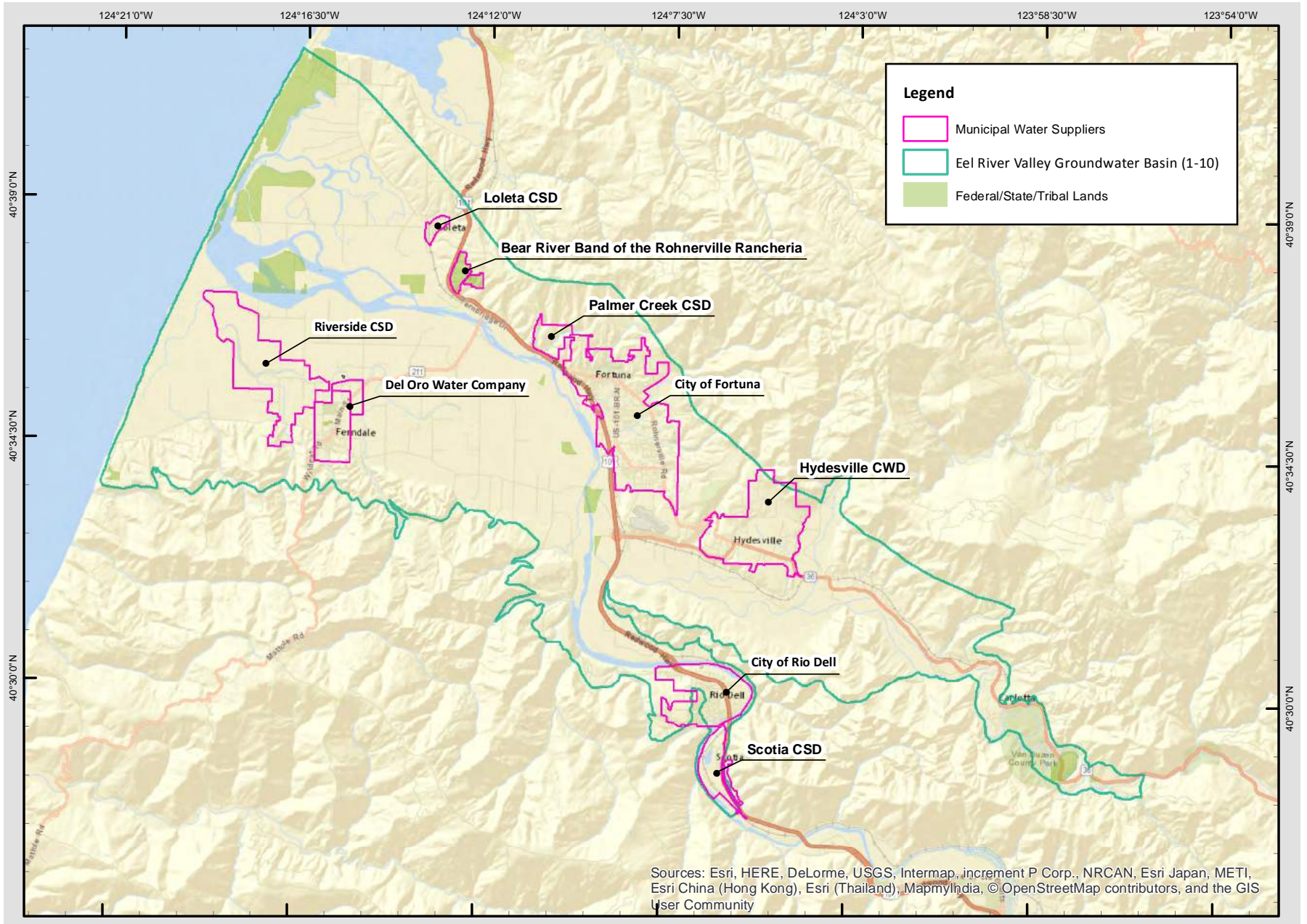


0 1.5 3 Miles

Maps are for graphical purposes only. They do not represent a legal survey. While every care has been taken to prepare this map, the HCRCD makes no representations about its accuracy, reliability or completeness for any particular purpose, and thus cannot accept any liability or responsibility of any kind which may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable.

Date: 12/7/2016
2014 NAIP Imagery





NO LONGER USED
(WELL DESTROYED)

CASGEM
WELL 23182

CASGEM
WELL 23181

CASGEM
WELL 23183

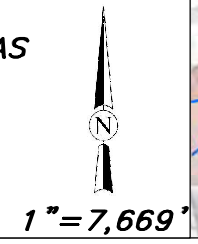
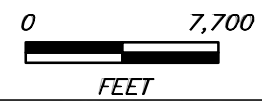
CASGEM
WELL 36942

Parameters Used in Analysis of Storage Changes

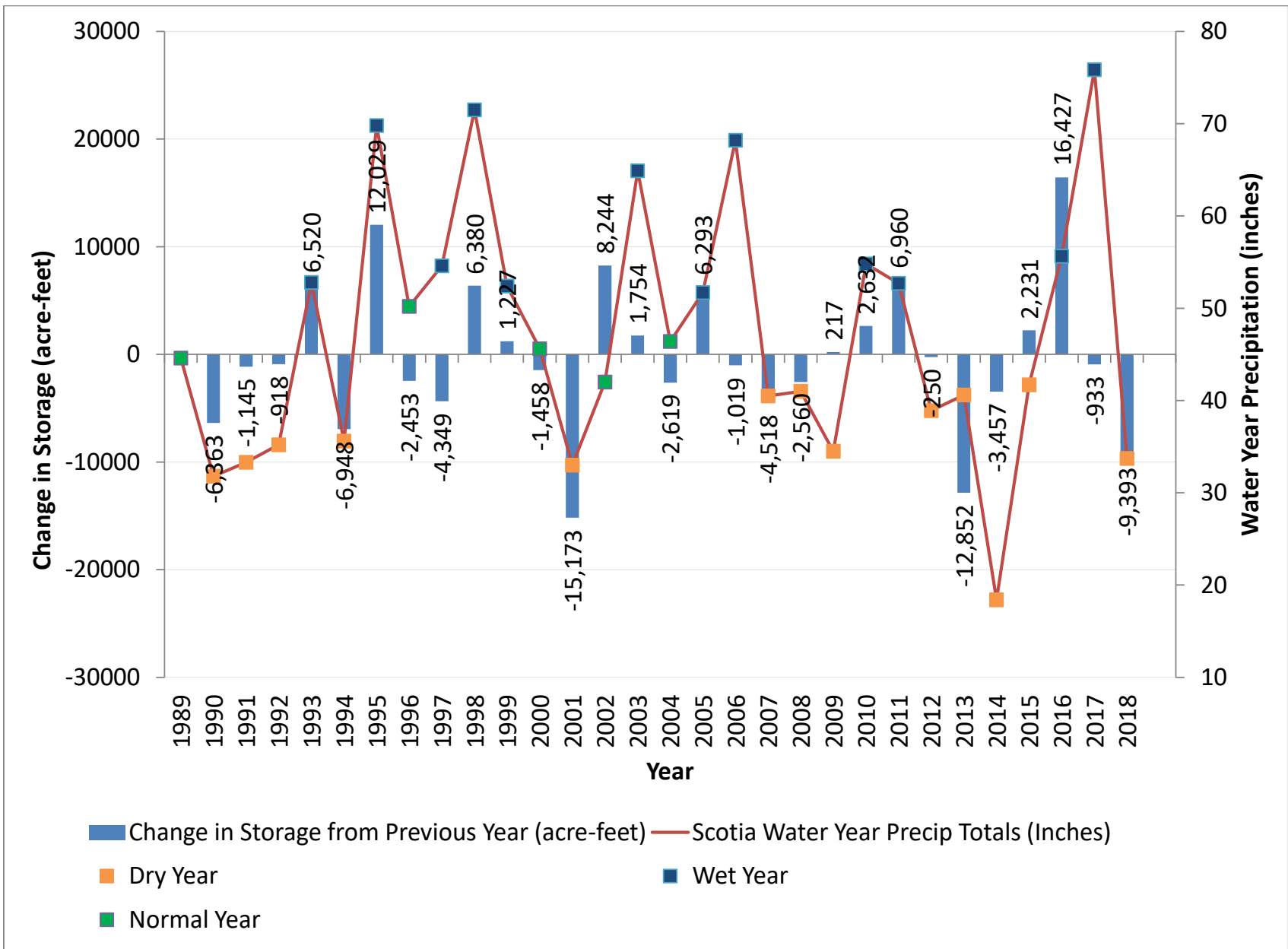
CASGEM Well ID#	Area of Associated Polygon (acres)	Estimated Specific Yield
23181	7019	17%
23183	7331	10%
36942	5724	22%

EXPLANATION

- CASGEM WELLS
- CHANGE IN STORAGE CALCULATION AREAS
- EEL RIVER GROUNDWATER BASIN



Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ_MXD\2019\13_Change_in_Storage_Analysis.mxd

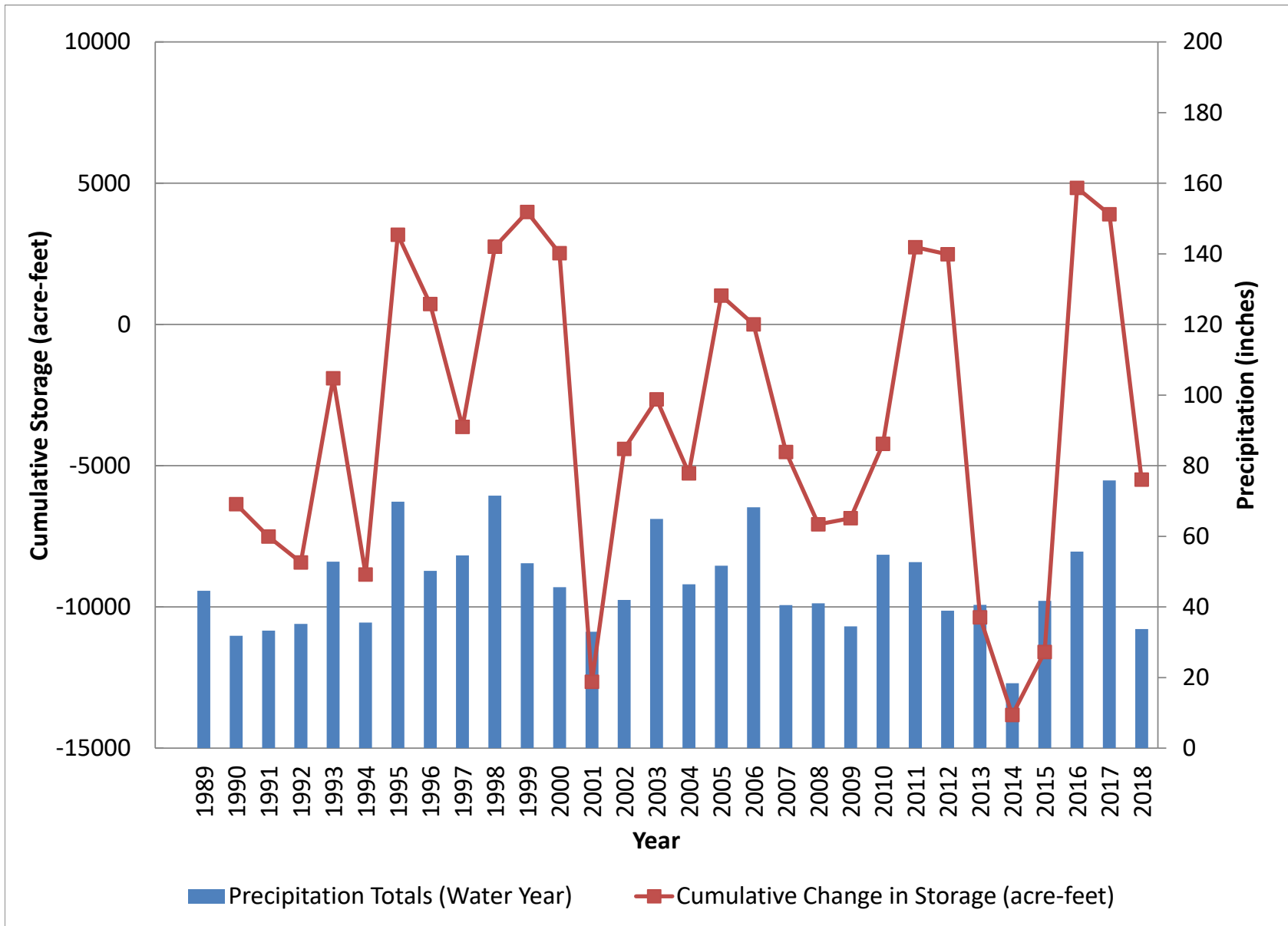


NOTE: CHANGES IN GROUNDWATER STORAGE WERE CALCULATED USING THE LONG-TERM BI-ANNUAL WATER LEVELS RECORDED BY DWR IN REPRESENTATIVE WELLS (SEE FIGURE 13).



Humboldt County Public Works
Eel River Groundwater Assessment
Humboldt County, California

Changes in Groundwater Storage
in the Lower Eel River Valley
SHN 016219



Humboldt County Public Works
 Eel River Groundwater Assessment
 Humboldt County, California

Cumulative Changes in Storage
 in the Lower Eel River Valley
 SHN 016219

**Groundwater Elevation
Data Tables 2**

**Table 2-1. Fall 2017 Elevation Monitoring
Eel River Valley Groundwater Basin**

Well Location	Field ID	Depth to Water Measurement Date	GW Elevation (ft, NAVD88) ¹	Well Depth	Analyzed by
Private Wells					
02N01W22H002H	20	11/16/2017	29.28	110	SHN/HCRCD ²
02N01W24E001H	22	11/16/2017	39.85	60	SHN/HCRCD
02N01E19L001H	C-23	11/16/2017	62.9	80	SHN/HCRCD
County Wells					
03N01W29Q001H	MW-1s	11/17/2017	2.65	35	SHN
03N01W29Q002H	MW-1d	11/17/2017	2.65	60	SHN
02N01W10R002H	MW-2s	11/17/2017	22.94	35	SHN
02N01W10R002H	MW-2d	11/17/2017	22.50	60	SHN
02N01W22H001H	MW-3d	11/17/2017	27.88	60	SHN
03N02W34A002H	MW-5s	11/17/2017	4.29	110	SHN
03N02W34A002H	MW-5d	11/17/2017	6.65	210	SHN
02N02W03C001H	MW-7s	11/17/2017	14.09	40	SHN
02N02W03C002H	MW-7d	11/17/2017	8.92	240	SHN
02N01W07J001H	MW-8	11/17/2017	14.26	160	SHN
02N01E19Q001H	MW-9s	11/17/2017	63.66	25	SHN
02N01E19Q001H	MW-9d	11/17/2017	63.56	48	SHN
02N01E16R001H	MW-10	11/17/2017	128.32	29	SHN
CASGEM Wells ³					
03N01W30N001H	23181	10/24/2017	0.02	50	DWR ⁴
03N02W35M001H	23183	10/24/2017	6.31	42	DWR
02N01W08B001H	23178	10/24/2017	8.43	40	DWR
02N01W09K001H	36942	10/24/2017	16.23	30	DWR
03N01W34J001H	36944	10/24/2017	21.03	496	DWR
02N02W02G001H	36943	10/24/2017	7.92	210	DWR
Municipal Wells					
02N02W01D001H	Del Oro	11/29/2017	14.01	--	MUNICIP.
02N01W11G001H	Fortuna #1	10/5/2017	24.84	--	MUNICIP.
02N01W11G002H	Fortuna #4	10/5/2017	21.91	--	MUNICIP.
<ol style="list-style-type: none"> 1. Groundwater elevation (measured by the foot; North American Vertical Datum of 1988) 2. HCRCD: Humboldt County Resource Conservation District 3. CASGEM: California Statewide Groundwater Elevation Monitoring (CASGEM) wells 4. DWR: California Department of Water Resources 					

**Table 2-2. Spring 2018 Elevation Monitoring
Eel River Valley Groundwater Basin**

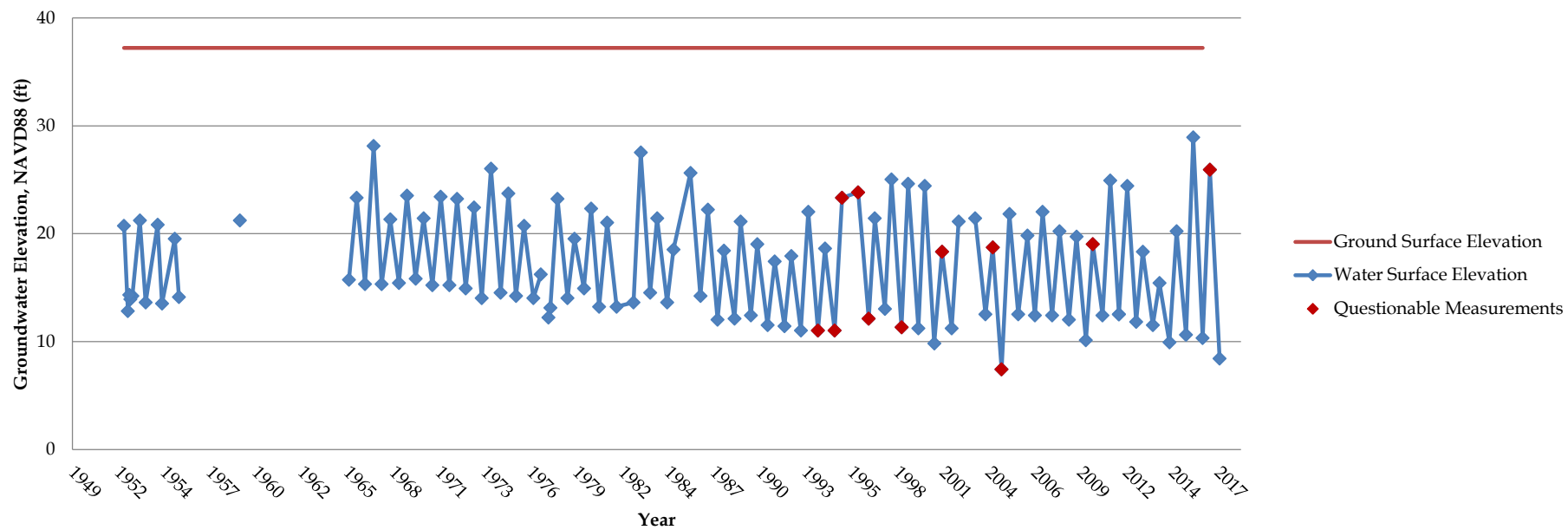
Well Location	Field ID	Depth to Water Measurement Date	GW Elevation (ft, NAVD88) ¹	Well Depth	Analyzed by
County Wells					
03N01W29Q001H	MW-1s	4/3/2018	4.24	35	SHN
03N01W29Q002H	MW-1d	4/3/2018	4.27	60	SHN
02N01W10R002H	MW-2s	4/3/2018	24.68	35	SHN
02N01W10R002H	MW-2d	4/3/2018	24.86	60	SHN
02N01W22H001H	MW-3d	4/3/2018	31.31	35	SHN
03N02W34A002H	MW-5s	4/3/2018	7.91	110	SHN
03N02W34A002H	MW-5d	4/3/2018	9.40	210	SHN
02N02W03C001H	MW-7s	4/3/2018	17.30	40	SHN
02N02W03C002H	MW-7d	4/3/2018	11.55	240	SHN
02N01W07J001H	MW-8	4/3/2018	21.91	160	SHN
02N01E19Q001H	MW-9s	4/3/2018	68.85	25	SHN
02N01E16R001H	MW-10	4/3/2018	134.18	29	SHN
02N01E23N001H	MW-11	4/3/2018	127.07	46	SHN
CASGEM Wells ²					
03N01W30N001H	23181	3/27/2018	7.92	50	DWR ³
03N02W35M001H	23183	3/27/2018	13.01	42	DWR
02N01W09K001H	36942	3/27/2018	22.73	30	DWR
02N02W02G001H	36943	3/27/2018	13.52	210	DWR
03N01W34J001H	36944	3/27/2018	25.03	496	DWR
Municipal Wells					
02N02W01D001H	Del Oro	4/4/2018	18.63	--	MUNICIP.
02N01W11G001H	Fortuna #1	4/10/2018	33.44	--	MUNICIP.
02N01W11G002H	Fortuna #4	4/10/2018	30.71	--	MUNICIP.
03N01W33A002H	Palmer Creek #2	4/2/2018	14.3	--	MUNICIP.
<ol style="list-style-type: none"> 1. Groundwater elevation (measured by the foot; North American Vertical Datum of 1988) 2. CASGEM: California Statewide Groundwater Elevation Monitoring (CASGEM) wells 3. DWR: California Department of Water Resources 					

**Table 2-3. River and Groundwater Monitoring Sites
Eel River Valley Groundwater Basin**

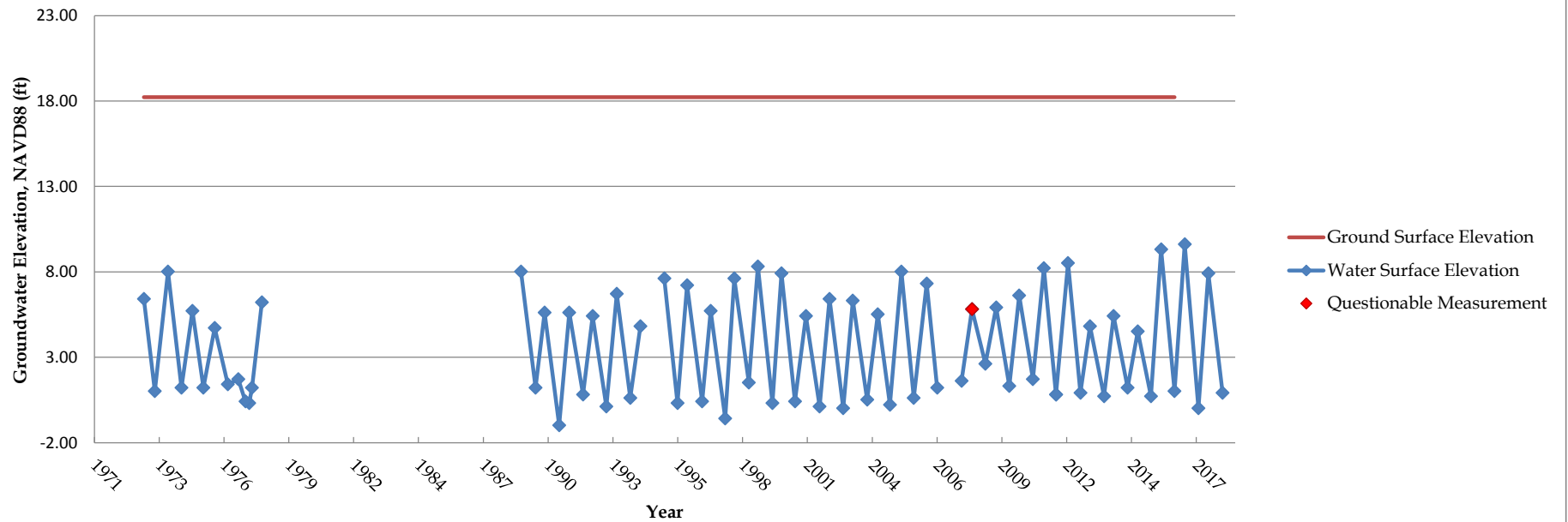
Location	Field ID	Date(s) Monitored	Well Depth	Notes
River Sites				
Eel River	River 3	9/30/16 – 12/10/16 and 7/5/17 – Present	--	Destroyed in Jan 2017 Flood (Replaced in July 2017)
Van Duzen	River 4	9/30/16 – Present	--	Thalweg Silted in at Installation in Jan 2017
County Monitoring Wells				
02N01W 10R002H	MW-2s	10/30/16 – 11/17/17 and 10/31/18 – Present	35	Reinstalled on 10/31/18 for 2019 WY monitoring
02N01W 10R002H	MW-2d	10/30/16 – Present	60	Period of Dry Transducer In Fall 2017
02N02W 03C002H	MW-7s	10/30/16 – 11/16/17 and 8/30/18 – Present	40	Reinstalled on 8/30/18 for 2019 WY monitoring
02N02W 03C002H	MW-7d	10/30/16 – 11/16/17 and 8/30/18 – Present	240	Reinstalled on 8/30/18 for 2019 WY monitoring
02N01E 19Q001H	MW-9s	10/30/16 – 11/16/17 and 10/31/18 to Present	25	Reinstalled on 10/31/18 for 2019 WY monitoring
02N01E 19Q001H	MW-9d	10/30/16 – Present	48	

Hydrographs **3**

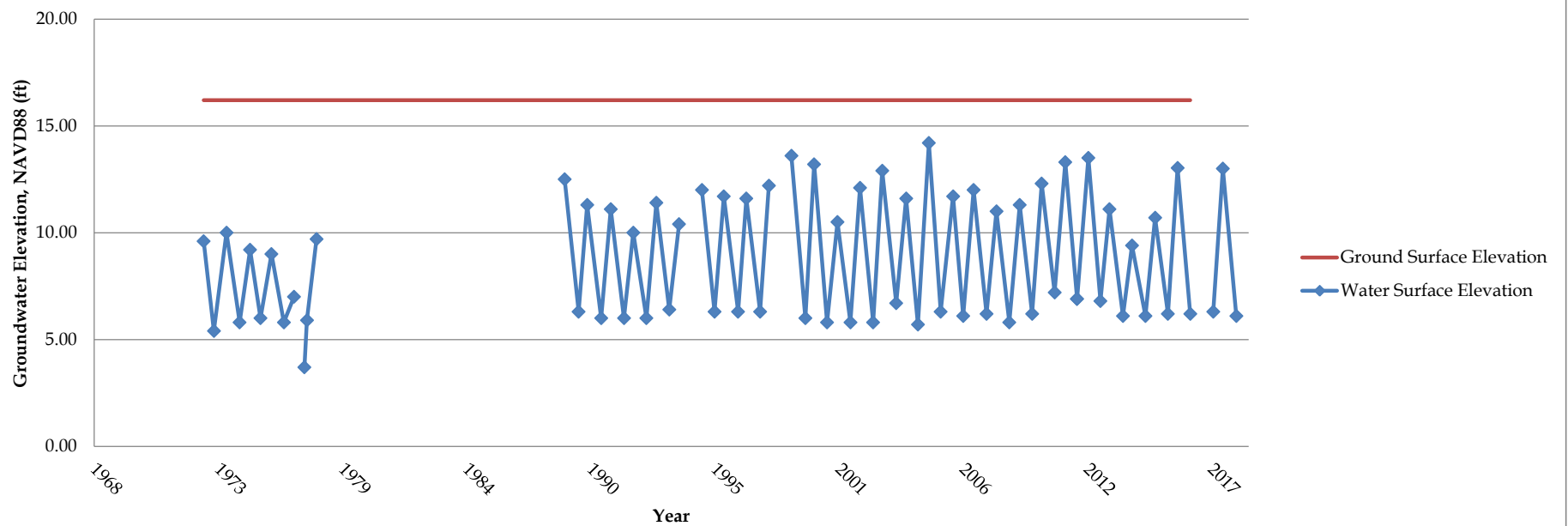
CASGEM Well ID 23178



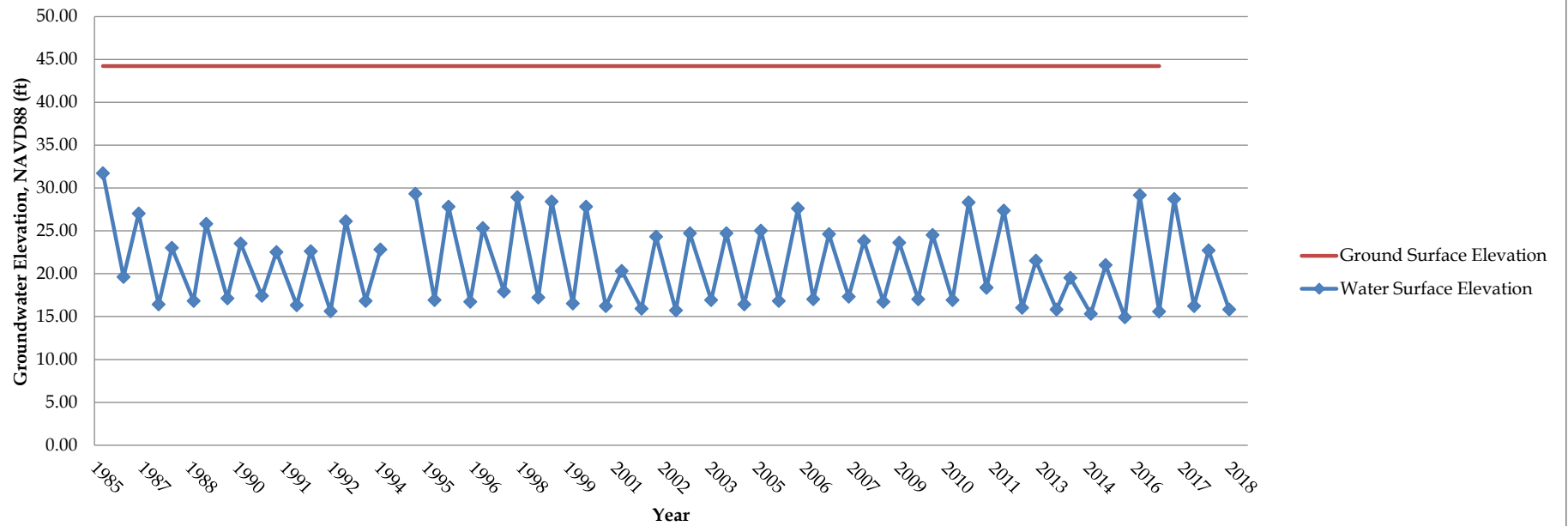
CASGEM Well ID 23181



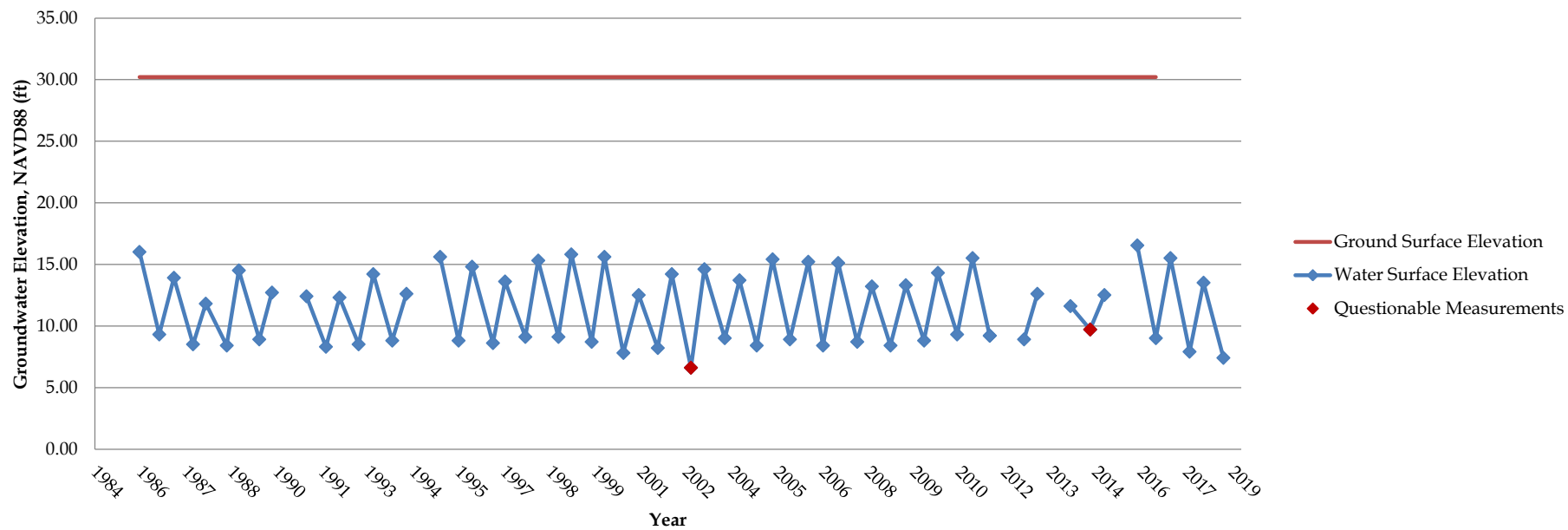
CASGEM Well ID 23183



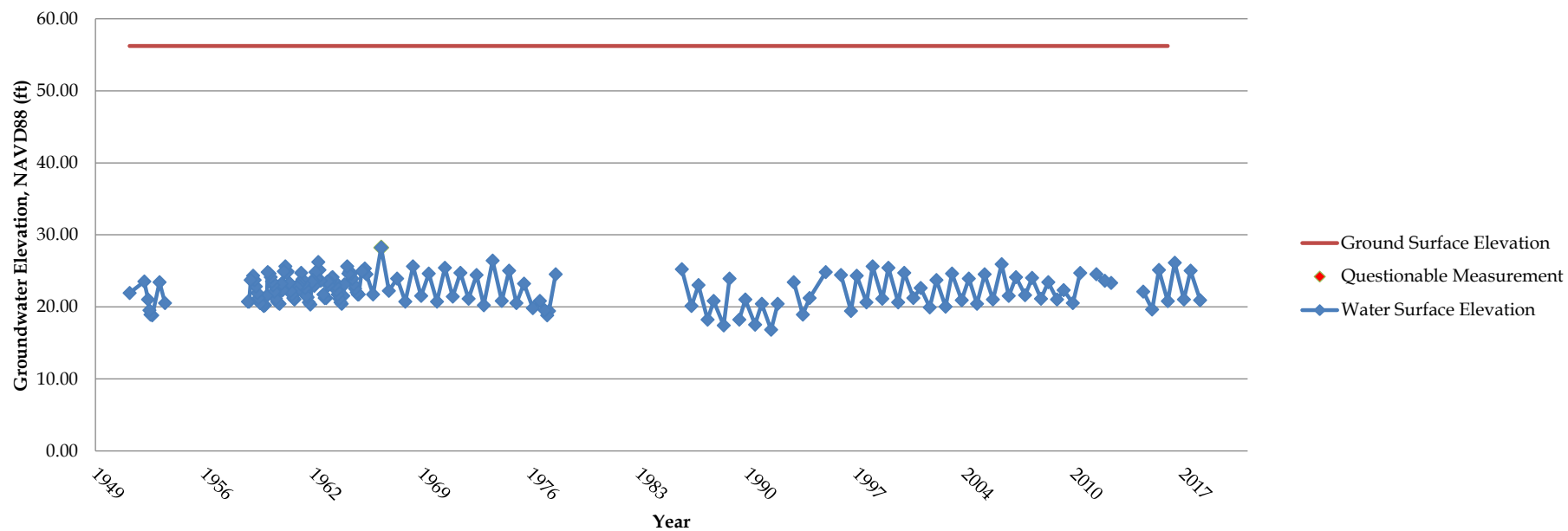
CASGEM Well ID 36942



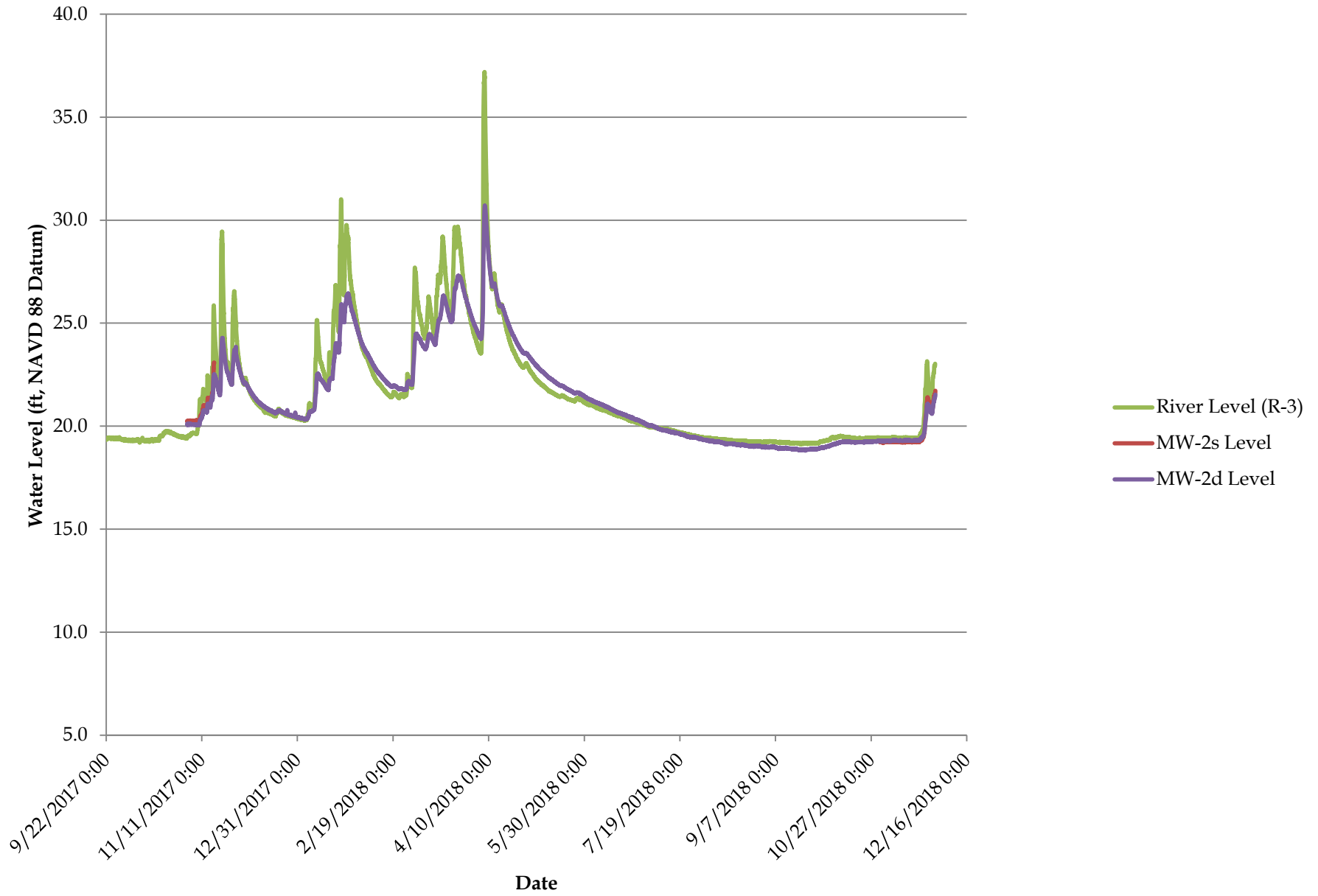
CASGEM Well ID 36943



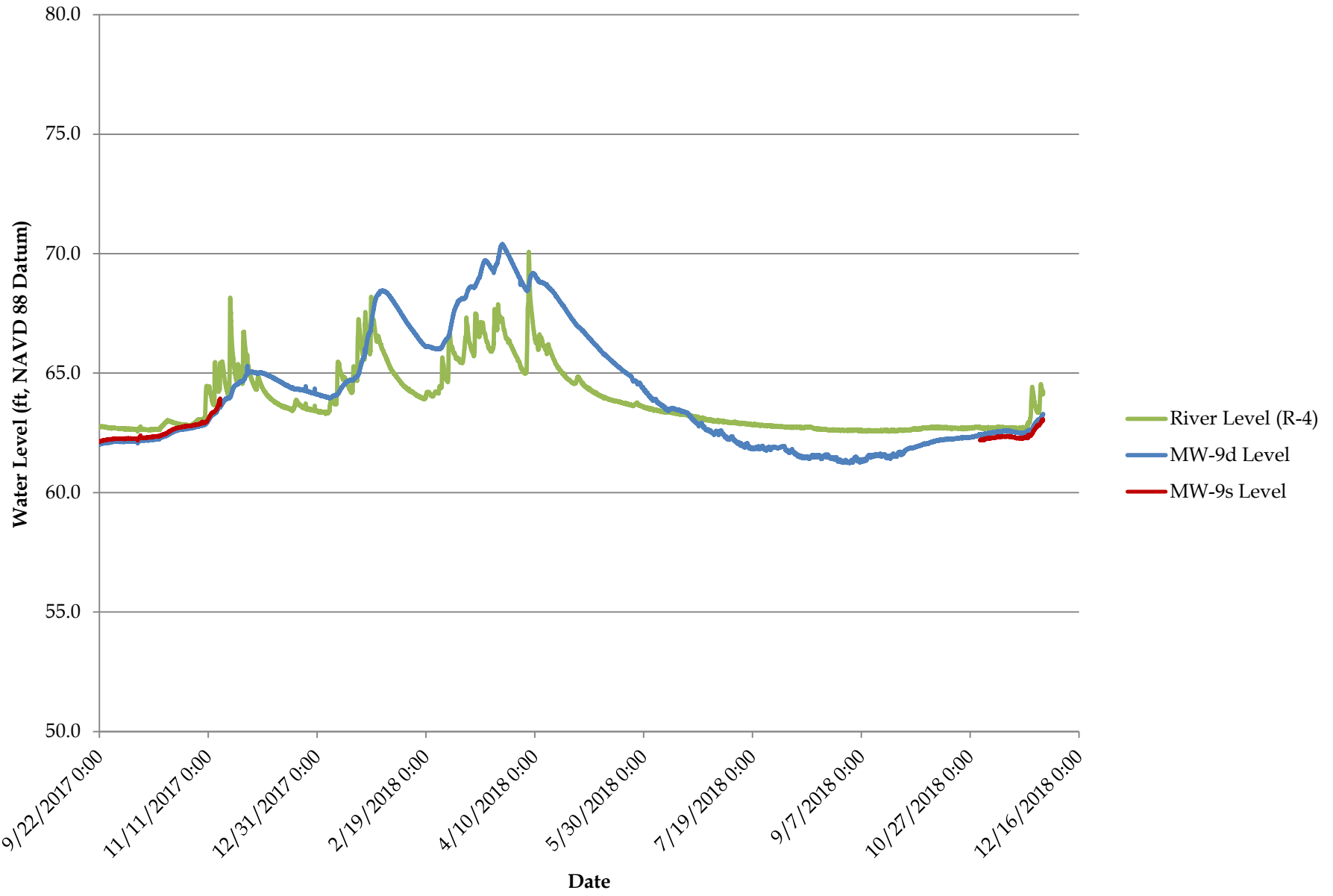
CASGEM Well ID 36944



MW-2 versus Eel River



MW-9 versus Van Duzen River





Eureka, CA | Arcata, CA | Redding, CA | Willits, CA | Coos Bay, OR | Klamath Falls, OR

www.shn-engr.com