

BASEMAP FROM HUMBOLDT COUNTY PUBLIC WORKS (DECEMBER, 2016)



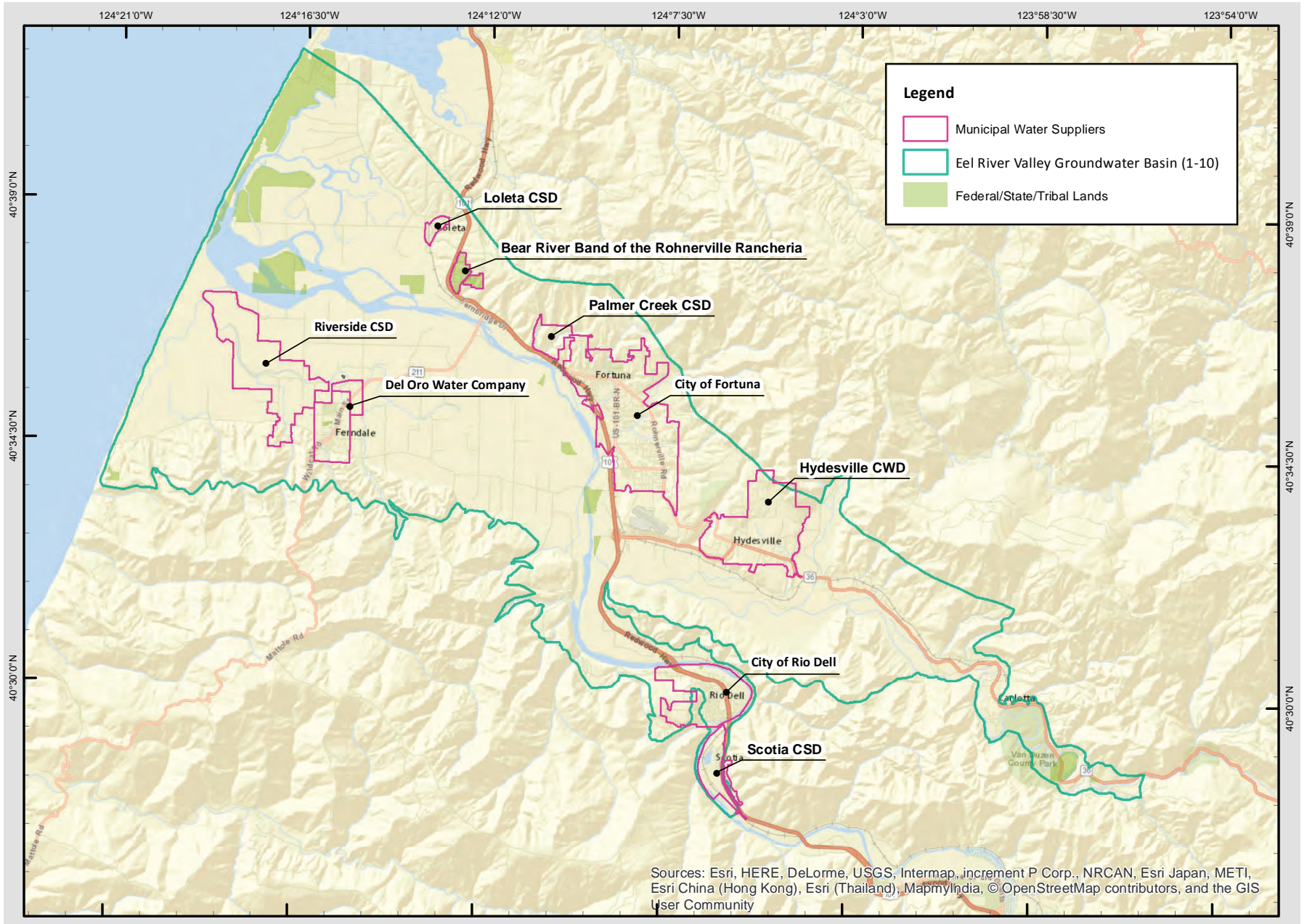
Humboldt County Public Works  
 Eel River Groundwater Assessment  
 Humboldt County, California

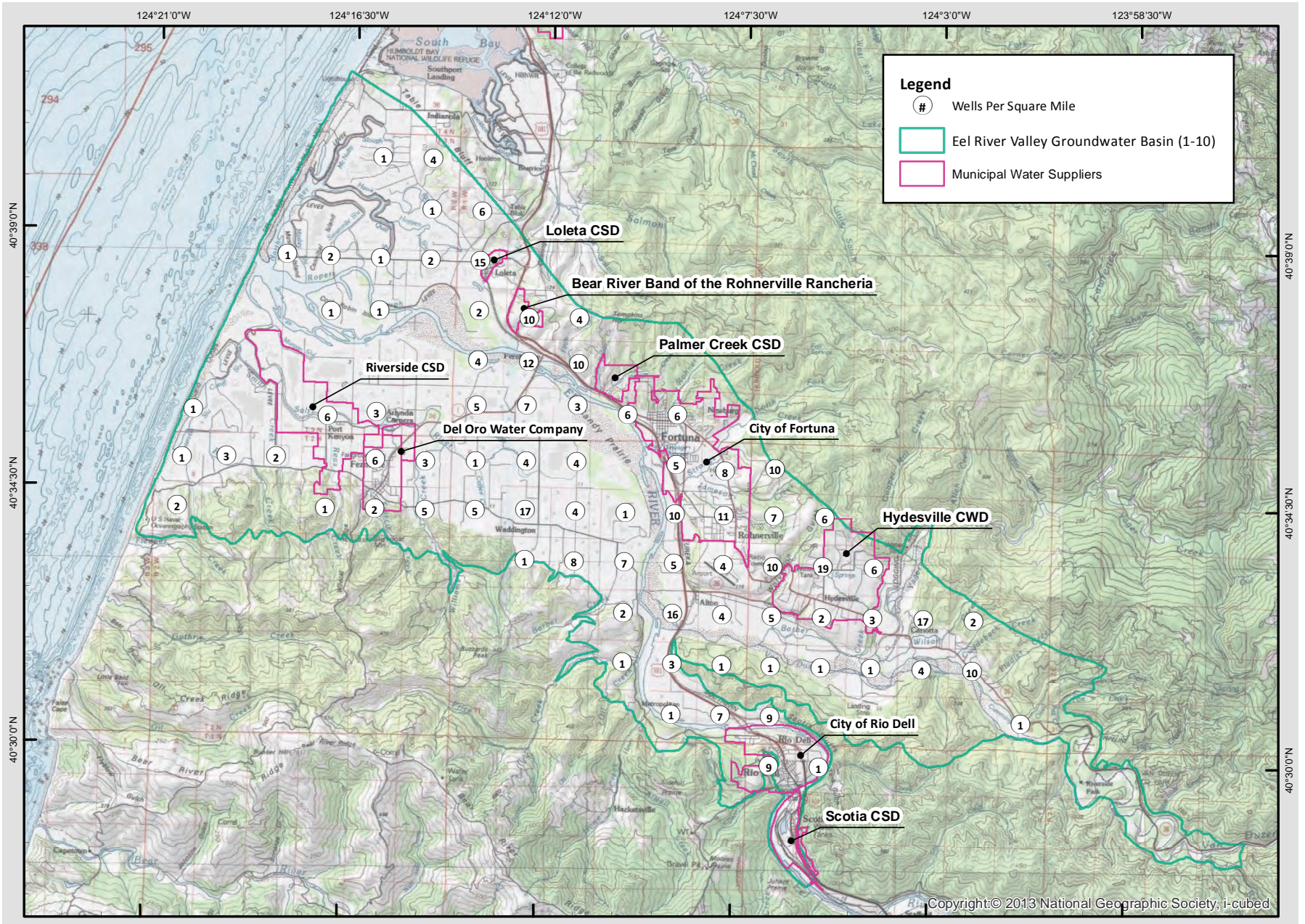
Site Location  
 Map  
 SHN 016219

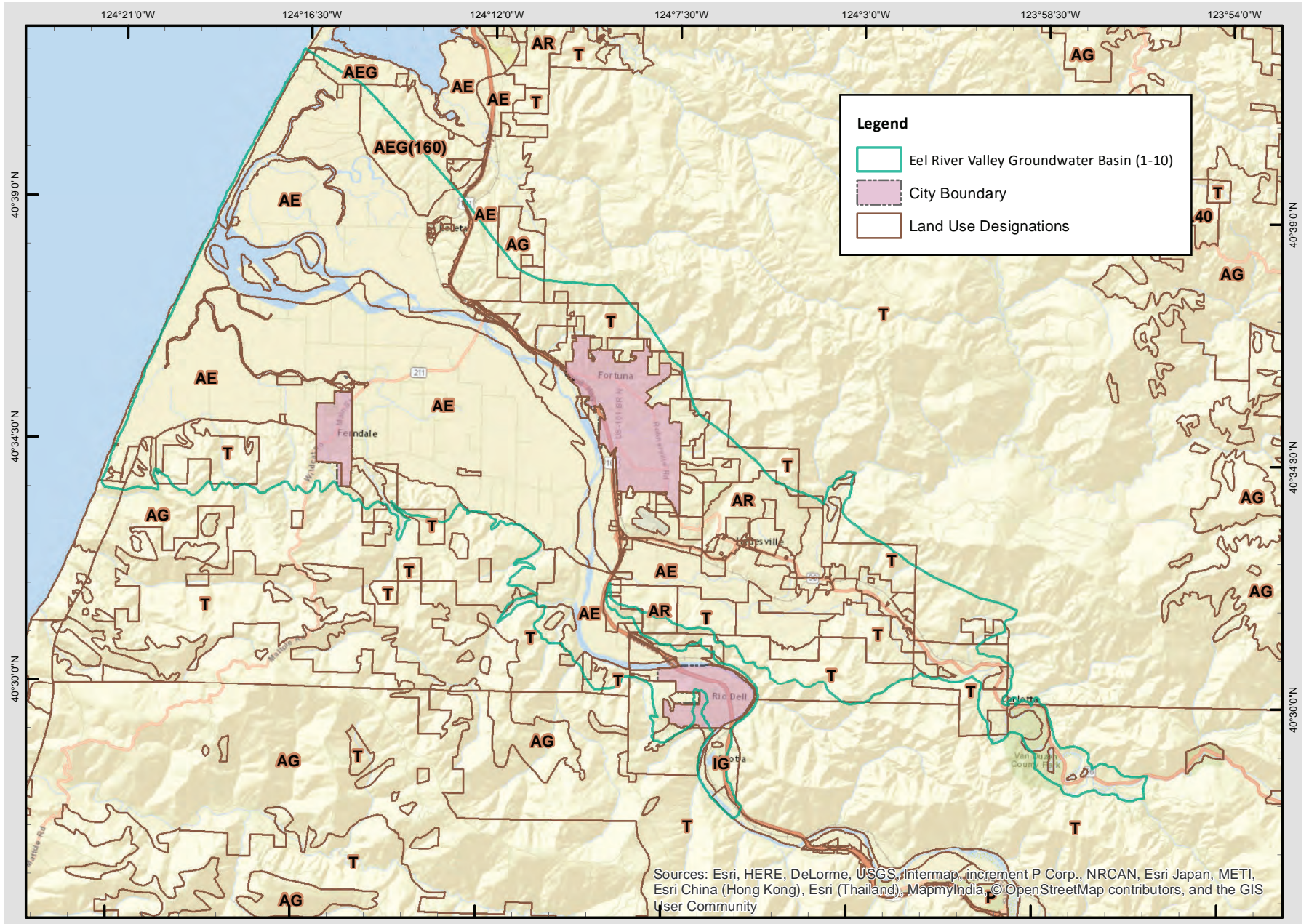
December 2016

1-1\_SiteLocationMap.ai

Figure 1-1

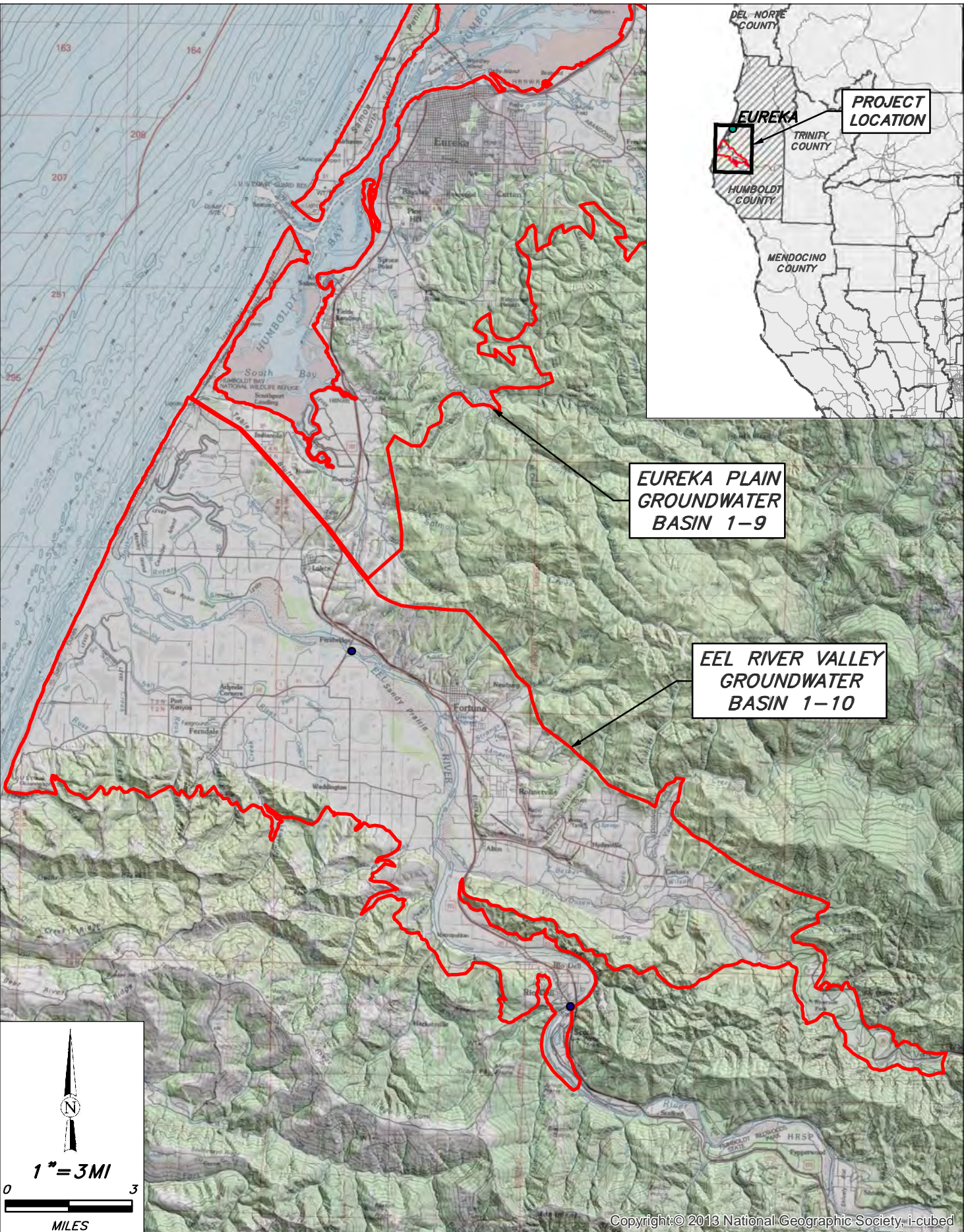






Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

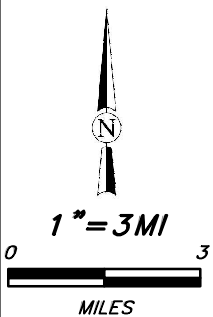
Path: \\eureka\projects\2016\016219-EelRiverGW\GIS\PROJ\_MXD\Report\_MXD\3\_1\_ProjectLocationMap.mxd




**EUREKA PLAIN  
GROUNDWATER  
BASIN 1-9**

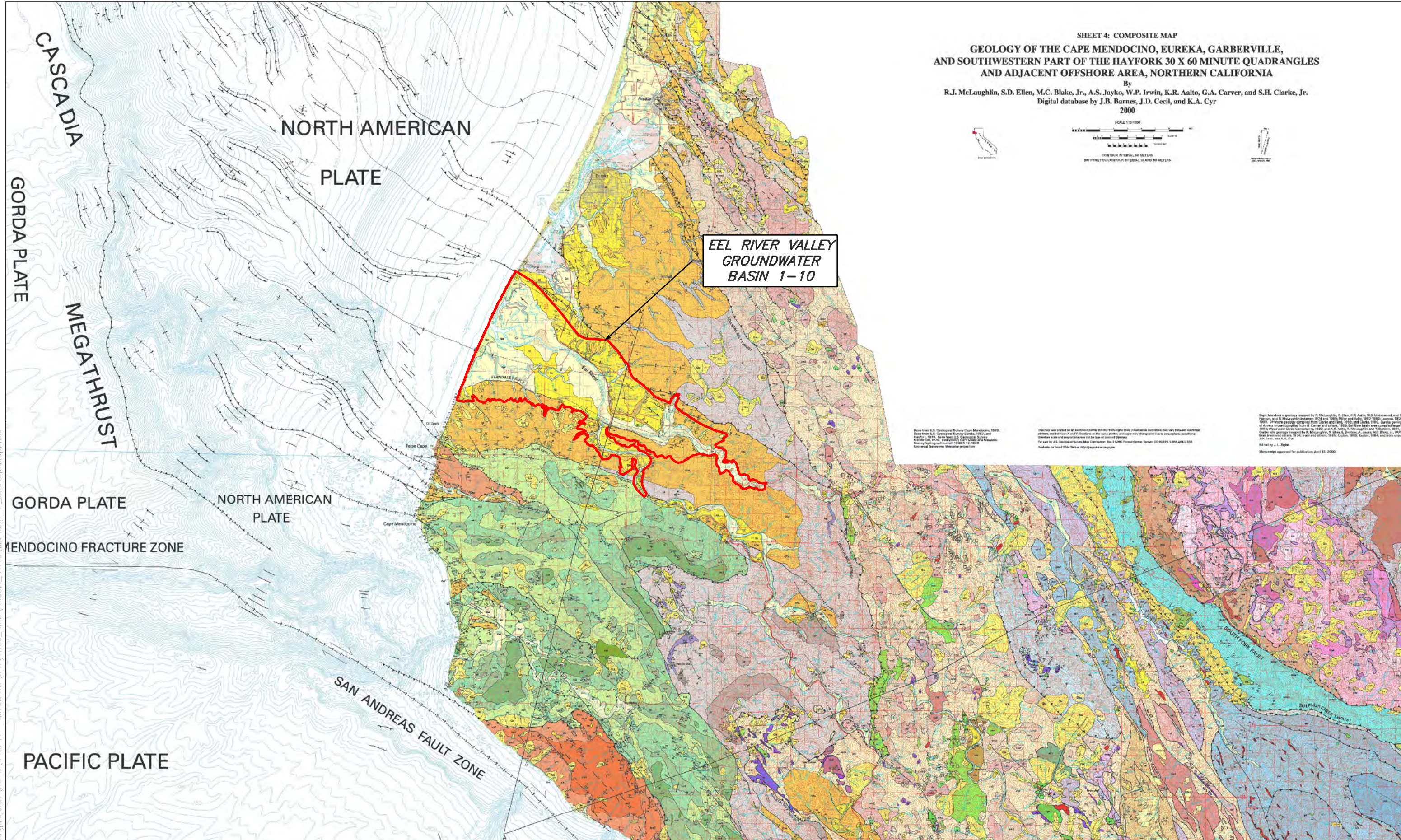
**EEL RIVER VALLEY  
GROUNDWATER  
BASIN 1-10**

**PROJECT  
LOCATION**

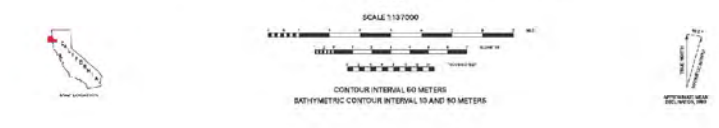


Copyright:© 2013 National Geographic Society, i-cubed

	Humboldt County Public Works Eel River Valley Groundwater Assessment Humboldt County, California		Project Location SHN 016219
	December 2016	3_1_ProjectLocationMap	Figure 3-1



SHEET 4: COMPOSITE MAP  
**GEOLOGY OF THE CAPE MENDOCINO, EUREKA, GARBERVILLE,  
 AND SOUTHWESTERN PART OF THE HAYFORK 30 X 60 MINUTE QUADRANGLES  
 AND ADJACENT OFFSHORE AREA, NORTHERN CALIFORNIA**  
 By  
 R.J. McLaughlin, S.D. Ellen, M.C. Blake, Jr., A.S. Jayko, W.P. Irwin, K.R. Aalto, G.A. Carver, and S.H. Clarke, Jr.  
 Digital database by J.B. Barnes, J.D. Cecil, and K.A. Cyr  
 2000



**EEL RIVER VALLEY  
 GROUNDWATER  
 BASIN 1-10**

Base from U.S. Geological Survey Cape Mendocino, 1959;  
 from U.S. Geological Survey Garberville, 1951, and  
 Carver, 1975. Base from U.S. Geological Survey  
 Humboldt 1979. Supplementary from Carver and  
 Barry hydrograph to chart 12000 N 12, 1989.  
 Unpublished manuscript.

This map was prepared as an electronic color display from digital data. Discrepancies between the  
 printed and electronic versions may occur due to differences in printing  
 standards and resolutions. The user is advised to verify the accuracy of the  
 data used in the map. For more information, contact the U.S. Geological Survey,  
 Open-File Report 01-104, Reston, Virginia. © 2002, U.S. Geological Survey.  
 Published on World Wide Web at <http://pubs.usgs.gov/of/01-104/>

Cape Mendocino geology mapped by R. McLaughlin, S. Ellen, K.R. Aalto, M.C. Blake, Jr., S.D. Ellen, and  
 W.P. Irwin, and J. McLaughlin between 1974 and 1982. Garberville and Eureka geology mapped by  
 G.A. Carver between 1974 and 1982. Humboldt geology compiled from Carver and Blake, 1975; and Clarke, 1975. Geologic  
 map of Eureka compiled from Carver and others, 1976. Geologic map of Garberville compiled from  
 1983; Woodward Clark Consultants, 1980; and R. Aalto, R. McLaughlin, and T. Daniels, 1984.  
 Digital data prepared by R. McLaughlin, S. Ellen, S. Irwin, A. Jayko, M.C. Blake, Jr., W.P.  
 Irwin, and others, 1974, 1976, and others, 1981; Irwin, 1983; Keston, 1984; and Irwin  
 and others, 1985.  
 Edited by J. L. Jigaw.  
 Manuscript approved for publication April 11, 2000.

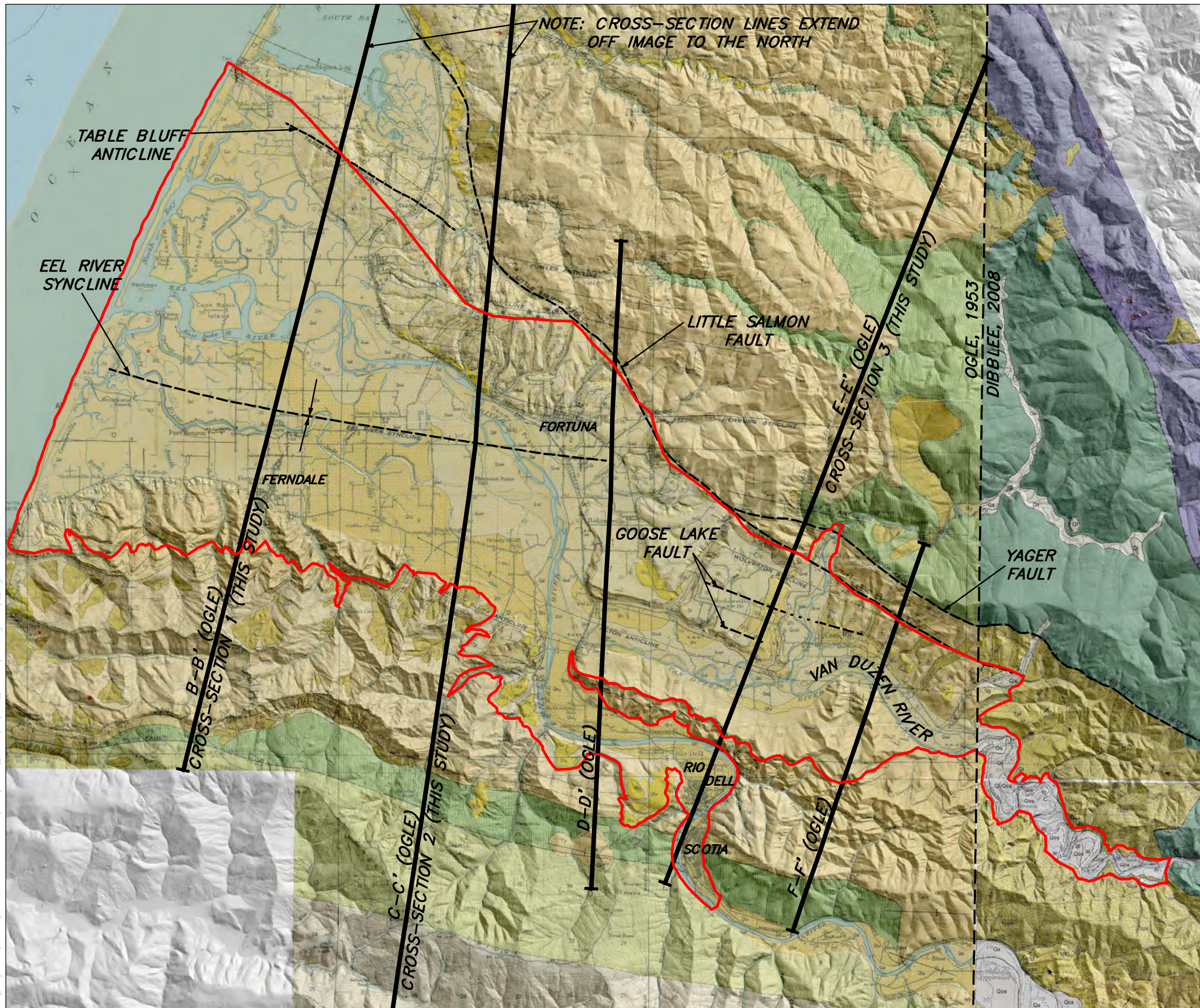
Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ\_MXD\Report\_MXD\Report\_MXD\McLaughlin\_GeologicMap.mxd



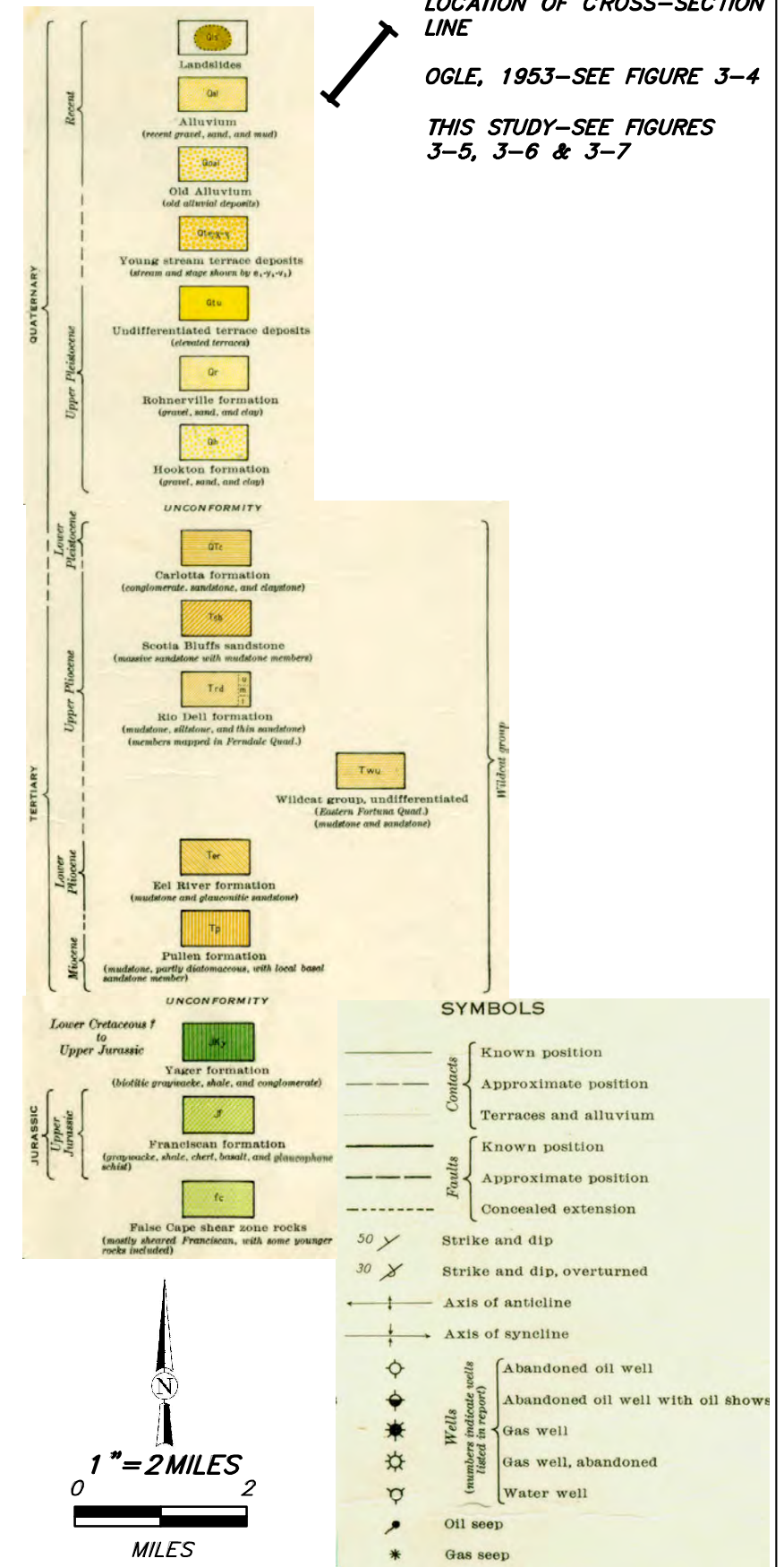
Humboldt County Public Works  
 Eel River Groundwater Assessment  
 Humboldt County, California  
 December 2016

Geologic Map  
 (McLaughlin, 2002)  
 SHN 016219  
 Figure 3-2

Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ\_MXD\Report\_MXD\GeologicMap\_OgleDibblee.mxd



### EXPLANATION

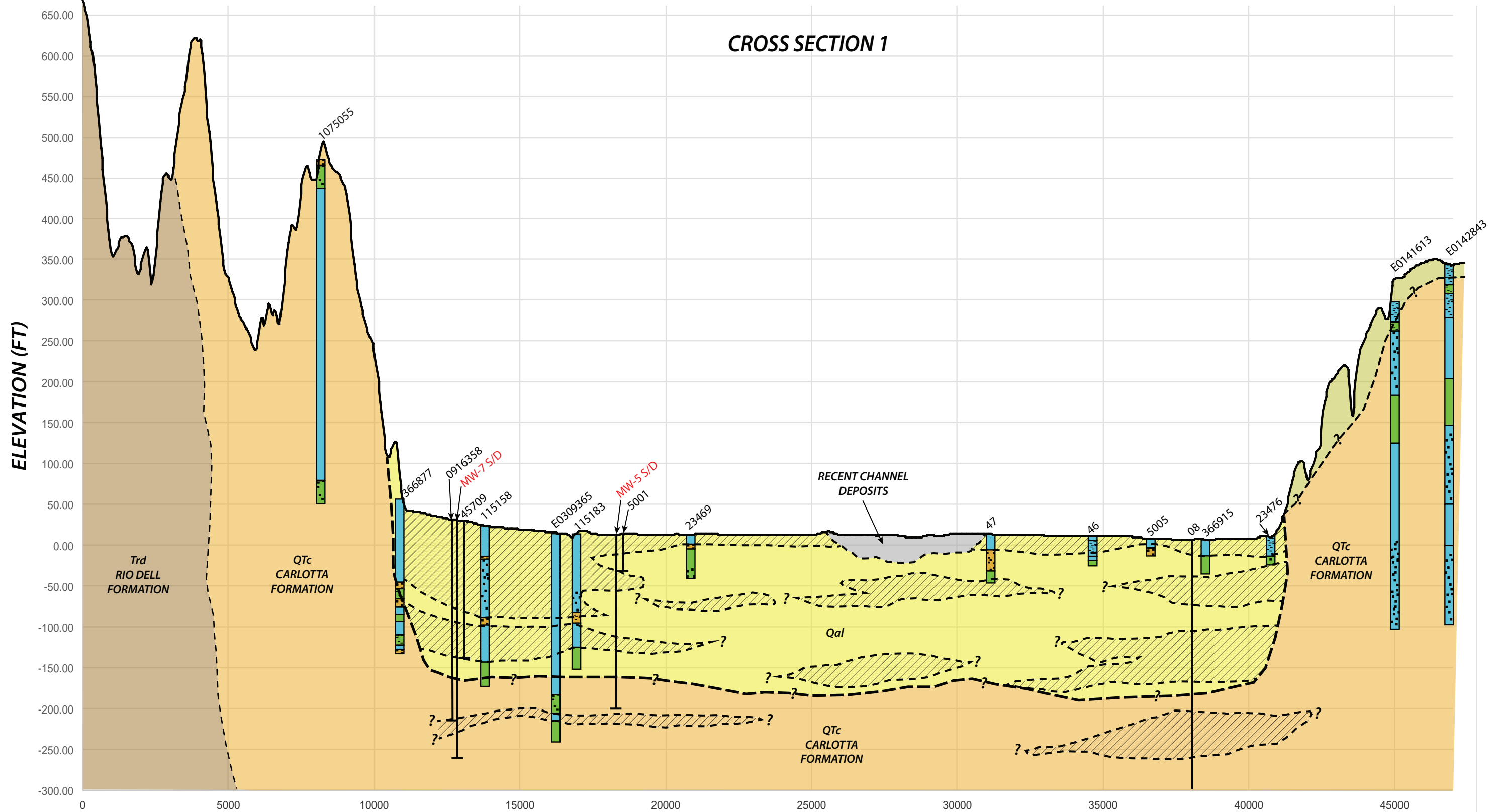


Humboldt County Public Works  
 Eel River Groundwater Assessment  
 Humboldt County, California  
 December 2016

Geologic Map  
 (Ogle, 1953; Dibblee, 2008)  
 SHN 001283  
 Figure 3-3



# CROSS SECTION 1



EXPLANATION					
	QUATERNARY ALLUVIUM (Qal)		FINE-GRAINED ALLUVIUM		SILT/CLAY
	CARLOTTA FORMATION (QtC)		GRAVEL		SAND
	RIO DELL FORMATION (Trd)				
				23469	DWR WELL LOG #
				MW-7	COUNTY WELL #

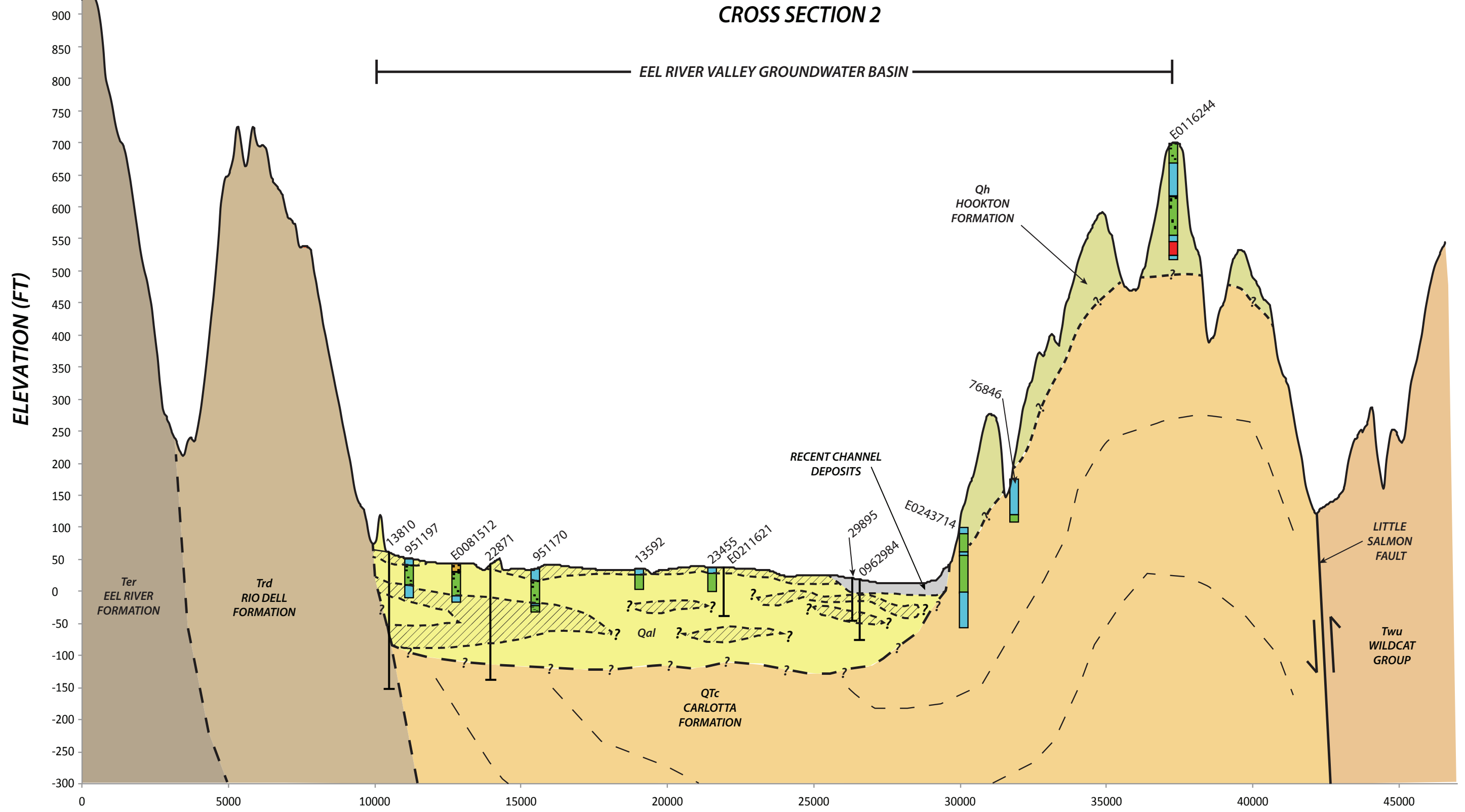
SCHMATIC SECTION SHOWS SHALLOW STRATIGRAPHY ALONG CROSS-SECTION LINE B-B' AS SHOWN ON FIGURE 3-3.



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

Geologic Cross-Section 1  
 (This Study)  
 SHN 016219

# CROSS SECTION 2



## EXPLANATION

	QUATERNARY ALLUVIUM (Qal)		RIO DELL FORMATION (Qrd)		FINE-GRAINED ALLUVIUM		SILT/CLAY		GRAVEL	23469 DWR WELL LOG #
	HOOKTON FORMATION (Qh)		WILDCAT GROUP (Twu)		QUATERNARY ALLUVIUM (Qal)		SAND		BEDROCK	
	CARLOTTA FORMATION (Qtc)		EEL RIVER FORMATION (Ter)							

SCHMATIC SECTION SHOWS SHALLOW STRATIGRAPHY ALONG CROSS-SECTION LINE C-C' AS SHOWN ON FIGURE 3-3.



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

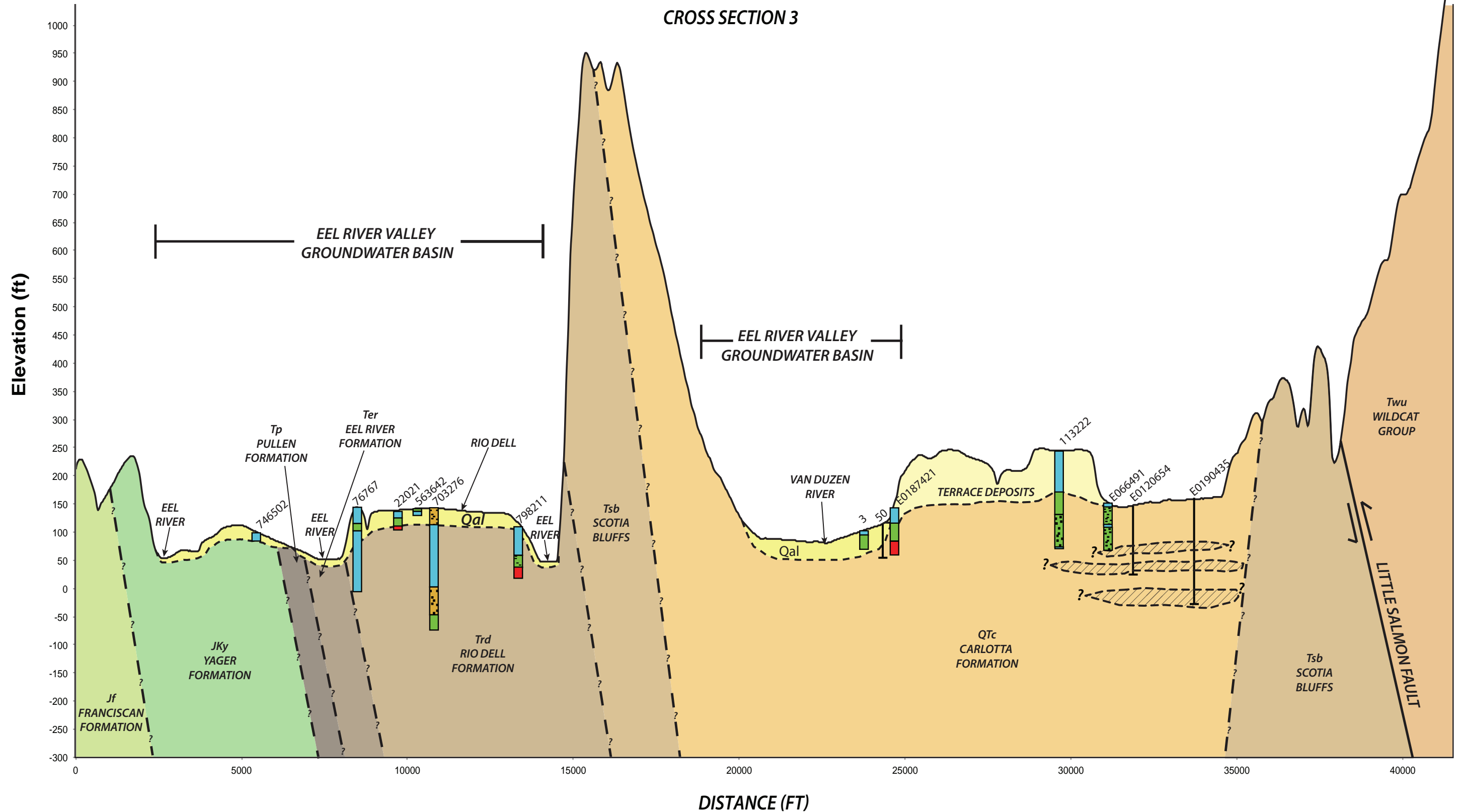
Geologic Cross-Section 2  
(This Study)  
SHN 016219

December 2016

CrossSection2.ai

Figure 3-6

CROSS SECTION 3



EXPLANATION

QUATERNARY ALLUVIUM (Qal)	RIO DELL FORMATION (Trd)	YAGER FORMATION (JKy)	FINE-GRAINED ALLUVIUM	SILT/CLAY	GRAVEL	23469 DWR WELL LOG #
CARLOTTA FORMATION (QTc)	EEL RIVER FORMATION (Ter)	FRANCISCAN FORMATION (Jf)		SAND	BEDROCK	
SCOTIA BLUFFS (Tsb)	PULLEN FORMATION (Tp)					

SCHEMATIC SECTION SHOWS SHALLOW STRATIGRAPHY ALONG CROSS-SECTION LINE E-E' AS SHOWN ON FIGURE 3-3.



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

Geologic Cross-Section 3  
(This Study)  
SHN 016219

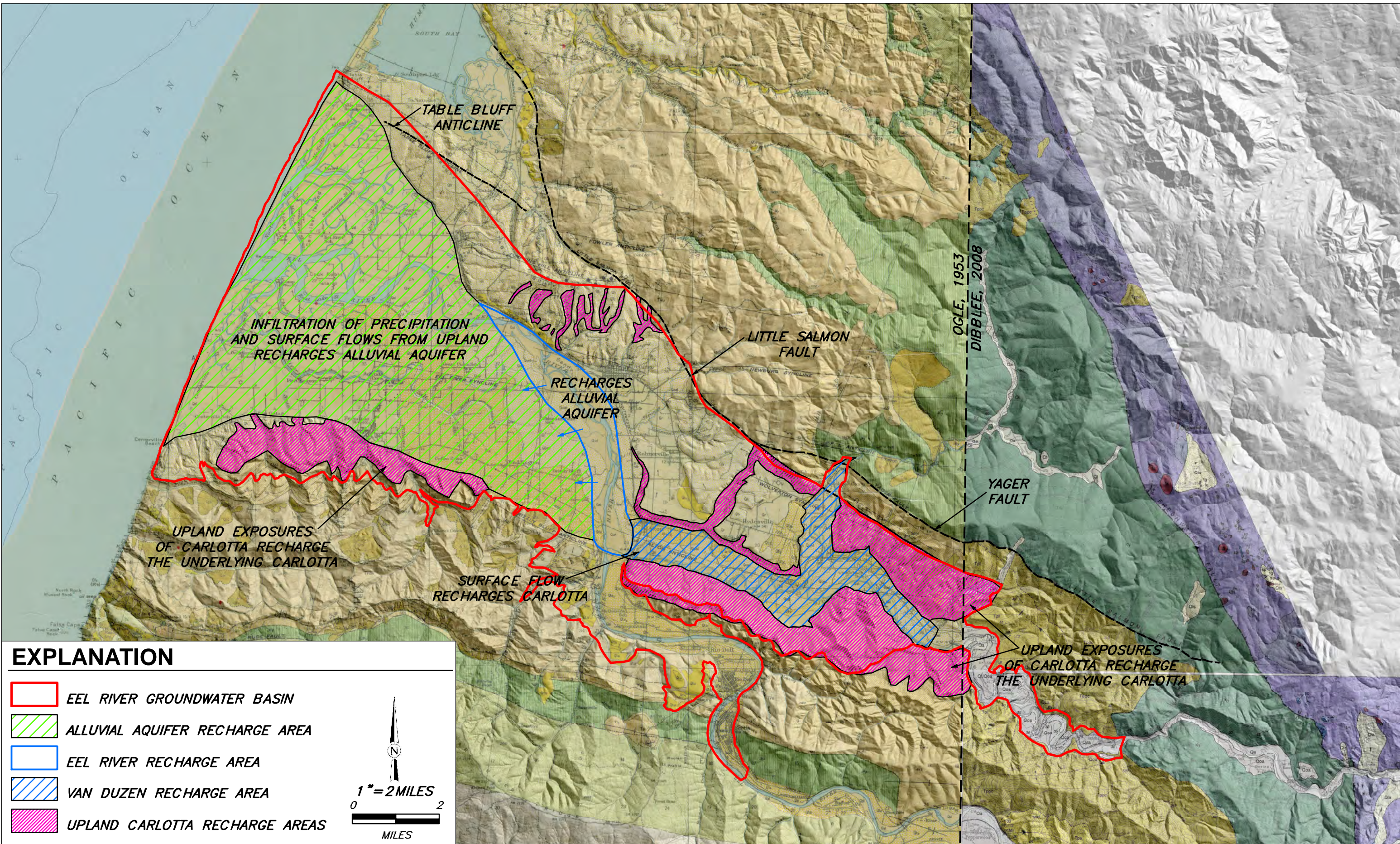
December 2016

CrossSection3.ai

Figure 3-7

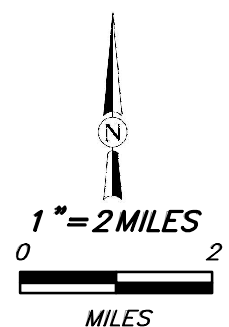
Path: \\eureka\projects\2016\016219-EelRiver\GIS\FIGURES\Presentation\_Figures\3-7\_CrossSection3.pdf

Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ\MXD\Report\_MXD\Important\_Recharge\_Areas.mxd



### EXPLANATION

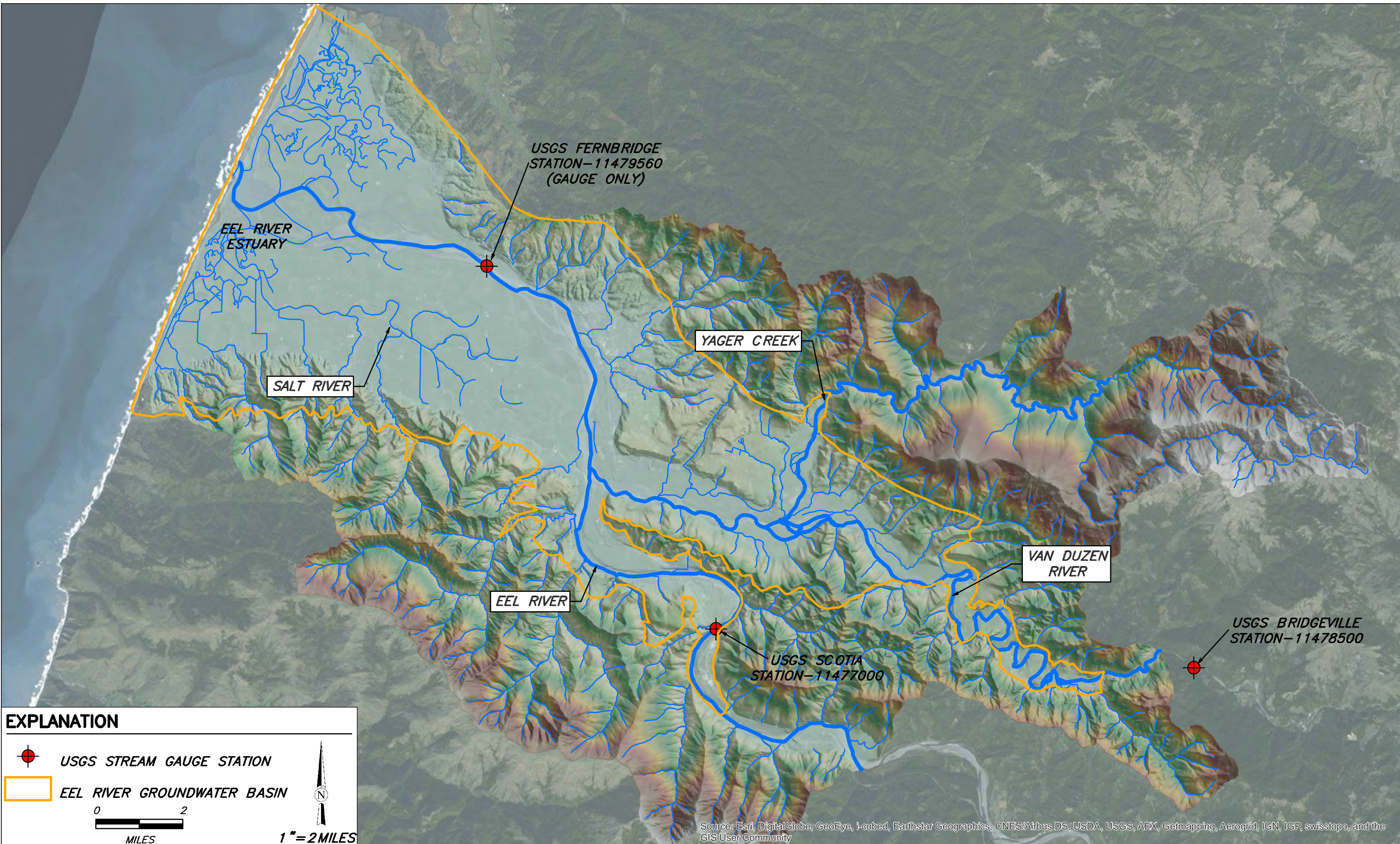
- EEL RIVER GROUNDWATER BASIN
- ALLUVIAL AQUIFER RECHARGE AREA
- EEL RIVER RECHARGE AREA
- VAN DUZEN RECHARGE AREA
- UPLAND CARLOTTA RECHARGE AREAS





Humboldt County Public Works  
 Eel River Groundwater Assessment  
 Humboldt County, California  
 December 2016

Important Recharge  
 Areas  
 SHN 001283  
 Important\_Recharge\_Areas  
 Figure 3-8

Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ\_MXD\Report\_MXD\SurfaceWatersMap.mxd



**EXPLANATION**

-  USGS STREAM GAUGE STATION
-  EEL RIVER GROUNDWATER BASIN

0 2  
MILES

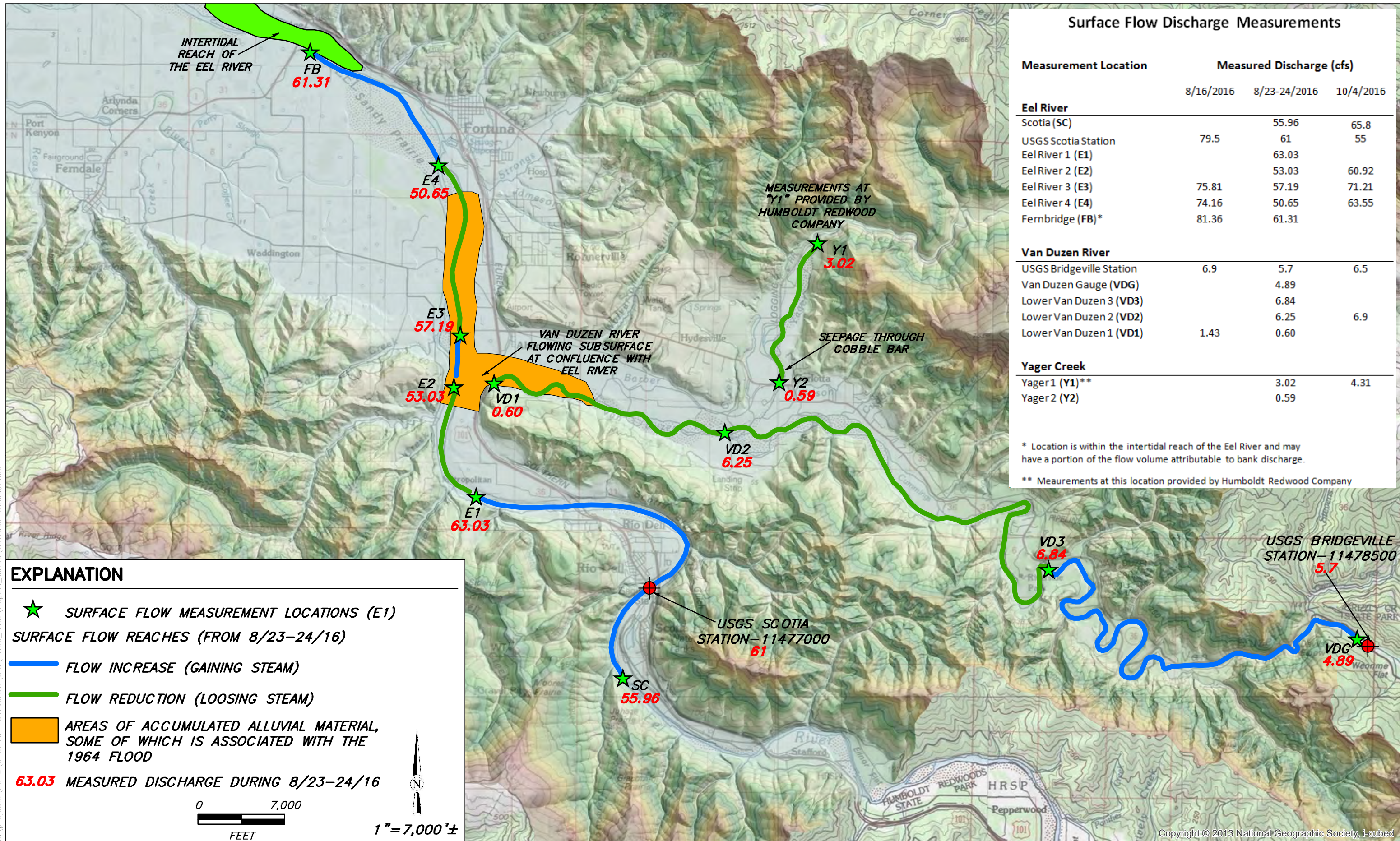
1" = 2 MILES

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



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

Surface Waters Map  
SHN 016219  
December 2016  
SurfaceWatersMap  
Figure 3-9



### Surface Flow Discharge Measurements

Measurement Location	Measured Discharge (cfs)		
	8/16/2016	8/23-24/2016	10/4/2016
<b>Eel River</b>			
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	
<b>Van Duzen River</b>			
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	
<b>Yager Creek</b>			
Yager1 (Y1)**		3.02	4.31
Yager2 (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.  
 \*\* Measurements at this location provided by Humboldt Redwood Company

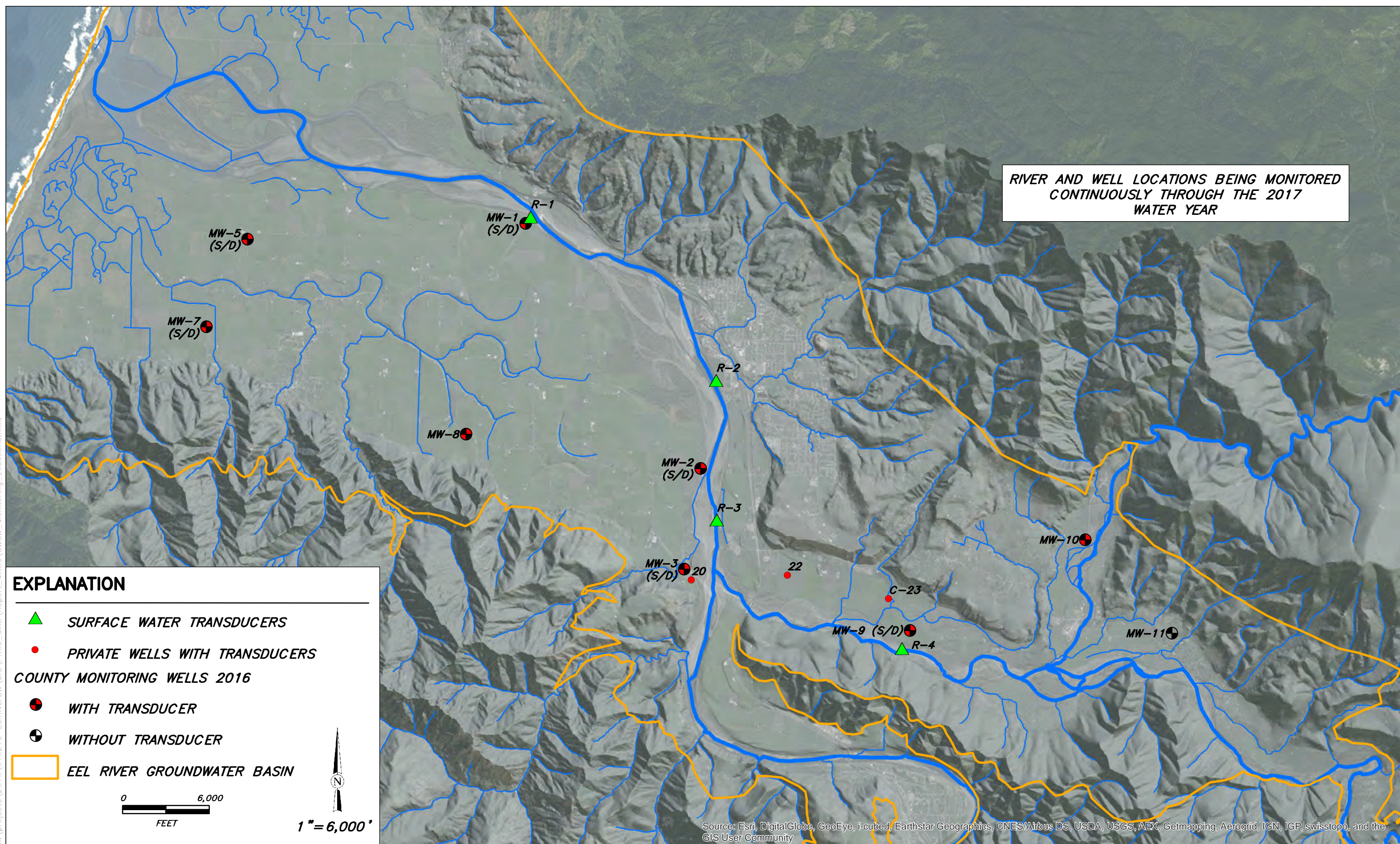
### EXPLANATION

- ★ SURFACE FLOW MEASUREMENT LOCATIONS (E1)
- SURFACE FLOW REACHES (FROM 8/23-24/16)
- FLOW INCREASE (GAINING STEAM)
- FLOW REDUCTION (LOSING STEAM)
- AREAS OF ACCUMULATED ALLUVIAL MATERIAL, SOME OF WHICH IS ASSOCIATED WITH THE 1964 FLOOD
- 63.03** MEASURED DISCHARGE DURING 8/23-24/16

0 7,000  
FEET

1" = 7,000' ±

**RIVER AND WELL LOCATIONS BEING MONITORED CONTINUOUSLY THROUGH THE 2017 WATER YEAR**




**EXPLANATION**

- ▲ SURFACE WATER TRANSDUCERS
- PRIVATE WELLS WITH TRANSDUCERS


**COUNTY MONITORING WELLS 2016**

- WITH TRANSDUCER
- WITHOUT TRANSDUCER

EEL RIVER GROUNDWATER BASIN



0 6,000  
FEET

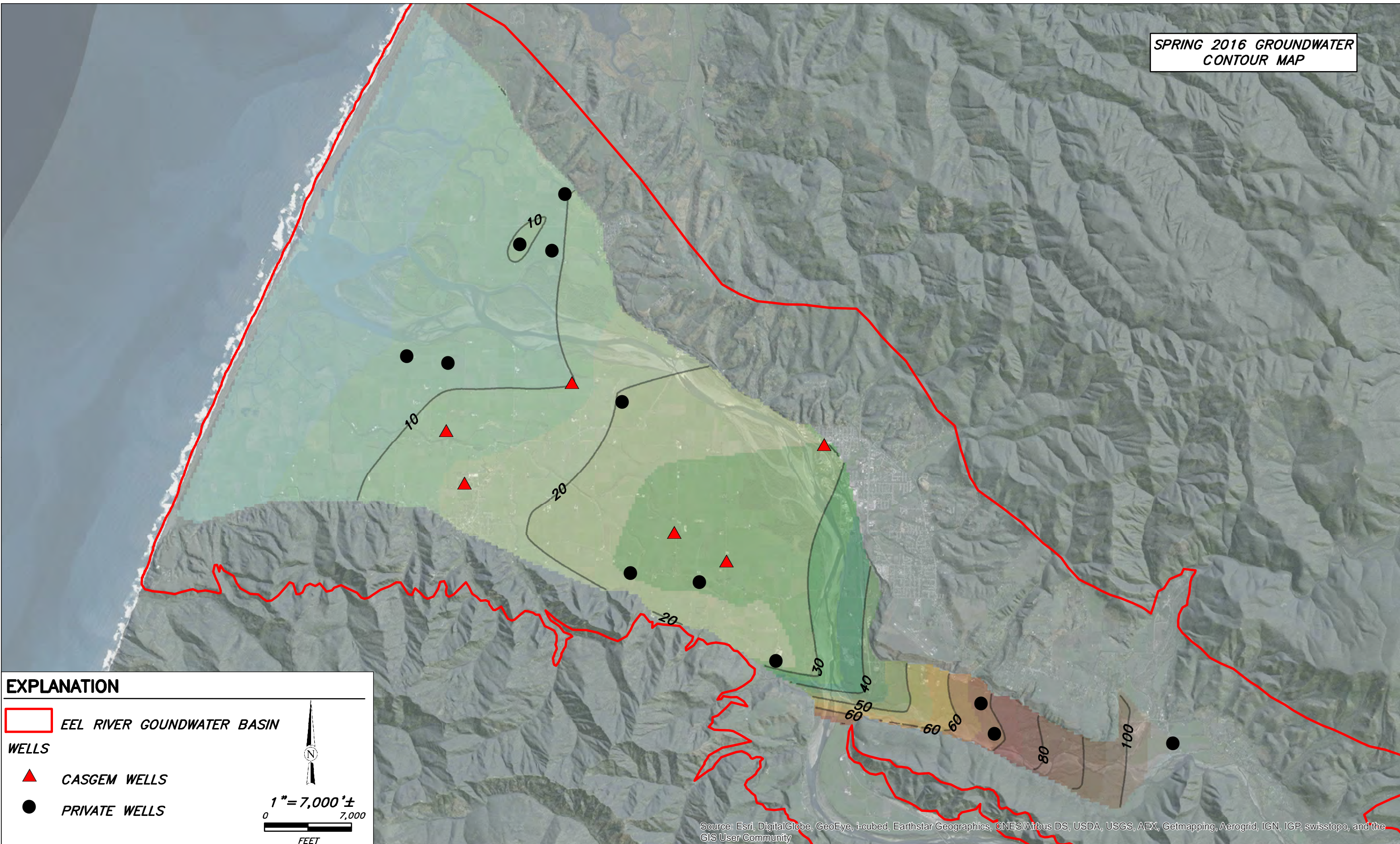


1" = 6,000'

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ\_MXD\Report\_MXDs\GWSW\_Monitoring\_Locations.mxd

**SPRING 2016 GROUNDWATER  
CONTOUR MAP**



**EXPLANATION**

**WELLS**

- ▲ CASGEM WELLS
- PRIVATE WELLS

1" = 7,000' ±

0 7,000

FEET

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

CASGEM WELLS MEASURED BY DWR ON 3/29/2016;  
PRIVATE WELLS MEASURED BY DON AND CHERYL LAFFRANCHI ON 3/1/2016



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

Groundwater Elevation  
Map - Spring 2016  
SHN 016219

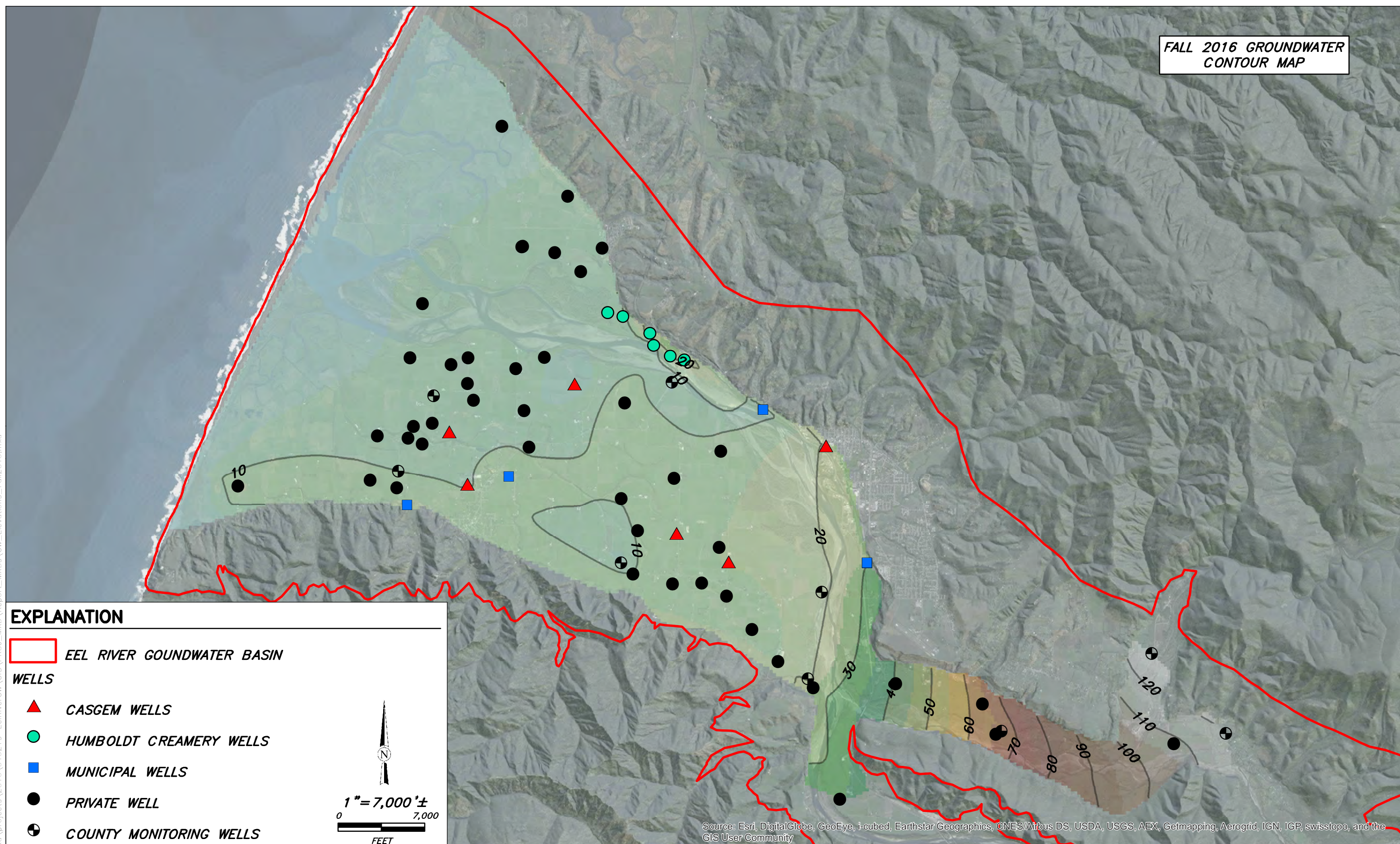
December 2016

GW\_Elevations\_Spring2016

Figure 3-12

Path: \\eureka\projects\2016\016219-EelRiverGW\GIS\PROJ\_MXD\Report\_MXD\GW\_Elevations\_Spring2016.mxd

FALL 2016 GROUNDWATER  
CONTOUR MAP




**EXPLANATION**

EEL RIVER GOUNDWATER BASIN

**WELLS**

- ▲ CASGEM WELLS
- HUMBOLDT CREAMERY WELLS
- MUNICIPAL WELLS
- PRIVATE WELL
- ⊕ COUNTY MONITORING WELLS



1" = 7,000' ±

0 7,000

FEET

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

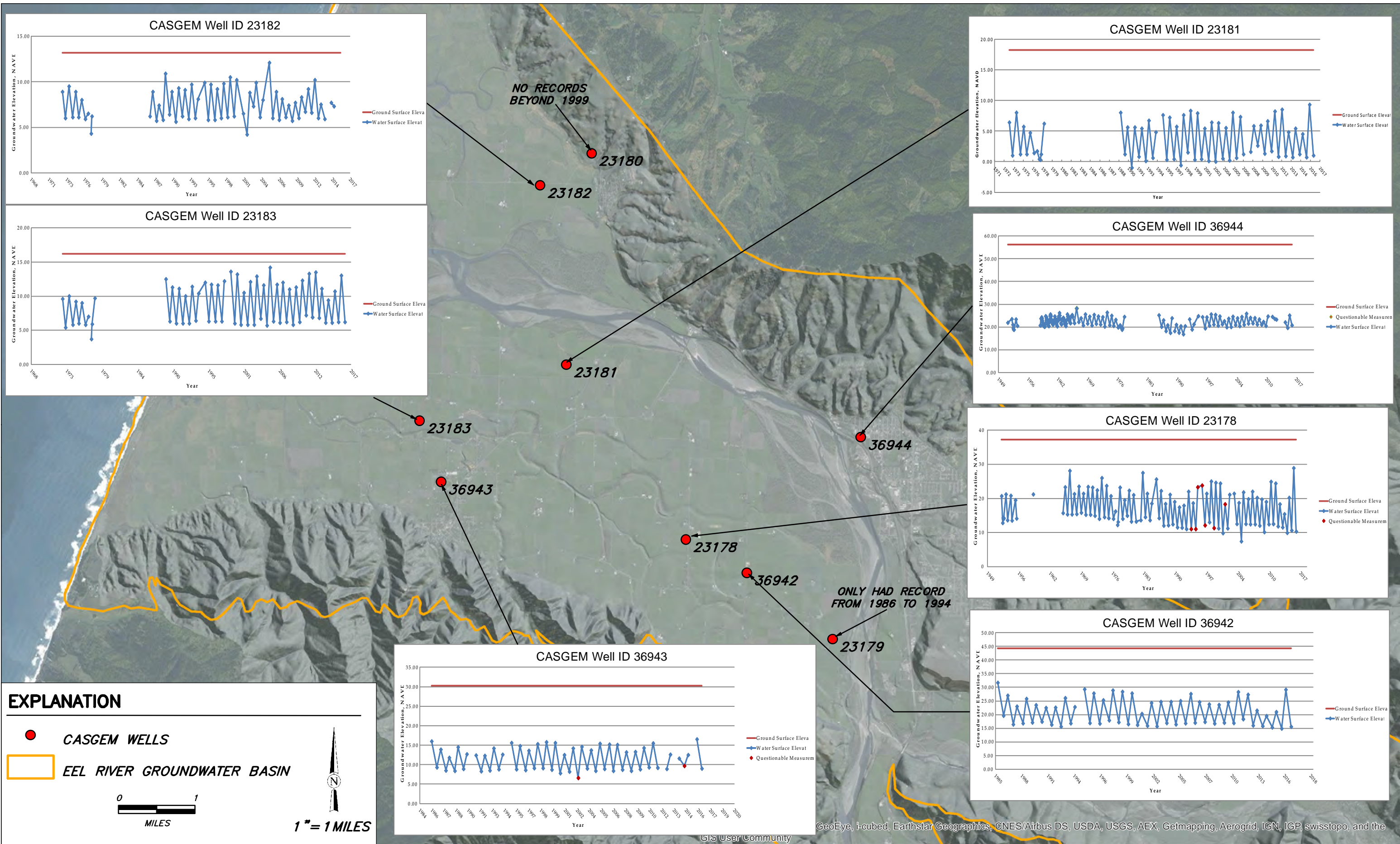
SEE APPENDIX F FOR DETAILS ON SAMPLING DATES



Humboldt County Public Works  
Eel River GW Assessment  
Humboldt County, California  
December 2016

Groundwater Elevation  
Map - Fall 2016  
SHN 016219  
GW\_Elevations\_Fall2016  
Figure 3-13

Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ\MXD\Report\_MXD\GW\_Elevations\_Fall2016.mxd

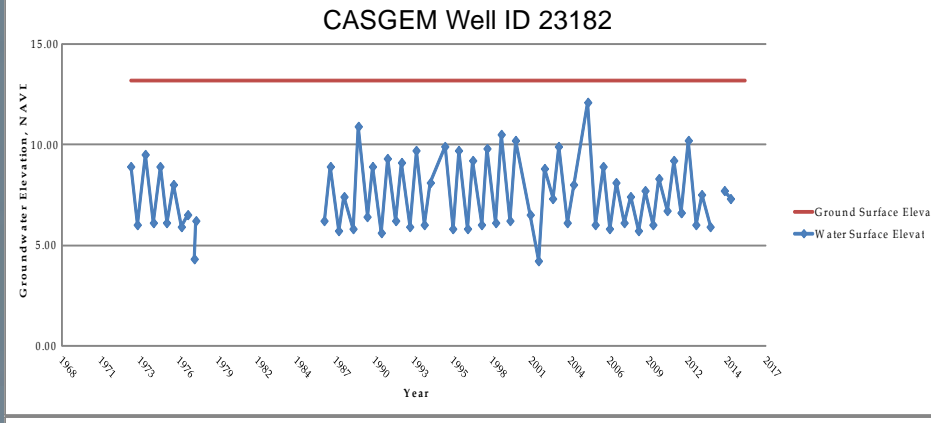
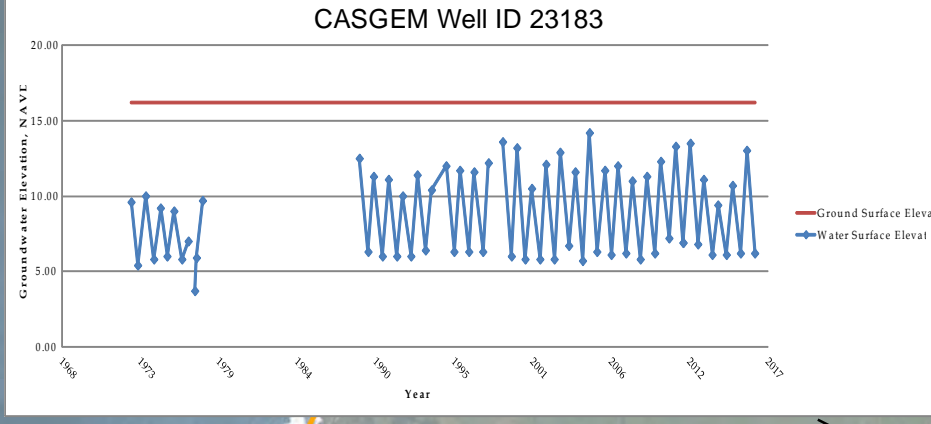
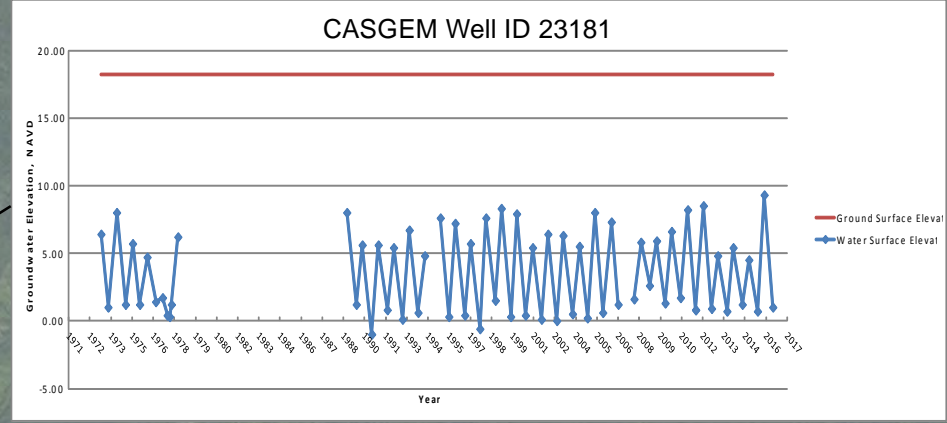
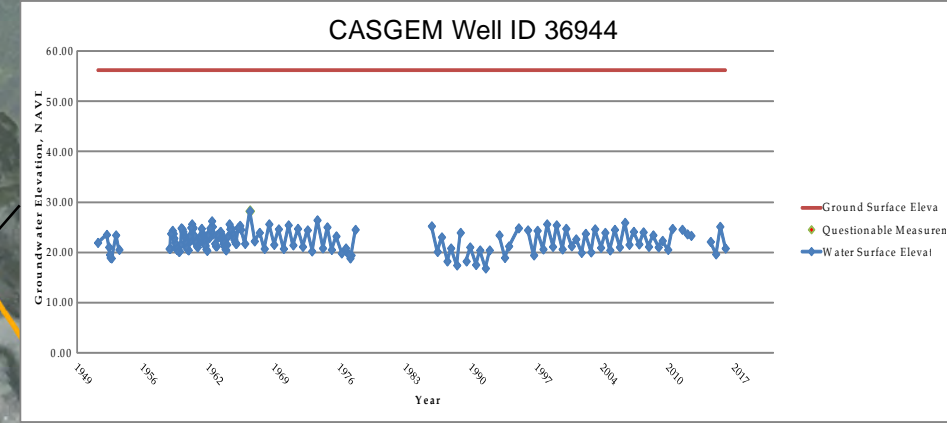
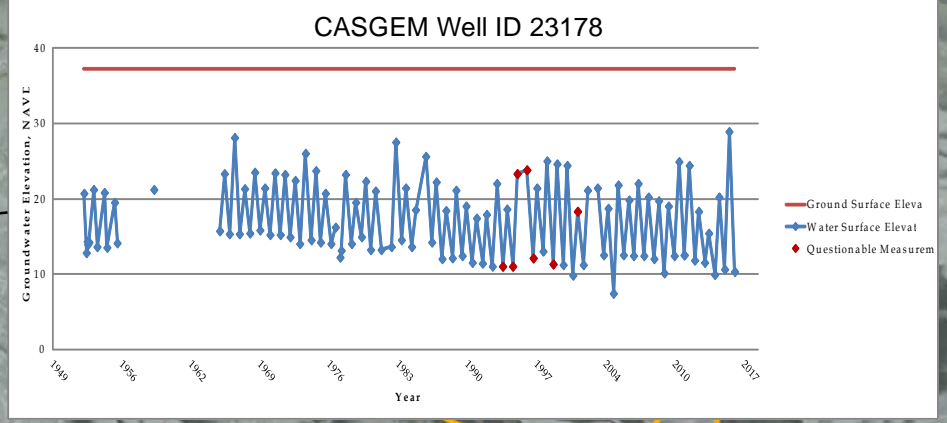
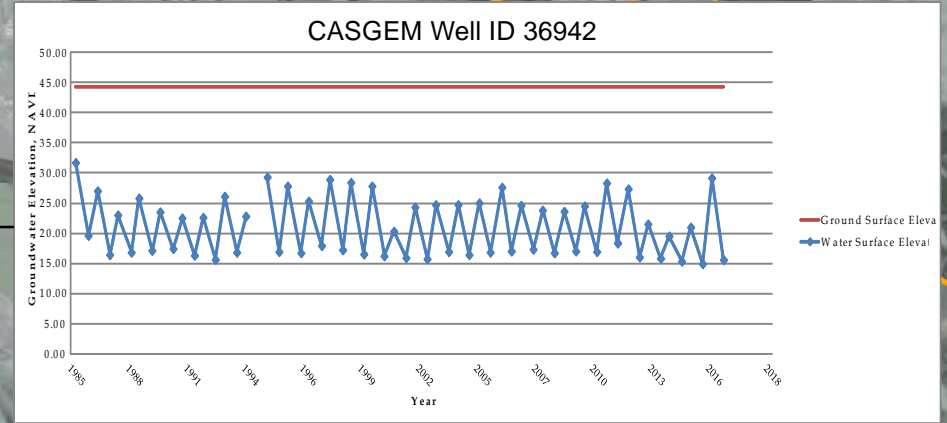
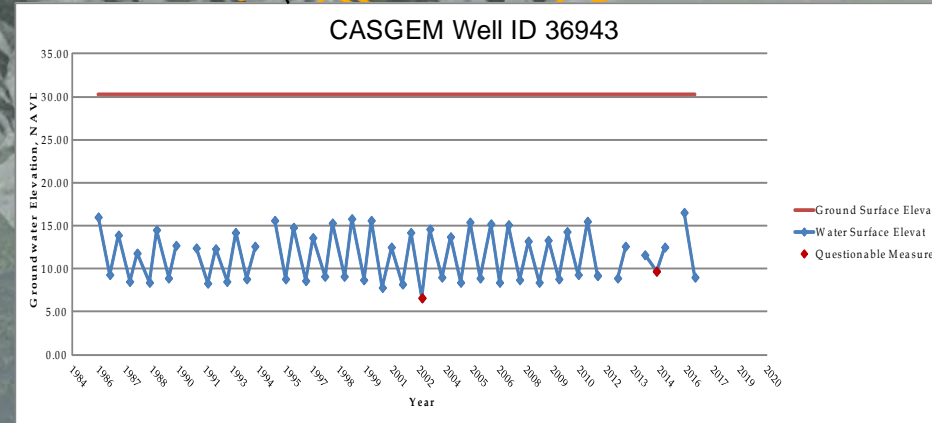


**EXPLANATION**

- CASGEM WELLS
- EEL RIVER GROUNDWATER BASIN

0 1  
MILES

1" = 1 MILES



GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Humboldt County Public Works  
Eel River GW Assessment  
Humboldt County, California  
December 2016

CASGEM Well Locations and Hydrographs  
SHN 016219  
CASGEMWell\_Locations  
Figure 3-14

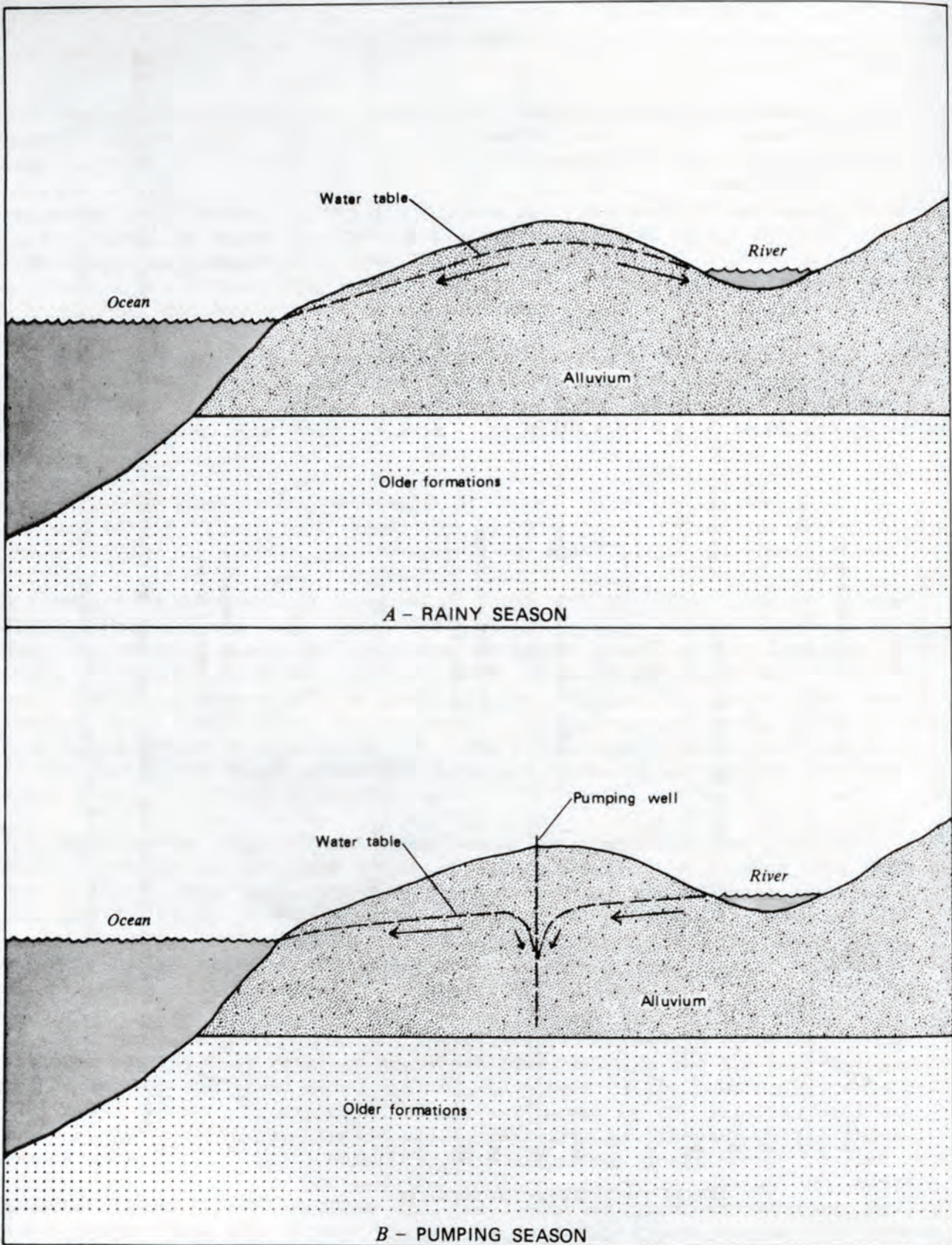
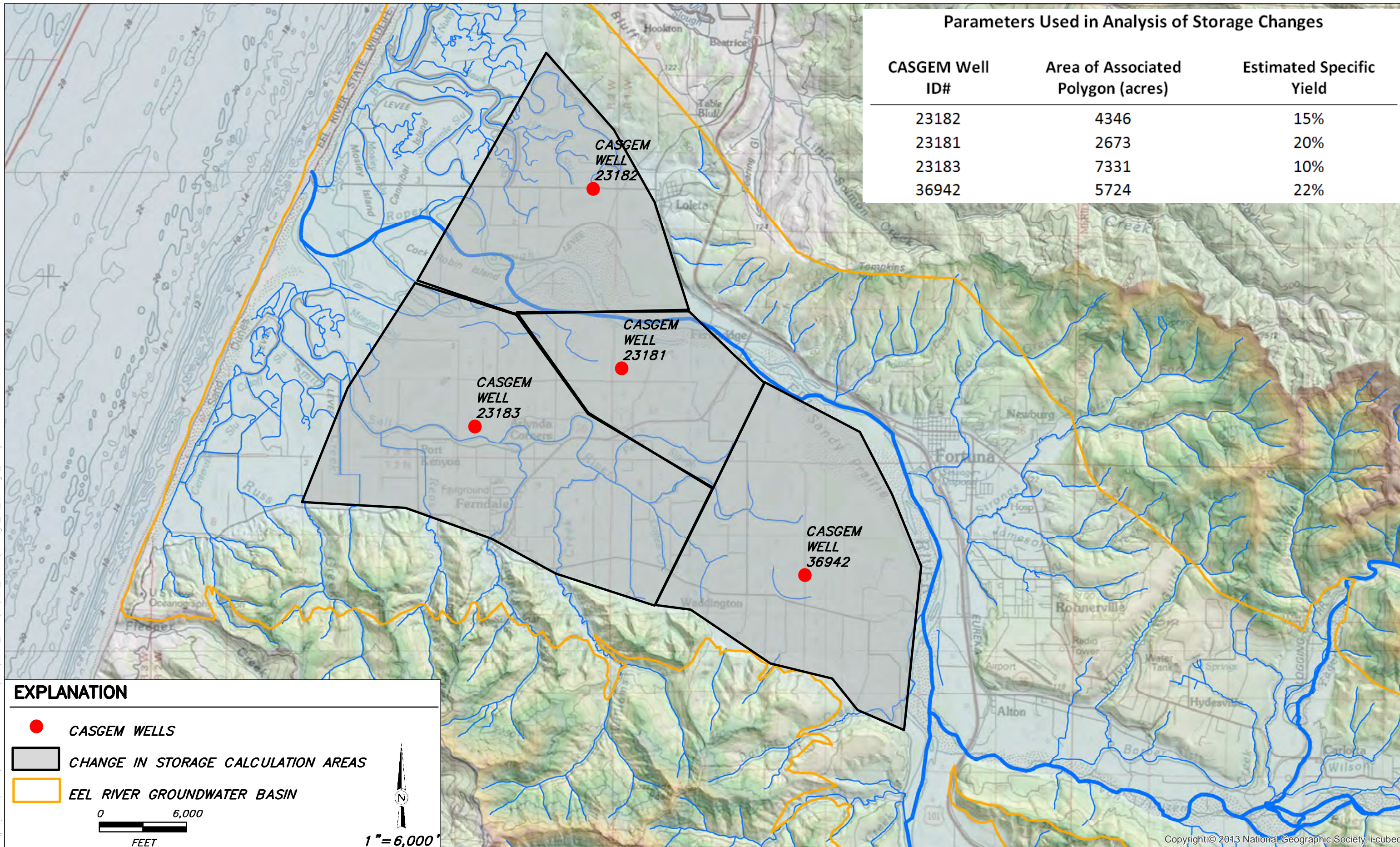


FIGURE 6.--Relation of water table to river and direction of ground-water flow during the rainy season and pumping season.

Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\FIGURES\Report\_Figures\Schematic\_EelRiver\_Ocean.pdf

Parameters Used in Analysis of Storage Changes

CASGEM Well ID#	Area of Associated Polygon (acres)	Estimated Specific Yield
23182	4346	15%
23181	2673	20%
23183	7331	10%
36942	5724	22%



**EXPLANATION**

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

0 6,000  
FEET

1" = 6,000'

Copyright © 2013 National Geographic Society, i-cubed

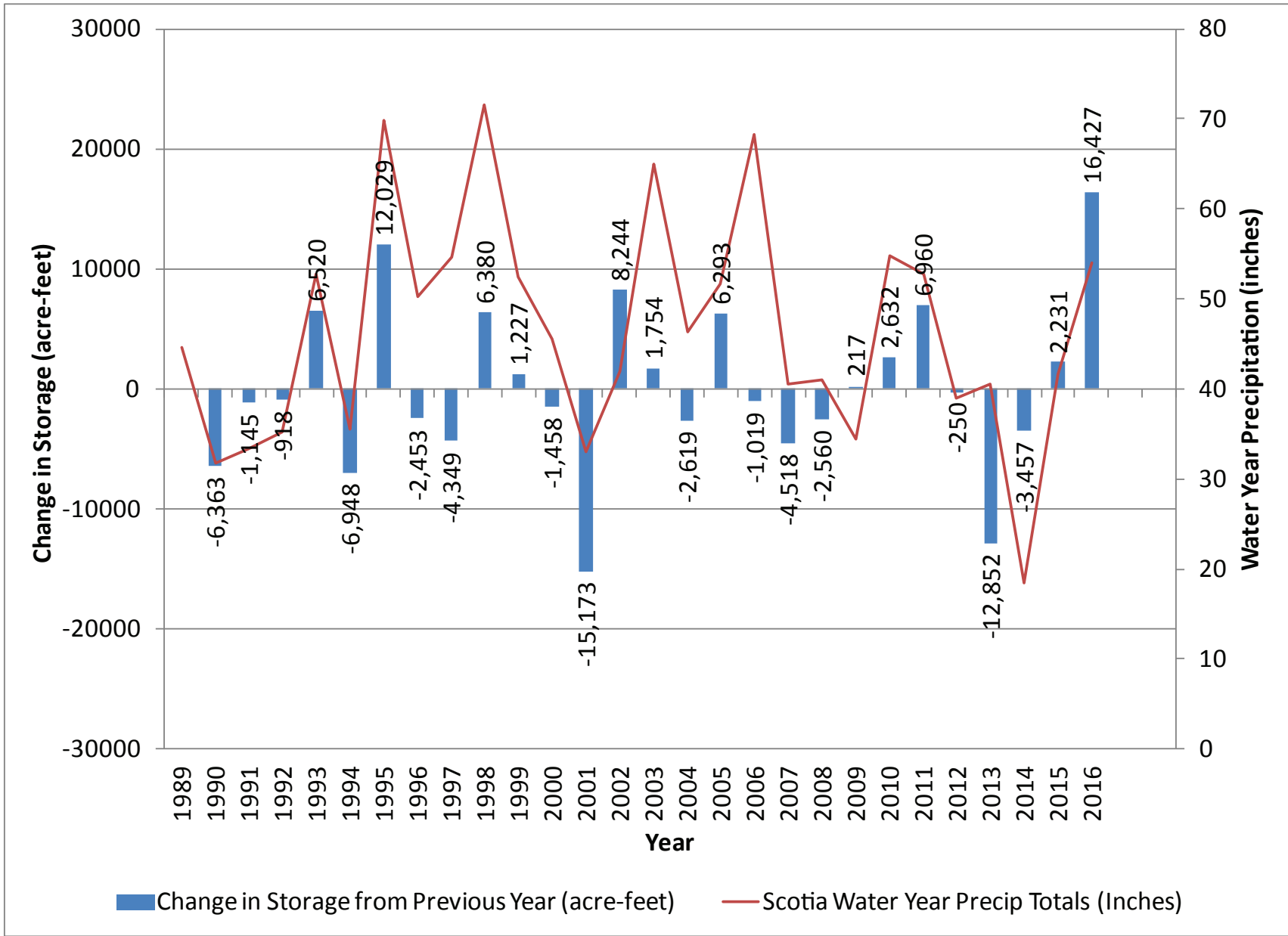


Humboldt County Public Works  
Eel River Groundwater Assessment  
Humboldt County, California  
December 2016

CASGEM Wells and Associated Areas  
Used in Change in Storage Analysis  
SHN 016219  
Change\_in\_Storage\_Analysis

Figure 3-16

Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ\_MXD\Report\_MXD\Change\_in\_Storage\_Analysis.mxd

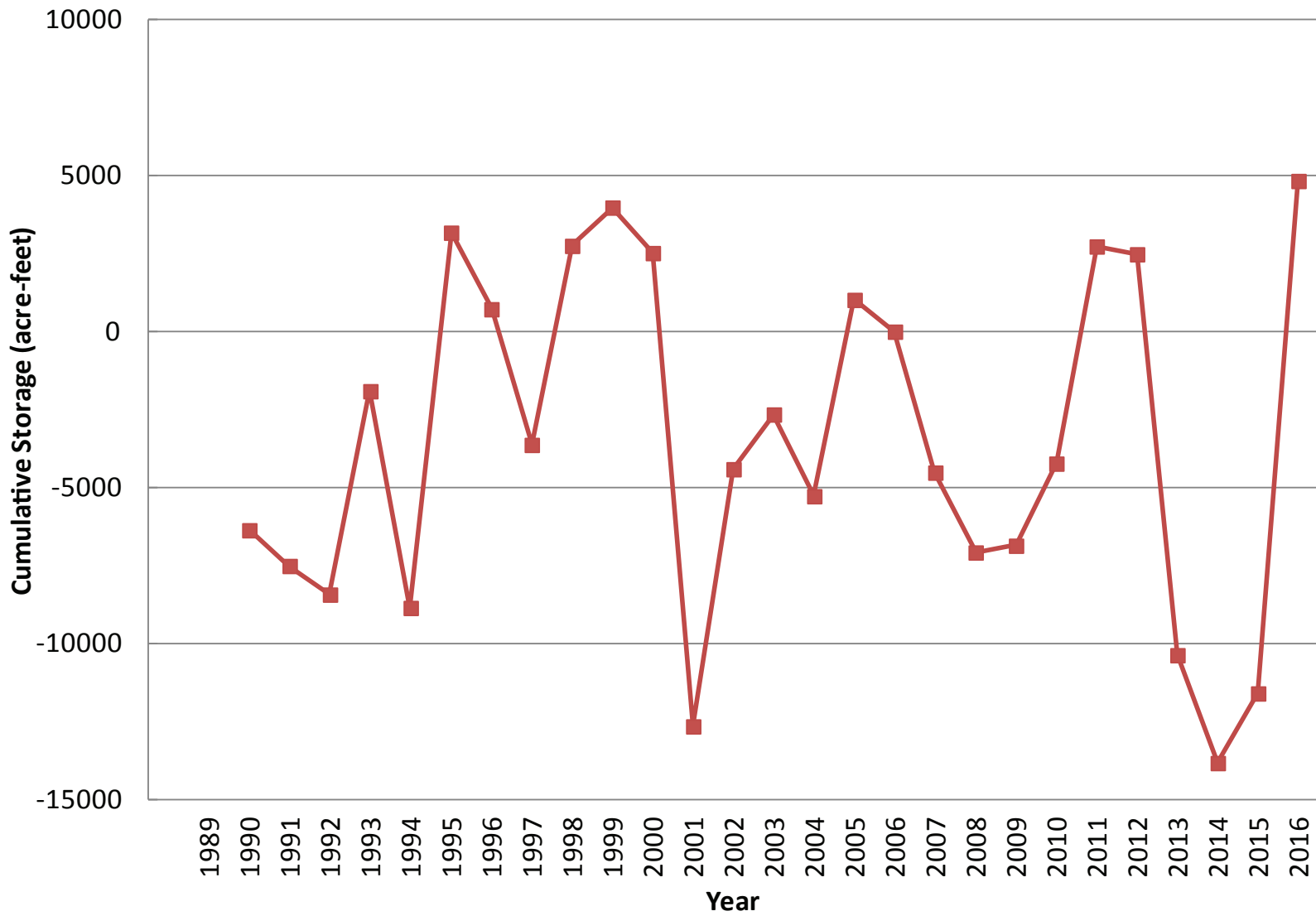


NOTE: CHANGES IN GROUNDWATER STORAGE WERE CALCULATED USING THE LONG-TERM BI-ANNUAL WATER LEVELS RECORDED BY DWR IN REPRESENTATIVE WELLS (SEE FIGURE 3-16).



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

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

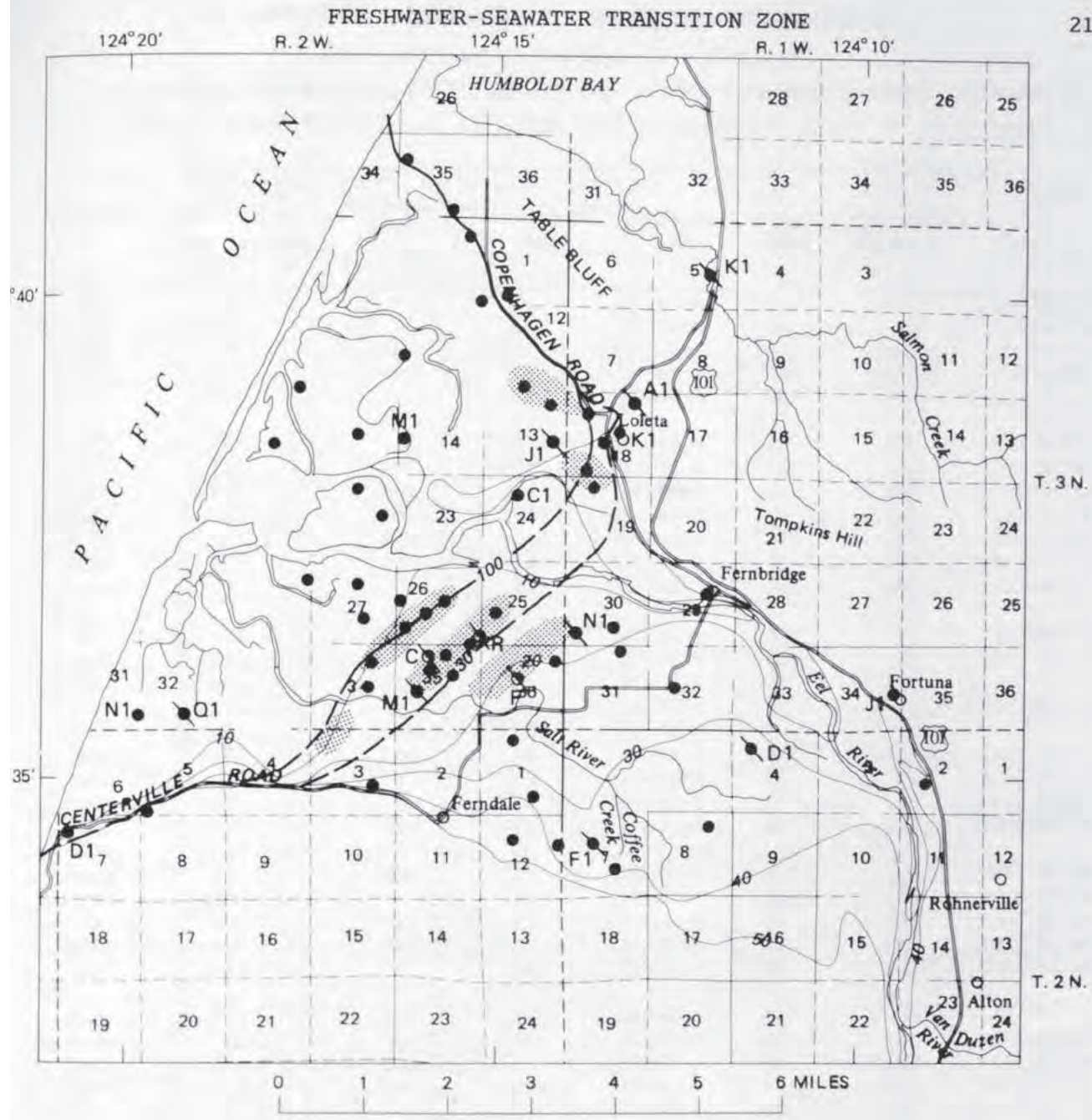


— Cumulative Change in Storage (acre-feet)



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

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



CONTOUR INTERVAL 10 FEET  
 DATUM IS MEAN SEA LEVEL

**EXPLANATION**

- Area suggested for additional water-quality monitoring
- LINE OF EQUAL CHLORIDE CONCENTRATION, 1975 - Dashed where approximately located. Concentration in milligrams per liter. The 100-milligrams-per-liter line indicates the landward edge of the freshwater-seawater transition zone. Area generally east of the 30-milligrams-per-liter line contains shallow ground water with chloride concentrations less than 30 milligrams per liter
- D1 ● Control well and identification for well referred to in text
- M1 ● Well monitored by California Department of Water Resources and identification for well referred to in text
- C ● Recommended additional monitoring well and identification for well referred to in text

NOTE: FROM USGS, 1975



Humboldt County Public Works Eel River Groundwater Assessment Humboldt County, California	Freshwater/Seawater Transition Zone In Alluvial Aquifer, Eel River Valley-1975 SHN 016219
December 2016	SaltwaterFreshwater_Interface_1975.pdf
Figure 3-19	

Path: \\eureka\projects\2016\016219-EelRiverGW\GIS\FIGURES\Report\_Figures\SaltwaterFreshwater\_Interface\_1975.pdf

**EXPLANATION**

100 MG/L LINE OF EQUAL CHLORIDE CONCENTRATION (JOHNSON, 1975)

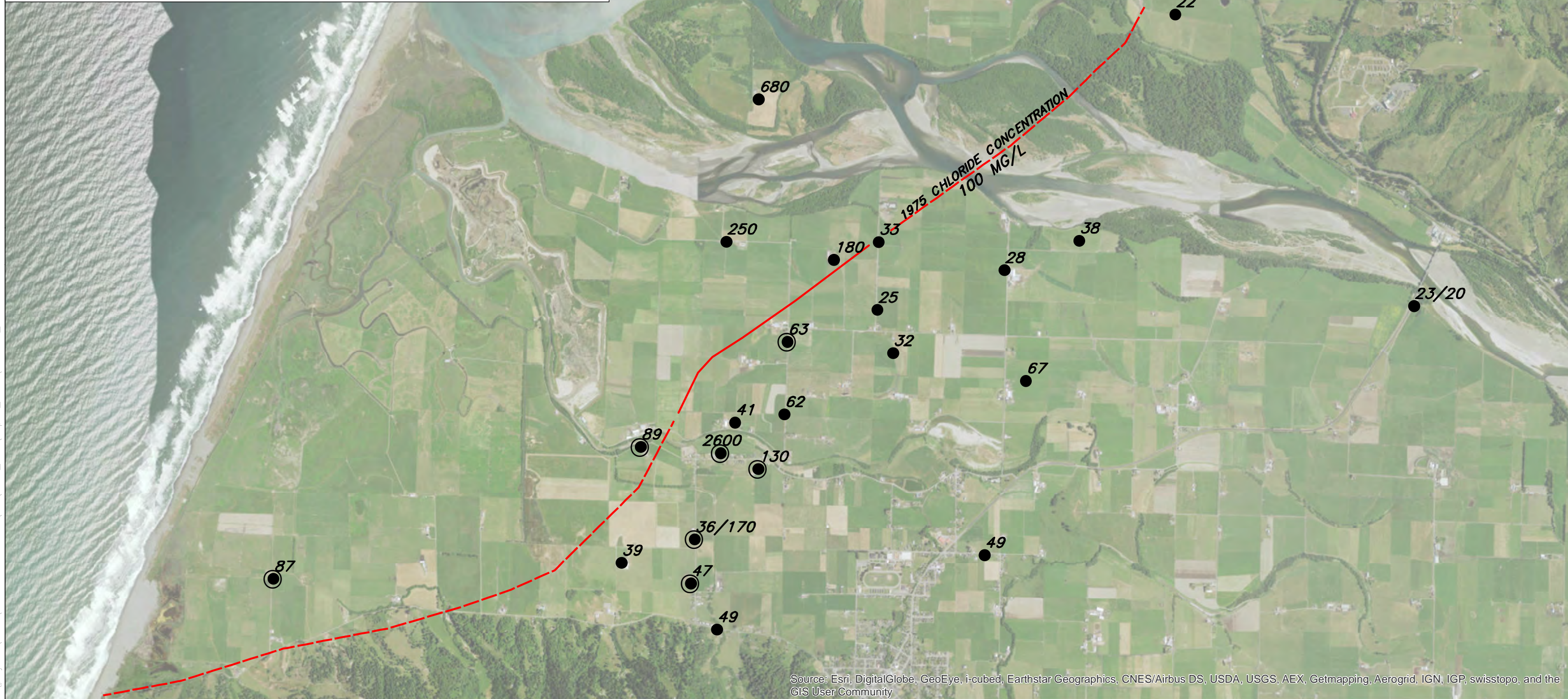
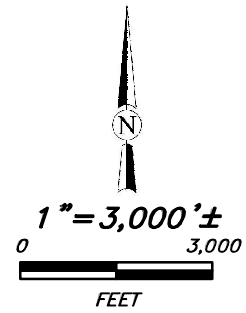
— CERTAIN

- - - APPROXIMATE

● 2016 CHLORIDE DATA VALUES (MG/L)

⊙ INDICATES WELL DEPTH >100 FEET

23/20 INDICATES SHALLOW/DEEP CONCENTRATIONS



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

NOTE: SEE APPENDIX F FOR DETAILS ON SAMPLING DATES



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

2016 Chloride Concentrations  
Map  
SHN 016219

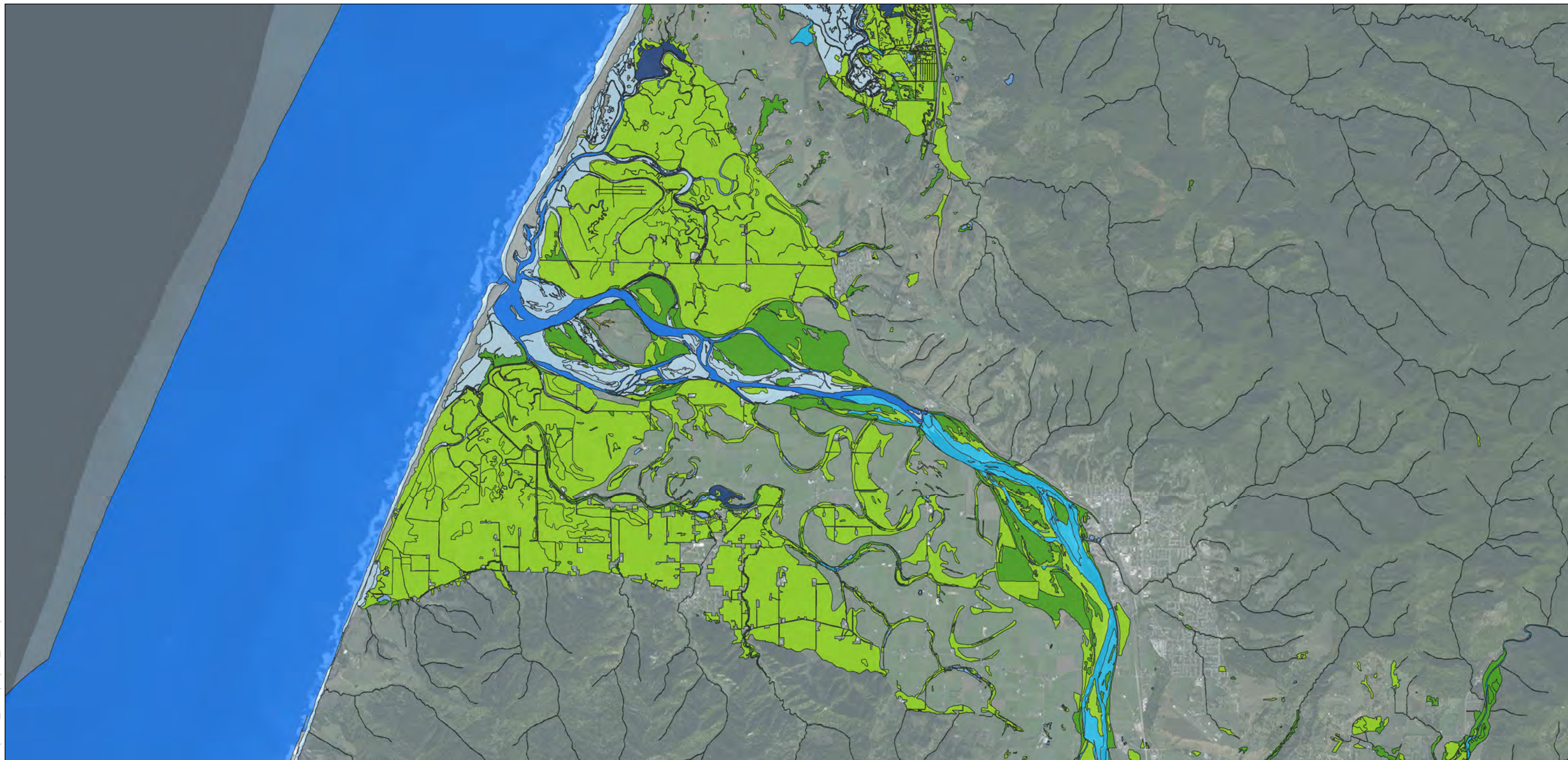
December 2016

Chloride\_Concentrations

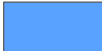

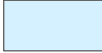
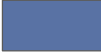




Figure 3-20

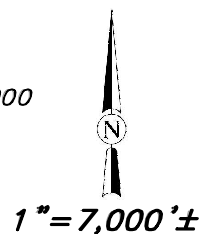
Path: \\eureka\projects\2016\016219-EelRiverGW\GIS\PROJ\_MXD\Report\_MXD\Chloride\_Concentrations.mxd

Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ\_MXD\Report\_MXD\NW1.mxd



**EXPLANATION**

- |                                                                                     |                                          |                                                                                     |                        |
|-------------------------------------------------------------------------------------|------------------------------------------|-------------------------------------------------------------------------------------|------------------------|
|  | <i>ESTUARINE AND MARINE DEEPWATER</i>    |  | <i>FRESHWATER POND</i> |
|  | <i>ESTUARINE AND MARINE WETLAND</i>      |  | <i>LAKE</i>            |
|  | <i>FRESHWATER EMERGENT WETLAND</i>       |  | <i>OTHER</i>           |
|  | <i>FRESHWATER FORESTED/SHRUB WETLAND</i> |  | <i>RIVERINE</i>        |



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

*NOTE: NATIONAL WETLANDS INVENTORY FROM U.S. FISH AND WILDLIFE SERVICE--ACCESSED 2016*



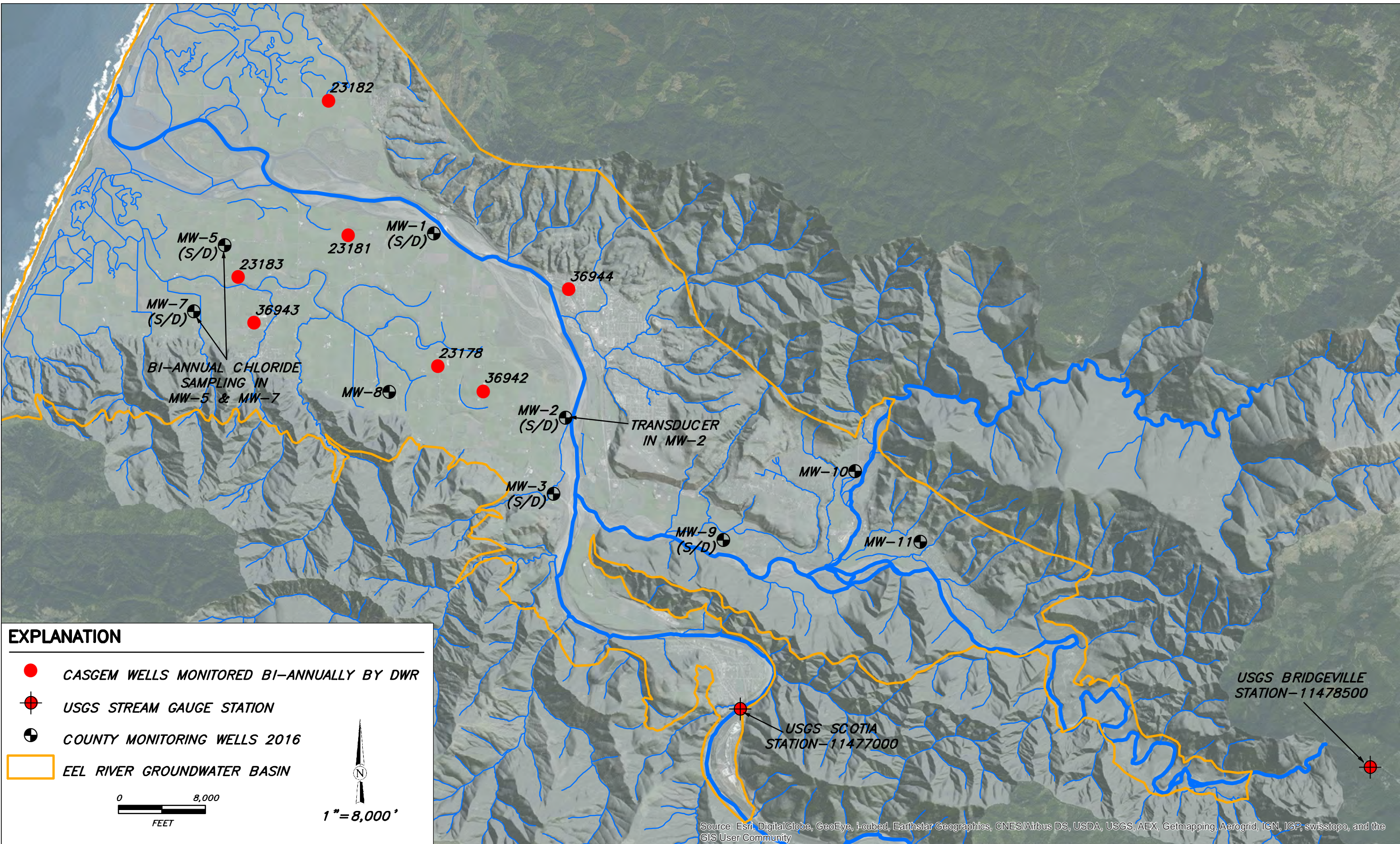
Humboldt County Public Works  
Eel River GW Assessment  
Humboldt County, California

National Wetlands Inventory  
SHN 016219

December 2016

NWI

Figure 3-21



**EXPLANATION**

- 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, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Path: \\eureka\projects\2016\016219--EelRiverGW\GIS\PROJ\_MXD\Report\_MXD\Monitoring\_Network\_Locations.mxd