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Technical Memorandum

SHN Reference:	020091.232
GHD Reference:	11217388. 2.3.1
Date:	January 24, 2022
To:	Summer Daugherty, Senior Environmental Analyst Humboldt County Department of Public Works-Environmental Services
Copy To:	Hank Seemann, Deputy Director Humboldt County Department of Public Works-Environmental Services
From:	SHN: Jason Buck and Alyssa Troia
Subject:	**Preliminary Analysis of 2020/2021 Surface Water and Groundwater Interaction Studies–Eel River Valley Groundwater Basin**

1.0 Introduction

1.1 Overview

This technical memorandum summarizes work and preliminary findings associated with studies focused on evaluating the surface water and groundwater interactions within the Eel River Valley Groundwater Basin, for inclusion in the Humboldt County Department of Public Works' Eel River Valley Groundwater Sustainability Plan (GSP).

The groundwater-surface water interactions within the Eel and Van Duzen rivers are complex and heavily influenced by the dynamic nature of the channel morphology. Relatively high flows and the resulting redistribution of channel deposits can significantly alter the locations of pools and riffles year to year. The river channels are primarily underlain by coarse alluvial deposits which are in good hydrologic connection with the shallow alluvial aquifers. Exchange of surface water and shallow groundwater below and surrounding the channel is easily accommodated by these conditions. Underflow, or shallow water flowing within the porous sediment below the channel, is a significant component of the flow system, and the topography of the channel can directly affect the complexity of this exchange.

The continuous water level data presented herein has only recently been initiated (at the time of this writing) and this memorandum is focused on presenting data that are considered the highest priority. Additional insight into the spatial and temporal relationships between these two systems will be afforded by the data collection that will continue under the GSP monitoring plan and will be reviewed during the development of annual reports and the 5-year update of the GSP.

1.2 Previous Work

This memorandum provides a preliminary look at the data collected within the Eel and Van Duzen rivers over the 2020 and 2021 low-flow seasons, building on previous work conducted as part of the

2016 "Eel River Valley Groundwater Basin, Sustainability Plan Alternative" (SHN, 2016) and monitoring since that time, which has been summarized in a 2019 Technical Memorandum titled "Preliminary Analysis of Surface Water/Groundwater Interaction Monitoring; Eel River Valley Groundwater Basin" (SHN, 2019).

The first broad-based surface-flow study within the Eel and Van Duzen rivers was conducted in 2016 by Thomas Gast & Associates Environmental Consultant (TGAEC). The results of that study are summarized on Figure 1.

2.0 2020/2021 Surface Flow Studies

Surface flow studies were conducted by TGAEC on selected sites on the Eel and Van Duzen Rivers in Fall 2020 and 2021 to provide empirical data to support the refinement of the hydrogeologic conceptual model and the development/calibration of the integrated groundwater surface water model, and improve the understanding of the groundwater-surface water interactions along the Eel and Van Duzen Rivers. Details of the data collection methods and results of the 2020 and 2021 surface flow studies are provided in technical memorandums prepared by TGAEC (2022, 2022a).

2.1 Site Selection

Ten locations were identified for the collection of surface water discharge measurements (three measurements at each location over the low-flow season) and each site was outfitted with a continuous surface water level monitoring station nearby to facilitate the development of a stage-discharge rating curve. Some sites were selected to provide a distribution of measurements within the Eel and Van Duzen Rivers, while a subset of locations was concentrated within the reach of the Eel River that traverses the head of the Lower Eel River Valley beginning at its confluence with the Van Duzen River extending downstream to the confluence with Palmer Creek (upstream of Fernbridge). This reach is of interest because it has the greatest potential for impact from groundwater use and was chosen as the focus for evaluating the sustainability indicator that relates to impacts to interconnected surface waters.

Locations within the river channels where surface discharge measurements can be made over a broad range of flow conditions requires specific channel configurations that have adequate water column depth and sufficient flow velocity to allow accurate measurements. Locations like this are limited within the Eel and Van Duzen Rivers. Final locations selected for these studies were adjusted based on field reconnaissance.

2.2 2020 Surface Flow Discharge Measurements

Three Eel River locations between the confluence with the Van Duzen River and Fernbridge were measured in 2020 and are shown on Figure 2. The results from three separate measurement campaigns at low flow, middle flow, and high flow conditions are provided on Table 1 (on the next page).

Table 1. Calibration Flows and USGS Gage Readings from the Same Time[a b]

Discharge Measurement Locations	Time	Measured Discharge (cfs)[c]	USGS[d] Scotia Discharge (cfs) 11477000	USGS Van Duzen Discharge (cfs) 11478500	Sum USGS (cfs)
Low Flow 9/23/2020					
QM-5	12:50	39.4	60.9	6.75	67.65
QM -2	16:20	33.1	60.9	6.75	67.65
Low Flow 9/25/2020					
QM -3	14:20	38.5	60.9	7.21	68.11
Middle Flow 11/16/2020					
QM -5	8:37	139.9	149	32.8	181.8
QM -2	10:37	144.2	147	31.7	178.7
QM -3	14:00	153.4	159	31.7	190.7
High Flow 12/14/2020					
QM -5	11:38	1235.47	623	501	1124
QM -2	12:52	1563.2	650	458	1108
QM -3	13:11	1596.97	657	453	1110

[a] Flows were changing during the middle and high flows and there is travel time for water to reach each location.
[b] Source: TGAEC (2022) showing the 2020 surface discharge measurements.
[c] cfs: cubic feet per second
[d] USGS: United States Geological Survey

2.3 2021 Surface Flow Discharge Measurements

In 2021, seven locations were added to the three measured in 2020 for a total of ten locations for surface flow measurements over the 2021 low-flow season. The 10 discharge measurement locations are shown on Figure 3, and measured surface flow discharges are shown on Table 2 (on the following page).

Table 2. Measured Discharge Values at each Discharge Measurement Location Over the 2021 Low-Flow Season and Discharge Reported by Nearby USGS[a] Gauging Stations[b] (cfs)[c]

Site	Date	Time	Measured Discharge (cfs)
QM-2	6/25/2021	8:50	175.084
	7/23/2021	9:30	43.50
	8/26/2021	12:43	8.81
QM -3	6/11/2021	13:42	299.03
	7/21/2021	13:45	51.87
	8/25/2021	14:06	22.09
QM -5	6/25/2021	9:52	189.347
	7/23/2021	11:50	49.96
	8/26/2021	15:38	13.95
QM-SW-1	6/25/2021	7:45	168.706
	7/21/2021	9:55	49.05
	8/25/2021	9:30	27.51
QM-SW-2	6/10/2021	10:15	6.98
	7/22/2021	13:00	2.26
	8/18/2021	11:45	0.09
QM-SW-3	6/4/2021	13:32	32.73
	7/22/2021	10:55	7.16
	8/18/2021	10:12	3.44
QM-SW-4	6/10/2021	13:27	44.53
	7/22/2021	14:20	7.71
	8/18/2021	13:30	5.05
QM-SW-5	6/11/2021	15:28	298.31
	7/23/2021	8:11	44.91
	8/25/2021	15:00	12.63
QM-SW-6	6/11/2021	12:17	261.93
	7/22/2021	9:00	54.04
	8/26/2021	10:43	25.15
QM-SW-7	6/11/2021	11:01	293.86
	7/21/2021	11:30	55.67
	8/25/2021	10:45	27.23
USGS Site #11478500 (Van Duzen near Bridgeville)	6/4/2021	13:30	34.4 [Pd]
	7/22/2021	11:00	6.24 [P]
	8/18/2021	10:15	3.44[P]
USGS Site # 11477000 (Eel at Scotia	6/11/2021	12:15	233 [Ae]
	7/22/2021	9:00	57.9 [A]
	8/26/2021	10:45	26.3[A]

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[a] USGS: United States Geological Survey
[b] Source: TGAEC (2022a) showing the 2021 surface discharge measurements.
[c] cfs: cubic feet per second
[d] USGS provisional value
[e] USGS-accepted value

2.4 Preliminary Analysis of 2020/2021 Discharge Measurements

In general, the results indicate that during low-flow conditions, Eel River surface flows decrease in the downstream direction through the upper and middle portions of the study area and then increase in the lower portion. This condition was observed in the 2016 surface flow studies (SHN, 2016) and is interpreted to be in part due to the geomorphology of the Eel River channel and the sediments that form the underlying channel substrate.

The channel profile of the Eel River, taken from the project Digital Elevation Model (DEM; GHD, 2021), is shown on Figure 4 and illustrates that the upper portion of the Eel River through this reach has a series of steps, which often occurs as a sequence of pools and riffles. This stepped profile of the surface water results in a complex pattern of interaction with the groundwater, which is generally planar, and easily flows through the thick sequence of coarse deposits underlying the channel. In general, areas where the surface water is above the groundwater promote losing stream conditions or discharge losses to underflow along the profile. The areas where the surface water is below the groundwater promote gaining stream conditions or discharge gains from emergent underflow.

Both the QM-2 and QM-3 locations are positioned on the downstream end of pools at an inflection point (change in slope) of the profile, which is an environment that can see increased underflow. QM-2 is located where a section of the Eel River went completely subsurface in 2014. According to reports, surface flows picked back up downstream where underflow emerged back onto the surface (Times Standard, 2014).

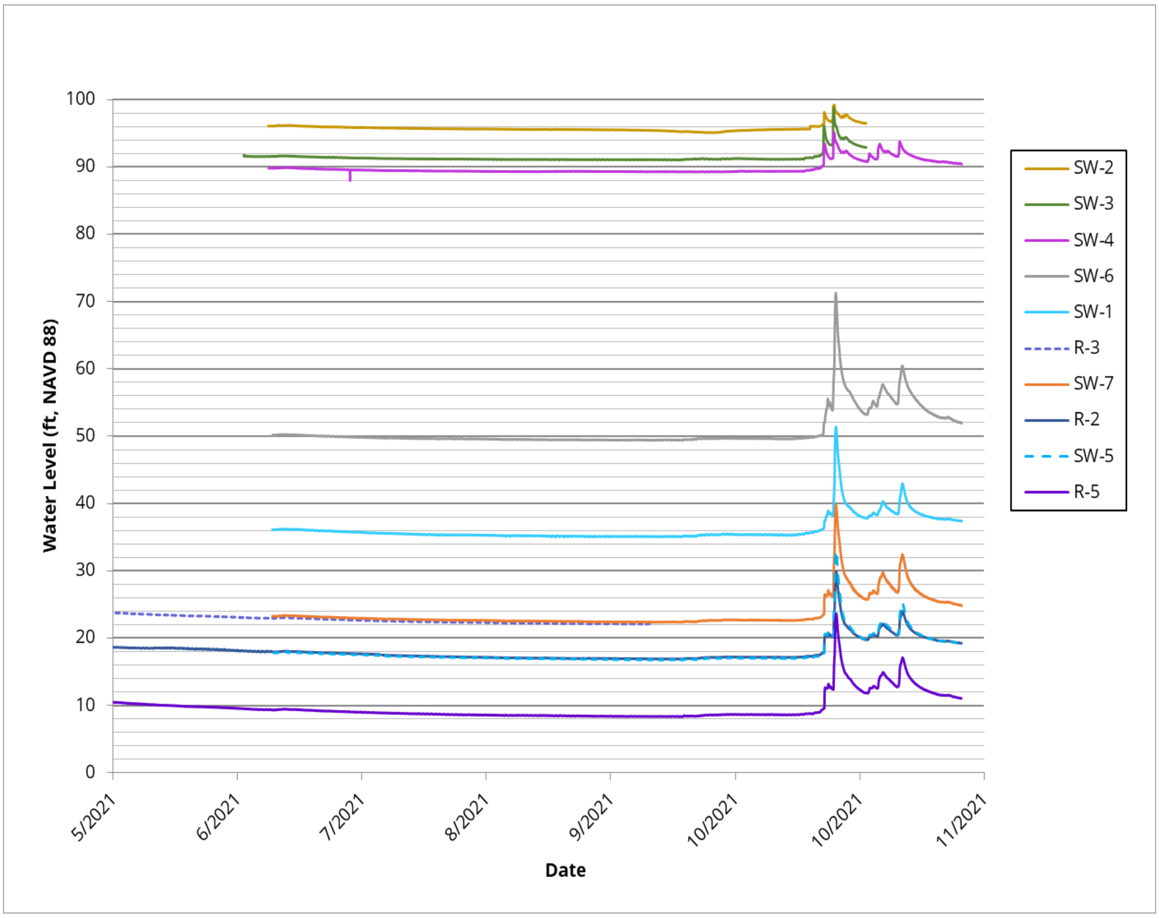
3.0 Surface Water and Groundwater Interactions

Continuous water level monitoring in the river channels and nearby County monitoring wells over the course of the 2021 low-flow season provides the opportunity to assess the relationship between surface water and groundwater and identify the spatial and temporal patterns of gaining and losing stream conditions. Figure 5 shows locations where continuous water level data has been collected within and near the Eel and Van Duzen rivers over the 2021 low flow season. The data collected as of November 2021 is reviewed and discussed below, and a focused review of the data is made for the 5-mile section of the Eel River between its confluence with the Van Duzen River extending downstream to the intertidal reach near Fernbridge (Figures 5-1, 5-2, and 5-3).

3.1 Surface Water Level Monitoring

As part of TGAEC's 2020 and 2021 surface water monitoring studies, continuous surface water level data was collected using pressure transducers at each of the ten study sites. Transducer R-3 has been collecting data since 2017 and two additional transducers (R-2 and R-5) were installed in September 2020. As part of the 2021 surface water monitoring studies, seven additional transducers were installed in June 2021 (SW-1 through SW-7) and recorded water levels through the 2021 dry season and into the wet season before they were pulled at the end of November 2021. Three transducers (R-2, R-3, and R-5) have been left in place to continue collecting surface water level data along the Lower Eel River into the future.

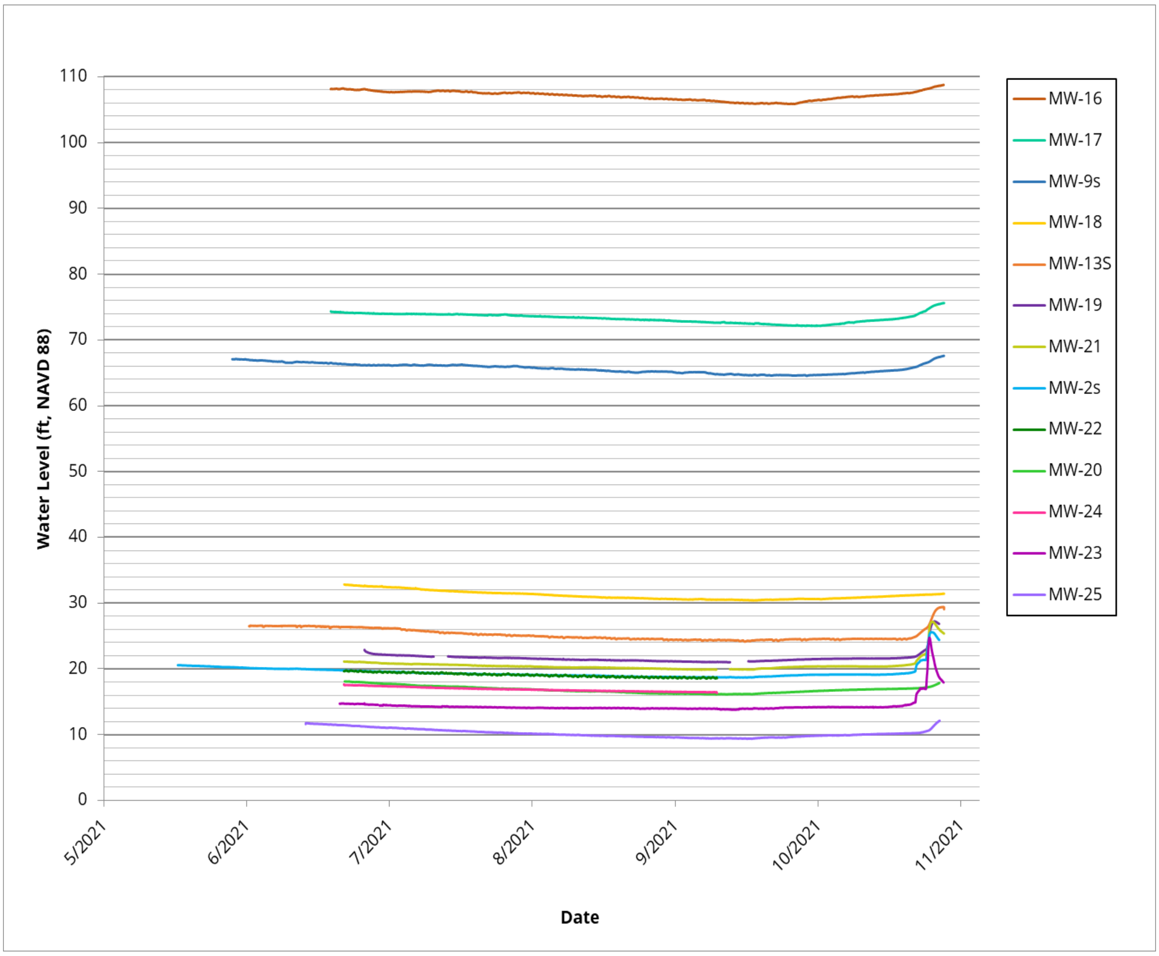
A composite graph of the continuous surface water level data that was collected in 2021 is provided as Graph 1, below.



Graph 1. Continuous Surface Water Level Data Collected Over the 2021 Dry Season.

3.2 Groundwater Level Monitoring

The collection of continuous water level data was initiated in all the 37 active County monitoring wells beginning in June/July 2021. A subset of these wells was specifically located to provide groundwater level data near the rivers. County monitoring wells near the Eel and Van Duzen Rivers, and the surface water stations that were monitored over the course of the 2021 dry season are shown on Figure 5. A composite hydrograph showing the continuous groundwater level data collected in 2021 from the County monitoring wells shown on Figure 5 is provided as Graph 2, below.



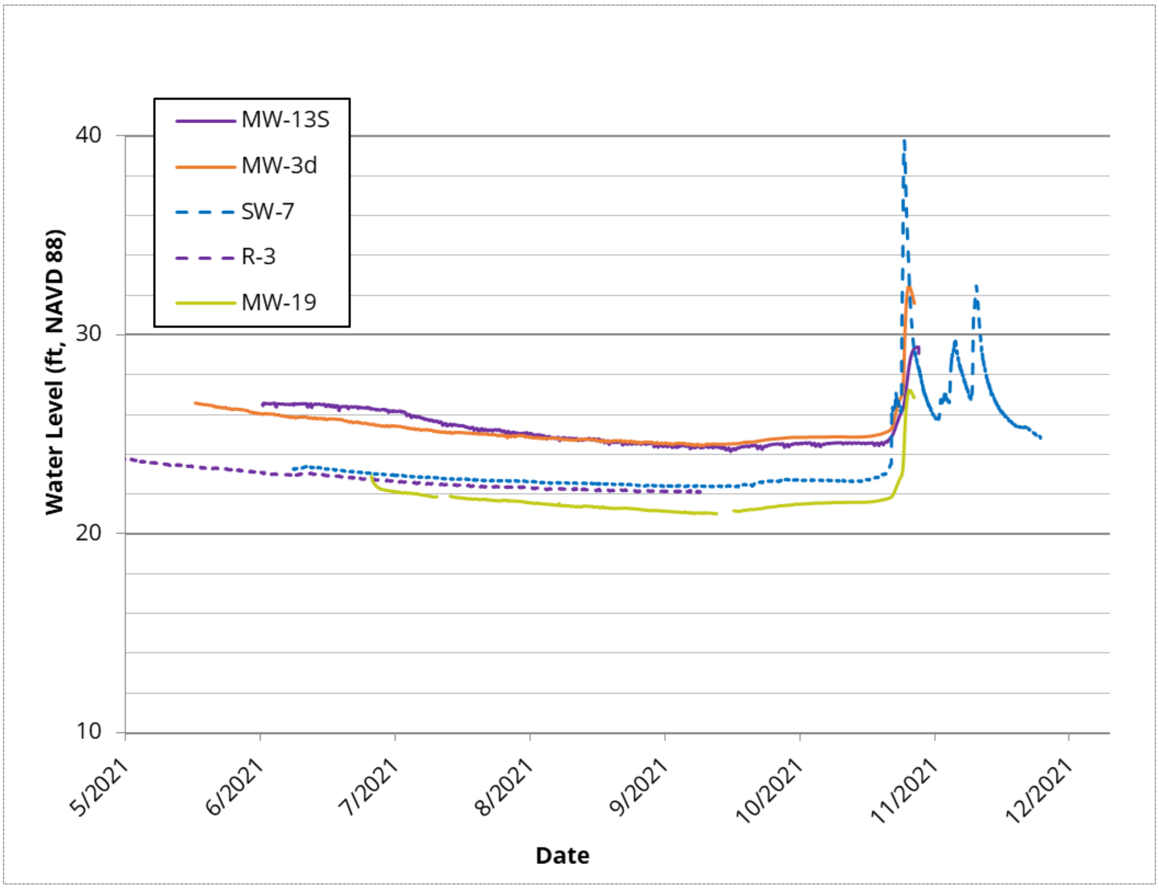
Graph 2. Continuous Groundwater Level Data Collected Near the Eel and Van Duzen Rivers Over the 2021 Dry Season (see Figure 5 for locations).

3.3 Surface Water and Groundwater Conditions along the Lower Eel River

A focused look at the gaining and losing conditions along the Lower Eel River during the low-flow season is discussed below. The lowest water levels within the groundwater and surface water systems occurred in mid- to late-September, just prior to the first rains of the wet season. The water level elevations during this lowest point are plotted on Figures 5-1 through 5-3. It's important to note that surface water level elevations have been tied to surveyed benchmarks (high accuracy), whereas the groundwater elevations are tied to ground surface elevations pulled from the Project DEM (lower accuracy).

3.3.1 Conditions near the Confluence with the Van Duzen

Figure 5-1 shows the continuous monitoring locations in the vicinity of the Eel River's confluence with the Van Duzen River. A plot of the water levels recorded at these locations is provided on Graph 3, below.



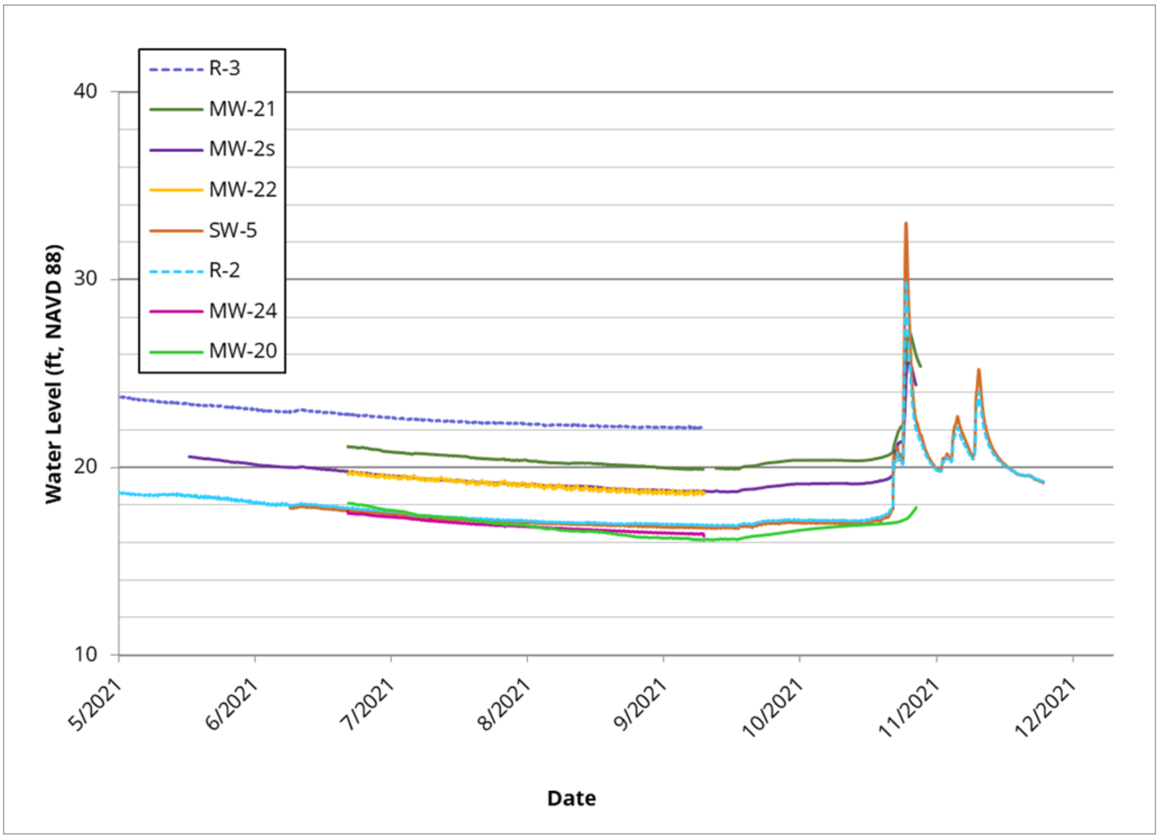
Graph 3. Surface Water (Dashed) and Groundwater Elevations Near the Confluence of the Eel and Van Duzen Rivers (see Figure 5-1 for locations).

A review of the relationship of the water levels between MW-13s and SW-7 indicate that the right bank of the Eel River is a gaining stream throughout the low-flow season with a persistent head difference of approximately 2 feet. The relationship between SW-7 and MW-19 indicates that the left bank is in a losing stream condition with approximately 1 foot of head difference.

MW-3d is positioned near the base of the Wildcat hills off the left bank of the Eel River where it enters into the Lower Eel River Valley. The Eel River channel drops in elevation through a series of steps as it enters the valley and surface waters are higher than those recorded at the SW-7 location (see Figure 4). The relationship between groundwater levels in MW-3d and adjacent surface water levels has been shown in previous studies (SHN, 2019) to represent losing conditions throughout the low flow season.

3.3.2 Conditions Downstream of the Eel/Van Duzen Confluence (Figure 5-2)

Figure 5-2 shows the continuous monitoring locations downstream of the Eel River's confluence with the Van Duzen River and upstream of the 12th Street pool. A plot of the water levels recorded at these locations is provided on Graph 4, below.

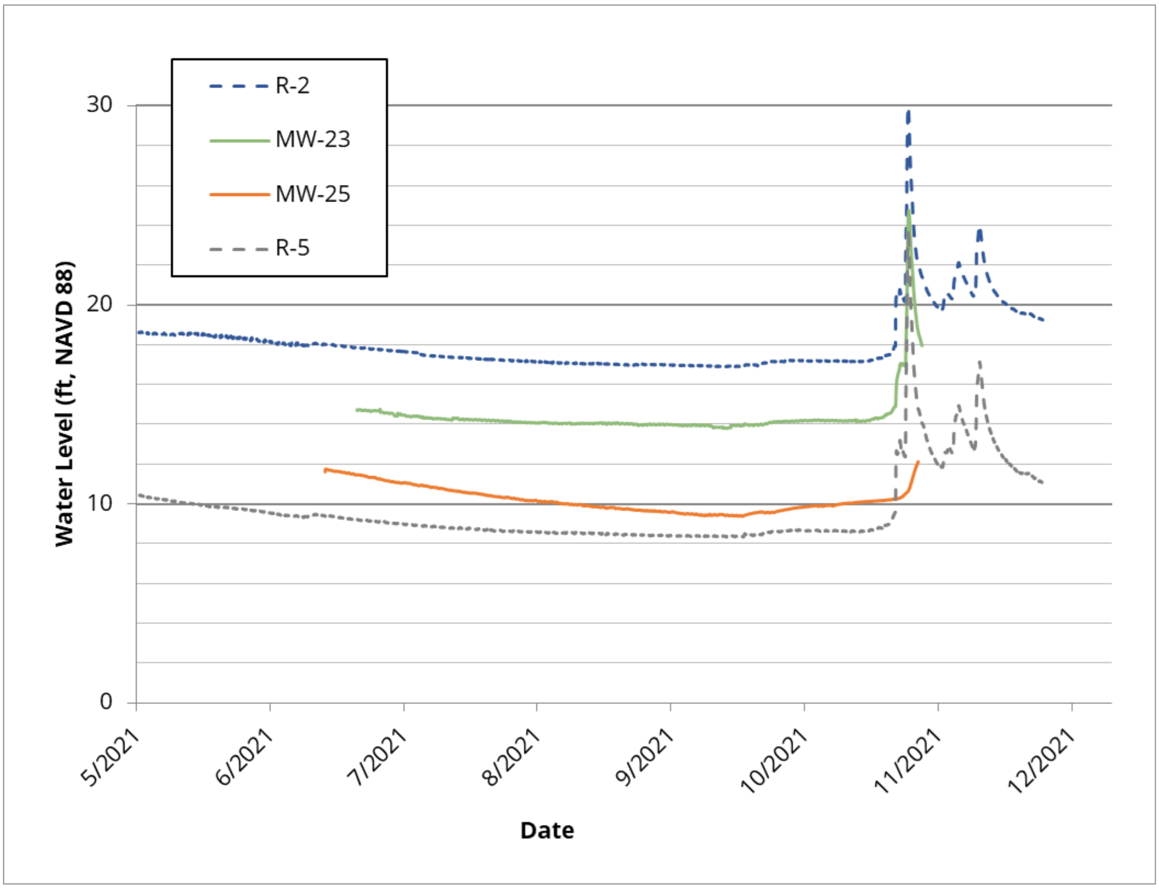


Graph 4. Surface Water (Dashed) and Groundwater Elevations Above the 12th Street Pool on the Lower Eel River (See Figure 5-2 for Locations).

This section has a complex gaining and losing pattern based on the stepped profile of the channel (see Figure 4). Approximately 7 feet of elevation difference occurs between the R-3 pool and the SW-5 pool (12th Street pool). This section has the only known right bank losing stream condition, which begins just downstream of the R-3 location with a transition to a gaining stream condition somewhere near the location of SW-5 at the bottom of a long riffle. The right bank losing conditions help explain the reduction in measured surface flows between QM-3 and SW-5 (Figure 3). Left bank losing conditions are interpreted to exist along this entire section during the low flow season.

3.3.3 Conditions Between 12th Street Pool and Palmer Creek (Figure 5-3)

Figure 5-3 shows the continuous monitoring locations between the 12th Street pool and the confluence with Palmer Creek. A plot of the water levels recorded at these locations is provided on Graph 5, below.



Graph 5. Surface Water (Dashed) and Groundwater Elevations Downstream of the 12th Street Pool on the Lower Eel River (See Figure 5-3 for Locations).

This reach includes a section of the river channel that widens significantly into a braided series of side channels, many of which have been abandoned as vegetation is established and the active channel remains along the right bank. Limited groundwater data exists within this reach, but based on previous groundwater contouring through this area, left bank losing conditions are interpreted along much of the reach, with a gaining condition interpreted as the river swings more toward the west. More than 8 feet of surface water elevation change occurs between R-2 and R-5. Previous studies indicate that the groundwater flow direction through this area is generally to the northwest (sub-parallel to the river), which can result in a higher potential for underflow conditions that affect the surface flows. In Fall 2014, surface water was observed to go completely subsurface near the downstream end of the 12th Street pool, with corresponding emergent flows further downstream.

MW-25 is the closest groundwater monitoring location along the left bank as the river bends westward. The relationship between groundwater levels in MW-25 and surface water levels at R-5 suggest a left bank gaining condition exists through the low-flow season and may be partially responsible for the downstream increases in surface flows observed in 2016, 2020, and 2021 (see Figures 1, 2, and 3).

4.0 Impacts of Groundwater Pumping

4.1 Surface Flow Discharge Measurements

Surface flow discharge measurements collected in the low flow seasons in 2016, 2020, and 2021 all show a pattern of decreasing surface flows in the downstream direction on the Eel River as it traverses the eastern edge of the Lower Eel River Valley and then increasing surface flows in the lower portion of the study area. Our preliminary evaluation of these surface flow declines is considerate of a variety of potential influences on surface water flow, including:

1. channel morphology and the potential for underflow,
2. natural groundwater elevations and the dominant flow pattern from east to west, and
3. influence of groundwater pumping.

Channel morphology plays an important role, particularly where grade controls form long pools that result in a stepped profile of the surface water. This stepped profile (see Figure 4) is in contrast to the relatively planar surface of the groundwater and the downstream ends of these steps have the potential to sustain surface waters above the adjacent groundwater levels, which leads to a stronger potential for losing stream conditions and/or promotes underflow. This condition is evident at the downstream end of the R-3 pool (Figure 5-2) where losing stream conditions occur on both sides of the river and is considered partially responsible for the reduction in surface flows between the QM-3 and the QM-SW-5 locations. A similar condition is interpreted to be affecting the reduced surface flows at QM-2, as discussed in Section 3.3.3, above.

A persistent groundwater gradient toward the west has been mapped within the Van Duzen alluvial valley, and groundwater flowing into and beneath the Eel River near the confluence provide significant recharge to both the surface water (right bank gaining conditions) and groundwater within the Lower Eel River Valley. As the Eel traverses northward from the confluence, the groundwater recharge from the Van Duzen alluvial valley is reduced and groundwater conditions are dominated by the inflow from the older upland units that underly the Rohnerville Terrace and the City of Fortuna. A reduction of surface flows downstream of the confluence with the Van Duzen can be expected as the groundwater inputs along the right bank are reduced. In addition, the left bank losing stream conditions will tend to increase over the course of the low-flow season as groundwater levels continue to lower.

4.2 Influence of Pumping on Groundwater Levels

The effect of groundwater pumping in the basin is expected to be detectable in monitoring wells through either a localized effect (when a monitoring location is within the cone of depression of a nearby pumping well), or a more regional effect that would correspond to a broad water level lowering, typically during the irrigation season. Localized effects typically appear as daily fluctuations in water levels that reflect the schedule of pumping for a nearby well. Regional effects are expected to be more subtle and would appear as an inflection in the water levels that correspond to the irrigation season. Previous studies have identified localized effects and potentially minor regional effects on groundwater levels in MW-9, on River Bar Road near the Van Duzen River (SHN, 2019). Preliminary review of data collected from the 2021 County monitoring wells over the summer/fall season indicates that localized effects may be interpreted in many of the hydrographs with cyclic water level changes typically less than 0.5 feet. A record of water levels over a complete irrigation season is not yet available for the 2021 County monitoring wells, so the ability to analyze the more regional effects of pumping is limited. Some hydrographs, such as MW-13s, show a slight downward inflection that occurs in the profile in mid-July, and may be reflective of cumulative impacts from pumping in the vicinity. The collection of continuous water level data over the coming years will provide an opportunity to better understand groundwater fluctuations in the vicinity of the rivers and evaluate potential impacts associated with groundwater use.

4.3 Influence of Pumping on Surface Water Levels

A signature of the irrigation season is not immediately discernable from surface water hydrographs. Based on the consistency of the hydrographs associated with surface water and nearby groundwater levels, the more regional effects associated with pumping is expected to be subtle and will be better evaluated after collection of groundwater level data over the coming years.

4.4 City of Fortuna Municipal Well Field

The City of Fortuna municipal supply wells are located approximately 1,600 feet east of the right bank of the Eel River within the eastern margin of the alluvial valley (see Figure 5-2 for location). Based on the proximity to the active channel, the potential impact that pumping has on the surface water is of special interest. MW-22 (located approximately 800 feet south of the well field) was specifically located to provide the opportunity to monitor water levels within the vicinity of the well field. Water levels in MW-22 from late June through early September remain approximately 2 feet above the surface water level at SW-5. The hydrograph for MW-22 has a water level profile nearly identical in form to MW-21 (located upstream of the well field) and MW-2s (located on the opposite side of the Eel River) and doesn't appear to reflect the signature of pumping that could be interpreted as derived from the well field. The collection of additional data over the coming years will provide an opportunity to more closely review potential impacts associated with the Fortuna well field.

5.0 References

GHD. (2021). "Terrain Data and Imagery Technical Memorandum." Eureka, CA:GHD.

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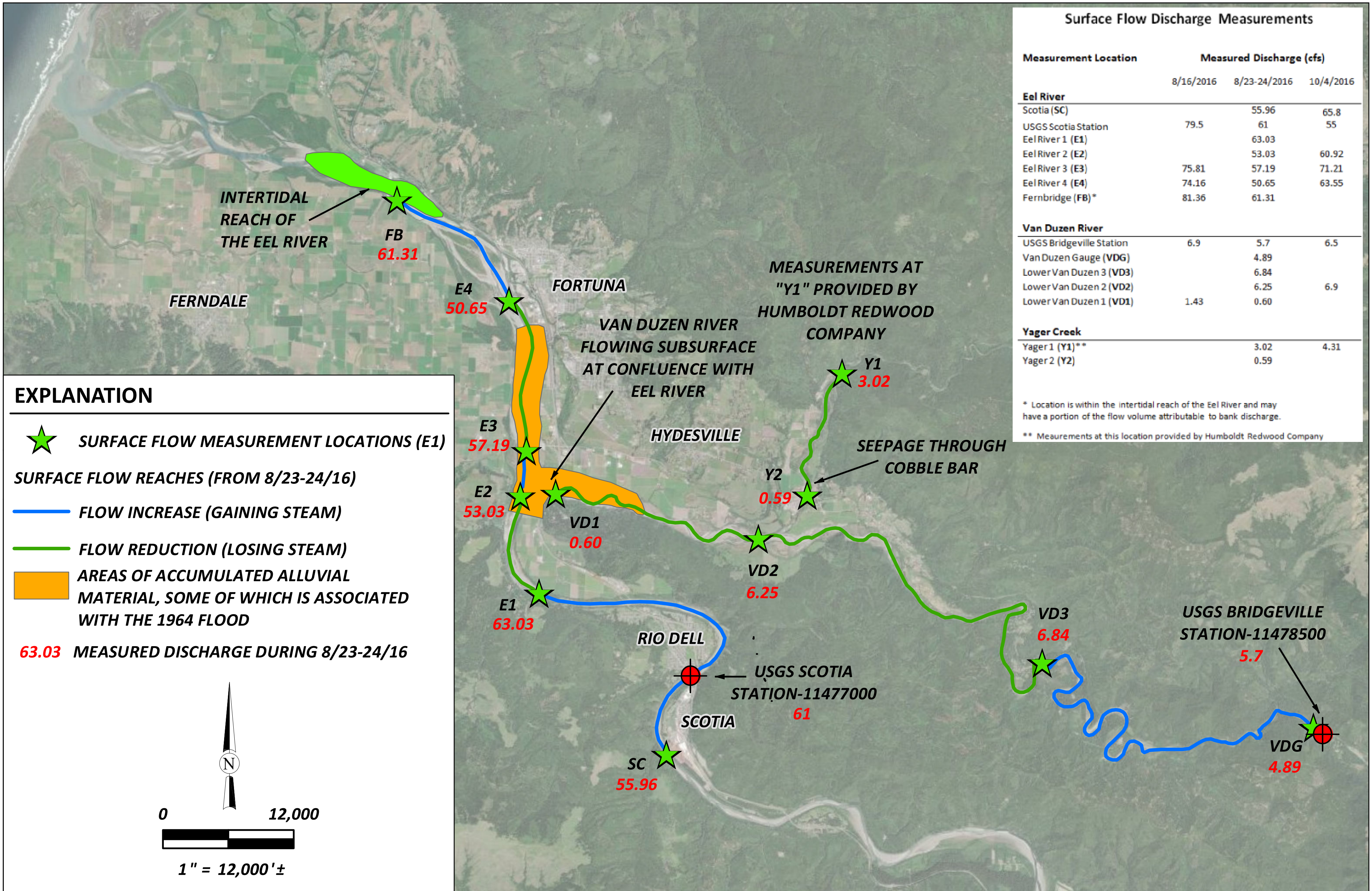
Times Standard. (September 14, 2014; updated July 30, 2018). "Lower Eel River Appears Dry Near Fortuna." Accessed at: https://www.times-standard.com/2014/09/14/lower-eel-river-appears-dry-near-fortuna/

Appendix 1: Figures

Figures 1

Path: \\eureka\projects\2020\020091-Eel-River-GSP\GIS\PROJ_MXD\232\Figure1_2016SurfaceFlowDischargeLocations.mxd User Name: mrose DATE: 1/24/22, 4:35PM



Surface Flow Discharge Measurements

Measurement Location	Measured Discharge (cfs) 8/16/2016	8/23-24/2016	10/4/2016
Eel River			
Scotia (**SC**)		55.96	65.8
USGS Scotia Station	79.5	61	55
Eel River 1 (**E1**)		63.03	
Eel River 2 (**E2**)		53.03	60.92
Eel River 3 (**E3**)	75.81	57.19	71.21
Eel River 4 (**E4**)	74.16	50.65	63.55
Fernbridge (**FB**)*	81.36	61.31	
Van Duzen River			
USGS Bridgeville Station	6.9	5.7	6.5
Van Duzen Gauge (**VDG**)		4.89	
Lower Van Duzen 3 (**VD3**)		6.84	
Lower Van Duzen 2 (**VD2**)		6.25	6.9
Lower Van Duzen 1 (**VD1**)	1.43	0.60	
Yager Creek			
Yager 1 (**Y1**)**		3.02	4.31
Yager 2 (**Y2**)		0.59	

* Location is within the intertidal reach of the Eel River and may have a portion of the flow volume attributable to bank discharge.

** Meaurements at this location provided by Humboldt Redwood Company

NOTES: FLOW STUDY PERFORMED BY THOMAS GAST & ASSOCIATES ENVIRONMENTAL CONSULTANTS

Humboldt County Public Works
Eel River Basin (1-010)
Humboldt County, California

2016 Surface FLow Discharge Measurement Locations and Results
SHN 020091.232

January 2022	Figure1_2016SurfaceFlowDischargeLocations	Figure 1

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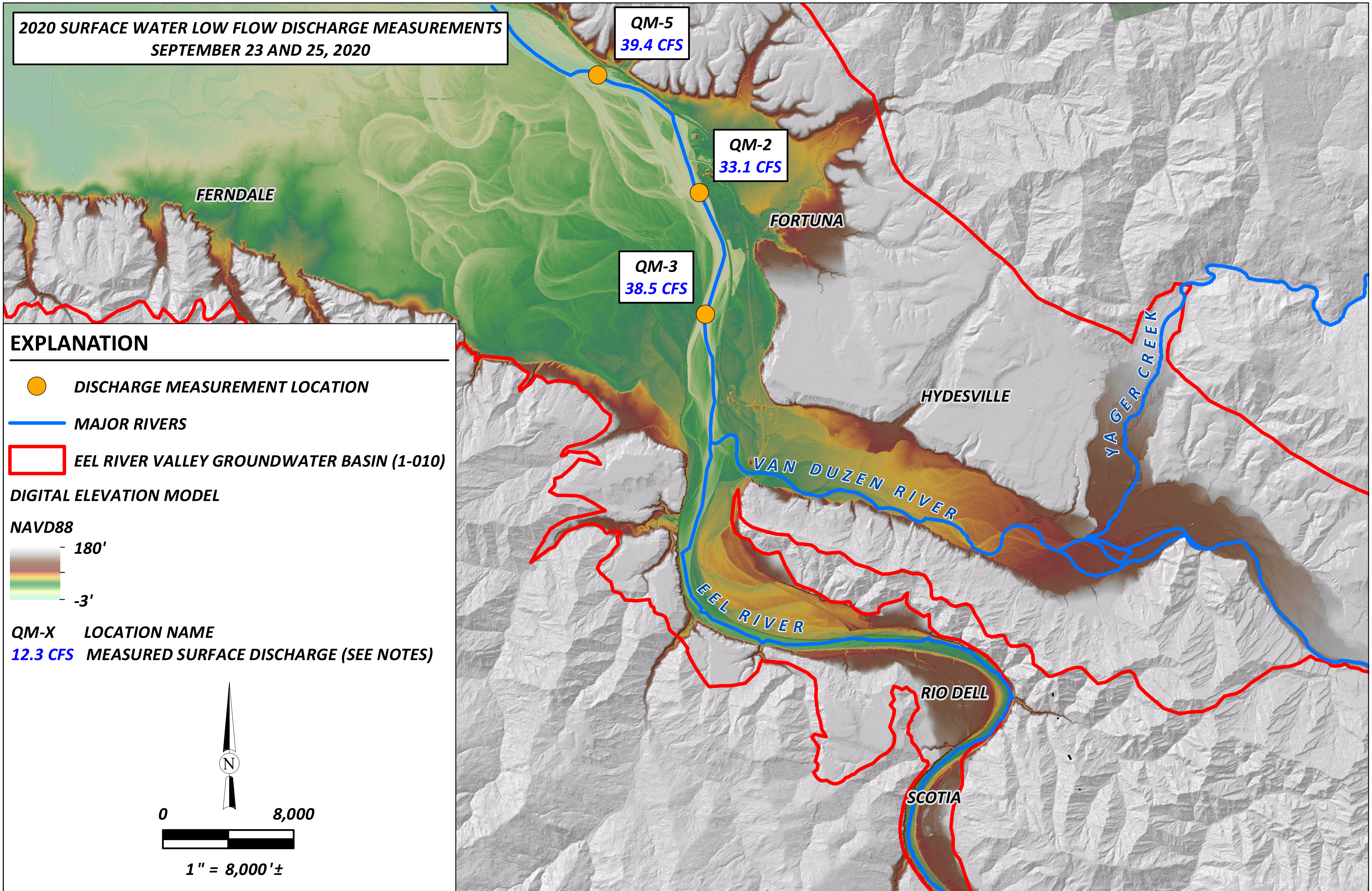

NOTES: DIGITAL ELEVATION MODEL DERIVED FROM: USGS, 2019;
IMAGE SOURCE FROM: ESRI, MAXAR, 2021;
LOW FLOW SURFACE DISCHARGE MEASURED ON 9/23/2020 AND 9/25/2020

Humboldt County Public Works
Eel River Basin (1-010)
Humboldt County, California

2020 Surface Water Discharge Measurement Locations
SHN 020091.232

January 2022 | Figure2_2020SurfaceWaterDischargeLocations | Figure 2

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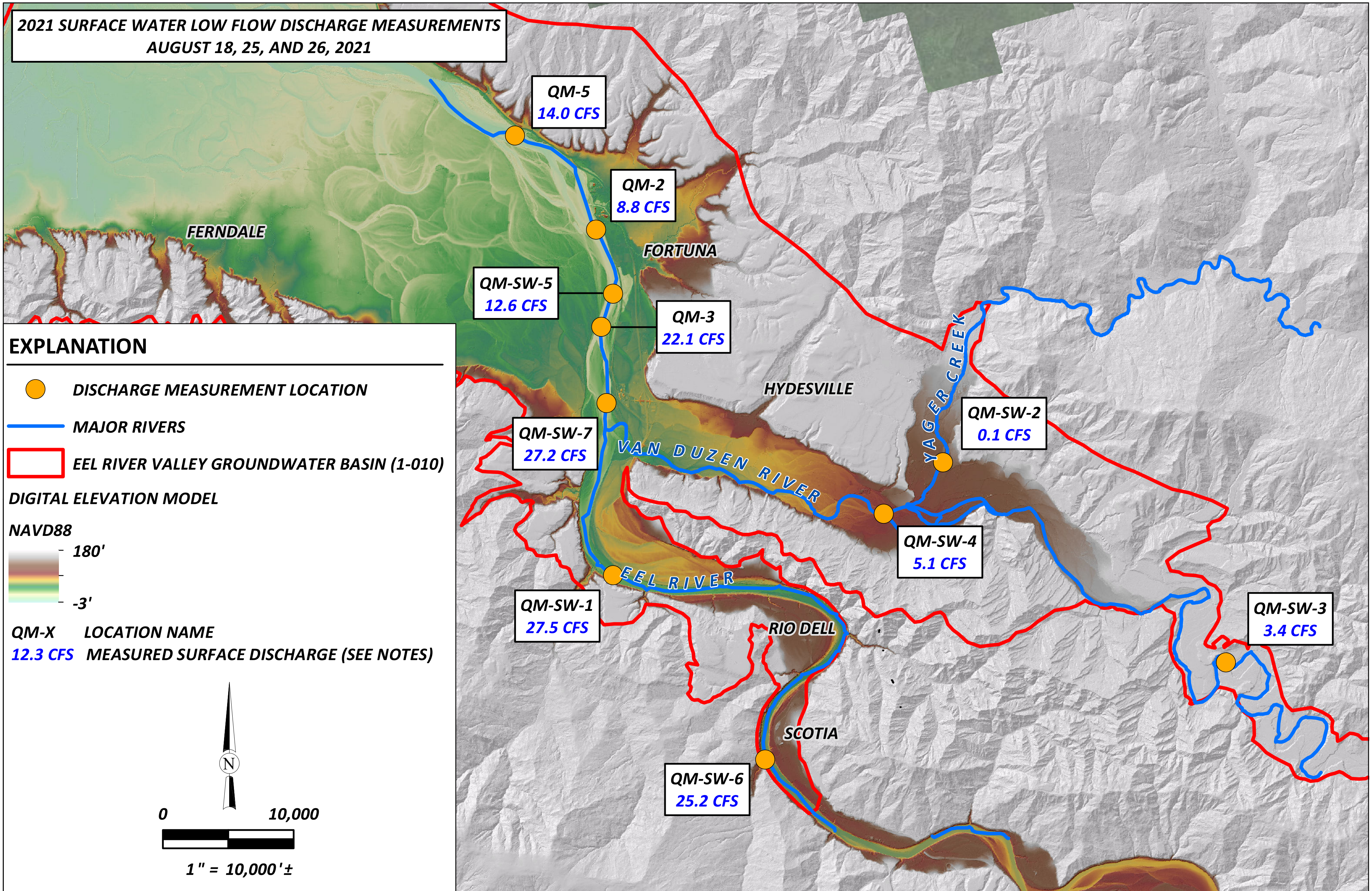
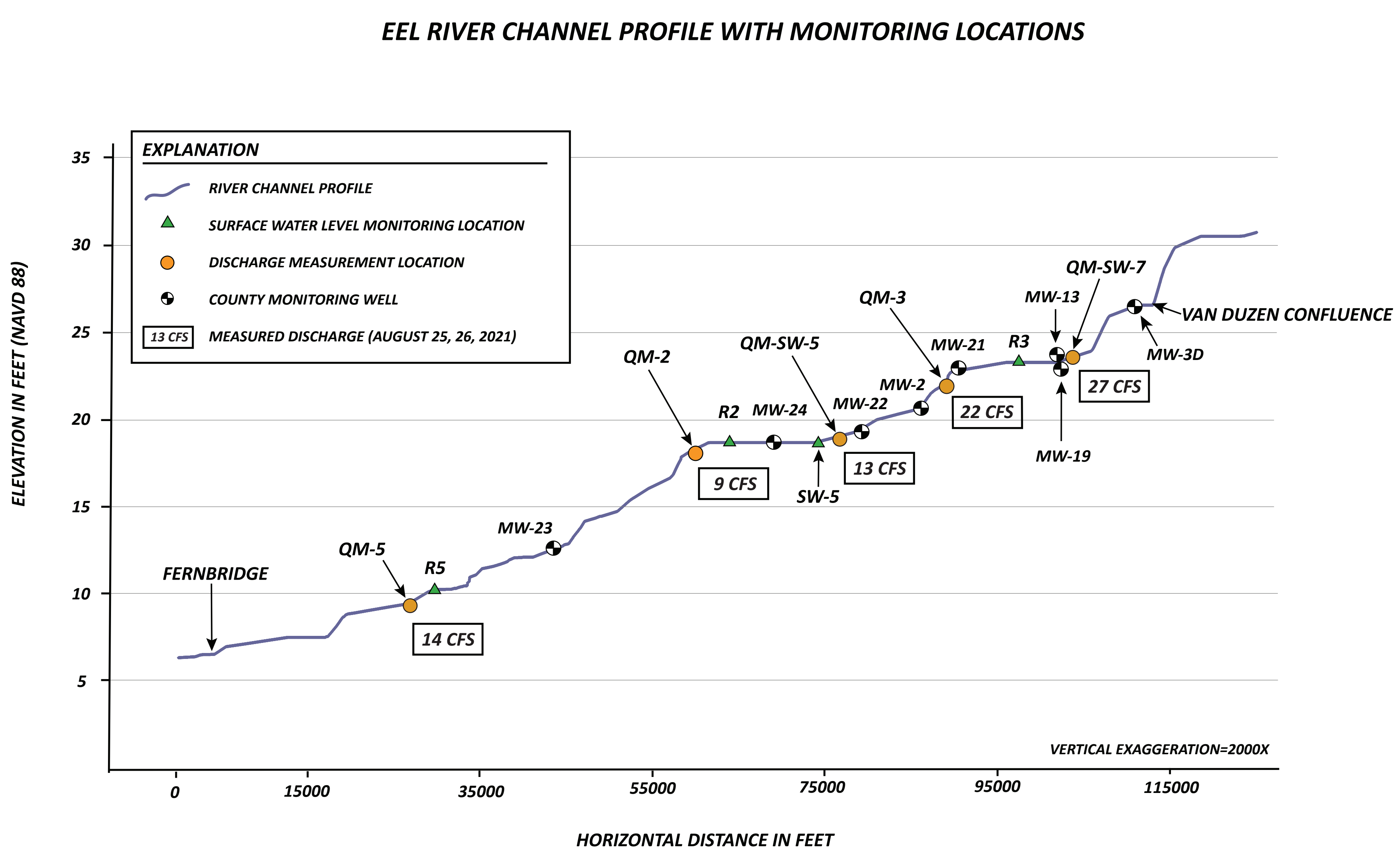


NOTES: DIGITAL ELEVATION MODEL DERIVED FROM: USGS, 2019;
IMAGE SOURCE FROM: ESRI, MAXAR, 2021;
LOW FLOW SURFACE DISCHARGE MEASURED ON 8/18/2021, 8/25, 2021, AND 8/26/2021

Humboldt County Public Works Eel River Basin (1-010) Humboldt County, California		2021 Surface Water Discharge Measurement Locations SHN 020091.232
January 2022	Figure3_2021SurfaceWaterDischargeLocations	Figure 3



NOTE: THE RIVER CHANNEL WAS TAKEN FROM THE PROJECT DEM (GHD, 2021), WHICH IS LARGELY BASED ON LIDAR COLLECTED BY THE USGS IN 2018.

Humboldt County Public Works Eel River Basin (1-010) Humboldt County, California		Eel River Channel Profile SHN 020091.232
January 2022	Figure4_ChannelProfile	Figure 4

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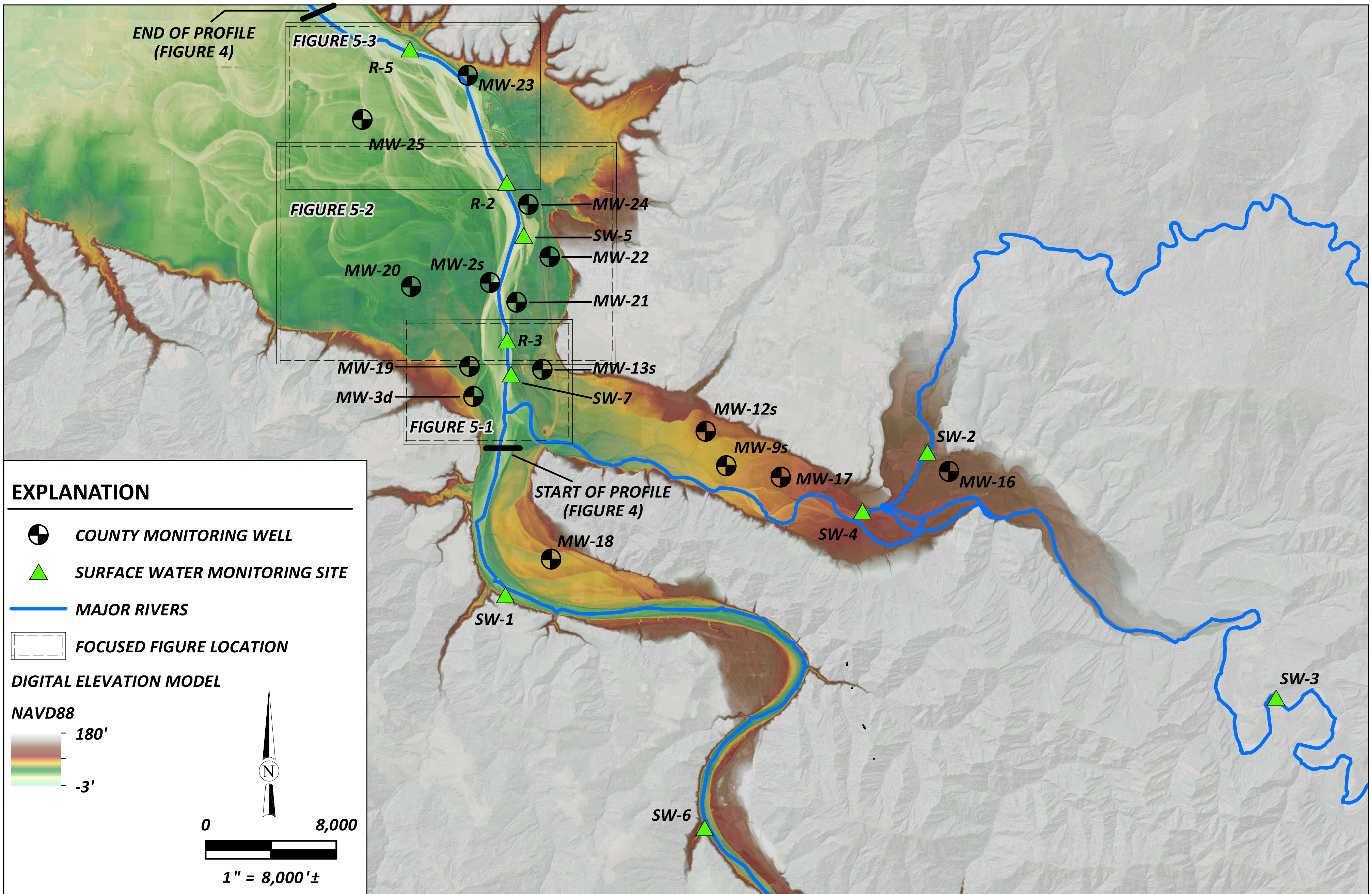

NOTES: DIGITAL ELEVATION MODEL DERIVED FROM: USGS, 2019
IMAGE SOURCE FROM: ESRI, MAXAR, 2021

Humboldt County Public Works
Eel River Basin (1-010)
Humboldt County, California

2021 Surface Water & Groundwater Monitoring Locations
SHN 020091.232

January 2022	Figure5_2021SurfaceWater&GWMonitoringLocations	Figure 5

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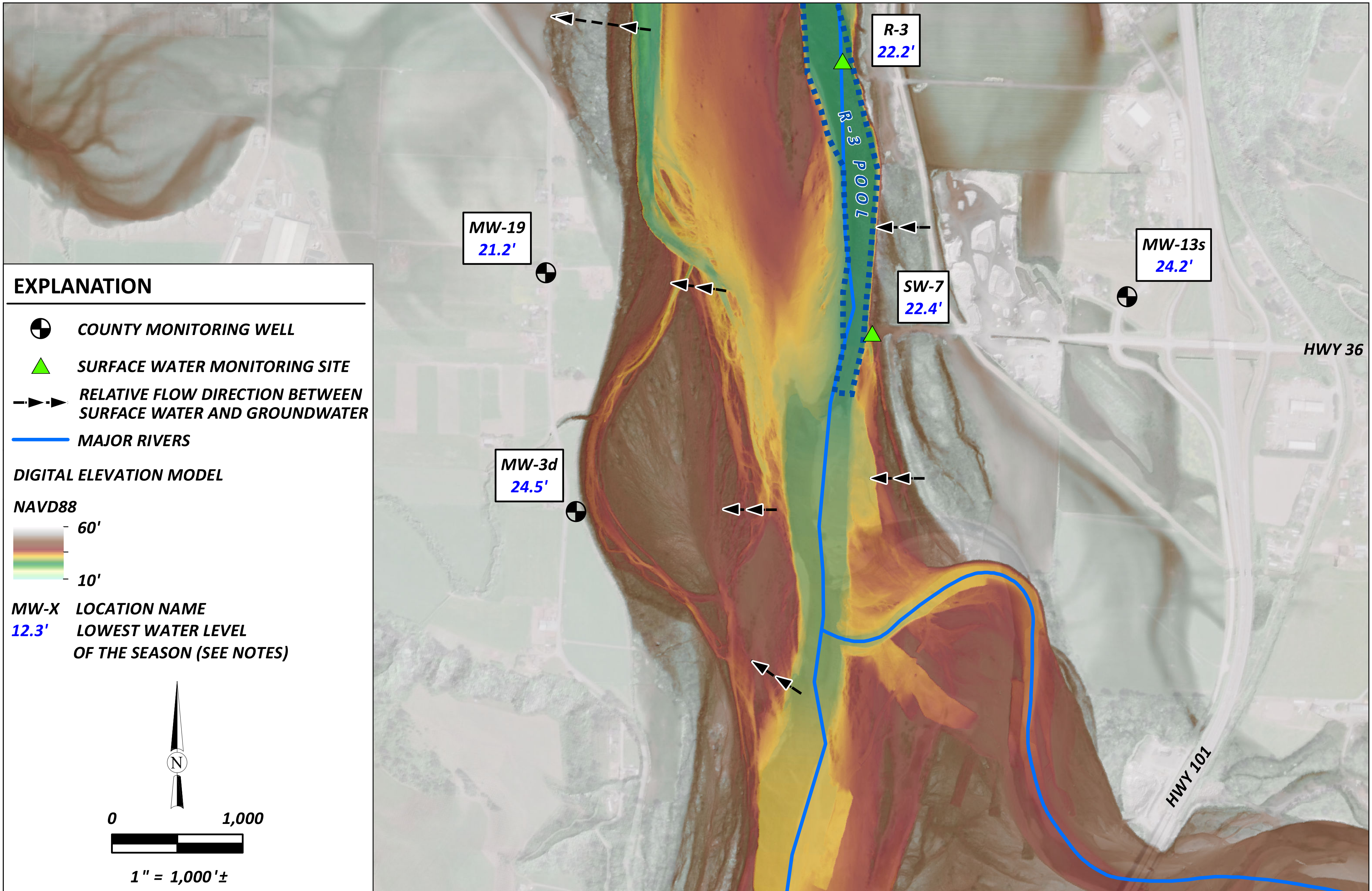


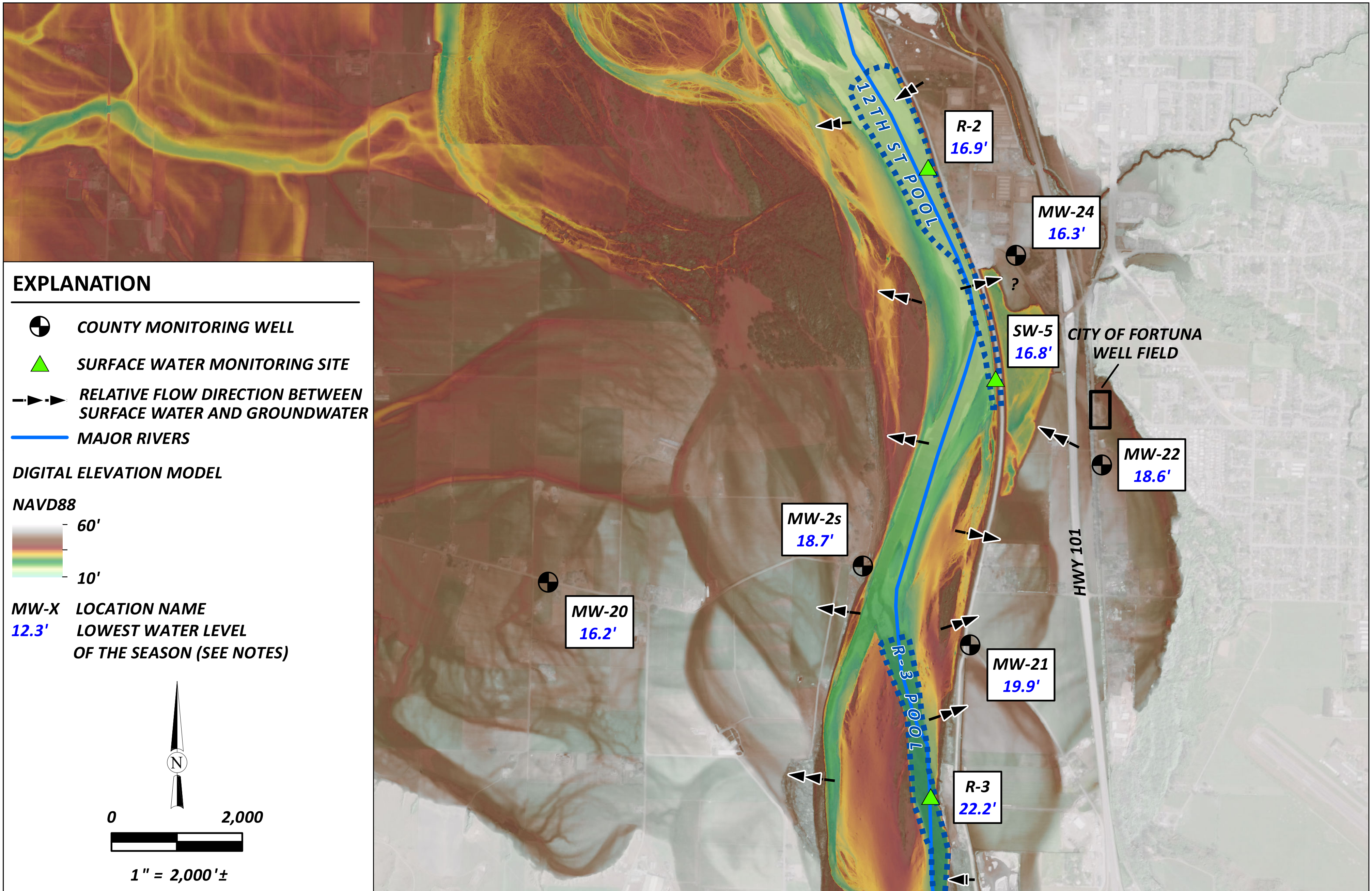
NOTES: DIGITAL ELEVATION MODEL DERIVED FROM: USGS, 2019;
IMAGE SOURCE FROM: ESRI, MAXAR, 2021;
GROUNDWATER AND SURFACE WATER ELEVATION SHOWN REPRESENT THE LOWEST LEVELS IN THE FALL WHICH OCCURRED ON OR AROUND 9/17/2021

Humboldt County Public Works
Eel River Basin (1-010)
Humboldt County, California

2021 Surface Water & Groundwater Monitoring Locations
SHN 020091.232

January 2022 | Figure5-1_2021SurfaceWater&GWMonitoringLocations | Figure 5-1

Path: \\eureka\projects\2020\020091-Eel-River-GSP\GIS\PROJ_MXD\232\Figure5-2_2021SurfaceWater&GWMonitoringLocations.mxd User Name: mrose DATE: 1/24/22, 5:14PM



NOTES: DIGITAL ELEVATION MODEL DERIVED FROM: USGS, 2019;
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GROUNDWATER AND SURFACE WATER ELEVATION SHOWN REPRESENT THE LOWEST LEVELS IN THE FALL WHICH OCCURRED ON OR AROUND 9/17/2021

SHN

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Humboldt County, California

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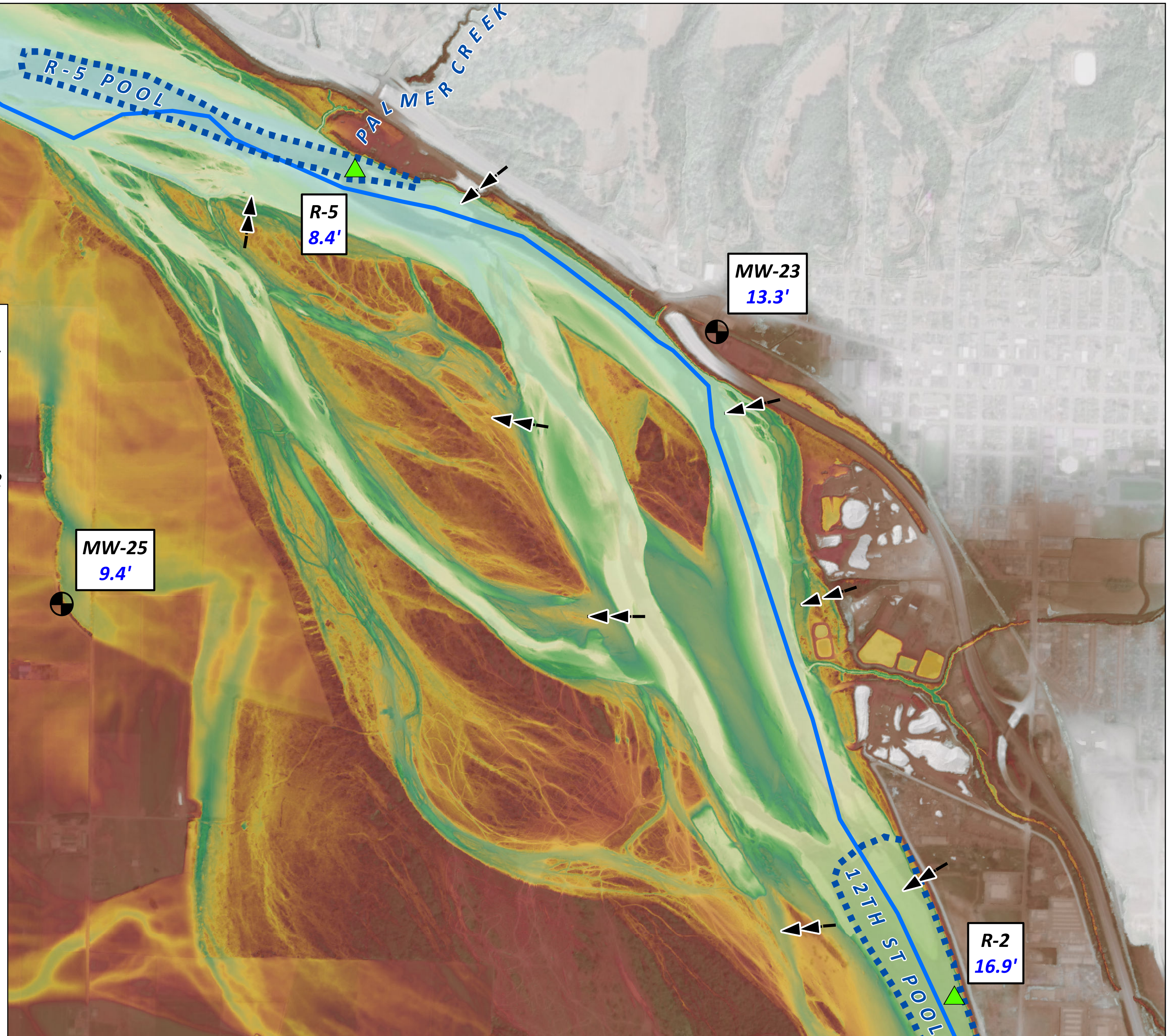
January 2022 | Figure5-2_2021SurfaceWater&GWMonitoringLocations | Figure 5-2



EXPLANATION

- COUNTY MONITORING WELL
- SURFACE WATER MONITORING SITE
- RELATIVE FLOW DIRECTION BETWEEN SURFACE WATER AND GROUNDWATER
- MAJOR RIVERS

DIGITAL ELEVATION MODEL

NAVD88

60'

10'

MW-X LOCATION NAME

12.3' LOWEST WATER LEVEL OF THE SEASON (SEE NOTES)

N

0 1,500

1" = 1,500'±

NOTES: DIGITAL ELEVATION MODEL DERIVED FROM: USGS, 2019;
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January 2022	Figure5-3_2021SurfaceWater&GWMonitoringLocations	Figure 5-3