HUMBOLDT BAY MUNICIPAL WATER DISTRICT
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6		CATEGORY, LOCATION, PROJECT NUMBER & TITLE	PROJECT EXPENDITURES THIS FY			PROCEEDS FOR PROJECTS				ADDITIONAL CHARGES		Resulting Customer Charges	2019/20	PROJECT DESCRIPTION
7			Treatment	Base Facility	Total	Advance Charges (Collected)	Grants	Reserves	Loans	Advance Charges (Cur. FY)	Debt Service		Prior Year Budget Amount	
8		**Maintenance**												
9		**Essex Area Maintenance**												
10	M1	Pipeline Maintenance		12,750	12,750							12,750	12,750	**ANNUAL PROJECT:** Routine annual maintenance to include re-establishing access to the right-of-way, minor grading, sign replacement, and equipment maintenance.
11	M2	12 kV Electric System Maintenance		4,000	4,000							4,000	4,000	**ANNUAL PROJECT:** Required to inspect, clean, maintain, and ensure the safe operation of the existing 12kV system which supports the Domestic Water System, Industrial Water System, and the Control Center at Essex.
12	M3	Main Line Meter Flow Calibration		14,000	14,000							14,000	10,000	**ANNUAL PROJECT:** The District uses a five-year cycle for mainline meter maintenance. This year, the MCSD and Eureka meters are due for maintenance. The meters will be removed for calibration during the winter months.
13	M4	Technical Support and Software Updates to Include Control System		17,250	17,250							17,250	19,000	**ANNUAL PROJECT:** This is an annual expense for licensing and technical support on an as needed basis: 1)Rockwell SCADA and control systems 2)ESRI GIS software 3) IMSI CAD software and 4)Microsoft operating systems. This also includes auxiliary software such as 5)Antivirus software 6) Firewall software 7) Phone system support.
14	M5	Generator Services		3,500	3,500							3,500	3,500	**ANNUAL PROJECT:** Routine service on 2MW and 35kw emergency generators.
15	M6	TRF Generator Service	500		500							500	500	**ANNUAL PROJECT:** Routine service on Korblex emergency generator.
16	M7	Hazard & Diseased Tree Removal		8,000	8,000							8,000	6,500	**ANNUAL PROJECT:** Required to remove hazardous trees in the Essex parks.

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17	M8	Cathodic Protection		6,500	6,500							6,500	6,500	**ANNUAL PROJECT:** To inspect and perform minor maintenance on cathodic protection system.
18	M9	Maintenance Emergency Repairs		50,000	50,000							50,000	50,000	**ANNUAL PROJECT:** Funding for unforeseen maintenance, unplanned replacements, and emergency repairs.
19	M10	Fleet Paint Repairs		5,000	5,000							5,000	5,000	**ANNUAL PROJECT**: This project continues preventive maintenance to preserve our equipment to prolong assets useful life.
20		Surge Tank Refurbishments		3,000	3,000							3,000	0	This is a CIP project that will perform needed refurbishment and painting of the surge tanks on Collectors 1, 2 and the surge tank at Line Shed 4.
21		Upgrade Microsoft Office Package at Essex		8,250	8,250							8,250	0	Updates all administrative system computers at Essex to Microsoft Office 2019 Pro. This may be the last stand alone office suite by Microsoft. We are using Office 2010 Pro since 2011. Microsoft will cease support for Office 2010 later in 2020. This upgrade prevents security issues in the future, particularly with e-mail.
22		Emergency Pipeline Repair Parts		12,250	12,250							12,250	0	This project is for purchasing additional Pipeline repair parts for inventory. These items are not readily available in an emerency.

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23		Collector Lube Oil Reservoir Replacement		16,000	16,000							16,000	0	This project replaces the lube oil reservoirs for the collector pumps. This would include a tank that is easier to clean, monitor the oil level, and to maintain oil quality improving efficiency and reliability. The current oil reservoirs are original equipment and do not have access for cleaning.
24		Oil Filter Crushing Station		2,500	2,500							2,500	0	This project purchases a mechanical oil filter crushing station for the processing of waste filters from fleet servicing. Purchasing this station reduces our waste generation turnover greatly and reduces cost for hazardous waste disposal. The District is charged a per drum price for filter disposal. Crushed filters are 25% smaller than non crushed. Therefore four times as many filters fit in a drum for disposal, reducing disposal fees.
25		Essex 35kW Voltage Selector Switch		5,500	5,500							5,500	0	This project purchases and installs a voltage selection switch assembly on the Essex 35KW emergency generator. It would allow this generator, which is mobile, to be moved and configured for multiple-voltages via a switch. This would make this generator more versatile in an emergency situation as a back up power solution. Currently it is hardwired to run 208V 3 phase and requires extensive rewiring to change it to alternate voltages like 480V 3phase.
26		Replace Fence and Gate Around DG Fairhaven Power Fire Service Meter		6,400	6,400							6,400	0	This project is the the replacement of the fence and gate around the DG Fairhaven Power fire-service meter. This fence and gate are very degraded and need to be replaced to adequately protect the meter.

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27		**TRF Maintenance**												
28		TRF Limitorque Valve Retrofit Supplies	14,500		14,500							14,500	10,250	This project is for the purchase of more Limitorque valve actuator retrofit kits and spare parts for the TRF valves. This will become a reoccurring budget item in the future until such time as a sufficient inventory of spare parts and actuators are achieved and/or at end of product life span which has prompted the phasing out of the Limitorque actuators.
29		Chemical Pump Spare Parts Inventory	5,250		5,250							5,250	0	This project is for the purchase of spare inventory parts for the TRF chemical delivery systems. This would include spare motors, drives, and pump or skid components for chemical delivery. We have standardized the pumps where possible and have also upgraded some other equipment. This would now create a spare inventory for those systems.
30		Emergency Sample Sump Pump	6,250		6,250							6,250	0	This project is for the purchase of a new lab sample sump pump and discharge piping assembly for one of the two existing units. These pumps run year round and the piping discharge connection assembly is showing evidence of leakage due to corrosion. The removed pump will be re-conditioned if parts are available and if not then a project to replace the second pump will be submitted in the next year's budget.

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31		TRF Process Pumps Rebuild Kit Inventory	8,250		8,250							8,250	0	This project purchases spare rebuilt / service kits for several of our process pumps including the WWR, sludge, sewer grinder, lab sump and plant sample sump pumps. We have several generations of pumps in these systems with redundancy. We also need to have rebuild kits for both generations of pumps.
32		Sludge Bed Lighting Project	4,250		4,250							4,250	0	This project proposes installing focused lighting on the valve end of the sludge beds to allow Operators to visibly observe sludge draw discharges at night for efficient operations. It would also include some small focused walkway lighting for safety at night.
33		Emergency Limitorque Gear Boxes	14,750		14,750							14,750	0	This project purchases additional gearboxes of different sized valves that have critical roles in the TRF daily function. These gearbox's are essential to have onsite to make a quick repair if there was a failure, due to the fact that the original model's are not manufactured any more and parts unavailable or hard to find because they are obsolete.

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34	**Ruth Area Maintenance**													
35	RM1	Brush Abatement Ruth Hydro		6,500	6,500							6,500	6,500	**ANNUAL PROJECT:** Dam-safety related; FERC and DSOD require that we remove or kill trees and brush to prevent the root systems of the trees from damaging the face of the Dam. It is essential to keep earth-fill dams clear of such growth so that root systems do not weaken the impervious clay core.
36	RM2	Howell Bunger Valve Inspection		1,110	1,110							1,110	1,110	**ANNUAL PROJECT:** Inspect the Howell Bunger Valve to determine maintenance, repairs or replacement are required. This is an essential component to operate the Hydro Plant at Ruth Lake.
37		LTO Insurance		5,000	5,000							5,000	5,000	**ANNUAL PROJECT:** This project purchases insurance for our LTO for tree management on lease lots and general timber management.
38		Log Boom Inspection		1,000	1,000							1,000	1,000	**ANNUAL PROJECT:** This project is for boat rental, materials and parts as needed, to maintain the Worthington Log boom at Ruth. This is an essential safety feature of the dam.
39		Abandoned Vehicle Abatement - Ruth Area		4,000	4,000							4,000	20,000	This project funds removal of abandon vehicles on District owned property around Ruth Lake that pose an environmental hazard to our water quality. Staff will coordinate with the Trinity County vehicle abatement program.

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40		Log Boom Interconnection Hardware Replacement		7,000	7,000							7,000	0	This project replaces the interconnection hardware on the Ruth log boom per the GHD 2019 Logboom inspection report. It was determine through wear analysis that the attachment hardware was nearing or slightly beyond manufacturer recommendations for replacement.
41		**Subtotal Maintenance**	**53,750**	**199,510**	**253,260**	**0**	**0**	**0**	**0**	**0**	**0**	**253,260**	**161,610**	
42		**CAPITAL**												
43		**Essex Area Capital Proj.**												
44	C1	Ranney Collector 3 and Techite Pipeline Projects -Debt Service									162,200	162,200	162,200	**CIP - Related**: Debt Service for the Ranney Collector 3 and Techite Pipeline projects. **Funding**- US Bank loan amount was $1,418,000 for both projects. Financed for 10 years at 2.63% interest with debt service of $162,200/year. First debt service payment made in 11/12, the last payment is on September 1, 2021.
45		12KV Grant (FY20/21)		3,023,328	3,023,328	763,000	2,260,328					0	0	This project will relocate the 12kV Switchgear from the side of the shop building up to Railroad Grade (Annie-Mary Trail), and out of the floodplain. It is largely funded by a FEMA Hazard Mitigation Grant. This project will be completed at the beginning of FY21. Anticipated Project total is $3,023,000 - HMG funding is 75% or $2.2M, remaining District portion is $756,000.

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46	Collector Mainline Redundancy Project ($3.1M FY 23)			0	100,000				50,000		50,000	0	This project will provide a redundant pipeline to convey water from the District's collectors to the TRF. There is currently only one water line that conveys the water from all of the District's collectors to the TRF for treatment, storage, and distribution to customers. Failure of this source water supply line would mean total failure of the HBMWD system. Repair of the collector mainline would be very difficult, as it travels along a steep and narrow road, and failure of the pipe would likely cause significant erosion of the hillside and roadway creating costly and time-consuming repairs. Currently in the approval process for FEMA Hazard Mitigation Grant funding, construction is anticipated in FY22/23. Project total is currently budgeted at $3,100,000 with a District match of $775,000.
47	Collector 2 Rehabilitation (Project $1.6M - FY22)			0	625,000				200,000		200,000		This project will begin the rehabilitation of Collector 2. This will include the design/engineering/replacement of the laterals. Engineering in FY 20/21 and Construction in FY21/22. The project is currently estimated at $1,658,000 and has received NCRP Prop. 1 grant funding of $600,000, and Advanced Charges collected of $625,000 leaving a District balance of $200,000.
48	3x Tank Seismic Retro Grant (Project $3.5M - FY22)		-	0	175,000				200,000		200,000		This project will provide a Seismic Retrofit for all three storage reservoirs (1MG and 2MG at TRF, and 1MG Industrial). This will bring all three reservoirs up to the current seismic code. Currently in the approval process for FEMA Hazard Mitigation Grant funding, construction is anticipated in FY21/22. Project total is currently budgeted at $3,500,000 with a District match of $875,000.

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7		CATEGORY, LOCATION, PROJECT NUMBER & TITLE	Treatment	Base Facility	Total	Advance Charges (Collected)	Grants	Reserves	Loans	Advance Charges (Cur. FY)	Debt Service	Resulting Customer Charges	Prior Year Budget Amount	PROJECT DESCRIPTION
49		Cathodic Protection Project ($405,000 - FY22)			0					100,000		100,000	0	Cathodic protection is a form of corrosion control commonly used to mitigate external corrosion on buried pipelines. Impressed Current Cathodic Protection (ICCP) is a type of cathodic protection relying on an external power source: AC power which is converted to DC by a rectifier. DC current is sourced through the soil via buried anodes to the project pipeline(s). There are typically several anodes associated with a single rectifier that may be buried in various configurations or arrays; including installation of multiple anodes in a vertical column as a part of a shallow anode well array or a deep anode well. HBMWD has an ICCP system dedicated to the DW pipelines; composed of five (5) rectifiers and associated anode beds. The CP system components are aging, and in some cases are estimated to have been in service for 30 or more years. The CP systems have been maintained by HBMWD staff and periodic system surveys have been conducted by a specialized Contractor retained by the District. Of the five District Rectifiers, two (the Jachson Rance and Jane's Creek), were found to not be functioning at the time of assessment.
50		Fiber Optic Link to Collector 2, Phase 1		65,000	65,000							65,000	0	This project is for the purchse of conduit, trenching, and pull boxes to begin the underground 12KV electrical feed and new fiber optic cable from Essex to Collector 2. The goal of this project would be to eliminate the vulnerability of relying on overhead power transmission lines and would establish a separate breaker feed to Collector 2. A fiber optic link is also part of the project to further harden communications, and control reliability.

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51		On Site Generation of Chlorine, Phase 1 ($850,000 - FY21)			0	366,250				80,000		80,000	0	To eliminate the high risk hazard of Chlorine Gas at Essex, this project replaces our current Chlorination system with a Chlorine gas generator. This is a much safer process than currently. Chlorine generation is a very low consentration process therefore, it is not considered a hazardous product with far less regulation. There will be no need for our SCBA PPE. These are advanced charges to pre-fund this project. See Pages 40-49
52		Techite Intertie Location Abandonment		12,000	12,000							12,000	0	This project completes the permanent isolation and abandonment of the old techite line intertie valves at three locations. One at the IW reservoir intertie, a second at the Bay street intertie, and the third at the Bay street crossing intertie. This will involve excavating, cutting back the old techite line and installing a blind flange on the valve that will then isolate these locations from the new 20" C-900 line. The existing valves risk cross connection and could cause damage to property or the pipeline if they were to be accidentally opened or fail.
53		**TRF Capital Proj.**												
54		TRF Emergency Generator (Project $1.9M - FY23)	0		0	275,000				25,000		25,000	0	This project will continue Advance Charges to install a larger Emergency Generator at the TRF to power the facility at full functionality. The current generator is not large enough to operate the facility at full capacity. Currently in the approval process for FEMA Hazard Mitigation Grant funding, construction is anticipated in FY22/23. Project total is currently budgeted at $1,925,000 with a District match of $500,000.
55		Mainline Valve Replacement		31,750	31,750							31,750	0	This is a CIP project. This project is to replace the isolation valve for the TRF.
56		**Eureka Office Capital**												
57		Main Office Emergency Generator		37,250	37,250							37,250	0	This project: purchases, permits, installs, and commissions a new emergency generator, automatic transfer switch and new service and lighting panels to be installed at the main office for PSPS and other power outage disaster events.

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58	**Ruth Area Capital Proj.**												
59	Replace Transformer at Hydro Plant	0	160,000	160,000							160,000	0	This is a CIP project, This transformer is original equipmenmt with the Hydro Plant (1981). We perform oil analysis on transformers every 5 years. This transformer is shopwing the most degerdation of all of our current transformers. It is subject to the most high and low temperatures which breaks down the oil. This project will replace it with like size. This project also includes dollars for PG&E's G-5 permiting and some possible engineering to complete the installation.
60	Replace Interuptor Switchgear Panel		28,000	28,000							28,000	0	This is a CIP project. The load break will be replaced with a like kind but may be configured differently and conduiting may need to be modified to fit new switch. This project will also require PG&E G-5 permitting and engineering. The transformer and load break will both go through the G-5 permit process together so we are not paying the PG&E engineering fees twice.
61	Headquarters Remodel		120,000	120,000							120,000	0	This project will repair the Ruth Representative/Hydro plant operator residence. This project will include insulating the exterior walls as needed, replacing old paneling with sheetrock, replacing single pane windows with fire code accessible double pane windows, upgrading some of the electrical components (sub panel, lights etc.) to meet current building code standards installing hardwired fire alarms and CO2 detector, replacing the old carpet, painting the interior, repairing the porch and replacing the sidewalks to the house and garage.
62	Rebuild Headquarters Fire System and Pump House		4,500	4,500							4,500	0	The Headquarters fire / irrigation system is obsolete and currently not functional. This project will replace the fire pump, and associated plumbing and replace the pump house for weather protection.

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63		Ruth HQ & Bunkhouse Generator		15,000	15,000							15,000	0	This project purchases and installs a stationary emergency generator for Ruth headquarters and cabin. This would include the purchase of a Tier 4 diesel generator w/ quiet operation, permitting with Trinity County and Air Quality, installation and enclosure costs, fuel storage and transfer switches for both headquarters and the cabin. This project continues the District's resiliency hardening in response to PSPS events by PG&E.
64		Curbing along Mad River Road		5,800	5,800							5,800	0	This project is for 300ft. of curbing along the west side of Mad River Road near the spillway at Ruth Dam. A registered geologist has suggested that we install this safety measure to direct surface water from the road away from the spillway.
65		**Subtotal Capital Projects**	**0**	**3,329,328**	**3,329,328**	**2,304,250**	**2,260,328**	**0**	**0**	**655,000**	**162,200**	**1,296,500**	**162,200**	
66		**Equipment/Fixed Assets**												
67		**Essex Area**												
68		Replace Administrative Computer		2,500	2,500							2,500	6,250	Annually replace two obsolete workstations in the administration network with new computers including peripherals, printers and monitors.. Also maintain software security to the highest levels currently available. This year we are only replacing one computer since we propose purchasing a laptop for operations

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69		Replace Ruth Vehicle (Unit 6)		62,500	62,500							62,500	0	This project will replace Unit 6 per the Capital Improvement Plan. This fleet vehicle is the District's Ruth Representative / Hydro plant operator truck and it is a vital part the activities associated with the position. We are recommending due to the winter conditions where snow accumulations can be significant that the current 1/2 ton 4-wheel drive truck be replaced with a 3/4 ton 4-wheel drive truck to increase ground clearance and to accommodate a snow plow attachment.
70		High Pressure Washer		11,250	11,250							11,250	0	This project replaces the 2010 Landa pressure washer unit per the CIP. The current unit has 500 hours of burner time on it and is at the end of its useful life.
71		14,000 to 16,000 Lb. Excavator ($222,800 - FY21)		222,800	222,800	222,800				0		0	0	This multi-year funding project will provide the District with an excavator to be used for general excavation, valve replacements, pipeline repairs, demolition, vegetation management and other activities. This excavator is designed and sized for operation in confining areas where the backhoe is less suitable or has difficulty operating due to its footprint. This excavator will also provide a platform for attachments (included in the project cost) such as a 12" trench bucket, a 60" grading bucket, and a hydraulic powered mulching head unit for Right-of-Way maintenance. This is the largest excavator that can be self-transported by the District with the existing dump truck and equipment trailer, eliminating the need to hire an equipment hauler to transport.
72		Replace Portable Sandblasting Unit		4,750	4,750							4,750	0	This project replaces our 1 cu ft portable sandblasting system including the pot, hose, and the shut-off system. Our current system was purchased in 1975 and the shut off system has failed and parts are not available. This unit has reached the end of it's useful life. This unit is used for various small projects and for any projects that require a portable system to be taken to a work site.

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73		Replace Wheels and Tires on Zieman Equipment Trailer		3,250	3,250							3,250	0	This project proposes the replacement of the wheels and tires on the Zieman equipment trailer. The wheels on the trailer are an uncommon size by today's standards which is limiting the options for higher quality tires. The project proposes the changing of the wheels to a more standard size to allow for a more economical selection of tire choices.
74		Humboldt Bay Radio-Read Meter Project		7,500	7,500							7,500	0	This project purchases more radio read meters to install at high risk locations where safety is an issue. These meters will be placed along West End Rd, Warren Creek Rd, in Backyards, Cow fields, Etc. Radio read meters will improve time efficiency.
75		Ergonomic Desks for AOS, WOS and 1 in electrical shop		4,750	4,750							4,750	0	This project purchases more ergonomical desks for: the AOS, WOS and Electrical shop. These desks are consistent with the desks we have purchased for other offices within the District to improve workspace ergonomics. We will also purchase filing cabinets to replace the current desk drawers.
76		2 New Laptop Computers		3,000	3,000							3,000	0	Two new laptops for Superintendent and Operations. Operations laptops will be used for troubleshooting network issues and field computing. Superintendent's computer will be used as a secondary workstation capable of running Turbo CAD and MS Office applications.
77		Replace Tractor Mower		8,500	8,500							8,500	0	This project replaces the JD 609 rotary blade mower deck with a flail mower. This style mower will be more efficient maintaining the parks and Right of Ways. The current mowing deck was purchased in 1996-97.
78		Tool and Equipment Storage for Essex Shop		2,750	2,750							2,750	0	The purpose of this project will be to purchase storage cabinets for the back wall of the carport for the storing carpentry equipment and supplies. It will improve organization of the equipment and fastener inventories in a specific location which improves shop efficiency while working on projects.

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6		CATEGORY, LOCATION, PROJECT NUMBER & TITLE	PROJECT EXPENDITURES THIS FY			PROCEEDS FOR PROJECTS				ADDITIONAL CHARGES		Resulting Customer Charges	2019/20	PROJECT DESCRIPTION
7			Treatment	Base Facility	Total	Advance Charges (Collected)	Grants	Reserves	Loans	Advance Charges (Cur. FY)	Debt Service		Prior Year Budget Amount	
79		Trench Shoring Equipment		3,750	3,750							3,750	0	This project purchases 4 vertical shores that are adjustable from 24"- 46" for use in excavations over 5' deep where the trench width needs to remain narrower than our current vertical shores. It decreases the amount of excavation necessary for performing smaller line repairs and service installations.
80		Replace Portable Electric Valve Operator		11,000	11,000							11,000	0	This project is to replace the electric valve operator. The Wach's unit we have now was originally purchased in 1968, is very heavy, and does not have a torque adjustment. New units are much lighter and have variable torque adjustments, making them much safer to use.
81		Hazardous Spill Containment Equipment		2,500	2,500							2,500	0	This project purchases a portable foam wall containment berm for spill prevention of various pieces of equipment that operate in support roles for crew field work and repairs. The berm itself is compact, very portable and easy to deploy, saving crews time for set-up under equipment such as compressor, welder, portable pump or cranes work in sensitive environments.

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6		PROJECT EXPENDITURES THIS FY			PROCEEDS FOR PROJECTS				ADDITIONAL CHARGES			2019/20	
7	CATEGORY, LOCATION, PROJECT NUMBER & TITLE	Treatment	Base Facility	Total	Advance Charges (Collected)	Grants	Reserves	Loans	Advance Charges (Cur. FY)	Debt Service	Resulting Customer Charges	Prior Year Budget Amount	PROJECT DESCRIPTION
82	Replace Tractor		70,750	70,750							70,750	0	This project replaces the existing JD TLB110 with a new tractor with similar specifications. The JD TLB110 would then be permanently relocated to Ruth Headquarters for snow removal, debris and brush management, and ditching and road work at the hydro plant. The JD110 has approximately 2500 hrs of runtime. It is a very viable machine for the remainder of its useful life as the Ruth machine. The new machine would take on the role as the main right-of-way, and parks mowing and clearing machine. It is a work horse and during the mowing season is used daily for those activities for 3 to 4 months every year. It is also a very convenient machine for moving items around Essex and in locations where the larger CAT 420 is not as functional due to its size. The new machine would share the same Bobcat style attachment and hydraulic connections as the JD110 so that any attachments we have could be shared between machines.
83	Tilt-Deck Equipment Trailer		12,750	12,750							12,750	0	This project purchases a new equipment trailer for Essex. This would allow for the current Durable equipment trailer to remain at Ruth for the transporting of the JD110 between locations needed at Ruth. The new trailer would be a tilt deck trailer that will accommodate transporting a new tractor loader backhoe and the mowing attachment to and from job sites. It will also be suited to transport the forklift. This new trailer will be a 16K pound rated bumper pull style trailer.

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7		Treatment	Base Facility	Total	Advance Charges (Collected)	Grants	Reserves	Loans	Advance Charges (Cur. FY)	Debt Service		Prior Year Budget Amount	
84	Hydraulic Bolt Torque Machine		12,000	12,000							12,000	0	This project purchases a hydraulic bolt torque machine. This model will handle bolts from 1" - 2-9/16" and has a torque range of 278-1869 lbs. It has a compact design to allow it to be used in the tight confines around a pipe flange and deliver a repeatable amount of torque to all the fasteners. Along with the head unit it requires an electric hydraulic pump , hose and the specific wrench size to fit in the head unit. We propose purchasing the hydraulic unit, the head unit, hose and one common wrench, and have the ability to rent other wrench sizes as needed.
85	**TRF Equipment/Fixed**												
86	Sieve Shaker	2,500		2,500							2,500	0	This device will be used to measure filter media particle size to determine to life span of the filter media. This project includes the Sieve shaker, sieves, digital scale and measuring trays. Currently we only send off a couple of filters every couple of years. With this equipment we can check the filter media as many times as needed for each filter annually, which will improve operating efficiency.
87	**Eureka Office**												
88	Replace Administrative Computers		5,500	5,500							5,500	6,250	Administrative computers are replaced on a 5-year cycle. This is for the replacement of the Program Analyst (2016) and the Executive Assistance/Board Secretary (2016) computers. This will also replace the two monitors at the Customer Service desk. These are two older, smaller monitors, making it challenigng to view some of the detail available in the new software programs the Distrct is currently using. The District's computer replacement cycle improves cyber security and employee efficiency.

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7		Treatment	Base Facility	Total	Advance Charges (Collected)	Grants	Reserves	Loans	Advance Charges (Cur. FY)	Debt Service		Prior Year Budget Amount	
89	Ergonomic Desk for Customer Service Desk		3,000	3,000							3,000	0	This is the last desk in the Eureka Office to be converteid to an ergonomic desk. This desk is currently a larger "L-Shape" and will require a heavier duty motor. To minimize cost, the current desktop will be modifed to fit on the ergonomic work station.
90	Replace Fornt Office Doors		6,000	6,000							6,000	0	This project is to replace the Eureka Main Office front doors with clear doors as were installed at the rear of the building. The clear glass doors increase staff safety by allowing greater visibility to individuals/activities outside.
91	**Ruth Area**												
92	Base Radio Units for Headquarters and Relief Operator		3,750	3,750							3,750	0	This project purchases the equipment and shop setup cost for two base radio systems for the Headquarters residence and at one Relief Operator residence for hearing and responding to plant alarms and emergency communications essential for District operations.
93	Spare Howell Bunger Valve Cylinders		8,750	8,750							8,750	0	This project is for the purchase of two spare hydraulic cylinders for the Howell Bunger valve and two complete rebuild kits. The inability to immediately repair failed Howell Bunger cylinders would be potentially be catastrophic to the Mad River. The replacements we currently have are two "old" cylinders that have been refreshed many years ago. This will give us the ability to swap out the currently installed hydraulic cylinders when they need to be rebuilt or develop a problem requiring removal and not leave the Howell Bunger valve inoperable.
94	Ruth Property Maintenance Equipment		4,000	4,000							4,000	0	Purchase ground maintenance equipment at Ruth headquarters. Items will include a smaller chainsaw, pole saw, leaf blower, trimmer, and lawn mower. All necessary maintenance tools for HQ and some will also be used at the Hydro Plant.

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95	Ruth HQ Shop Lighting Upgrade and Equipment		6250	6,250							6,250	0	The purpose of this project will be to install and or retrofit the shop lighting and install a NFPA & OSHA hazardous chemical/paint storage locker, a flammables locker, a tire storage rack, at tool chest and some vehicle service maintenance equipment for maintaining Unit 6 and the JD110 tractor when stored and used at Ruth. These tools will be used to maintain the Headquarters facilities.
96	Ruth Log Boom Inspection Equipment		2,500	2,500							2,500	0	This project purchases equipment to inspect the log boom. The log boom connection links and debris screens are all below water line. To inspect and/or repair these connections, multiple hours are spent in the water. Wet suits are needed. Currently we are using Staff's personal wet suits and associated gear or borrowing gear from other Staff members.
97	**Subtotal Equipment/Fixed**	**2,500**	**473,300**	**475,800**	**222,800**	**0**	**0**	**0**	**0**	**0**	**265,750**	**12,500**	
98	**Professional and Consulting Services**												
99	Crane Testing/Certification		10,000	10,000							10,000	7,500	**ANNUAL PROJECT:** Every four years the District is required to test the crane load to comply with OSHA-safety requirements. Each crane must be certified by a licensed contractor in accordance with OSHA regulations. This will also dielectric test the Altec boom truck and certify boom truck operators.
100	Chlorine System Maintenance	16,750		16,750							16,750	16,100	**ANNUAL PROJECT:** Although the chlorine system is well maintained by District staff, each year we contract for review/repair/replacement of the more complex elements of the system to assure proper operation and safety.
101	Backflow Tester Training		3,000	3,000							3,000	3,000	**ANNUAL PROJECT:** Backflow recertification training for Assistant Operations Supervisor This will be far less expensive if we can get the trainer to return to Humboldt County. Otherwise, staff must go out of the area for the training. Regulatory Requirement.

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7		Treatment	Base Facility	Total	Advance Charges (Collected)	Grants	Reserves	Loans	Advance Charges (Cur. FY)	Debt Service		Prior Year Budget Amount	
102	Hydro Plant Annual Electrical and Maintenance Inspection (ReMat Contract)		2,050	2,050							2,050	2,050	**ANNUAL PROJECT:** Hydro Plant electrical and maintenance inspection letter required annually for the Districts' ReMat Contract
103	Essex Mad River Cross-Sectional Survey		10,000	10,000							10,000	10,000	**Annual Project:** This task consists of the annual field survey of the seven historic cross sections along the Mad River and an update of the AutoCAD figures comparing the new cross sections to the historic cross sections. Two hardcopies of the AutoCAD drawings showing the current elevations of the cross sections in comparison to the last few years will be submitted along with a Technical Memo detailing the recent changes and highlighting any corrective measures that the District may need to implement. Copies of the electronic files in AutoCAD format will also be submitted.
104	Technical Training		23,250	23,250							23,250	27,750	This project provides software training classes and the related travel expenses for District staff heavily involved in computer science and the related technology due to their job requirements. This includes: Computer Science, Computer/SCADA networking, Computer/SCADA programing, and all related software. Recurring funding enables staff to rotate through trainings on different budget cycles, minimizing the impact on scheduling. This budgeted amount includes training for five out of seven qualifying employees.
105	O & M Training		20,000	20,000							20,000	7,500	This budget funds training classes and associated travel expenses for District staff on a variety of specific topics related to their job responsibilities. It also includes some funding for other staff to attend other local training opportunities that may arise throughout the year on water treatment and distribution principles and practices and education for CEU's, and sending supervisors to AWWA conference as a component of succession training and continuing regulatory education.

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7		Treatment	Base Facility	Total	Advance Charges (Collected)	Grants	Reserves	Loans	Advance Charges (Cur. FY)	Debt Service		Prior Year Budget Amount	
106	Essex Server Backup System (Monthly Service Fees)		8,750	8,750							4,250	4,250	This budget is for the server backup system monthly service fees. The annual contract cycle is from February to January each year.
107	Public Education Funds		5,000	5,000							5,000	5,000	The Board has expressed interest in expanding public outreach for various topics such as water resource planning. This projects provides funding for communications to the public as directed by the Board.
108	Water Plan		30,000	30,000							30,000	0	California Code of Regulations Title 22, Section 64416(a)(4) requires an updated Water Quality Monitoring Plan at least once every 10 years. The District's current plan is due for update. The WaterBoard has requested an updated plan from the District. A qualified consultant with experience preparing WQMP's will be selected to prepare the required updated plan.
109	Electrical Technical Training		13,250	13,250							13,250	13,250	This project is for the training for both Electrical Staff to a "Substation Maintenance Technician" level certification through an accredited training program. This training would consist of three classes to be completed within 18 months and once successfully completed would certify them to meet the OSHA standards of 1910.269 (a) 2 "Training" requirements, 1910.332 "Electrical Training". Once certified they would be able to maintain the certification through a online refresher course and exam every three years for $1000. This program provides a range of knowledge in both the safe operations and maintenance procedures for a variety of electrical equipment that we currently employ as well as prepare us for the future addition of the new 12KV switchgear. This budget would provide for two of the three required courses, followed in the next budget cycle by one additional course to complete certification.
110	In-Stream Flow Grant		526,700	526,700		526,700					0	612,700	The In-Stream Flow Grant was began in FY2018/19, and work will continue through FY2020/21. This Project is fully grant funded (approved grant $693,400).

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7			Treatment	Base Facility	Total	Advance Charges (Collected)	Grants	Reserves	Loans	Advance Charges (Cur. FY)	Debt Service		Prior Year Budget Amount	
111		Annual Section 115 Pension Trust Contribution		50,000	50,000							50,000	50,000	As approved by the Board in March 2018, this is the annual contribution into the PARS Pension Trust for the Unfunded CalPERS Liability. (This is contribution year three of five).
112		Grant Applications Assistance		20,000	20,000							20,000	20,000	This budget is for potential grant application assistance that the District would require in the upcoming year. Examples of potential grant programs/applications that could be submitted include: Notice of Intent and/or Application for the FEMA Hazard Mitigation Grant (HMG) Program; various programs for the State Proposition 1 funding; as well as DFW, Coastal Conservancy, and the Safe Drinking Water State Revolving Fund programs. The level of effort between these programs is considerably different, and assistance with a detailed application may have to be further negotiated with the District prior to the performance of the work.
113		Comprehensive Domestic Water Pipeline Fittness Evaluation		195,000	195,000							195,000		The existing transmission pipelines for the District's potable water system were installed in the 1960's and 1970's and they are 50+ years old. Exposures of the pipe during other construction projects have found it to be generally in good shape with years of life left in it; however, several operational valves have reached the end of their lives and have had to be replaced, and the underbay crossing from the Samoa Peninsula to the Humboldt Community Services District Truesdale Pump Station has never been inspected. The condition of this pipeline and most of the other pipes in the system is unknown. The scope of work for this task would consist of a comprehensive assessment of the pipeline and a detailed risk assessment report as detailed in the August 5, 2016 letter from GHD to John Friedenbach. See pages 30 - 34

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114		Staff Gauge Survey		3,800	3,800							3,800	0	Professional elevation survey of Ruth Lake level staff gages to ensure accurate lake level measurements. Last survey was completed in 2015.
115		Retail Rate Study Assistance		5,000	5,000							5,000	0	Assistance in preparing the Retail Rate Study for Humboldt Bay Retail. This study is required to compete a thorough analysis of the cost of providig retail service and to adjust retail water rates appropriately.
116		**Ruth Dam Safety Program**												
117		FERC Part 12 - Plunge Pool Underwater Inspection		13,500	13,500							13,500		**RECURRING PROJECT** (every five years) The last one was done in 2015; next one will be done in FY25/26 or if we have a discharge greater than 20,000 cfs) - This is a FERC Part 12 inspection requirement.
118		FERC Part 12 - Geologist Inspection		6,800	6,800							6,800		**RECURRING PROJECT** (every five years - last one in 2015; next one FY25/26. This is a FERC Part 12 inspection requirement. Cost is based on competative quotes obtained for services.
119		FERC Part 12 - Independent Consultant Inspection and Engineering Support ($100,000 - FY22)		20,000	20,000							20,000		**RECURRING PROJECT** (every five years -last one 12/2016; next one FY26/27) FERC requires a comprehensive safety inspection of the dam, spillway and hydro-plant every five years by an approved "Independent Consultant" (pursuant to Part 12D of FERC regulations). The District's Eighth Independent Consultant Inspection was completed December 2016. The Nineth Inspection will be due by December 2021. This is advance charges to begin pre-funding this project.

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120		FERC Dam Safety Surveillance and Monitoring Report		8,000	8,000							8,000	5,000	**ANNUAL PROJECT**-This task consists of assisting the District with the preparation of the Annual DSSMR for the R. W. Matthews Dam. This report is submitted to the State Division of Safety of Dams (DSOD) and the Federal Energy Regulatory Commission (FERC). The intent is that the District will do the majority of the report preparation, while GHD will do a review of the active instrumentation, determine whether the monitoring systems in place are adequate, and will do a final review of the overall report after it is assembled by the District, and stamp and certify the Final Report.
121		FERC Chief Dam Safety Engineer		12,000	12,000							12,000	10,000	**ANNUAL PROJECT -** FERC requires the District have a Chief Dam Safety Engineer either on staff or engaged as a consultant. The individual must have substantial experience and knowledge about dam safety. The District has chosen to outsource this function/duty to Bill Rettberg of GEI, Engineering. This project provides for the continuation of these services. As a consequence of the Ororville Dam spillway failure, both FERC adn DSOD have intensified their required dam safety program compliance.

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122		Dam Spillway Wall Monument Survey		7,600	7,600							7,600	0	**RECURRING PROJECT (annual Crest Monument Survey):** This work not required by FERC. District initiated this work given FERC and DSOD questions Re: monitoring of spillway walls. Targets set and baseline established in FY2010/11. Due to recent elevation fluctuations in survey data, survey is changing from bi-annual to annual to obtain more timely data to analyze fluctuations.
123		Spillway Repair, Dam Inspection & Reporting Assistance		10,000	10,000							10,000	0	This task, if required, is for assisting the District with recommendations for spillway repairs and reporting of the necessary spillway repairs at Matthews Dam, as well as other inspections and reporting assistance. The 2017 inspection of the spillway found several areas where there appeared to be delamination of the concrete on the spillway floor. Areas of the spillway were repaired in 2017, 2018 and 2019. GHD will assist the District in the assessment of those repairs after this year's winter, and assist in the reporting and discussions with the State Division of Safety of Dams and the Federal Energy Regulatory Commission. It is difficult to estimate the exact amount of effort required in this year's design and reporting.
124		**Subtotal Professional &**	**16,750**	**983,700**	**1,000,450**	**0**	**526,700**	**0**	**0**	**20,000**	**0**	**489,250**	**988,800**	
125		**Carryover Projects**												
126		Harden Collector 5 (Vandalism & Security)		7,500	7,500							7,500	0	**CIP PROJECT**: This project will add security measures to Collector 5. This project includes securing the collector doors, ladder access and replacing the plywood cover of the pump ports. This will add a layer of security to the Collector and will replace the rotting plywood with steel.

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127		Subtotal Carryover Projects	0	7,500	7,500	0	0	0	0	0	0	7,500	0	
128		Subtotal Project Budget	73,000	4,993,338	5,066,338	2,527,050	2,787,028	0	0	675,000	162,200	2,312,260	1,325,110	
129		Industrial System Project												
130		Refurbish Pump Station 6 (Phase 1)			3,500,000		2,800,000	700,000				0	0	Two viable industrial customers have approached the District requesting I/W. This project rehabilitates Station #6 (PS6). The District is applying for a US EDA grant to fund this project. Grant match will be from zero to 20%. Exact amount will not be known until grant application is approved. Match will ultimately be reimbursed to District from I/W customers.
131	IW1	Maintain Water Supply to Industrial Pump Station 6 During Low-Flow Months		13,250	13,250							13,250	13,250	**ANNUAL PROJECT:** From 1976 to 1991, channel conditions in Mad River allowed operation of Pump Station 6 without any water stage control. Since then, the river bed has degraded and in the late 1980's it approached an elevation at which pumps would not operate. In 1991, District installed two rock structures to control water surface elevation (rock jetty and grade-control weir). The jetty projects from north bank and downstream weir maintains the water surface elevation to PS6 at 21.5 feet msl. When runoff declines, for many years, the District constructed a gravel berm connecting jetty to the weir. Per the District's HCP, a study was completed to explore options. The current "base case" is creation of a channel along the south bank connecting the thalweg to PS6. The District reserves the right and has permit authority to construct the berm if the channel is not successful. This project covers activities necessary to complete this work: 1) construction of channel 2) biological survey per HCP and 3) protection of aquatic species during construction.
132		Fencing Repairs and Replacement at I/W Reservoir Site		11,250	11,250			11,250				0	0	This project will replace the fence and gate around the I/W reservoir as well as add security features. The fence and gate are very degraded and needs to be replaced to adequately protect the reservoir.

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133		I/W System Evaluation Memo		26,000	26,000			26,000				0	26,000	Currently the District is keeping the Industrial pipeline charged with water, which helps provide support to the pipe and ensure a continuous electrical conductance to make sure the cathodic protection operates as designed. The District also occasionally operates the pumps at Collector 6 to keep the motors dry and operational and confirm the electrical system is functional. The District is not spending money to perform extensive maintenance, painting, etc. on any of the system components since there is not a customer to pay for these costs. At some point the District needs to make a decision on whether they will perform these deferred maintenance tasks and continue to keep the pipe charged or just let the system gradually fail. This Budget item will entail an overview of the Industrial System, including: general assessment of the assets; level of needed deferred maintenance needed; expected lifetime of the assets without continued maintenance; suggestions for potential alternative use for the asset; and suggestions for procedures to lengthen the lifetime of the assets at minimum expense. The memo will provide a framework for decisions that the District should be making in the next few years concerning the Industrial System components, assuming a new customer is not identified. This task does not include any physical assessment or sampling of the industrial system components.
134														

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6		CATEGORY, LOCATION, PROJECT NUMBER & TITLE	PROJECT EXPENDITURES THIS FY			PROCEEDS FOR PROJECTS				ADDITIONAL CHARGES		Resulting Customer Charges	2019/20	PROJECT DESCRIPTION
7			Treatment	Base Facility	Total	Advance Charges (Collected)	Grants	Reserves	Loans	Advance Charges (Cur. FY)	Debt Service		Prior Year Budget Amount	
135		Pump Station 6 Gravel Bar Work Permitting		76,100	76,100			76,100				0	0	The existing weir in the Mad River that is intended to prevent the Mad River from bypassing the Pump Station 6 intake has become less efficient over the last several years, and the main channel in this reach has moved north, away from the Pump Station 6 intake. The District is in the process of discussing with California Dept. of Fish & Wildlife ways to help ensure the channel in front of Pump Station 6 remains the main channel. This would likely include additional grading and work on the gravel bar downstream of the Pump Station. GHD submitted a scope of work and budget in August 2018 for preparing design plans, updating the river model, and permitting the proposed river work with NMFS, California DFW, Army Corps of Engineers and the State Water Quality Control Board. This line item includes the work detailed in the August 23, 2018 scope letter.

See Pages 35-39

HUMBOLDT BAY MUNICIPAL WATER DISTRICT
FY2020/21 Project Budget

	A C	G	H	I	J	K	L	M	N	O	P	Q	S
6	CATEGORY, LOCATION, PROJECT NUMBER & TITLE	PROJECT EXPENDITURES THIS FY			PROCEEDS FOR PROJECTS				ADDITIONAL CHARGES		Resulting Customer Charges	2019/20	PROJECT DESCRIPTION
7		Treatment	Base Facility	Total	Advance Charges (Collected)	Grants	Reserves	Loans	Advance Charges (Cur. FY)	Debt Service		Prior Year Budget Amount	
136	Industrial System Assistance		10,000	10,000			10,000				0	0	This task will consist of assisting the District with the refurbishment of the Industrial System to provide water to Nordic Aquafarms and other potential users on the Samoa Peninsula. The District has developed a budget and preliminary design to refurbish the Industrial System including the Pump Station 6 building and intake screens and pumps to provide continued service and correct deferred maintenance on the system. The District will be able to perform most of this work themselves and should not need much assistance. However, there are some outstanding questions, such as whether to install new transformers that step the voltage down to 480V instead of the current 2300V. There is also the outstanding issue of turbidity removal including whether to install a clarifier or some other sediment removal system on District property. This Task will consist of assisting the District with these and other engineering design issues that may arise this year associated with the Industrial Water system refurbishment. It is difficult to estimate the exact amount of effort required in this task, and the figure below is simply for budgetary purposes.
137	Industrial and Domestic System Intertie		11,000	11,000			11,000				0	11,000	Nordic Aquafarms requested Collector water during river high turbidity events. The District will re-establish the Industrial / Domestic inter-connection. This project would be for engineering and the inter-connection rehabilitation.
138	**Subtotal Industrial System**	**0**	**147,600**	**3,647,600**	**0**	**2,800,000**	**834,350**	**0**	**0**	**0**	**13,250**	**50,250**	
139	**TOTAL PROJECT BUDGET**	**73,000**	**5,140,938**	**8,713,938**	**2,527,050**	**5,587,028**	**834,350**	**0**	**675,000**	**162,200**	**2,325,510**	**1,375,360**	

SECTION 5.1 PAGE NO. 30

Project Line Item 113
on Page 22

Ref: 11109030

August 18, 2016

Mr. John Friedenbach
Humboldt Bay Municipal Water District
828 Seventh Street
Eureka, CA 95501

Re: Scope and Budget for Domestic Water Pipeline Fitness for Continued Service Evaluation

Dear John,

The following is a scope and cost estimate to provide an evaluation of the Fitness for Continued Service of Humboldt Bay Municipal Water District's (HBMWD) domestic water pipelines. The detailed scope of work, itemized by major task item, is as follows:

Task 1 – Collect and Review Characteristics Data, Review Nondestructive Condition Assessment Alternatives, Develop a Risk Ranking/Priority Matrix, Prepare a Project Work Plan

The purpose of this task is to collect and review available information relating to the domestic water pipelines in order to identify locations and methods for condition assessment. The data and information may include Record Drawings, specifications, construction and test reports, records of maintenance and repairs data including records of failures, cathodic protection data, soil reports, operational data, air release valve operation, or other reports or related available data. GHD will conduct field visits as necessary to verify and identify locations of appurtenances other features, identify access and constrains, Right-of-Way ownership, cathodic protection test stations and facilities, traffic conditions, and other information pertaining to the project.

GHD will prepare detailed descriptions of applicable nondestructive assessment technologies including visual, physical, and direct non-destructive assessment. The technologies considered may include pipeline locating services, measurement of pipe-to-soil potential, Pipeline Current Mapping (PCM) to determine pipeline depth and electrical continuity, Close-Interval Survey (CIS) coupled with Direct Current Voltage Gradient (DCVG) survey or Alternating Current Voltage Gradient Survey (ACVG), and Current Span Testing to assess stray current interference, where applicable, of the project pipelines. The viability of direct assessment will be evaluated as a part of this project phase. The information for each alternative considered will include the scope of the method, status of the method (commercial, experimental, or in development), advantages, limitations, degree of performance and accuracy, breadth of use, and other pertinent information.

Based on input and collaboration with District staff and project stakeholders, GHD will identify and weight various service, operational and environmental risk factors to be quantified as a part of the pipeline assessment. As a result of the identification and weighting of risk factors, GHD will develop a draft assessment work plan which will serve as the "road map" for data collection and assessment. A critical component to preparation of the proposed work plan will include development of a Risk Ranking/Priority matrix with the objective of facilitating field work planning decision making by identifying discreet unique and/or high risk zones for field assessments. Identification of the zones may be based on consideration of, but is not limited to, the following risk factors: geography, customer service boundaries, available soil chemical composition data such as resistivity, chloride ion content, sulfate ion content, and pH; anticipated coating integrity by zone; service history per zone; topography and environmental risk factors; and stray current corrosion/interference risk factors. Along with risk factors, logistical constraints and factors will be weighted to develop efficient and effective field work planning. Logistical factors

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considered may include, but are not limited to: access (including traffic control requirements and related impacts), ease of scheduling within the identified field work time window, and estimated cost impact. A sample matrix based on field assessment planning by risk and logistical considerations developed by GHD for this project is included below. Once populated, the Risk Ranking/Priority matrix can be used as tool to weigh the risk (probability) of corrosion related failure to the consequence of corrosion related failure in order to facilitate decision making with respect to budgeting and planning for future repairs and/or replacements; discussed in more detail in the Task 4 description.

	Risk Factor	Method of Assessment	Ranking System		Weight
SOIL PARAMETER FACTORS	Local pH	Data, if available, from soil sample located in selected zone	>7.5 7.5 to 6.5 6.5 to 6 6 to 5 <5	1 2 3 4 5	2.5%
	Local and Saturated Resistivity	Data, if available, from soil sample located in selected zone	>10K Ohm-cm 10-2K Ohm-cm 2,000-1,000 Ohm-cm 1,000-500 Ohm-cm <500 Ohm-cm	1 2 3 4 5	7.5%
	Chloride Ion Conc.	Data, if available, from soil sample located in selected zone	< 100 ppm 100-500 ppm 500-1,500 ppm 1,000-1,500 ppm > 2,000 ppm	1 2 3 4 5	2.5%
	Sulfate Ion Conc.	Data, if available, from soil sample located in selected zone	< 100 ppm 100-500 ppm 500-1,000 ppm 1,000-2,000 ppm > 2,000 ppm	1 2 3 4 5	2.5%
PIPE CONSTRUCTION AND OPERATION FACTORS	Pipe Material, Coating, and Construction	Determined from pipe specifications and confirmation with operations	Recent coating/piping repair or replacement High coating integrity expected Fair coating integrity expected Low coating integrity expected Bare Piping	1 2 3 4 5	15%
	Maintenance, Service, and History	Discussion with operations and PWB input including age, service history, leaks, repairs, material handling, and operational area	New/Recent Pipe Repair Recently Assessed as Acceptable Limited or Unknown History Known Adverse History Assessed as Less-Than-Acceptable	1 2 3 4 5	15%
	Environmental Risk and Location	Factors including vegetation, cyclic water table, close-proximity soil conditions, construction below infrastructure, road crossings	Factors with be weighed on an individual basis according to 'as-found' conditions	1 2 3 4 5	10%
STRAY CURRENT RISK	Cathodic Protection and Interference	Stray current corrsion or interefence risk based on identification of cathodically protected foreign utilities or other DC sources	No Sources of Interfence Identified Low Probability of Interfence Identified Moderate Probability of Interfence Identified High Probability of Interfence Identified Significant Interference Confirmed	1 2 3 4 5	10%
	Factor	Zone Planning Ranking System			Weight
LOGISTICAL FACTORS	Access	No restrictions on vehicle access to alignment Minor access challenge Moderate access challenges Significant access challenges Prohibitive acccess issues		1 2 3 4 5	33%
	Scheduling Priority Ranking	Can be scheduled conveniently within testing window Can be scheduled at little inconvenience within testing window Can be scheduled at moderate inconvenience within testing window Can be scheduled atsignificant inconvenience within testing window Prohibitive scheduling issues		1 2 3 4 5	33%
	Estimated Cost Impact	Less than $10K Less than $20K but more than $10K Less than $30K but more than $20K Less than $40K but more than $30K Greater than $40K		1 2 3 4 5	33%

Deliverables: GHD will prepare a Task 1 Memorandum summarizing data analyses and recommendation for detailed assessment; including summary and recommendation of nondestructive assessment alternatives; sample Risk Ranking/Priority matrix, and proposed project work plan. GHD will meet with HBMWD and stakeholders following the Task 1 Memorandum submittal to review the nondestructive condition assessment alternatives and select the appropriate assessment approach for the project; build consensus regarding the proposed data input factors and weighting; and adopt the project work plan.

Task 2: Condition Assessment/Data Collection
GHD shall proceed with the assessment techniques selected. Current requirement testing may be conducted concurrently as a part of the non-destructive methods deployed. In-situ soil resistivity using the Wenner 4-pin method will be performed at a maximum of ten (10) locations at pin spacings of 2.5,5, and 10 feet. Based on the results of the indirect assessments, locations for excavation and direct assessment may be identified. If applicable, direct assessment of exposed piping which will include a visual and tactile examination of the exposed piping, digital pit depth measurement, photography and ultra-sonic (UT) thickness testing. Direct assessments will be performed at a maximum of ten (10) locations. UT testing will utilize the "A"-Scan survey technique. UT measurements will be obtained at up to five (5) circumferential positions at each site. Excavation work and work related to coating repair will be performed by others, contracting directly with HBMWD, based on the locations identified by GHD. The condition assessment will define the existing condition of the domestic water pipelines and, when considered during the Task 3 analysis, provide an understanding of the fitness for continued and future service.

Soil samples will be collected at each of the (up to) ten (10) direct assessment locations at depths corresponding to pipe depths. GHD will coordinate laboratory corrosivity evaluation of soil samples obtained which will include analysis of as-received soil resistivity, saturated soil resistivity, pH, chloride ion content, and sulfate ion content.

Deliverables: GHD will submit weekly progress reports via email as described in Task 4.

Task 3: Perform Risk Assessment and Prepare a Fitness for Service Memorandum
GHD will use the developed Risk Ranking/Priority matrix tool to weigh the risk (probability) of corrosion related failure to the consequence of corrosion related failure in each identified zone. The risk of failure will be developed by the GHD based on analysis of the data gathered as a part of the field assessment and data review. The specific purpose of this task is to identify priorities for determining the likelihood of failure for domestic water pipelines specific to a zone, degradation mechanism or risk factor. Determining a zone-specific risk factor which is used to select the appropriate means and methods of asset management, and corresponding O&M protocols, results in increased public and operator safety; control of capital expenditures; and reduction of short- and long-term repair expenditures. Following weighting of data collected from identified input sources, a composite risk factor is generated for each zone identified.

Deliverables: GHD will prepare a draft Fitness for Continued Service Memorandum summarizing the risk assessment and conclusions developed from other project phases. The Fitness for Service Memorandum will be prepared outlining conclusions regarding the fitness for continued service of the domestic water pipelines based on the anticipated risk of corrosion related failure. The memorandum will discuss practical methods of corrosion control if such methods are believed to be viable and provide recommendations for assessment or remediation strategy; along with recommended asset management

plans including recommendations of: cathodic protection practices; inspection procedures and schedules; and operation and maintenance practices.

GHD will prepare and submit five (5) draft copies of the Memorandum which will include:

- Compilation of data collected including field visit reviews;
- Detailed description of the nondestructive condition assessment methods utilized;
- Results of the condition assessment program and direct assessments for determining existing conditions; and
- Detailed description of the risk assessment and corrosion control asset management program

GHD will meet with HBMWD staff and stakeholders following draft report submission to review methodologies, present finding and address questions. Following the meeting and a submission of written comments from the District and stakeholders, GHD will revise and submit five (5) final copies of the Memorandum along with an electronic (pdf) copy on CD.

Task 4: Project Management

GHD will provide weekly project updates, via email, which will include a summary of work completed, work planned, coordination requirements, and budget and schedule status. GHD will attend up to eight one-hour conference calls with HBMWD staff to discuss milestones, critical path items and to provide progress updates. In addition to the conference calls, it is anticipated that GHD will attend up to six (6) two-hour meetings during the project duration with District staff and various stakeholders. GHD will provide meeting minutes to HBMWD to review and final minutes will incorporate comments.

Professional Service Fee
GHD will provide the above described scope of services on a Time and Material Basis at our Standard Labor Rates in place at the time of execution of the work.

Task 1:	Collect and Review Characteristics Data, Review Nondestructive Condition Assessment Alternatives, Develop a Risk Ranking/Priority Matrix, Prepare Project Work Plan	**$34,800**
Task 2:	Condition Assessment/Data Collection	**$88,400**
Task 3:	Risk Assessment and Fitness for Service Technical Memorandum	**$56,600**
Task 4:	Project Management	**$14,900**
Total:		**$194,700**

We look forward to working with you on this important project. Please do not hesitate to call me if you have any questions.

Sincerely,

Patrick Kaspari, P.E.
District Engineer

Cc: Paul Helliker, HBMWD
Jeff Knauer, GHD

SECTION 5.1 PAGE NO. 35

Project Line 135 on Page 28

Ref: 11146362

August 23, 2018

Mr. Dale Davidsen
Humboldt Bay Municipal Water District
P.O. Box 95
Eureka, CA 95502-0095

Re: Proposal for Mad River Work around Pump Station 6

Dear Dale,

As we discussed at our meeting on March 23rd with you, Dennis Halligan, Steve Allen and myself, this scope and budget cover the cost for developing construction documents and related permitting work in to help ensure that the main channel of the river continues to run past the intake for Pump Station 6. As you are aware, the existing rock jetty that was constructed on the right bank of the river and the low flow weir constructed on the left bank to direct flows toward the Pump Station, have been becoming less effective, and the main channel appears to be moving to the center of the river. The following scope would include the design of in-river work to reinforce the jetty and weir design and potentially add new elements to improve their effectiveness. It would also include permitting this in-river work with California Department of Fish & Wildlife, National Marine Fisheries, the Army Corps of Engineers, and the State Water Resources Control Board. The proposed scope is as follows:

Task 1 – Mad River Work at Pump Station 6

Task 1.1 – Background Research and Survey Data

This task will consist of the review of background material and gathering new field survey data for the modeling and design of the proposed improvements. Northwest Hydraulic Consultants (NHC) prepared a Phase 1 evaluation report in 2005 presenting several potential in-stream modifications to the reach near Pump Station 6 (PS6). The alternatives ranged from modifications to the configuration and physical details of the rock weir and rock jetty, to relocation of the intake facility to an alternative location on the river. The recommended alternative consisted of an extension and modification to the existing rock jetty. The design was intended to eliminate the need for the annual grading of the gravel dike constructed in the river channel and minimizing channel excavation of sediment deposits in the immediate vicinity of the PS6 intake channel. In 2007, NHC preformed a Phase 2 study, entitled "Humboldt Bay Municipal Water District Station 6 Hydraulic Feasibility Assessment, Technical Report", NHC, August 15, 2007. This Report assed adding a larger "Main Dike" where the existing rock jetty is located as well as adding a "Spur Dike" upstream of PS6. It modeled the flows with these dikes at three different heights and looked at the effects around PS6 and along this stretch of the river. The report recommended the addition of the main dike (without the addition of the spur dike) with a crest elevation of 29-feet.

Under this Task, GHD will review this previous study and attempt to obtain the model data from NHC. We will also survey the reach of the Mad River in the study area to see how it has changed since the NHC modeling effort. The geometric data in NHC modeling analysis was based on the Winzler & Kelly Consulting Engineers (now GHD) October 2006 survey in the study reach. The proposed survey scope for this project will approximately match the 2006 survey to provide data consistency for the channel geometry comparison and model development. The survey will be done in conjuncture with the annual Mad River Cross Sectional survey. The historic Cross Section 3 is located between Collector 1 & PS6, Cross Section 2 is just downstream of PS6 and Cross Section 1 is just upstream of the Highway 299 bridge. These cross sections will be resurveyed as part of the historic cross sectional survey, and while

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they are being surveyed, we will have the surveyor collect additional topographic data around the existing rock jetty and weir and the PS6 intake.

GHD will subcontract with Points West to perform a topographic survey of the river bed and existing weirs for the purpose of the proposed change to the existing weir structures. The survey will start at the historic Cross Section 3 and extend downstream to 50 feet beyond the smaller of two weirs in the "southern" channel. The edge of water and one additional shot on the bank at vegetation line will be shot within this corridor. The face of sheet piling and curtain wall at pump inlet will be located. The survey will locate visible features and spot elevations sufficient to determine one foot contours. As you know, the main weir on north side of river bed is made up of large boulders and is very irregular. Points West will shoot the toe of weir and selected tops to define it. Trees 12 inch and larger will be located as well as underground utility appurtenances, if any. Underground utilities will be shown based on visible physical evidence and mapping provided by client (it is anticipated none exist in this area). The survey will be based on historical data for Cross Section 3. The relationship between this control and the California State Plane Coordinate System of 1983 (CCS83) and the North American Datum of 1988 (NAVD 88) will not be determined. A Digital Elevation Model (DEM) will be developed as a part of the survey scope, the DEM will be used in the final modeling and design.

In addition, GHD will monitor river stages at three gauge locations in the study area. Figure 1 (attached) shows the approximate gauge locations and the proposed extent of the hydraulic modeling. The proposed gauge locations will provide important upstream and downstream stage conditions, and the backwater effects on the hydraulic grade lines at the upstream of rock jetty and low flow weir. GHD will install the pressure transducers with data loggers from approximately October 2018 to February 2019 to gather low and high flow river data. The data loggers will capture 15-minute interval measurements. In addition, GHD will provide two manual measurements during river high flows to verify and calibrate the pressure transducers measurements. The stage data will be coupled with flow data and creek cross sectional data from the USGS gauge station 11481000 to provide a time series stage discharge dataset and rating curves at each monitoring location. The stage discharge dataset and rating curves will be used to set the boundary conditions of the hydraulic model, and for model calibration.

Task 1.2 – Improvement Design Construction & Permitting Documents

This task will consist of checking the original design recommendations from the NHC study and preparing design documents that can be used to permit the proposed work and guide the District staff in the construction of the work. For this scope of work, we will assume that the District will perform the instream work and that we will not need to develop a formal bid package and contract documents.

Based on the survey data and stage discharge dataset produced in this project, GHD will develop a new two-dimensional model covering the model boundary as shown in Figure 1. The model development will leverage the prior efforts in NHC 2005 and 2007 in terms of model parameters and model setup, to the extent practical. The model software platform will move from the River2D used in NHC 2005 and 2007 to HEC-RAS, with the new river geometry based on the 2018 survey data. HEC-RAS, developed by the USACE Hydraulic Engineering Center, is one of the industry standard software on river model and is approved by FEMA on two-dimensional modeling and floodplain mapping. The two-dimensional model capability in HEC-RAS was not available in the 2000s during the Phases 1 and 2 studies. The hydraulic modeling will develop an existing condition scenario for model calibration, then the project team will develop up to two (2) alternative scenarios to assess and fine tune improvement design concepts. Under each of the two (2) scenarios, a 2-year flood, 10-year flood, and 100-year flood flow conditions will be

analyzed. In addition, a scouring analysis based on the bend scour equation will be prepared at the pump station intake under the 100-year flood flow condition.

GHD will then prepare design drawings and details necessary for the permitting and construction of the improvements. We will also prepare a design report indicating the model development and modeling report as well as the recommended basis of design for the improvements. The intent of this Basis of Design Report will be to provide the necessary information for the regulatory agencies to permit the work and to guide the District staff on the construction of the improvements.

GHD will prepare 60% and 90% design drawing submittals. These submittals will be provided to the District and Dennis Halligan at Stillwater Sciences for review and comment. We will incorporate the District's and Dennis' comments and issue a Final Draft Basis of Design Report. This will be the document that we will work with the permitting agencies for implementation. It is anticipated that the regulatory agencies will have comments, and these comments will be incorporated into a Final Design Report to be utilized for construction of the improvements.

Task 1.3 – Permitting

GHD will work with Dennis Halligan at Stillwater Sciences on the permitting of the proposed improvements. It is anticipated that the District's existing Habitat Conservation Plan and Long Term Streambed Alteration Agreement (LTSAA) will be utilized as the basis of the permitting, and the agreed upon Notifications and Mitigation Measures contained in these documents will be utilized as the basis of this permitting work. However, it is also felt that the extent of this work will not fall within the "minor and routine activities" of the Maintenance definition contained in the LTSAA. GHD will work with Dennis to prepare and submit the following permits:

- Section 1600 Streambed Alteration Agreement to California DFW
- Section 404 Clean Water Act Permit to the Army Corps of Engineers
- Section 401 Clean Water Act Permit to the State Water Resource Control Board

As part of the standard 404 permitting process, GHD will also consult with the National Marine Fisheries Service (NMFS).

It is assumed that GHD will prepare the permits listed above and will submit Draft permit applications to the District and Dennis Halligan. We will then incorporate your comments and submit final applications to the District. It is assumed that the District will copy and distribute all the request copies to the Agencies and pay all permitting fees. GHD will respond to agency comments during the review period.

Task 1 Submittals

Submittals will include:

- Basis of Design Report, Draft and Final in electronic .pdf format.
- 60%, 90%, Draft Final and Final Construction Drawings in electronic .pdf format and three hardcopies of each submittal in 11x17 format to the District and one electronic copy in pdf format to Dennis Halligan.
- Draft permit applications listed above, including all attachments, to the District and Dennis Halligan in electronic pdf format for their review. Final permit application and attachments in hardcopy and/or pdf format to the agencies, and two hardcopies and an electronic copy in pdf format to the District and Dennis Halligan.

Assumptions
The scope is based on the following assumptions:

- The District will construct the proposed improvements and full bid and contract documents are not required.
- GHD will submit the permit applications listed above and will work with the agencies to usher the permits through to approval, but we cannot control the final approval or schedule at which the agencies process the permits.

Schedule
GHD proposes to complete the design report within 90 days of the receipt of a signed contract. The permits will be submitted to the regulatory agencies within 45 days of the completion of the Final Draft Design Report. It is the intent to get the design and permitting completed in preparation for the 2019 construction season.

Professional Service Fee
GHD will provide the above described scope of services on a Time and Material Basis at our Standard Labor Rates in place at the time of execution of the work per the cost estimated below:

Task 1 - Mad River Work at Pump Station 6 – $76,100

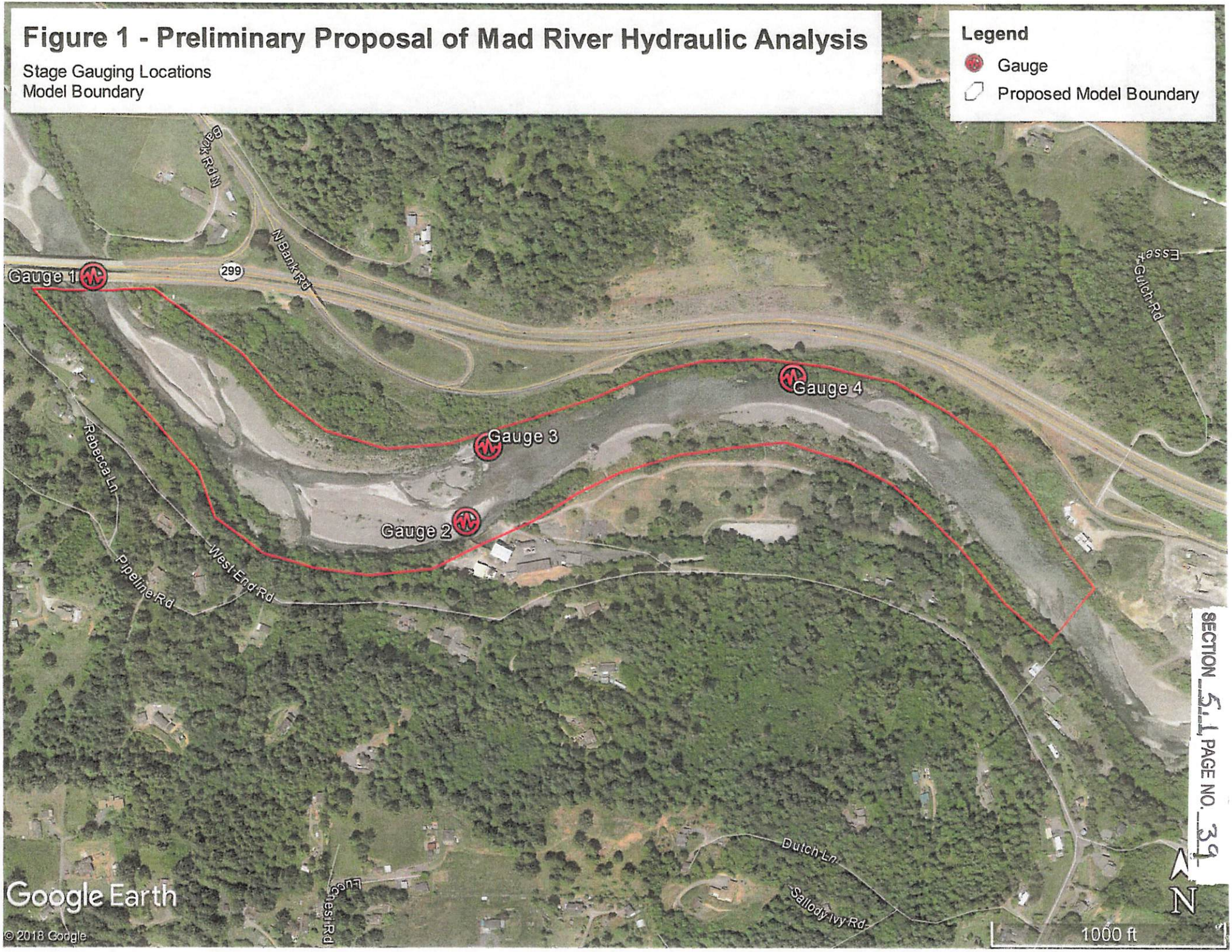
As always, we appreciate the opportunity to assist you. Please do not hesitate to call me if you have any questions.

Sincerely,

Patrick Kaspari, P.E.
District Engineer

Figure 1 - Preliminary Proposal of Mad River Hydraulic Analysis

Stage Gauging Locations
Model Boundary



SECTION 5.1 PAGE NO. 39

PSI Water Technologies
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Project Line 51
on Page 10

MICROCLOR® ON-SITE HYPOCHLORITE GENERATION SYSTEM

PSI Water Technologies
A UGSI SOLUTIONS COMPANY

A. PROCESS DESCRIPTION

A packaged on-site generation system will be provided that will manufacture a 0.8% ± 0.05% solution of sodium hypochlorite (NaOCl) to be used as a disinfectant using salt, water and DC current. Equipment required for on-site hypochlorite generation includes consist the following major components (Fig. 1):

- One (1) Microclor® OSHG system including a programmable logic controller (PLC), rectifier, cells, brine pump, and hydraulic control equipment
- Water softener
- Brinemaker with makeup water solenoid valve, brine liquid level pressure transducer or switch, and remote display for both sensors
- Hypochlorite storage vessel(s) with ultrasonic level controls
- Chemical metering pump(s)
- Cast aluminum blower(s) with current and air flow switches

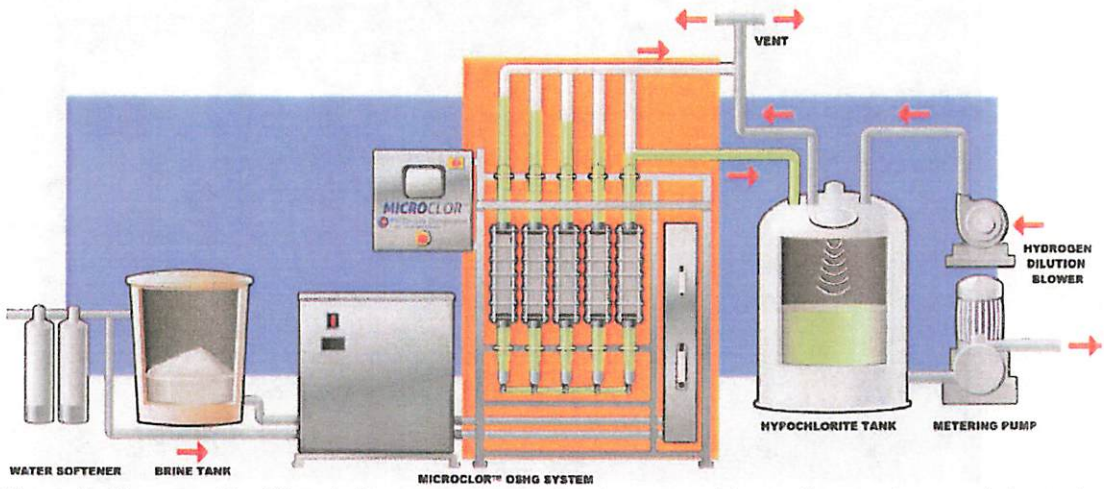

Figure 1. Diagram of the Microclor® process showing the placement of the ancillary equipment relative to the Microclor® system process skid.

The patented Microclor® system works by feeding softened water into the brine tank to form a saturated salt solution. This brine solution is pumped via a gear pump to a stream of softened water and diluted to approximately 3% salt concentration (a 10:1 ratio of softened water to concentrated brine). This 3% brine solution is fed into the electrolytic cells. DC current from the rectifier is applied to the electrolytic cell, and the brine solution is converted to a 0.8% concentration of sodium hypochlorite. During this conversion, a small amount of hydrogen is produced by the electrolytic process. This hydrogen is released safely through a vent pipe at the top of the electrolytic cell. The small amounts of hydrogen gas are further diluted at a minimum ratio of 100:1 using a dilution air blower which reduces the hydrogen concentration to less than 25% of the Lower Explosive Limit (LEL) of hydrogen gas.

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The Microclor® system under normal operation is designed to automatically start and stop sodium hypochlorite production based upon the storage tank level. The PLC will function to monitor the hypochlorite level sensor. When the level reaches a preset low level point, a signal is sent to the OSHG controller to turn the generator on. Generation will continue while the OSHG controller continually monitors the storage tank level sensor. When the tank is full, and the high level point is reached, the Microclor® system will cease generation. The system will then remain in standby mode, continuously monitoring the tank level until a low level is reached.

A variable speed pump alters cell feed rate of the brine, or electrolyte, solution, based on signals from the PLC and a current transducer. This operational strategy allows the Microclor® system to vary the electrolyte solution conductivity so as to indirectly provide constant current. This philosophy eliminates expensive electronics that would otherwise be necessary to operate in a less reliable fashion.

Instrumentation is included to continuously monitor operational permissives during generator operation (airflow, current draw, water flow, flooded cells, and temperature). If any permissive times out, generator operation is interrupted. If the fault clears, generator operation is again called to run. If the fault reoccurs three additional times, the generation system is shut down and an alarm condition is sent to plant SCADA.

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B. MAJOR SYSTEM COMPONENTS

The Microclor® On-Site Hypochlorite Generation System is pre-assembled, piped, wired, and factory-tested prior to shipping to the job site. Following are the major system components. **Additional details are provided in our equipment specifications.**

1. Electrolytic Cells

The transparent acrylic design of the electrolytic cells provides quick visual indication of operation and condition. Each cell shall include Viton flexible couplings for quick disconnect an optical level switch, and a temperature switch or sensor. A cell spool is provided for installation should a cell need to be removed for maintenance or replacement. On systems using five electrolytic cells in series, 80% of the total generation capacity can be achieved when one cell is removed.

2. Rectifier

The transformer rectifier uses an innovative design that eliminates the need for the outdated and unreliable switching rectifier or phase angle fired SCR voltage correction technology.

3. Brine Pump

The brine pump supplies a saturated salt solution to a stream of softened water for further dilution. Reliable brine feed is required for precise control of solution concentration. The pump flow rate is controlled automatically via an analog output.

Parameter	Value
Type	Gear
Material (Housing/Gears/Seals)	316SS/PPS/PTFE
Drive Type	Electromagnetic

4. Hydrogen Dilution Blower

A critical component of the enhanced safety system, the blower is provided to dilute the hydrogen gas byproduct. The blower is shipped loose for installation adjacent to the hypochlorite storage tank and arranged such that the tank will be under positive pressure. All air from the blower and any fumes from the hypochlorite will be vented outside the building.

Parameter	Value
Fan Type	Pressure Blower
Wheel Type	Radial
Material	Cast Aluminum
Drive Type	Direct
Motor Type	TEFC

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5. Water Softener

A dual-tank automatically-regenerating water softener treats the water supply prior to entering either the brine tank or the electrolytic cells. An adjustable water meter will monitor the processed volume and initiate system regeneration. A flow-based hydraulic control valve operates all functions of the softener, eliminating the need for any electrical connections.

Parameter	Value
Material (Media Vessel)	Fiberglass-Wrapped Polyethylene
Media	Non-solvent Cationic Resin
Regeneration Type	Countercurrent
Outlet Hardness as $CaCO_3$ (Max.), gpg	0.5

6. Brine Tank

A tank is used for salt storage and brine production. Both manually- and pneumatically-filed tanks are available. Brine tank water makeup is controlled by a level sensor or switch. Pneumatically-filled tanks use a stainless steel salt fill tube, dust collection assembly, and salt level indicator. Depending on the tank dimensions, top and/or side access manways and a ladder with safety cage may be necessary to facilitate inspection.

7. Hypochlorite Tank

Hypochlorite storage tanks are sized for a specific amount of hypochlorite based on the peak generator capacity and project requirements. An ultrasonic level transmitter or pressure transducer continuously monitors the liquid level, initiating and ending operation of the generator. Hypochlorite fill, supply, drain, overflow, dilution air, and vent piping connections are typically included in the tank design. Depending on the tank dimensions, top and/or side access manways and a ladder with safety cage may be necessary to facilitate inspection.

8. Hypochlorite Metering Pump

A metering pump supplies disinfectant to the process from the hypochlorite storage tank. Reliable hypochlorite feed is required for precise control of chlorine residual. The pump flow rate is controlled automatically via 4-20 mA input signal sent to a variable frequency drive. Typical pump accessories are a calibration column, back pressure valve, pressure relief valve, pulsation dampener, wye strainer, and pressure gauge.

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9. Electrical Control Panel

The Microclor® On-Site Hypochlorite Generation Feed System includes a complete, pre-wired, PLC system. If the controls are remote mounted, a local junction box is provided on the generator system equipment skid.

The control system is designed to function using the power supply available at the installation site.

The PLC system, as a minimum, shall have the following interfaces and features:

- Programmable logic controller with color touchscreen HMI
- Ethernet communication
- "Water Solenoid Status" display
- "Brine Solenoid Status" display
- "Blower Status" display
- "Rectifier Status" display
- "Cell Level Alarm Status" display
- "Blower Air Flow Alarm Status" display
- "Blower Current Switch Status" display
- "Cell Temperature Alarm Status" display
- "Hypochlorite Tank Level" display
- "Cell Amperage" display
- "Cell Temperature" display
- "Cell Flowrate" display
- "Brine Pump Manual-Auto" selection
- "Brine Pump Speed" display and manual adjustment
- "Emergency Stop" pushbutton

10. Instrumentation and Miscellaneous Accessories

The on-site hypochlorite generation system shall include the following instrumentation and accessories:

- Water and brine rotameters
- Water and brine makeup solenoid valves
- Water flow sensor
- Cell Temperature Sensor and Switches
- Blower current sensor
- Blower air flow switch (shipped loose)
- Stainless steel open frame equipment skid

Depending on project constraints or customer requests, the following optional instrumentation and accessories, all of which will ship loose, may be available or required:

- Heat exchanger
- Water chiller
- Hypochlorite dilution panel with a magnetically-driven pump, rotameters, flow control valves, and venturi eductor

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- Acid cleaning system
- Hydrogen detector
- Water hardness monitor
- Chlorine analyzer

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D. SYSTEM FEATURES & ADVANTAGES

The Microclor® On-Site Hypochlorite Generation System offers maximum value measured by performance and reliability as well as capital, installation, maintenance, and operating costs. This is illustrated by the following system advantages:

1. Passive Hydrogen Removal for Superior Safety

Cells are configured in a vertical format with a recirculation loop for each cell that allows for optimized brine utilization and passive release of the hydrogen gas from each cell. Hydrogen gas is not allowed to pass from cell to cell. This design radically increases operator safety and substantially reduces the possibility of hydrogen gas build-up in the cell and the potential of catastrophic failure. Removing the hydrogen immediately from each cell eliminates the blinding of the electrodes by gas bubbles.

2. Brine Conductivity Control Optimizes Salt Efficiency

Constant current is achieved via a current feedback loop where the brine pump speed is controlled by the system programmable logic controller. This feedback loop accounts for variations in temperature, conductivity, and water flow. The titanium, Teflon impregnated gear pump is attached to a variable speed drive that continually provides a consistent blended electrolyte flow to the cells maximizing salt efficiency.

3. Indirect Constant Current

An active feedback loop which very slightly adjusts the brine flow rate achieves constant current in an indirect fashion. This innovative operational strategy eliminates the excessively high failure rate seen with forty year old switching rectifier or phase angle fired SCR voltage correction technology.

4. No Cell Internal Baffles or Gaskets

The electrolytic cells consist of thirteen internal bipolar electrodes. All anodic surfaces are coated with DSA catalytic coating. The design of the cell precludes the need for wet D.C. cable connections. There are no internal cell baffles, gaskets, or fasteners found inside the cell. The cells are built with clear acrylic guides that support the internal bi-polar plates and allow for direct visual inspection of the plates.

5. Easy Access for Maintenance

The Microclor® On-Site Hypochlorite Generation System is skid-mounted. The stainless steel skid construction provides superior structural strength while electrolytic polishing ensures ultimate passivation, chemical compatibility, and corrosion resistance. Use of an open frame design for the skid and a simple equipment layout facilitates access to each system component from multiple sides

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for easy inspection and maintenance. The vertical cell design allows for the cell to easily be removed from the cell carrier piping by simply breaking two coupled connections. This makes for simple cell maintenance and/or replacement. Custom-designed skid configurations and equipment layouts are available.

6. Reliable Performance and Robust Construction

The robust construction of the Microclor® On-Site Hypochlorite Generation System allows the electrolyte feed, cells, power supply, controls, and monitoring components to be subjected to minimum stress, lowering maintenance requirements.

7. Factory-Tested

Each system is pre-assembled, piped, and wired at the factory, allowing for thorough factory-testing of not just each component, but of the entire system prior to shipment. At a minimum, a factory quality control technician shall operate and calibrate the brine feed pump, verify calibrations for the instrumentation, and test the complete control system prior to running the unit in automatic mode for a minimum of four hours.

8. Minimum Installation Cost and Time

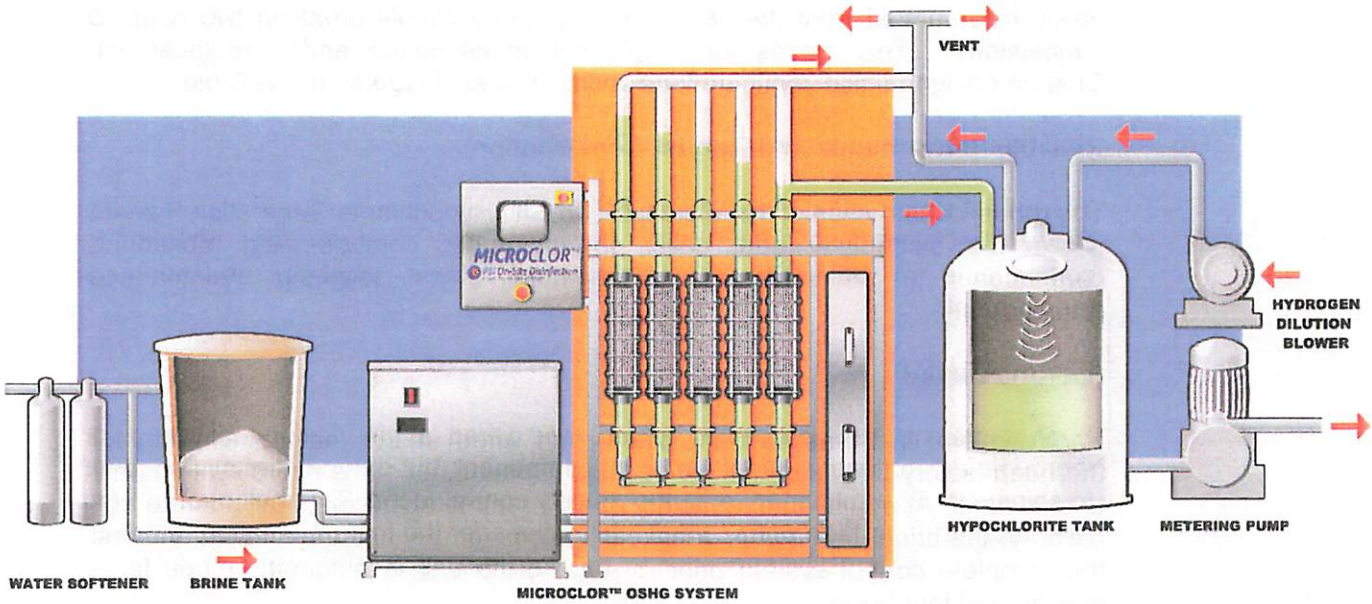
Most parts for the Microclor® On-Site Hypochlorite Generation System are inventoried at the factory, reducing lead times. By skid-mounting the system, installation is quick and straightforward, with minimum time and cost. Water line, brine feed, hypochlorite solution, and electrical connections are all predetermined and are clearly indicated.

9. Proven Track Record

The Microclor® On-Site Hypochlorite Generation System has been in production for over ten years. This system is a fully-developed, mature product supported by an extensive list of successful installations.

MICROCLOR™
On-Site Hypochlorite Generation

Microclor™ Process Flow Diagram



Microclor™ MC-1000

Features:

- Brine/salt tank(s), water softeners, solution tank(s), dosing pumps, and other ancillary equipment are available in various sizes to satisfy project requirements.
- System configurations available using alternate power supplies (380 VAC, 600 VAC, 50 Hz, etc.).
- Complete supply of equipment scope, system start up and installation inspection.
- Three-year warranty available.
- UL-, CE-, and CSA-Certified electrical control panel.

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Narrative Summary for Petition for Change
Humboldt Bay Municipal Water District
May 29, 2020

Introduction

The Humboldt Bay Municipal Water District (HBMWD or "the District") provides water on a wholesale basis to municipal and industrial customers in the Humboldt Bay area, and on a retail basis to a few hundred retail customers. Located in Humboldt County, the District's wholesale municipal customers include the cities of Arcata, Blue Lake and Eureka, and the Humboldt, McKinleyville, Manila and Fieldbrook Community Services Districts. Via the wholesale relationship, the District serves a population of approximately 88,000 in the greater Humboldt Bay area, or about 2/3 of the region's population.

Due to unique circumstances described below, the District is currently releasing more water from storage in Ruth Reservoir than it diverts downstream at the Essex Diversion Facility; the additional water is a benefit to aquatic organisms and habitat along approximately 75 miles of river corridor downstream of the dam. These releases do not impact or affect any senior water rights holder, as determined by the District's Water Injury Analysis. This Petition for Change is a request that the District be able to continue these releases by changing its existing water rights purpose of use to add instream flow for environmental benefit. Without this change, the District would be required to cease releasing the additional water over and above its municipal and industrial demands, which would be detrimental to aquatic organisms and habitat.

The District currently holds three post-1914 appropriative water rights on the Mad River (Appendix A). They are:

- Permit No. 11714 of March 16, 1959, which stipulates storage rates, storage timing, diversion methods and uses, and a fish protection release schedule.
- Permit No. 11715 of March 16, 1959, which further stipulates diversion and storage rates.
- Permit No. 18347 of September 25, 1981, which stipulates diversion and storage rates for operation of the 2-MW hydroelectric generation facility at Matthews Dam.

On February 28, 2007, the State Water Board (dated February 28, 2007) granted the District a permit extension from 2009 to 2029 (Appendix A).

In 1981, the Federal Energy Regulatory Commission (FERC) granted Exemption No. 3430 for the 2-MW hydroelectric plant at Matthews Dam. The District has a contract to sell "as available" energy and capacity to PG&E. The District does not operate the plant as an electric "peaking" facility, nor does the District "ramp" its flow releases (i.e., dramatically change flow in a short period of time in response to power needs). Power production is incidental to water released for the District's water supply function.

The District's water supply infrastructure is best described from the top of the Mad River watershed to its mouth. Near the top of the watershed, the District operates a small reservoir (Ruth Lake, storage capacity 48,000 acre-ft), Matthews Dam, and a small 2-MW hydroelectric facility (Figure 1). The reservoir generally fills quickly each year, usually after the first two or three major storms in the fall. After it fills, the District releases water through the hydroelectric facility penstock or over the spillway, when the flow is "run of the river." Water continues to flow approximately 75 miles downstream to the Essex Facility, where the District operates five Ranney wells for municipal water use and a surface water diversion for industrial water use. Downstream of the Essex Facility, water flows approximately 9 miles to the Mad River estuary and Pacific Ocean.

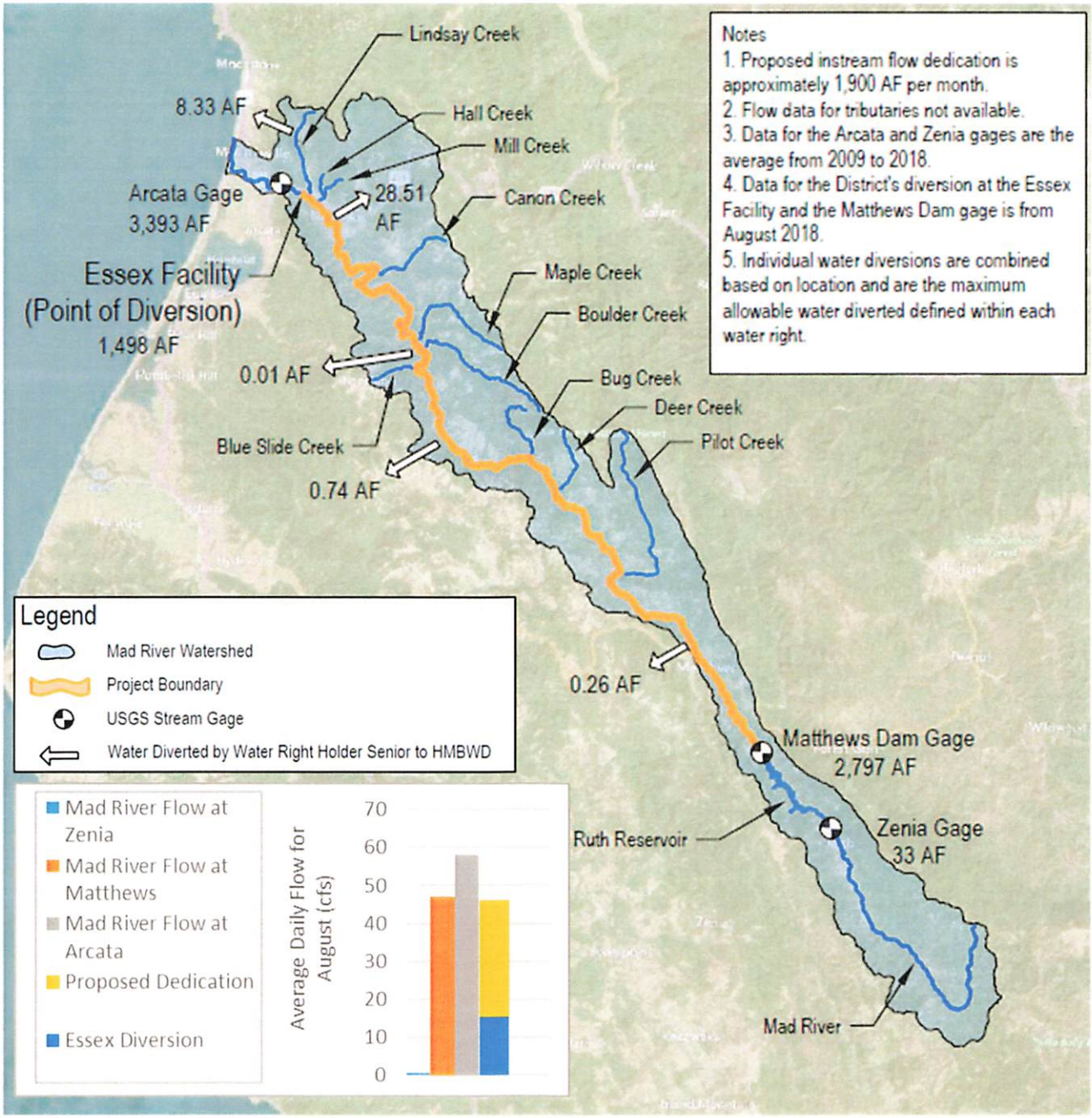

Figure 1. Water Diversions and Flow Measurements for the Month of August.

During the late spring and throughout the summer, discharge over the spillway ceases and flows in the Mad River are from tributary contributions and releases from Ruth Lake through the hydro-plant. The District releases water to meet its municipal and industrial demands, minimum flow environmental requirements, and to generate electricity.

When the District government and infrastructure were formed in the late 1950s and early 1960s, two pulp mills on the Samoa peninsula were the District's primary industrial customers, who required up to 60 million gallons per day (MGD). Since 2009, both pulp mills have closed and industrial demand is negligible. New industrial users are likely to re-develop the Samoa peninsula in the future, but their water use will be a fraction (likely no more than 20%) of the former pulp mills' demands.

Revenue from industrial water sales significantly decreased when the pulp mills closed. To address both the decrease in revenue and a potential loss of water rights due to lack of use, the District organized a public engagement process starting in 2008, to understand the public's views and desires related to water use. The engagement process continues to the present, and their views are consistent over time. The public support supports three water use options: 1) local use by existing and new municipal customers, and new industrial customers, 2) transport outside of District boundaries to a public agency, and 3) instream flow releases for environmental benefit.

Cannabis cultivation in the Mad River watershed, which falls under the jurisdiction of both Humboldt and Trinity counties, has dramatically increased and become a public concern. Numerous illegal diversions of water have been documented by enforcement agencies and the District. In one case, District staff discovered an illegal cultivation operation that was diverting water directly from Ruth Lake. Numerous accounts have documented diversions from Mad River tributaries, and Humboldt and Trinity County enforcement agencies have limited resources that must be stretched to cover the Klamath, Trinity, and Eel River watersheds in addition to the Mad River basin.

Given the public's desire for instream flow releases for environmental benefit and the continuing threat of illegal diversions from cannabis cultivation, and the District's desire to continue releasing more water than it diverts, the District is pursuing a water rights change in purpose of use under Water Code Section 1707. Given that our current permits and extension expire in 2029, we request a Long-Term Change Petition under Water Code Section 1707.

Purpose of the Project

The purpose of the Project is to:

- Improve summer rearing habitat for juvenile salmonids
- Improve spring mainstem shallow water edge habitat for foothill yellow-legged frogs and salmonid fry
- Provide resilience for river biota to ameliorate the effects of climate change

The District's system poses minimal environmental impacts compared to many large-scale dams in California. The reasons for this are several:

1. The total volume of water impounded at Ruth Lake represents a small fraction of the total runoff within the Mad River watershed because Matthews Dam is a) located high in the watershed and b) relatively small compared to the size of the watershed and the total discharge of the watershed.
2. Ruth Lake is a fill-and-spill reservoir that generally fills early in the rainy season. This allows the river to experience the high flow winter hydrograph and associated geomorphic processes.
3. Tributaries downstream of Matthews Dam contribute significantly to the Mad River discharge.
4. Matthews Dam is upstream of a full barrier to salmon migration and a partial barrier for steelhead migration.
5. No out-of-basin transfers occur in the upper watershed, as happens on other North Coast rivers, for example, the Eel River to the Russian River.
6. The hydroelectric facility at Matthews Dam does not operate on a power-peaking mode as do many other California dams.

Throughout the year, but particularly in the summer and early fall low flow periods, the District's flow releases substantially augment flows in the Mad River, compared to what otherwise would occur naturally.

Proposed and Current Operations

Comparisons of the District's current and proposed water rights parameters are tabulated (Table 1). The District's bypass flow schedule as described in its Habitat Conservation Plan is provided in Table 2.

Table 1. Comparison of District's Current and Proposed Water Rights Parameters

Water Rights Parameter	Current	Proposed
Amount	• Permit No. 11714. Limited to what can be beneficially used • Permit No. 11715. Limited to what can be beneficially used • Permit No. 18347. Limited to what can be beneficially used	No changes proposed
Rate	• Permit No. 11714. Not to exceed 100,000 acre-ft per year • Permit No. 11715. Not to exceed 200 cfs by direct diversion and 200,000 acre-ft per year by storage • Permit No. 18347. Not to exceed 1,000 cfs by direct diversion and 120,000 acre-ft per year by storage	No changes proposed

Water Rights Parameter	Current	Proposed
Season of diversion	• Permit No. 11714. From October 1 to about April 30 of the succeeding year • Permit No. 11715. Year-round for direct diversion and about October 1 of each year to April 30 of the succeeding year for storage. • Permit No. 18347. Year-round for direct diversion and October 1 of each year to April 30 of the succeeding year for storage.	No changes proposed
Authorized purposes and place of use	• Permit No. 11714. Storage at Ruth Reservoir, minimum flow of 5 cfs below Matthews Dam, bypass flows according to schedule downstream of the Essex Facility[1] • Permit No. 11715. Same as 11714. • Permit No. 18347. Power generation	Change of purpose of use to add instream flow for environmental benefit
Points of diversion	• Permit No. 11714. At the Essex Facility • Permit No. 11715. Same as 11714. • Permit No. 18347. Ruth Reservoir	No changes proposed
Priority	• Permit No. 18347. "subject to future upstream appropriations for consumptive use within the Mad River watershed"	No changes proposed
[1] See Table 2. Bypass Flows Schedule downstream of Essex Diversion.		

Table 2. Bypass Flow Schedule Downstream of the Essex Facility, Measured at the Arcata Gage.

Time Periods	Minimum Flow Downstream of Essex Diversion, cfs
October 1 through October 15	30
October 16 through October 31	50
November 1 through June 30	75
July 1 through July 31	50
August 1 through August 31	40
September 1 through September 30	30

Water Availability for Instream Flow

The focus of water availability is during the late spring, summer, and early fall months, because it is during those months that the District's releases are a significant portion of the river's flow (Figures 2 and 3). During August and September, flows as measured above Matthews Dam at Zenia (blue bars in Figures 2 and 3) are very low, and the District's releases as measured at Matthews Dam (gray bars) are a significant portion of the flow at the Arcata gage (green bars), which demonstrates that the District augments flows for the benefit of the environment.

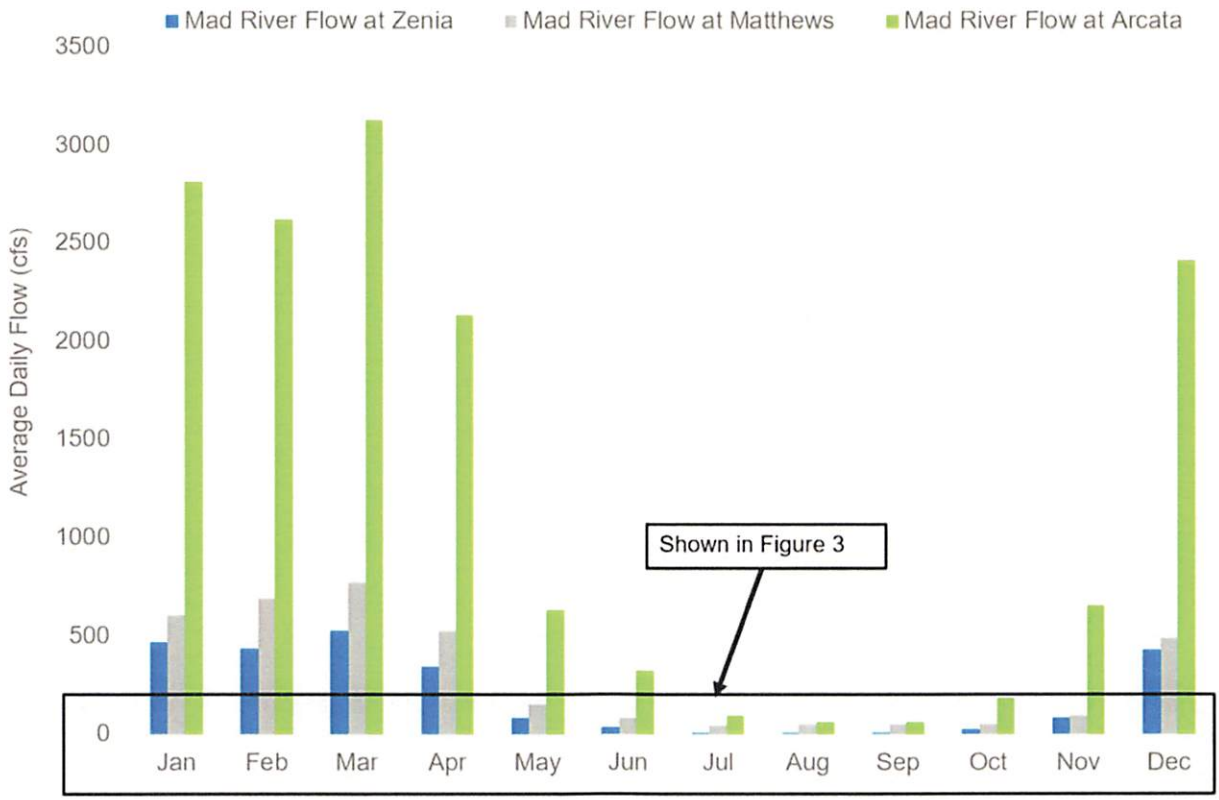

Figure 2. Mad River Flows at Zenia, Matthews Dam, and Arcata Gage Stations.

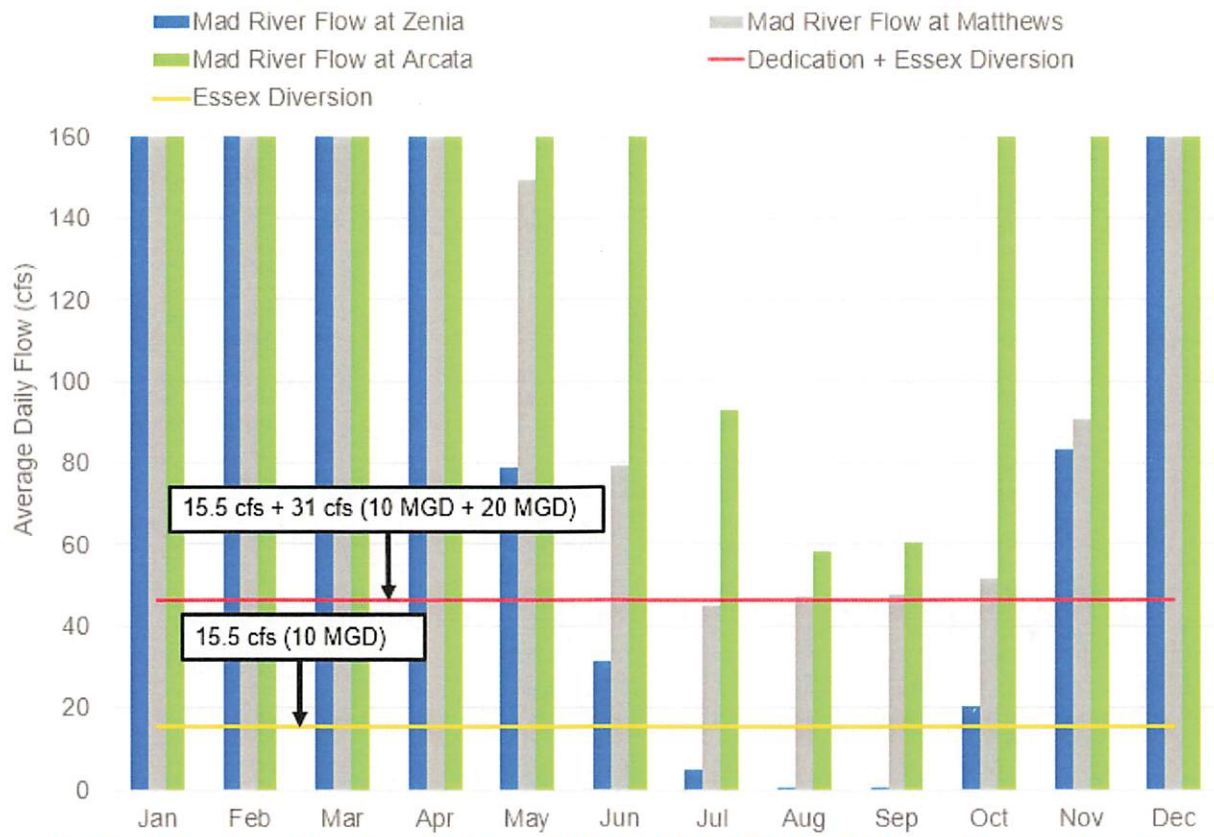

Figure 3. Mad River Flow (based on data from 2010 to 2019) at Zenia, Matthews Dam, and Arcata Stations with District's Diversion and Proposed Dedication. These flows are monthly average over a period of years. Actual dedication amounts will vary.

The flow volume requested to be dedicated is 1,900 AF per month (31 cfs, 20 MGD), based on monthly average daily flows. The flow commitment would be subject to reservoir conditions and the Water Storage Contingency Planning guidelines set in the HBMWD Urban Water Management Plan (current version dated June 9, 2016) The approximate flow that the District extracts (yellow line in Figure 3) is the volume of water that would be released from Matthews Dam without the instream flow dedication. The red line indicates the total dedication to the environment and the needs of the municipal and industrial users, and reflects uniform average monthly volumes based on water rights, not measured values. Water rights values are not necessarily the amount executed, but represent a projection of what flows would be, should the District execute its water rights to the fullest extent on an average monthly basis. During the dry season (July through September), the red line and gray bar are approximately equal, which suggests that all of the water released by the District from Ruth Reservoir would be either consumptively used or dedicated to the environment. It would be difficult, if not impossible, to dedicate more water to the environment.

Sufficient water availability is based on modeling of four consecutive years of drought conditions. Availability was considered for municipal demands, foreseeable future industrial demands, instream flows for environmental benefit, and senior water rights holders (see section below, "Consumptive Use and Injury Analysis" for meeting senior water rights holders uses).

Based on the original design studies that determined the size of Ruth Lake reservoir and industrial and municipal demands, there is sufficient water available for the proposed instream flow dedication. Several studies were completed that assessed the District's water source and its reliability. Bechtel Corporation was retained in the 1950s to perform various water supply studies and to complete the design and specifications for the original water system. During this time, Bechtel completed a detailed operations study of the reservoir storage to determine the safe yield of the original project pursuant to the downstream diversion requirements in the District's water rights permits. The study was done based on a 75 MGD average annual diversion rate at the Essex Facility. Existing prior water rights downstream of Ruth Reservoir were incorporated into the study. Bechtel confirmed the safe yield of the reservoir to be 75 MGD assuming the driest period of record they studied (1923-1924). These hydrological conditions were supported by subsequent studies completed by DWR, the U.S. Army Corps of Engineers, Bechtel Corporation, and Winzler & Kelly Engineering.

More recent analyses of historical data support the original design studies. From the District's historical data, on average, Ruth Lake storage volume on October 1st is approximately 31,000 AF, or 64% of its 48,030 AF capacity. Most rainfall in the area occurs between November and April. In every year but one since 1969, rainfall was sufficient to fill the reservoir to capacity; the reservoir did not fill to capacity in 1977. The average reservoir volume at the end of the rainy season on May 1st is approximately 47,700 AF. This storage allows the District to supplement low summer flows until the rains begin again in the fall. Reservoir storage levels that could begin implementation of conservation measures are likely to be implemented after two consecutive winter seasons with severely reduced rainfall and runoff (below 50% of normal), which has not happened in the history of the District.

After the drought years of record (1976/77), which was the only declared water emergency in the history of the District, Winzler & Kelly re-evaluated the safe yield of the reservoir to be 67 MGD. The most recent study, included in the District's current Urban Water Management Plan, evaluated the most recent drought, which occurred from 2013 to 2015. A Rippl mass diagram was used to assess the maximum constant draft rate that could be achieved over the course of drought. The Rippl diagram showed that a maximum constant draft rate of 36.5 MGD could be achieved based on the mass budget.

During the summer and early fall months (typically July 1 to October 1), the District releases water from Ruth Lake for three reasons, 1) to run one turbine of the hydroelectric facility, 2) to supply water for diversion at the Essex Facility for municipal and industrial uses, and 3) to provide required bypass flows. Currently, industrial uses are minimal but recent interest in developments on the Samoa peninsula could increase industrial water demand again. In the District's history, its maximum water demand was from the two pulp mills and its municipal customers.

Between 2009 (when the last pulp mill closed) and 2018 (most recent year for USGS-certified flow data), average daily flows during the summer at the Arcata gage have been highly variable but have always been greater than 33 cfs. During this time, the District's Habitat Conservation Plan (HBMWD 2006) minimum flow requirements have always been met. If future industrial demands increase, the District will release more water during the summer to meet the demands of the industrial and municipal customers and the minimum flow requirements.

Consumptive Use and Injury Analysis

Using extremely conservative assumptions, there is no injury to senior water rights users resulting from the District's proposed instream flow dedication (Appendix B, GHD 2020 Water Rights Injury Analysis). There is also no impact to water rights holders that are junior to the District.

To assess potential effects to other legal users, an injury/impact analysis was performed. Ideally, an injury/impact analysis uses a mass balance approach to evaluate if sufficient flow remains in a stream if an instream flow dedication were to be approved. Because flow data were very limited for the 75-mile project reach (Figure 1), a comparison of known values was used to assess injury/impact.

Values used in this analysis included measured flow rates entering and exiting Ruth Reservoir (at Zenia and Matthews Dam gages, respectively) and downstream of the Essex Facility (at the Arcata gage), maximum allowable diversion rates for legal water users, and the District's measured diversion rates. Locations of the three gages and the District's diversion are shown in Figure 1. All other points of diversion (i.e., legal water users) are individually shown in Appendix B, and are combined based on proximity as indicated on Figure 1.

Water users in the Mad River watershed were listed, and data sources that characterize their water rights and usage were reviewed. Water users were categorized into these general groups:

- Legal water rights holders. Data were available through the State Water Resources Control Board Electronic Water Rights Information Management System (eWRIMS).
- Humboldt Bay Municipal Water District. Data were available through District records.
- Cannabis cultivation operations. In May 2014, the California Department of Fish and Wildlife used high resolution imagery to digitize cannabis cultivation sites and to estimate their water use. However, their analysis did not distinguish between legal and illegal cultivation sites. Legal cultivators who have applied for water rights are included in the eWRIMS database. In this injury/impact analysis, no attempt has been made to estimate water use of illegal cannabis operations, and we assume that illegal operations will become fewer in the future due to increased law enforcement.

Since 2009, when the last pulp mill closed, to 2018, a comparison of flows indicates that summer flows at the USGS Arcata gage were always greater than the diversions from senior and junior water rights holders according to eWRIMS and from the District. (This is true even with the very conservative assumptions applied as described below.) Therefore, no water rights holders will experience injury or even impact from the District's extractions, and there is sufficient flow for minimum bypass flows required by the District's 2006 Habitat Conservation Plan.

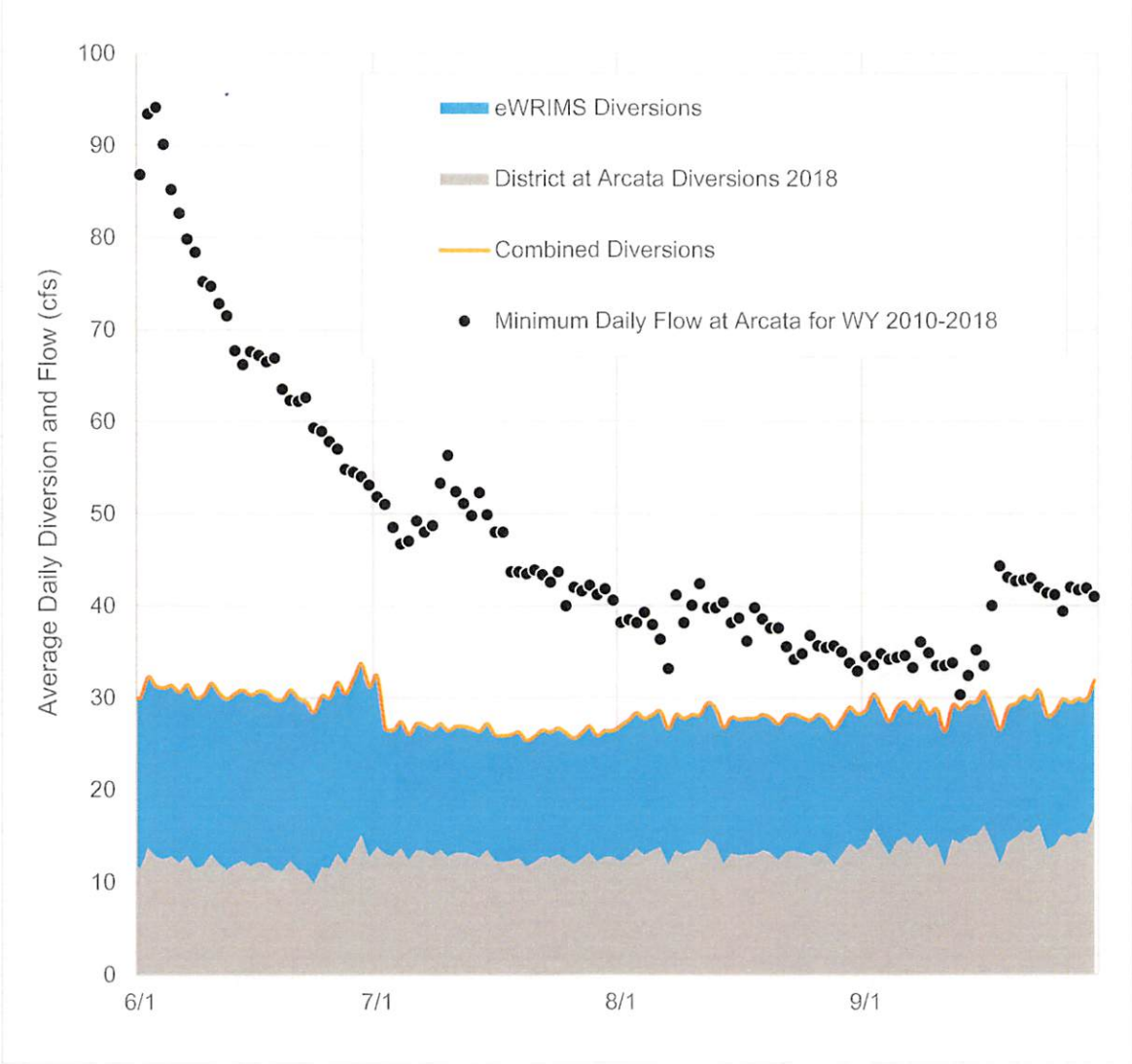

Figure 4. Daily Diversion Rates and Instream Flow Comparison (cfs).

This analysis can also be demonstrated in tabular form (Tables 3 and 4). Throughout the year, but especially in August, there is no injury/impact to senior water rights holders or all water rights holders as a result of the District's diversions. In Figure 3 above, approximate theoretical values were used to demonstrate potential future conditions. In Tables 3 and 4, the actual volume of water diverted by the District is used to demonstrate current conditions. Actual amounts of water diverted by other water rights holders were not available so maximum extraction rates included in the water rights were used as a conservative assumption that reflects the worst-case scenario.

Table 1. Monthly diversion rates for the District (HBMWD) and water rights holders senior to the District and indicated flow rates (cfs).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Senior Water Rights Holders	0.02	0.02	0.02	0.02	0.50	0.64	0.64	0.64	0.64	0.02	0.02	0.02
HBMWD	12.1	12.7	12.2	12.4	13.1	14.6	16.1	15.7	15.0	13.5	12.8	12.2
Total	12.1	12.7	12.2	12.4	13.6	15.2	16.7	16.4	15.6	13.6	12.8	12.2
Flow at Arcata Gage	2,808	2,449	3,365	2,089	600	320	93	58	61	198	718	2,581
HCP Flow Requirements at Arcata Gage	75	75	75	75	75	75	50	40	30	50	75	75
HCP Flow Requirement Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2. Monthly diversion rates for the District and all water rights holders and indicated flow rates (cfs).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
All Water Rights Holders	17	18	19	14	15	15	15	15	16	15	15	16
HBMWD	12.1	12.7	12.2	12.4	13.1	14.6	16.1	15.7	15.0	13.5	12.8	12.2
Total	29.1	30.5	30.8	26.1	27.9	29.2	30.9	30.8	30.8	28.7	28.3	28.4
Flow at Arcata Gage	2,808	2,449	3,365	2,089	600	320	93	58	61	198	718	2,581
HCP Flow Requirements at Arcata Gage	75	75	75	75	75	75	50	40	30	50	75	75
HCP Flow Requirement Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes:
Proposed dedication (20 MGD) = 31 cfs
HCP Flow = Flow requirements in the District's Habitat Conservation Plan (HCP). If a single month had two different minimum flows, the higher of the two is shown.
Water Rights Holders = The total flow rate assumed to be diverted by water right holders listed in the State Water Board's database.
Senior Water Right Holders = The total flow rate assumed to be diverted by all water right holders that are senior to the District.
HBMWD = Actual average flow diverted by the District, may vary from their water rights
Total = The sum of Water Right Holders and HBMWD.
Flow at Arcata Gage = Average monthly flow rate at the Arcata gage for 2010 – 2018.

SECTION 5.2, PAGE NO. 12

Several limitations in the data are detailed (Appendix B), but very conservative assumptions were applied in every case. Two key conservative assumptions were:

1. Many of the diversion rates in the eWRIMS database are maximum rates that the water rights holder could divert. It is likely that their diversion is less than maximum, however we assumed they divert their maximum flow.
2. Flow data from the Arcata gage is downstream of the Essex Facility, where the District diverts water for industrial and municipal use. Due to the paucity of data sources, we elected to use the Arcata gage data in the water mass balance, even though it reflects the District's diversions. In essence, the District's diversions are counted twice in the water mass balance.

Other assumptions include negligible seepage based on the Mad River's bedrock confinement, and negligible evaporation. The importance of these water losses is likely more than offset by the water contributions from named but ungaged tributaries such as the North Fork of the Mad River, Pilot Creek, Bug Creek and Lindsay Creek.

Water Quality Considerations of the Petition

The North Coast Regional Water Quality Control Board has listed the Mad River as impaired for sediment, turbidity, and temperature under Section 303(d) of the California Clean Water Act, and water quality is an important consideration in the conservation of salmonids and other special-status species.

The major sources of sediment and turbidity in the Mad River are from landslides and surface erosion associated with roads, timber harvest, and other disturbance within the watershed; most of this disturbance occurs in the watershed downstream of Matthews Dam, which is approximately 76% of the basin area (Stillwater Sciences and RCAA 2010). The District's operations and this Petition for Change would have no effect on sediment and turbidity in the middle and lower reaches of the Mad River, but the dam does hold back sediment immediately below the dam.

Ruth Reservoir has a seasonal effect on water temperature in the river downstream of Matthews Dam (Appendix C). During warmer months, because the intake for the discharge outlet is deep (approximately 132 feet below crest elevation), water temperatures downstream of the outlet are cool, ranging from 48.4°F in May 2018 to 61.2°F degrees in October 2018. The cool water source at the outlet affects water temperatures in the 7.5 miles downstream of Matthews Dam (at the sensor at Highway 36). However, stream temperature equilibrates with air temperature by the next downstream temperature sensor, 38.6 miles downstream from the Dam (at RM 41.6) (Figure 5). Temperature sensors from RM 41.6 to the downstream-most sensor on the mainstem at the Mad River Boat Launch (RM 3.1) are affected by ambient air temperatures, which cool closer to the coast due to the influence of the Pacific Ocean, as well as localized cooler water inputs from specific tributaries in the lower Mad River.

The main benefits of releases from Matthews Dam are primarily felt in the first 10 miles of so downstream of the dam. These benefits increase habitat quality and quantity for salmonids and yellow-legged frogs in spring and summer, and water quality (e.g., cooler water temperatures) in the upper reach in summer. Releases from Matthews Dam increase habitat in the Mad River primarily by providing higher discharge in the summer months than inflow into Ruth Reservoir. This higher discharge results in increased holding habitat for adult summer steelhead downstream of Pilot Creek, improved shallow edgewater rearing habitat for juvenile salmonids in the mainstem, expanded habitat for egg and juvenile life stages of yellow-legged frogs, and resilience to climate change.

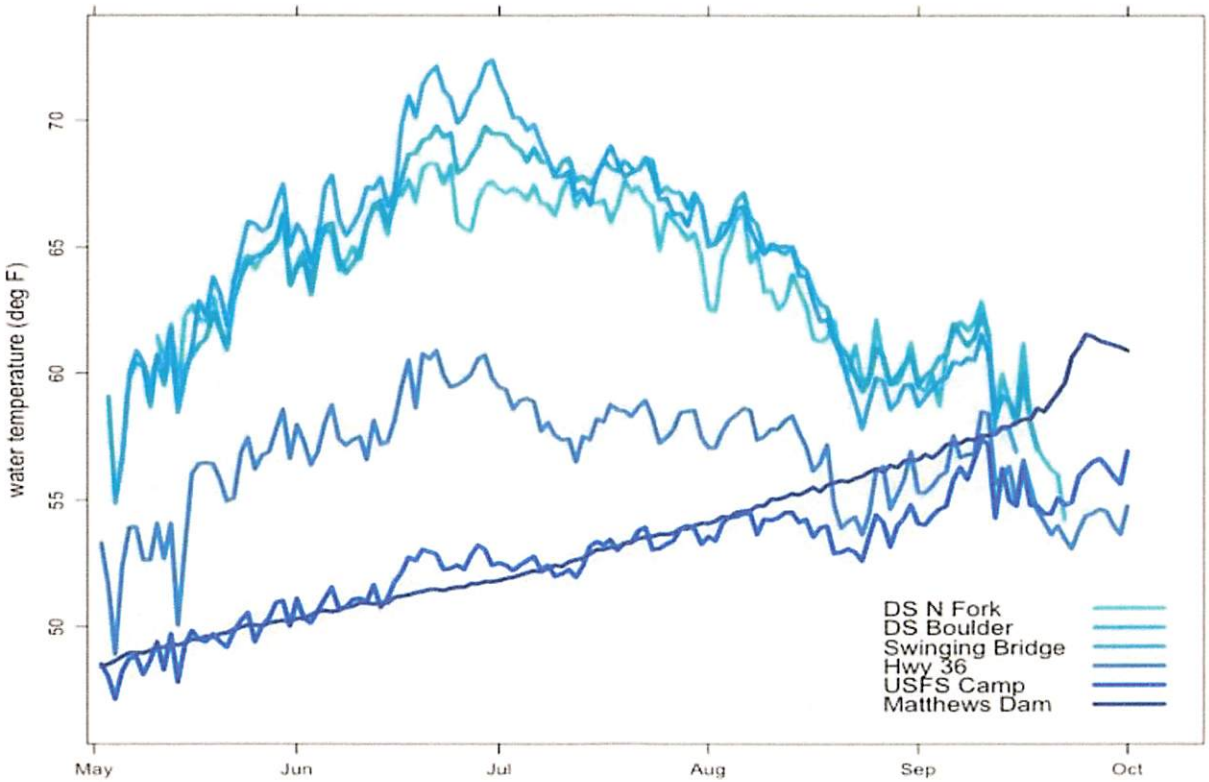

Figure 5. Water Temperatures Stations along the Mad River.
Lower Reach of the Mad River (DS N Fork [RM 13.7], DS Boulder [RM 32.6]) and the Middle Reach (Swinging Bridge [RM 41.6]) had similar temperatures. Note: Here, daily values only, distinctly warmer than those recorded from the Upper Reach (Hwy 36 [RM 72.7], USFS Camp [RM 77.0], Matthews Dam [RM 80.2]). Matthews Dam=MRDam, USFS Camp=MRUSFSCamp, Hwy 36=MRHWY36, Swinging Bridge=MRSwingB, DS Boulder=MRDSBoulder, DS N Fork=MRDSNF.

Conditions Without Augmented Flows

The District's releases from Matthews Dam have resulted in additional instream flow in the mainstem Mad River between the dam and estuary, particularly between June and October. Without these releases, the aquatic habitat that many fish and amphibians rely on would be significantly diminished. In the upper Mad River, between Matthews Dam and Pilot Creek, District releases are the source of inflow to the mainstem and provide important shallow edge water habitat for early life stages of steelhead and foothill yellow-legged frogs. Less of this important habitat would be available if releases from Matthews Dam were to be decreased.

Releases of bottom water from Matthews Dam (RM 80) currently results in water temperatures that are below 60°F (the preferred temperature zone for juvenile steelhead rearing during the summer and early fall months) downstream to Hwy 36 (RM 72.7). If releases were decreased, a consequence could be less habitat available with preferred temperatures because decreased volume and depth of water would equilibrate more quickly with air temperature.

Over the last 60 years, the releases from Matthews Dam have resulted in higher summer and fall flows in the lower river. These higher flows have allowed for the mouth of the river to remain open to the ocean year-round, which has enabled Chinook salmon, coho salmon, and steelhead to enter the river in the fall unencumbered by the presence of a barrier beach. Similar to what was reported in 1958 by CDFG, reduced flows could result in seasonal development of a barrier beach bar that would block upstream migration of anadromous salmonids until fall and winter runoff conditions are high enough to breach the bar (Pelgen and Fisk 1957). Given that Chinook salmon begin their upstream spawning migration and enter the Mad River in early September, a barrier beach could delay or eventually eliminate the early part of the run.

The lower Mad River provides habitat for juvenile steelhead and coho salmon rearing during the summer months. Augmented flows increase the amount of suitable habitat for these species during the summer and fall months. Reduced flows would decrease the amount of available habitat and increase the potential for density-related effects.

Actions and Approvals Requested of the State Water Board

The District requests that the SWRCB process a change petition under Water Code section 1707 that would dedicate a release of approximately 31 cfs (as described above in Figure 3) for the purpose of enhancing the fishery and aquatic/riparian ecosystem of the Mad River. This change would take effect upon approval by the SWRCB and would be a permanent change to the District's water rights.

Findings Needed for Long-Term Change Petition

Will the change initiate a new water right? No
Was the existing water right properly established? Yes
Has recent beneficial use occurred in accordance with the water right? Yes
Will the change injure or unreasonably affect any legal water user? No
Does the change petition address CEQA requirements? In progress
Will the change have any adverse effects on public trust resources? No

Project Map

A project map is included as Figure 1. This map includes:

- ✓ A delineation of the project site
- ✓ All known diversions within the vicinity of the project
- ✓ Identification of HBMWD's existing point of diversion
- ✓ Delineation of the stream habitat that the change petition intends to address

References

GHD. 2020. Water Right Injury Analysis. Memo of April 3, 2020 to John Friedenbach from Patrick Sullivan and Richela Maeda.

Pelgen and Fisk. 1957. A Preliminary Evaluation of the Effect of the Ruth Dam Project on Fisheries of the Mad River. June 1957, revised February 1958. In, State of California Department of Water Resources, Division of Resources Planning. 1958. Office Report on Preliminary Investigation of the Mad River. March 1958.

Stillwater Sciences and RCAA (Redwood Community Action Agency). 2010. Mad River watershed assessment. June 2010. Final report. Prepared for Redwood Community Action Agency, Eureka, California.

Humboldt Bay Municipal Water District Urban Water Management Plan 2015 (dated June 9, 2016). See Section 8 – Water Shortage Contingency Planning.

APPENDIX A. HBMWD Water Rights Permits

APPENDIX B. Injury Analysis Report

APPENDIX C. Temperature and DO Modeling Report

Appendix A

HBMWD Water Rights Permits

PERMIT No. 11714

This is to certify that the application of which the foregoing is a true and correct copy has been considered and approved by the State Water Rights Board SUBJECT TO VESTED RIGHTS and the following limitations and conditions:

1. The amount of water to appropriated shall be limited to the amount which can be beneficially used and shall not exceed 100,000 acre-feet per annum by storage to be collected from about October 1 of each year to about April 30 of the succeeding year.

2. The maximum amounts herein stated may be reduced in the license if investigation so warrants.

3. Actual construction work shall begin on or before December 1, 1960, and shall thereafter be prosecuted with reasonable diligence, and if not so commenced and prosecuted, this permit may be revoked.

4. Said construction work shall be completed on or before July 1, 1967.

5. Complete application of the water to the proposed use shall be made on or before July 1, 1970.

6. Progress reports shall be filed promptly by permittee on forms which will be provided annually by the State Water Rights Board until license is issued.

7. All rights and privileges under this permit including method of diversion, method of use, and quantity of water diverted are subject to the continuing authority of the State Water Rights Board in accordance with law and in the interest of the public welfare to prevent waste, unreasonable use, unreasonable method of use or unreasonable method of diversion of said water.

8. For the protection, propagation and preservation of fish life permittee shall:

a. At all times by-pass or release minimum flow of five cubic feet per second into the natural stream bed of

Mad River immediately below Ruth Dam.

b. During the periods herein specified, by-pass or release into the natural stream bed of Mad River immediately below Essex Diversion Dam the following minimum flows or the natural flow of Mad River as regulated by diversions now in existence, whichever is less:

October 1 through October 15	30 cfs
October 16 through October 31	50 cfs
November 1 through June 30	75 cfs
July 1 through July 31	50 cfs
August 1 through August 31	40 cfs
September 1 through September 30	30 cfs

9. This permit is subject to the Memorandum of Understanding between Humboldt Bay Municipal Water District and County of Trinity, drafted on January 28, 1959, and duly approved by both agencies and on file with the State Water Rights Board.

This permit is issued and permittee takes it subject to the following provisions of the Water Code:

Section 1390. A permit shall be effective for such time as the water actually appropriated under it is used for a useful and beneficial purpose in conformity with this division (of the Water Code), but no longer.

Section 1391. Every permit shall include the enumeration of conditions therein which in substance shall include all of the provisions of this article and the statement that any appropriator of water to whom a permit is issued takes it subject to the conditions therein expressed.

Section 1392. Every permittee, if he accepts a permit, does so under the conditions precedent that no value whatsoever in excess of the actual amount paid to the State therefor shall at any time be assigned to or claimed for any permit granted or issued under the provisions of this division (of the Water Code), or for any rights granted or acquired under the provisions of this division (of the Water Code), in respect to the regulation by any competent public authority of the services or the price of the services to be rendered by any permittee or by the holder of any rights granted or acquired under the provisions of this division (of the Water Code) or in respect to any valuation for purposes of sale to or purchase, whether through condemnation proceedings or otherwise, by the State or any city, city and county, municipal water district, irrigation district, lighting district, or any political subdivision of the State, of the rights and property of any permittee, or the possessor of any rights granted, issued, or acquired under the provisions of this division (of the Water Code).

Dated: MAR 16 1959

STATE WATER RIGHTS BOARD

L. K. Hill

L. K. Hill
Executive Officer

80888 7-58 10M ① SPO

PERMIT No. 11715

This is to certify that the application of which the foregoing is a true and correct copy has been considered and approved by the State Water Rights Board SUBJECT TO VESTED RIGHTS and the following limitations and conditions:

1. The amount of water appropriated shall be limited to the amount which can be beneficially used and shall not exceed 200 cubic feet per second by direct diversion, year-round, and 20,000 acre-feet per annum by storage to be collected from about October 1 of each year to about April 30 of the succeeding year.

2. The maximum amounts herein stated may be reduced in the licenses if investigation so warrants.

3. Actual construction work shall begin on or before December 1, 1960, and shall thereafter be prosecuted with reasonable diligence, and if not so commenced and prosecuted, this permit may be revoked.

4. Said construction work shall be completed on or before July 1, 1967.

5. Complete application of the water to the proposed use shall be made on or before July 1, 1970.

6. Progress reports shall be filed promptly by permittee on forms which will be provided annually by the State Water Rights Board until license is issued.

7. All rights and privileges under this permit including method of diversion, method of use, and quantity of water diverted are subject to the continuing authority of the State Water Rights Board in accordance with law and in the interest of the public welfare to prevent waste, unreasonable use, unreasonable method of use or unreasonable method of diversion of said water.

8. For the protection, propagation and preservation of fish life permittee shall:

   a. At all times by-pass or release minimum flow of five cubic feet per second into the natural stream bed of Mad River immediately below Ruth Dam.

b. During the periods herein specified, by-pass or release into the natural stream bed of Mad River immediately below Essex Diversion Dam the following minimum flows or the natural flow of Mad River as regulated by diversions now in existence, whichever is less:

October 1 through October 15	30 cfs
October 16 through October 31	50 cfs
November 1 through June 30	75 cfs
July 1 through July 31	50 cfs
August 1 through August 31	40 cfs
September 1 through September 30	30 cfs

9. This permit is subject to the Memorandum of Understanding between Humboldt Bay Municipal Water District and County of Trinity, drafted on January 28, 1959, and duly approved by both agencies and on file with the State Water Rights Board.

water.

This permit is issued and permittee takes it subject to the following provisions of the Water Code:

Section 1390. A permit shall be effective for such time as the water actually appropriated under it is used for a useful and beneficial purpose in conformity with this division (of the Water Code), but no longer.

Section 1391. Every permit shall include the enumeration of conditions therein which in substance shall include all of the provisions of this article and the statement that any appropriator of water to whom a permit is issued takes it subject to the conditions therein expressed.

Section 1392. Every permittee, if he accepts a permit, does so under the conditions precedent that no value whatsoever in excess of the actual amount paid to the State therefor shall at any time be assigned to or claimed for any permit granted or issued under the provisions of this division (of the Water Code), or for any rights granted or acquired under the provisions of this division (of the Water Code), in respect to the regulation by any competent public authority of the services or the price of the services to be rendered by any permittee or by the holder of any rights granted or acquired under the provisions of this division (of the Water Code) or in respect to any valuation for purposes of sale to or purchase, whether through condemnation proceedings or otherwise, by the State or any city, city and county, municipal water district, irrigation district, lighting district, or any political subdivision of the State, of the rights and property of any permittee, or the possessor of any rights granted, issued, or acquired under the provisions of this division (of the Water Code).

Dated: MAR 16 1959

STATE WATER RIGHTS BOARD

L. K. Hill

L. K. Hill
Executive Officer

80686 7-58 10M ⓘ SPO

C.C. Source Water Section
Coastal Watershed

STATE OF CALIFORNIA – RESOURCES AGENCY
EDMUND G. BROWN JR., *Governor*
STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER RIGHTS
77 Cadillac Drive, Sacramento, CA 95825
(916) 924-2478

RECEIVED SEP 28 1981

IN REPLY REFER
TO: 333:DEM:26657

SEPTEMBER 25 1981

Humboldt Bay Municipal Water District
c/o Arthur Bolli, General Manager
P. O. Box 95
Eureka, CA 95501

APPLICATION 26657 PERMIT 18347

YOUR WATER RIGHT PERMIT IS ENCLOSED. THE BOARD REQUIRES THAT YOU SUBMIT ANNUAL REPORTS SHOWING THE PROGRESS YOU HAVE MADE IN THE CONSTRUCTION OF YOUR PROJECT OR, IF CONSTRUCTED, THE USE MADE UNDER YOUR PERMIT WHICH WOULD QUALIFY FOR LICENSING PURPOSES. WE WILL MAIL THE FORMS TO YOU WHEN THE REPORTS ARE DUE.

PLEASE NOTE THAT, WITH RESPECT TO OTHER RIGHTS ATTACHING TO THIS SOURCE, THE PRIORITY OF THIS RIGHT COMMENCES WITH THE DATE OF THE APPLICATION. THEREFORE, IN TIME OF WATER SHORTAGE, THOSE WITH RIGHTS SENIOR TO YOURS CAN TAKE THEIR WATER FIRST. ADDITIONAL LIMITATIONS ON THE DIVERSION OF WATER ARE SPECIFIED BY THE TERMS OF THIS PERMIT. YOU SHOULD READ THE TERMS AND CONDITIONS CAREFULLY SO THAT YOU ARE FAMILIAR WITH YOUR RESPONSIBILITIES AS AN APPROPRIATOR OF WATER UNDER THIS ENTITLEMENT.

AFTER THE PROJECT HAS BEEN COMPLETED, AN INSPECTION WILL BE MADE TO DETERMINE THE AMOUNT OF WATER WHICH HAS BEEN PLACED TO BENEFICIAL USE WITHIN THE TERMS OF THE PERMIT. A LICENSE WILL THEN BE ISSUED CONFIRMING A RIGHT TO THAT AMOUNT OF WATER.

PLEASE INFORM US OF ANY CHANGE IN ADDRESS OR OWNERSHIP.

D. W. SABISTON
PROGRAM MANAGER
HEARING SECTION

ENCLOSURE

WR 14a (8/80)

STATE OF CALIFORNIA
THE RESOURCES AGENCY
STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER RIGHTS

PERMIT FOR DIVERSION AND USE OF WATER

PERMIT 18347

Application 26657 of Humboldt Bay Municipal Water District

P. O. Box 95, Eureka, California 95501

filed on December 9, 1980, has been approved by the State Water Resources Control Board SUBJECT TO VESTED RIGHTS and to the limitations and conditions of this Permit.

Permittee is hereby authorized to divert and use water as follows:

1. Source: Mad River

Tributary to: Pacific Ocean

2. Location of point of diversion:	40-acre subdivision of public land survey or projection thereof	Section	Township	Range	Base and Meridan
Ruth Reservoir South 18°East 3,194 feet from W1/4 corner of Section 18, T1S, R7E	NW1/4 of NW1/4	19	1S	7E	H

County of Trinity

3. Purpose of use:	4. Place of use:	Section	Township	Range	Base and Meridan	Acres
Power	NW1/4	19	1S	7E	H	

The place of use is shown on map filed with the State Water Resources Control Board.

APPLICATION 26657 PERMIT 18347

5. The water appropriated shall be limited to the quantity which can be beneficially used and shall not exceed 1,000 cubic feet per second by direct diversion to be diverted from January 1 to December 31 of each year and 120,000 acre-feet per annum by storage to be collected from October 1 of each year to April 30 of the succeeding year.

6. The amount authorized for appropriation may be reduced in the license if investigation warrants.

7. Construction work shall be completed on or before December 1, 1984.

8. Complete application of the water to the proposed use shall be made on or before December 1, 1985.

9. Progress reports shall be submitted promptly by permittee when requested by the State Water Resources Control Board until license is issued.

10. Permittee shall allow representatives of the State Water Resources Control Board and other parties as may be authorized from time to time by said Board, reasonable access to project works to determine compliance with the terms of this permit.

11. Pursuant to California Water Code Sections 100 and 275, all rights and privileges under this permit and under any license issued pursuant thereto, including method of diversion, method of use, and quantity of water diverted, are subject to the continuing authority of the State Water Resources Control Board in accordance with law and in the interest of the public welfare to prevent waste, unreasonable use, unreasonable methods of use, or unreasonable method of diversion of said water.

The continuing authority of the Board may be exercised by imposing specific requirements over and above those contained in this permit with a view to minimizing waste of water and to meeting the reasonable water requirements of permittee without unreasonable draft on the source. Permittee may be required to implement such programs as (1) reusing or reclaiming the water allocated; (2) using water reclaimed by another entity instead of all or part of the water allocated; (3) restricting diversions so as to eliminate agricultural tailwater or to reduce return flow; (4) suppressing evaporation losses from water surfaces; (5) controlling phreatophytic growth; and (6) installing, maintaining, and operating efficient water measuring devices to assure compliance with the quantity limitations of this permit and to determine accurately water use as against reasonable water requirements for the authorized project. No action will be taken pursuant to this paragraph unless the Board determines, after notice to affected parties and opportunity for hearing, that such specific requirements are physically and financially feasible and are appropriate to the particular situation.

12. The quantity of water diverted under this permit and under any license issued pursuant thereto is subject to modification by the State Water Resources Control Board if, after notice to the permittee and an opportunity for hearing, the Board finds that such modification is necessary to meet water quality objectives in water quality control plans which have been or hereafter may be established or modified pursuant to Division 7 of the Water Code. No action will be taken pursuant to this paragraph unless the Board finds that (1) adequate waste discharge requirements have been prescribed and are in effect with respect to all waste discharges which have any substantial effect upon water quality in the area involved, and (2) the water quality objectives cannot be achieved solely through the control of waste discharges.

Application 26657 **Permit** 18347

13. This permit is issued subject to future upstream appropriations for consumptive use within the Mad River Watershed.

This permit is issued and permittee takes it **subject to the following provisions of the Water Code:**

Section 1380. A permit shall be effective for such time as the water actually appropriated under it is used for a useful and beneficial purpose in conformity with this division (of the Water Code), but no longer.

Section 1391. Every permit shall include the enumeration of conditions therein which in substance shall include all of the provisions of this article and the statement that any appropriator of water to whom a permit is issued takes it subject to the conditions therein expressed.

Section 1392. Every permittee, if he accepts a permit, does so under the conditions precedent that no value whatsoever in excess of the actual amount paid to the State therefor shall at any time be assigned to or claimed for any permit granted or issued under the provisions of this division (of the Water Code), or for any rights granted or acquired under the provisions of this division (of the Water Code), in respect to the regulation by any competent public authority of the services or the price of the services to be rendered by any permittee or by the holder of any rights granted or acquired under the provisions of this division (of the Water Code) or in respect to any valuation for purposes of sale to or purchase, whether through condemnation proceedings or otherwise, by the State or any city, city and county, municipal water district, irrigation district, lighting district, or any political subdivision of the State, of the rights and property of any permittee, or the possessor of any rights granted, issued, or acquired under the provisions of this division (of the Water Code).

Dated: SEPTEMBER 25 1981

STATE WATER RESOURCES CONTROL BOARD

Raymond Walsh

Chief, Division of Water Rights

 SECTION 5.2 PAGE NO. 26

State Water Resources Control Board

Division of Water Rights
1001 I Street, 14th Floor ♦ Sacramento, California 95814 ♦ 916.341.5300
P.O. Box 2000 ♦ Sacramento, California 95812-2000
Fax: 916.341.5400 ♦ www.waterrights.ca.gov

Linda S. Adams
Secretary for
Environmental Protection

Arnold Schwarzenegger
Governor

In Reply Refer
to:333:PLM:16454 & 17291

MAILED FEBRUARY 28, 2007
Humboldt Bay Municipal Water District
c/o Ms. Carol Rische
P.O. Box 95
Eureka, CA 95502

Dear Ms. Rische:

AMENDED PERMITS 11714 AND 11715 (APPLICATIONS 16454 AND 17291) MAD RIVER TRIBUTARY TO THE PACIFIC OCEAN IN TRINITY AND HUMBOLDT COUNTIES

Your AMENDED WATER RIGHT PERMITS are enclosed. Please note that, with respect to other water rights attaching to this source, the priority of your right is identified by the filing date of your application. Therefore, in times of water shortage, those diverters with water rights senior to yours can take their water first. Additional limitations on your diversion and use of water are specified by the terms of this permit. Please read the terms and conditions of your permit carefully so that you are familiar with your responsibilities as an appropriator of water.

The State Water Resources Control Board (State Water Board) requires that you submit annual reports showing the progress you have made in the construction of your project and the use of water made under this permit that will qualify for licensing purposes. We will mail the forms to you when the reports are due.

Annual permit fees are required. The California Board of Equalization will mail you a Notice of Determination (billing) on behalf of the State Water Board when the fee is due. Please pay the fee promptly. Nonpayment of the fee may result in revocation of your permit.

You must comply with all of the conditions in your permit. The State Water Board will not issue a license for any water diverted and used for any purpose or at any place not authorized in the permit. Nor will the State Water Board credit you for any development or use that occurs after the date specified in Condition 6 unless you request and receive an extension of time to use the water. An extension of time to continue development of a project requires public noticing and reevaluation of then-current environmental considerations, and is becoming considerably more difficult to obtain.

After the project has been completed, an inspection will be made to determine the amount of water that has been placed to beneficial use within the terms of the permit. A license will then be issued confirming a right to that amount of water. Please keep sufficient records of your diversion and use of water to facilitate this process.

Please inform the Division of Water Rights of any changes in address or ownership.

5/14/07
NOTE: Updated letter and permits with corrected Permit 11714 attached.
CAR

Sincerely,

ORIGINAL SIGNED BY:

Steven Herrera, Chief
Water Rights Permitting Section

PLMiner:7-26-06:rcelebrado 10.05.06/xrivera:2-16-07
U:\PERDRV\PLMiner\16454,17291 AMENDED PERMITS TRANSS 2-5-04.doc

Enclosures

STATE OF CALIFORNIA
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
STATE WATER RESOURCES CONTROL BOARD

DIVISION OF WATER RIGHTS

PERMIT FOR DIVERSION AND USE OF WATER

AMENDED PERMIT 11714

Application **16454** of **Humboldt Bay Municipal Water District**
P.O. Box 95
Eureka, CA 95502

filed on **July 7, 1955**, has been approved by the State Water Resources Control Board (State Water Board) SUBJECT TO PRIOR RIGHTS and to the limitations and conditions of this permit.

Permittee is hereby authorized to divert and use water as follows:

1. Source of water

Source: **Mad River**

Tributary to: **Pacific Ocean**

within the Counties of **Trinity and Humboldt**

2. Location of point of diversion

By California Coordinate System of 1927 in Zone 1	40-acre subdivision of public land survey or projection thereof	Section	Township	Range	Base and Meridian
Storage-Ruth Dam South 18°East 3,194 feet from W¼ corner of section 18	**NW¼ of NW¼**	**19**	**1S**	**7E**	**HB**
1. Rediversion South 1,421 feet and East 2,392 feet from NW corner of section 15	**SE¼ of NW¼**	**15**	**6N**	**1E**	**HB**
2. South 1,657 feet and East 3,921 feet from NW corner of section 15	**SW¼ of NW¼**	**15**	**6N**	**1E**	**HB**
3. South 2,350 feet and East 246 feet from NW corner of section 14	**SW¼ of NW¼**	**14**	**6N**	**1E**	**HB**
4. South 2,287 feet and East 1,138 feet from NW corner of section 14	**SW¼ of NW¼**	**14**	**6N**	**1E**	**HB**
5. North 578,787 feet and East 1,437,911 feet	**NE¼ of SW¼**	**14**	**6N**	**1E**	**HB**
6. North 578,982 feet and East 1,432,339 feet	**SE¼ of NW¼**	**15**	**6N**	**1E**	**HB**

3. Purpose of use	4. Place of use	Section (Projected)*	Township	Range	Base and Meridian	Acres
Municipal	**Within the boundaries of Humboldt Bay Municipal Water District located within T3, 4, 5, 6 and 7N, R1W and R1, 2 and 3E, HB&M and areas adjacent to Ruth Lake Reservoir, as shown on maps filed with the State Water Board.**					

5. The amount of water to be appropriated shall be limited to the amount that can be beneficially used and shall not exceed 48,030 acre-feet per annum (afa) by storage, to be collected from October 1 of each year to April 30 of the succeeding year. The maximum amount per annum to be stored under this permit and Permit 11715 shall not exceed 48,030 afa. The total annual diversion and use allowed under this permit and Permit 11715 shall not exceed 132,030 afa.

(0000005)

6. Construction work and complete application of the water to the authorized use shall be prosecuted with reasonable diligence and completed by December 31, 2029.

(0000009)

7. For the protection, propagation and preservation of fish life permittee shall:

   a. At all times bypass or release minimum flow of five cubic feet per second into the natural streambed of Mad River immediately below Ruth Dam.

   b. During the periods herein specified, bypass or release into the natural streambed of Mad River immediately below Essex Diversion Dam the following minimum flow or the natural flow of Mad River as regulated by diversions now in existence, whichever is less:

October 1 through October 15	30 cfs
October 16 through October 31	50 cfs
November 1 through June 30	75 cfs
July 1 through July 31	50 cfs
August 1 through August 31	40 cfs
September 1 through September 30	30 cfs

(0360048)

8. This permit is subject to the Memorandum of Understanding between Humboldt Bay Municipal Water District and County of Trinity, drafted on January 28, 1959, and duly approved by both agencies and on file with the State Water Board.

(0000999)

ALL PERMITS ISSUED BY THE STATE WATER RESOURCES CONTROL BOARD ARE SUBJECT TO THE FOLLOWING TERMS AND CONDITIONS:

A. The amount authorized for appropriation may be reduced in the license if investigation warrants.

(0000006)

B. Progress reports shall be submitted promptly by permittee when requested by the State Water Board until a license is issued.

(0000010)

C. Permittee shall allow representatives of the State Water Board and other parties, as may be authorized from time to time by said State Water Board, reasonable access to project works to determine compliance with the terms of this permit.

(0000011)

D. Pursuant to California Water Code sections 100 and 275, and the common law public trust doctrine, all rights and privileges under this permit and under any license issued pursuant thereto, including method of diversion, method of use, and quantity of water diverted, are subject to the continuing authority of State Water Board in accordance with law and in the interest of the public welfare to protect public trust uses and to prevent waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of said water.

The continuing authority of the State Water Board may be exercised by imposing specific requirements over and above those contained in this permit with a view to eliminating waste of water and to meeting the reasonable water requirements of permittee without unreasonable draft on the source. Permittee may be required to implement a water conservation plan, features of which may include but not necessarily be limited to (1) reusing or reclaiming the water allocated; (2) using water reclaimed by another entity instead of all or part of the water allocated; (3) restricting diversions so as to eliminate agricultural tailwater or to reduce return flow; (4) suppressing evaporation losses from water surfaces; (5) controlling phreatophytic growth; and (6) installing, maintaining, and operating efficient water measuring devices to assure compliance with the quantity limitations of this permit and to determine accurately water use as against reasonable water requirements for the authorized project. No action will be taken pursuant to this paragraph unless the State Water Board determines, after notice to affected parties and opportunity for hearing, that such specific requirements are physically and financially feasible and are appropriate to the particular situation.

The continuing authority of the State Water Board also may be exercised by imposing further limitations on the diversion and use of water by the permittee in order to protect public trust uses. No action will be taken pursuant to this paragraph unless the State Water Board determines, after notice to affected parties and opportunity for hearing, that such action is consistent with California Constitution Article X, Section 2; is consistent with the public interest; and is necessary to preserve or restore the uses protected by the public trust.

(0000012)

E. The quantity of water diverted under this permit and under any license issued pursuant thereto is subject to modification by the State Water Board if, after notice to the permittee and an opportunity for hearing, the State Water Board finds that such modification is necessary to meet water quality objectives in water quality control plans which have been or hereafter may be established or modified pursuant to Division 7 of the Water Code. No action will be taken pursuant to this paragraph unless the State Water Board finds that (1) adequate waste discharge requirements have been prescribed and are in effect with respect to all waste discharges which have any substantial effect upon water quality in the area involved, and (2) the water quality objectives cannot be achieved solely through the control of waste discharges.

(0000013)

F. This permit does not authorize any act that results in the taking of a threatened or endangered species or any act that is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish & G. Code, §§ 2050 - 2097) or the federal Endangered Species Act (16 U.S.C.A. §§ 1531 - 1544). If a "take" will result from any act authorized under this water right, the permittee shall obtain authorization for an incidental take prior to construction or operation of the project. Permittee shall be responsible for meeting all requirements of the applicable Endangered Species Act for the project authorized under this permit.

(0000014)

G. Permittee shall maintain records of the amount of water diverted and used to enable the State Water Board to determine the amount of water that has been applied to beneficial use pursuant to Water Code Section 1605.

(0000015)

H. No work shall commence and no water shall be diverted, stored or used under this permit until a copy of a stream or lake alteration agreement between the State Department of Fish and Game and the permittee is filed with the Division of Water Rights. Compliance with the terms and conditions of the agreement is the responsibility of the permittee. If a stream or lake agreement is not necessary for this permitted project, the permittee shall provide the Division of Water Rights a copy of a waiver signed by the State Department of Fish and Game.

(0000063)

This permit is issued and permittee takes it subject to the following provisions of the Water Code:

Section 1390. A permit shall be effective for such time as the water actually appropriated under it is used for a useful and beneficial purpose in conformity with this division (of the Water Code), but no longer.

Section 1391. Every permit shall include the enumeration of conditions therein which in substance shall include all of the provisions of this article and the statement that any appropriator of water to whom a permit is issued takes it subject to the conditions therein expressed.

Section 1392. Every permittee, if he accepts a permit, does so under the conditions precedent that no value whatsoever in excess of the actual amount paid to the State therefore shall at any time be assigned to or claimed for any permit granted or issued under the provisions of this division (of the Water Code), or for any rights granted or acquired under the provisions of this division (of the Water Code), in respect to the regulation by any competent public authority of the services or the price of the services to be rendered by any permittee or by the holder of any rights granted or acquired under the provisions of this division (of the Water Code) or in respect to any valuation for purposes of sale to or purchase, whether through condemnation proceedings or otherwise, by the State or any city, city and county, municipal water district, irrigation district, lighting district, or any political subdivision of the State, of the rights and property of any permittee, or the possessor of any rights granted, issued, or acquired under the provisions of this division (of the Water Code).

STATE WATER RESOURCES CONTROL BOARD

ORIGINAL SIGNED BY:
JAMES W. KASSEL, FOR

Victoria A. Whitney, Chief
Division of Water Rights

Dated: **FEBRUARY 28, 2007**

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STATE OF CALIFORNIA
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
STATE WATER RESOURCES CONTROL BOARD

DIVISION OF WATER RIGHTS

PERMIT FOR DIVERSION AND USE OF WATER

AMENDED PERMIT 11715

Application **17291** of **Humboldt Bay Municipal Water District**
P.O. Box 95
Eureka, CA 95502

filed on **September 21, 1956**, has been approved by the State Water Resources Control Board (State Water Board) SUBJECT TO PRIOR RIGHTS and to the limitations and conditions of this permit.

Permittee is hereby authorized to divert and use water as follows:

1. Source of water

Source: **Mad River**

Tributary to: **Pacific Ocean**

within the Counties of **Trinity and Humboldt**

2. Location of point of diversion

By California Coordinate System of 1927 in Zone 1	40-acre subdivision of public land survey or projection thereof	Section	Township	Range	Base and Meridian
Storage-Ruth Dam South 18°East 3,194 feet from W¼ corner of section 18	**NW¼ of NW¼**	**19**	**1S**	**7E**	**HB**
1. Rediversion South 1,421 feet and East 2,392 feet from NW corner of section 15	**SE¼ of NW¼**	**15**	**6N**	**1E**	**HB**
2. South 1,657 feet and East 3,921 feet from NW corner of section 15	**SW¼ of NW¼**	**15**	**6N**	**1E**	**HB**
3. South 2,350 feet and East 246 feet from NW corner of section 14	**SW¼ of NW¼**	**14**	**6N**	**1E**	**HB**
4. South 2,287 feet and East 1,138 feet from NW corner of section 14	**SW¼ of NW¼**	**14**	**6N**	**1E**	**HB**
5. North 578,787 feet and East 1,437,911 feet	**NE¼ of SW¼**	**14**	**6N**	**1E**	**HB**
6. North 578,982 feet and East 1,432,339 feet	**SE¼ of NW¼**	**15**	**6N**	**1E**	**HB**

3. Purpose of use	4. Place of use	Section (Projected)*	Township	Range	Base and Meridian	Acres
Municipal	**Within the boundaries of Humboldt Bay Municipal Water District located within T3, 4, 5, 6 and 7N, R1W and R1, 2 and 3E, HB&M and areas adjacent to Ruth Lake Reservoir, as shown on maps filed with the State Water Board.**					

5. The amount of water to be appropriated shall be limited to the amount that can be beneficially used and shall not exceed 116 cubic feet per second (cfs) by direct diversion from January 1 through December 31 of each year, and 20,000 acre-feet per annum (afa) by storage, to be collected from October 1 of each year to April 30 of the succeeding year. The maximum amount to be appropriated by direct diversion under this permit shall not exceed 84,000 afa. The maximum amount per annum to be stored under this permit and Permit 11714 shall not exceed 48,030 afa. The total annual diversion and use allowed under this permit and Permit 11714 shall not exceed 132,030 afa.

(0000005)

6. Construction work and complete application of the water to the authorized use shall be prosecuted with reasonable diligence and completed by December 31, 2029.

(0000009)

7. For the protection, propagation and preservation of fish life permittee shall:

   a. At all times bypass or release minimum flow of five cubic feet per second into the natural streambed of Mad River immediately below Ruth Dam.

   b. During the periods herein specified, bypass or release into the natural streambed of Mad River immediately below Essex Diversion Dam the following minimum flow or the natural flow of Mad River as regulated by diversions now in existence, whichever is less:

October 1 through October 15	30 cfs
October 16 through October 31	50 cfs
November 1 through June 30	75 cfs
July 1 through July 31	50 cfs
August 1 through August 31	40 cfs
September 1 through September 30	30 cfs

(0360048)

8. This permit is subject to the Memorandum of Understanding between Humboldt Bay Municipal Water District and County of Trinity, drafted on January 28, 1959, and duly approved by both agencies and on file with the State Water Board.

(0000999)

ALL PERMITS ISSUED BY THE STATE WATER RESOURCES CONTROL BOARD ARE SUBJECT TO THE FOLLOWING TERMS AND CONDITIONS:

A. The amount authorized for appropriation may be reduced in the license if investigation warrants.

(0000006)

B. Progress reports shall be submitted promptly by permittee when requested by the State Water Board until a license is issued.

(0000010)

C. Permittee shall allow representatives of the State Water Board and other parties, as may be authorized from time to time by said State Water Board, reasonable access to project works to determine compliance with the terms of this permit.

(0000011)

D. Pursuant to California Water Code sections 100 and 275, and the common law public trust doctrine, all rights and privileges under this permit and under any license issued pursuant thereto, including method of diversion, method of use, and quantity of water diverted, are subject to the continuing authority of State Water Board in accordance with law and in the interest of the public welfare to protect public trust uses and to prevent waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of said water.

The continuing authority of the State Water Board may be exercised by imposing specific requirements over and above those contained in this permit with a view to eliminating waste of water and to meeting the reasonable water requirements of permittee without unreasonable draft on the source. Permittee may be required to implement a water conservation plan, features of which may include but not necessarily be limited to (1) reusing or reclaiming the water allocated; (2) using water reclaimed by another entity instead of all or part of the water allocated; (3) restricting diversions so as to eliminate agricultural tailwater or to reduce return flow; (4) suppressing evaporation losses from water surfaces; (5) controlling phreatophytic growth; and (6) installing, maintaining, and operating efficient water measuring devices to assure compliance with the quantity limitations of this permit and to determine accurately water use as against reasonable water requirements for the authorized project. No action will be taken pursuant to this paragraph unless the State Water Board determines, after notice to affected parties and opportunity for hearing, that such specific requirements are physically and financially feasible and are appropriate to the particular situation.

The continuing authority of the State Water Board also may be exercised by imposing further limitations on the diversion and use of water by the permittee in order to protect public trust uses. No action will be taken pursuant to this paragraph unless the State Water Board determines, after notice to affected parties and opportunity for hearing, that such action is consistent with California Constitution Article X, Section 2; is consistent with the public interest; and is necessary to preserve or restore the uses protected by the public trust.

(0000012)

E. The quantity of water diverted under this permit and under any license issued pursuant thereto is subject to modification by the State Water Board if, after notice to the permittee and an opportunity for hearing, the State Water Board finds that such modification is necessary to meet water quality objectives in water quality control plans which have been or hereafter may be established or modified pursuant to Division 7 of the Water Code. No action will be taken pursuant to this paragraph unless the State Water Board finds that (1) adequate waste discharge requirements have been prescribed and are in effect with respect to all waste discharges which have any substantial effect upon water quality in the area involved, and (2) the water quality objectives cannot be achieved solely through the control of waste discharges.

(0000013)

F. This permit does not authorize any act that results in the taking of a threatened or endangered species or any act that is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish & G. Code, §§ 2050 - 2097) or the federal Endangered Species Act (16 U.S.C.A. §§ 1531 - 1544). If a "take" will result from any act authorized under this water right, the permittee shall obtain authorization for an incidental take prior to construction or operation of the project. Permittee shall be responsible for meeting all requirements of the applicable Endangered Species Act for the project authorized under this permit.

(0000014)

G. Permittee shall maintain records of the amount of water diverted and used to enable the State Water Board to determine the amount of water that has been applied to beneficial use pursuant to Water Code Section 1605.

(0000015)

H. No work shall commence and no water shall be diverted, stored or used under this permit until a copy of a stream or lake alteration agreement between the State Department of Fish and Game and the permittee is filed with the Division of Water Rights. Compliance with the terms and conditions of the agreement is the responsibility of the permittee. If a stream or lake agreement is not necessary for this permitted project, the permittee shall provide the Division of Water Rights a copy of a waiver signed by the State Department of Fish and Game.

(0000063)

This permit is issued and permittee takes it subject to the following provisions of the Water Code:

Section 1390. A permit shall be effective for such time as the water actually appropriated under it is used for a useful and beneficial purpose in conformity with this division (of the Water Code), but no longer.

Section 1391. Every permit shall include the enumeration of conditions therein which in substance shall include all of the provisions of this article and the statement that any appropriator of water to whom a permit is issued takes it subject to the conditions therein expressed.

Section 1392. Every permittee, if he accepts a permit, does so under the conditions precedent that no value whatsoever in excess of the actual amount paid to the State therefore shall at any time be assigned to or claimed for any permit granted or issued under the provisions of this division (of the Water Code), or for any rights granted or acquired under the provisions of this division (of the Water Code), in respect to the regulation by any competent public authority of the services or the price of the services to be rendered by any permittee or by the holder of any rights granted or acquired under the provisions of this division (of the Water Code) or in respect to any valuation for purposes of sale to or purchase, whether through condemnation proceedings or otherwise, by the State or any city, city and county, municipal water district, irrigation district, lighting district, or any political subdivision of the State, of the rights and property of any permittee, or the possessor of any rights granted, issued, or acquired under the provisions of this division (of the Water Code).

STATE WATER RESOURCES CONTROL BOARD

ORIGINAL SIGNED BY:
JAMES W. KASSEL, FOR

Victoria A. Whitney, Chief
Division of Water Rights

Dated: **FEBRUARY 28, 2007**

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Appendix B

Injury Analysis Report

April 3, 2020

To:	John Friedenbach	Ref. No.:	11185389
From:	Patrick Sullivan and Richela Maeda	Tel:	707-443-8326
cc:	Sheri Woo, Michelle Fuller, Sharon Kramer, Dennis Halligan, Patrick Sullivan		
Subject:	**Water Right Injury Analysis**		

1. Introduction

The Humboldt Bay Municipal Water District (District) is a regional water wholesaler capable of delivering both potable water (through its Domestic Water System) and untreated surface water (through its Industrial Water System). The District owns and operates R.W. Matthews Dam, which forms Ruth Reservoir in southern Trinity County, and a diversion, pumping, and control facility adjacent to the Mad River near Essex at the John R. Winzler Operations and Control Center (Essex Facility). Water is diverted via four Ranney Collectors and a surface water intake at the Essex Facility, approximately 75 miles downstream of the dam. Water collected in the Ranney Collectors is treated and distributed to the District's 88,000 customers. Water from the surface water intake is pumped via the Industrial Water System to the Samoa Peninsula where it previously served two pulp mills that have subsequently closed.

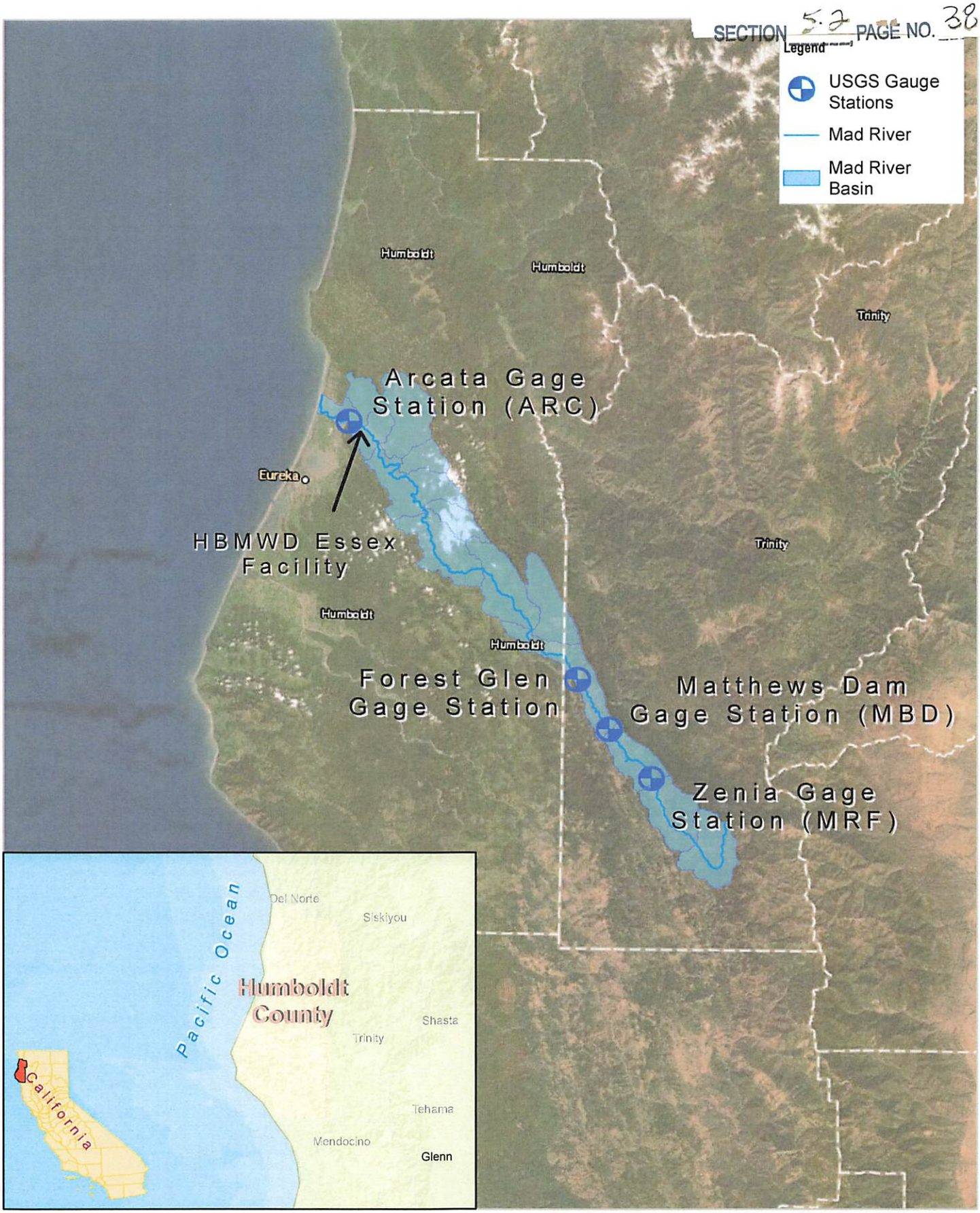
The District provides augmented flows to the Mad River under their 2004 Habitat Conservation Plan (HCP) (Trinity Associates and HBMWD 2004). The District is seeking to modify its appropriative water right to include an instream flow dedication to the Mad River that provides improved environmental benefits. The HCP would also be amended to reflect the instream flow dedication., Unlike typical Petitions for Change that seek to remove water from a source, the District's Petition for Change proposes to dedicate a portion of its water right to instream flow. The objective of this study is to assess the current factors that influence the Mad River hydrograph, and the potential impacts the District's flow dedication may have on other legal users. Potential environmental impacts of the District's flow dedication are assessed in other reports (H. T. Harvey & Associates and Stillwater Sciences 2019, HBMWD and Stillwater Sciences 2014). Again, unlike typical Petitions for Change that may prevent a current water user from utilizing their full water right, this report looks at how the proposed additional flows could enhance other Mad River water rights holders.

2. Hydrology of the Mad River Watershed

The Mad River drainage, shown in Figure 1, is located in the coastal range of California, approximately 270 miles north of San Francisco. The drainage area is approximately 485 square miles in area, approximately 100 miles long, and averages six miles in width. The headwaters of the watershed start at

the western ridge of the coastal range with a divide at approximately 6,000 ft above mean sea level. The Mad River flows from southeasterly to northwesterly and discharges into the Pacific Ocean north of Humboldt Bay. Principal tributaries to the Mad River include South Fork Mad River, North Fork Mad River, Barry Creek, Pilot Creek, Deer Creek, Lindsey Creek, and Mill Creek. Vegetation in the watershed is composed of early to late seral coniferous forests, hardwoods, and grasslands (Stillwater Sciences 2010).

Mean annual rainfall in the Mad River watershed averages from 40 inches along the coast to over 120 inches in the higher elevations. Most rainfall occurs in the late fall, through winter, and into the middle of spring. Snowfall occurs but its storage and melting are not considerable hydrograph components. Due to the conditions of the watershed, it can be characterized as flashy, whereby rainfall events within the watershed quickly result in surface water flow. Likewise, the surface water flow can decline relatively quickly following the passing of a storm event.



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0 4.5 9 13.5 18

Miles

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California I FIPS 0401 Feet

N

GHD

Humboldt Bay Municipal Water District
Injury Analysis

Project No. **11185389**
Revision No. **-**
Date **7/10/2019**

Mad River Watershed

FIGURE 1

\\ghdnetghd\US\Eureka\Projects\111\11185389 HBMWD-WCB Stream Flow Enhance Grant\08-GIS\Maps\Deliverables\11185389_001_StudyArea_RevB.mxd
Print date: 08 Jan 2020 - 14:46

Data source: Sources: Esri, USGS, NOAA
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: rmaeda

3. Historical Operations and Practices

The District was chartered in 1956 to provide water to several lower Mad River communities for both domestic and industrial use. In 1961, Matthews Dam and Ruth Lake were constructed in the upper reach of the Mad River. The District currently manages this source as a water supply reservoir and conducts releases from Matthews Dam in response to reservoir levels, municipal and industrial water supply needs, hydropower generation and to meet environmental goals. Prior to the District's operations, portions of the Mad River would regularly go dry in the later summer and fall (Trinity Associates and HBMWD 2004). Releases from Ruth Lake now augment flows in 84 miles of the river, and enhances habitat for aquatic species during the low-flow months (Trinity Associates and HBMWD 2004). Since the District began its operations, flows in the Mad River have been consistent and reliable year-round, and flow augmentation (i.e., discharge from Matthews Dam is greater than inflow to Ruth Reservoir) has occurred in every month except December when the reservoir is filling, as shown in Figure 1, which compares flows above and below Ruth Lake from 1989 to 2001 (Trinity Associates and HBMWD 2004).

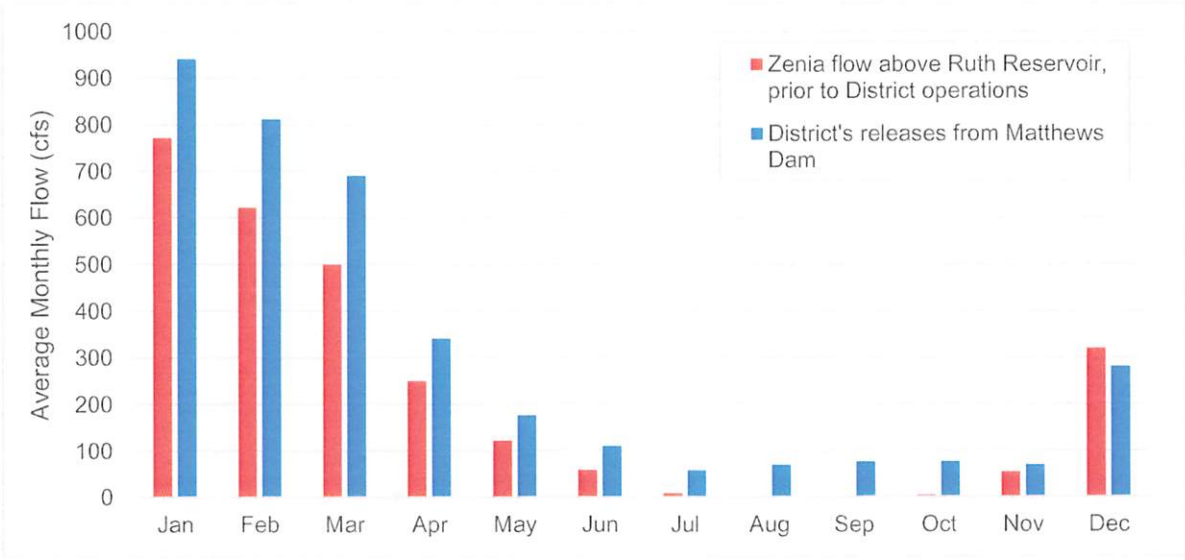

Figure 2. Mad River flow below Matthews Dam compared to natural flow (adapted from Trinity Associates and HBMWD 2004)

The Mad River drainage saw its largest logging boom in the mid-1900s (Stillwater Sciences 2010) with the harvesting of second-growth trees. During the late 1980s and early 1990s, the District's industrial water system supplied up to 60 MGD of untreated water to two pulp mills. Delivery continued at this rate until one of the pulp mills closed in the 1990s, and the remaining pulp mill ceased operation in 2009. With no existing industrial customers, the District has the capability of supporting future water supply needs, which they are currently exploring concurrently with dedicating a portion of the 60 MGD to instream flow to benefit the Mad River's aquatic and terrestrial environment.

4. Current Flow Rates

This section looks at the current flows in the Mad River since the closure of the pulp mills (from 2010 to 2018) in order to analyze the District's impact to the hydrology of the Mad River. The District has a Habitat Conservation Plan (HCP) for its operations on the Mad River; it is the first HCP from a water district in the state of California. The HCP categorizes water years as "Drier-than-Normal", "Normal", and "Wetter-than-Normal" based on the volume of water at the Arcata gage for a given water year (gage location shown in Figure 1). Classification definitions are shown in Table 1. Consistent with the HCP, flow data for current operational years was first assessed by identifying each water year as one of the indicated classifications. Figure 3 shows the hydrographs during dry months for the minimum, median, and maximum water year types (defined by the total annual flow at the Arcata gage). Minimum, median and maximum water years are shown instead of the HCP classifications because of the small dataset available. Hydrographs for the remaining portion of the year are provided in Exhibit A.

Table 1. Water Year Classification for the Mad River Watershed (adapted from Trinity Associates and HBMWD 2004).

Classification	Annual Flow (acre-ft)		
	Min	Average	Max
Drier-than-Normal	0	488,629	750,000
Normal	750,000	1,034,350	1,200,000
Wetter-than-Normal	1,200,000	1,434,857	1,794,000

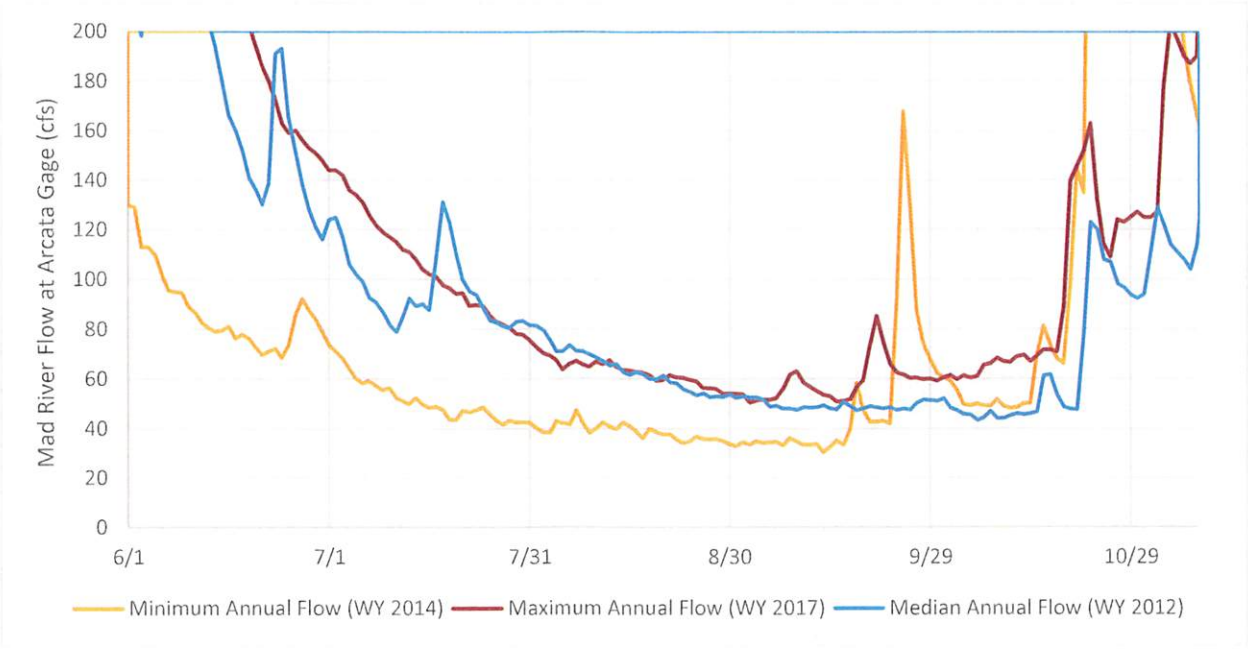

Figure 3. Summer Mad River flow at the Arcata gage for minimum, maximum and average water years from 2010 to 2018.

Annual hydrographs show temporal trends within a specific year but do not capture variability in monthly and daily flows across water years. The minimum water year defined by total annual flow shown in Figure 3 depicts flow rates for a low-flow year (2014), but may not capture the absolute minimum daily flows for the data record evaluated (2010-2018). Similarly, averaging the data does not provide useful insights when the goal of the analysis is to consider possible effects of District operations that are more nuanced. Only water years beginning with water year 2010 were used to reflect conditions following closure of the pulp mills.

To capture these nuances, and provide visualization of the dataset's variability, data was evaluated based on quartiles (Figure 4). Quartiles capture the deviation across a dataset by dividing the values into quarters. Quartiles can then be graphically represented. The gray-blue-red-gray segments of each line represent quartiles of the daily flow data. The ends of the gray quartile segments show the minimum and maximum values. Longer gray-blue-red-gray lines indicate a larger spread in the data. Where the blue and red segments meet represents the median value. Where the gray meets the red, and gray meets blue segments, indicates the first and third quartiles of the daily flow data. To more easily see the lower flow lines, the graph is reproduced with an expanded y axis in Figure 5.

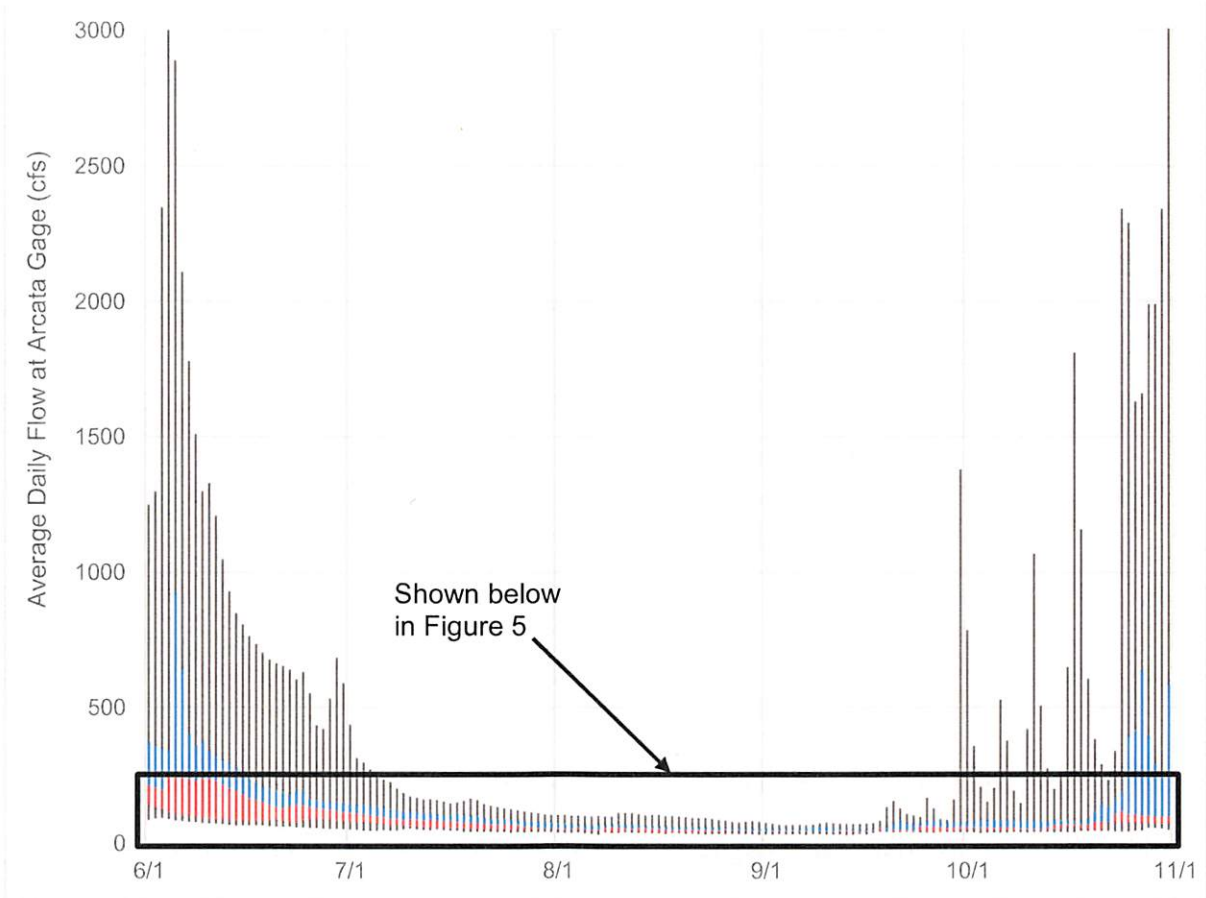

Figure 4. Representation of variation in average daily flow (cfs) during the summer at the Arcata Gage, for WY 2010 to 2018. Where red and blue segments meet is the median of the average daily flows. The ends of gray segments represent the minimum and maximum average daily flows.

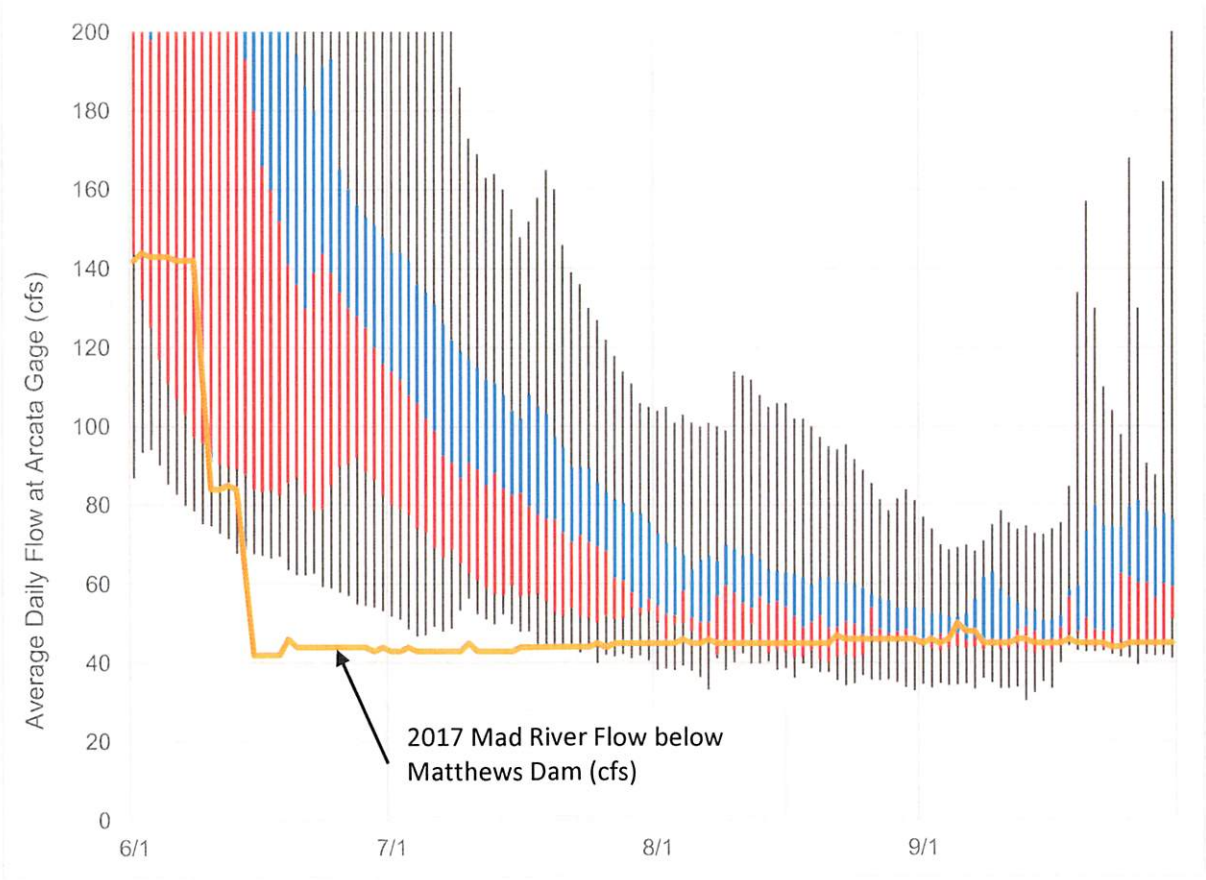

Figure 5. Representation of variation in average daily flow (cfs) with adjusted vertical access, for WY 2010 to 2018. Where red and blue segments meet is the median of the average daily flows. The ends of gray segments represent the minimum and maximum average daily flows.

Figure 5 demonstrates that, under current conditions, the Mad River does not "go dry" during the lowest flow months and is therefore not currently over-extracted. Anecdotal evidence suggests that Mad River would go dry prior to the District's operations. Flow below Matthews Dam (shown in green in Figure 5), even without instream flow dedications is an important flow component during summer months.

5. Extractions in the Mad River Watershed

Two primary data sources of extractions in the Mad River watershed were considered in this study: water rights available as detailed in the State Water Resources Control Board (SWRCB) Electronic Water Rights Information Management System (eWRIMS) database, and extraction data provided by the District.

Water rights within the Mad River watershed were obtained through the SWRCB's eWRIMS. eWRIMS provides a summary of submitted water rights applications in table or geospatial information systems

(GIS) format. The original water rights applications and Statements of Diversion and Use are also available through eWRIMS.

We also considered but ultimately did not include a dataset that characterizes both legal and illegal cannabis cultivation sites. Staff from CDFW conducted extensive research on the impacts of cannabis cultivation on streamflow in northwestern California (Bauer et al., 2015). In an assessment of the Mad River watershed, CDFW used high-resolution imagery from May 2014 to locate and digitize cannabis cultivation sites. Because imagery was used, the study did not discern which sites were legal or illegal. The results from the CDFW assessment provided the total number of cannabis plantings within the Mad River watershed and amounted to approximately 0.53 cfs of diversion (primarily from tributary streams) during the summer months. As shown in Figure 5, this is an additional stress on the river flows during the summer months, which the District's flow dedications will help mitigate. Because this analysis focuses on legal water users, the data developed by Bauer et al. (2015) were not included. Legal cannabis cultivators that have applied for water rights from the Mad River are included in the eWRIMS database and therefore captured in this study.

5.1 Data Gap Analysis

As of January 7, 2019, 473 points of diversion were listed in the eWRIMS database, which is the dataset used in this analysis. However, it should be noted that a search completed on February 26, 2019 returned eight new registered cannabis water rights. To evaluate the completeness of the eWRIMS database, the theoretical maximum number of parcels that could hold a riparian water right was estimated. Of the approximate 1,960 parcels that touch a National Hydrology Dataset flow line for the Mad River or a tributary to the Mad River and could therefore hold a riparian water right, approximately 200 parcels, or 10%, have a point of diversion in eWRIMS. Of the available data in eWRIMS, approximately 30% of the points of diversion were missing key data (e.g., diversion rates) required to complete a consumptive use analysis.

5.2 Data Reliability Analysis

The data listed in eWRIMS for approximately fifteen water rights were compared to the original water rights applications or statements. Based on these comparisons, and an overall evaluation of the eWRIMS data, the following observations and discrepancies, and resulting conservative assumptions were made:

- The window for which direct diversion is allowed was provided in the original application, but was not included in eWRIMS for one of the water rights. When diversion windows of time are not specified in eWRIMS, it was assumed that the diversion rate applies uniformly to the entire year.
- The diversion rate in eWRIMS did not match that of the original application for two water rights. For one water right, the value in eWRIMS was an order of magnitude less than shown in the application. For the second, the eWRIMS value was 10 GPD greater than shown in the application. It was assumed that the diversion rates listed in the eWRIMS database is correct; it is beyond the scope of this project to crosscheck all of the water rights.
- The diversion rate in eWRIMS was set to the maximum capacity of the diversion works (i.e., the diversion rate listed in eWRIMS assumes that the water right holder is constantly diverting the

maximum amount of water that their diversion system allows). If a diversion rate was listed in eWRIMS, it was used in the analysis.

- The majority of riparian water rights do not include dates for diversion. It was assumed that these users divert water during the entire year.
- Several riparian water rights did not have values specified for diversion. The original statements for two of these water rights included either a diversion rate and/or maximum storage capacity. For riparian water rights that do not have values specified for diversion, water use data were manually gathered from original statements of use.

5.3 Data Analyzed

The District provided their 2018 daily extraction rates; these values were used for the analysis. Of the 473 points of diversion included in the initial eWRIMS results, 304 water rights were included in this consumptive use analysis. The points of diversion excluded from the analysis were either duplicative, inactive, or not located within the reach of interest (between Ruth Lake and the Essex Facility). Key information associated with each of the water rights is included as Exhibit B.

6. Results and Discussion

Diversion and consumption rates gathered from the District were used as provided. Diversion rates from eWRIMS were applied for each month dependent upon the diversion window. Some of the water rights included a maximum diversion volume (i.e., face value). If the diversion rate over the course of the analysis period exceeded the maximum diversion volume, it was assumed that the maximum diversion volume was evenly distributed over the course of the analysis. It is important to note two caveats that could significantly overestimate the amount of water diverted:

1. Many of the diversion rates obtained from eWRIMS represent the maximum possible amount of water that could be diverted by a water rights holder. It is likely that many of these water rights holders divert less water.
2. Figure 6 shows flow data from the Arcata gage, which is located downstream of the extractions included in this analysis. Comparison of the Arcata gage flow with the extractions essentially "double counts" the extractions.

The purpose of this analysis was to evaluate the potential impacts the District's proposed flow dedication may have on other legal water users. It should be noted that a mass balance analysis was considered, but there is insufficient flow monitoring data available to perform a detailed mass balance. Inflow data is only available from above Matthews Dam at Zenia, and at the Arcata gage at the downstream end of the Mad River (downstream of all diversions). Flow contribution from all the major tributaries along the length is not available. A brief discussion of two components that would be included in a mass balance is provided here.

Seepage characterizes the interaction between river and groundwater flow. A stream can be a gaining or losing stream, or both depending on factors including groundwater levels, bedrock material, and flow rates. The Mad River is a bedrock-confined river and seepage is considered negligible along its mainstem.

Evaporation losses on the river surface are considered negligible; however, losses on Ruth Reservoir would likely be included in a mass balance. In its Water Shortage Contingency Plan (available upon request), the District estimated evaporation losses on Ruth Reservoir using nearby pan evaporation data (Table 2).

Table 2. Monthly and daily evaporation data

Month	Monthly (AF)	Average Daily (AF)
Jan	15,003	500
Feb	34,920	1,164
Mar	46,819	1,561
Apr	70,875	2,362
May	122,349	4,078
Jun	168,133	5,604
Jul	194,776	6,493
Aug	156,493	5,216
Sep	98,035	3,268
Oct	50,181	1,673
Nov	19,400	647
Dec	23,797	793

Estimated monthly water use for each of the water rights is included as Exhibit C. The cell shading in the table denotes how the values were determined. Cells with no shading indicate that the direct diversion provided in eWRIMS was used to determine the monthly water use.

Figure 6 shows maximum diversion rates within the Mad River watershed between the Zenia and Arcata gages during dry months. Included in the figure is the minimum daily flow rate at the Arcata gage for the water years 2010 to 2018. The minimum daily flow rates shown do not represent a specific water year type, but are provided to show the worst-case scenario. As mentioned above, the Arcata gage already accounts for the extractions shown in Figure 6. Thus, days on which the minimum daily flow at Arcata drops below the total extractions do not necessarily imply that the Mad River is over-extracted. The comparison between the minimum daily flows at Arcata with the maximum extraction rates is drawn to assess the relationship between the quantities. Taking into consideration that the District's extractions are already accounted for in the flow at the Arcata gage, Figure 6 suggests there is sufficient water available in the Mad River. Year-round extraction rates are provided in Exhibit D.

Figure 6. Daily extraction rates and instream flow comparison (cfs).

Although a true mass balance was not possible due to a lack of available data, water diverted and flow measurements were compared as a conservative analysis to demonstrate that the result of this project would not result in injury to water users senior to the District. Monthly values for water diverted, flow measurements at the Arcata Gauge (downstream of the District's diversions at the Essex Facility) and flow requirements outlined in the Habitat Conservation Plan (HCP) and the District's water rights permits are shown in Table 3a and Table 3b. In accordance with the District's permits, the District must bypass or release into the natural streambed of the Mad River immediately below the Essex diversion the minimum flows outlined below or the natural flow of the Mad River, whichever is less. The natural flow is defined by the following:

Natural Flow at the Arcata Gauge	=	Inflow into Ruth Reservoir at Zenia	-	Flow Release at Matthews Dam	+	Essex Diversion	+	Flow at Arcata Gauge

Figure 7 shows all known diverted water amounts and measured flow rates for the month of August, one of the driest months for the watershed.

Table 3a. Monthly diversion rates for the District and water rights holders senior to the District and indicated flow rates (cfs).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Senior Water Rights	0.02	0.02	0.02	0.02	0.50	0.64	0.64	0.64	0.64	0.02	0.02	0.02
HBMWD	12.1	12.7	12.2	12.4	13.1	14.6	16.1	15.7	15.0	13.5	12.8	12.2
Total	12.1	12.7	12.2	12.4	13.6	15.2	16.7	16.4	15.6	13.6	12.8	12.2
Flow at Arcata Gage	2,808	2,449	3,365	2,089	600	320	93	58	61	198	718	2,581
HCP Flow Requirements for Arcata Gauge	75	75	75	75	75	75	50	40	30	50	75	75
HCP Flow Requirement Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3b. Monthly diversion rates for the District and all water rights holders and indicated flow rates (cfs).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
All Water Rights Holders	17	18	19	14	15	15	15	15	16	15	15	16
HBMWD	12.1	12.7	12.2	12.4	13.1	14.6	16.1	15.7	15.0	13.5	12.8	12.2
Total	29.1	30.5	30.8	26.1	27.9	29.2	30.9	30.8	30.8	28.7	28.3	28.4
Water at Arcata Gauge	2,808	2,449	3,365	2,089	600	320	93	58	61	198	718	2,581
HCP Flow Requirements for Arcata Gauge	75	75	75	75	75	75	50	40	30	50	75	75
HCP Flow Requirement Met?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes:
Proposed dedication (20 MGD) = 31 cfs
HCP Flow = Flow outlined in the HCP. If a single month had two different minimum flows, the higher of the two is shown.
Water Rights Holders = The total flow rate assumed to be diverted by water right holders listed in the water board's database.
Senior Water Right Holders = The total flow rate assumed to be diverted by all water right holders that are senior to the District.
HBMWD = The average flow diverted by the District.
Total = The sum of Water Right Holders and HBMWD.
Flow at Arcata Gage = Average monthly flow rate at the Arcata gage for 2010 – 2018.

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N

0 5 mi 10 mi 20 mi

1" = 10 mi

GHD

Humboldt Bay Municipal Water District

Water Diversions and Flow Measurements for the Month of August

Project No. **11185389**
Report No.
Date **1/6/2020**

FIGURE 7
Page 14

Filename: N:\US\Eureka\Projects\111\11185389 HBMWD-WCB Stream Flow Enhance Grant\06-CAD\User\RKM\Injury Cartoon GeoRefd.dwg
Plot Date: 7 January 2020 - 11:35 AM

Source:

7. Concluding Remarks

Approving the District to dedicate a portion of its water right to instream flow would allow the District to provide beneficial biological conditions for salmonids and other special status species, particularly during the dry months of the year and into the fall when steelhead are present in the middle reaches. The District can release a maximum of 250 cfs from Matthews Dam, depending on the amount of water behind the dam. Once the water surface elevation in Ruth Lake drops and ceases flowing over the spillway, the District could release water to mimic or have a slower rate of hydrograph decline than would occur under existing dam operations (i.e., supplemental releases). This slower rate of decline may offset the anthropogenic reductions in tributary flows, minimize climate change-related effects, and add additional mitigation flows to help prevent the Mad River from going dry during summer months.

Because the proposed change does not remove water from the Mad River, other legal water users would not be adversely impacted by the instream flow dedication. The proposed Petition for Change may help ensure they have access to their water right. If the proposed petition for change is not accepted, the District would release less water in the dry months, which could force other legal water users downstream of the reservoir to curtail their water use, and have potential adverse effects on instream habitat and biota.

8. References

Bauer, S., Olson, J., Cockrill, A., van Hattem, M., Miller, L., Tauzer, M., and Leppig, G. (2015). Impacts of Surface Water Diversions for Marijuana Cultivation on Aquatic Habitat in Four Northwestern California Watersheds. PLoS ONE 10(3): e0120016. doi:10.1371/journal.pone.0120016.

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H. T. Harvey & Associates and Stillwater Sciences. 2019. Draft Environmental Effects Analysis of Instream Flow Dedication on Habitats and Species of the Mad River.

Humboldt Bay Municipal Water District and Stillwater Sciences. 2014. Mad River instream flow dedication feasibility assessment. Prepared for California Department of Fish and Wildlife, Fortuna, California. Agreement No. P 1110302.

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Trinity Associates and HBMWD. 2004. Humboldt Bay Municipal Water District Habitat Conservation Plan for its Mad River Operations. Final Approved HCP - April 2004. Prepared for the Humboldt Bay Municipal Water District.

Exhibit A: Average Daily Flow at Arcata Gage

Exhibit A: Average Daily Flow at Arcata Gage

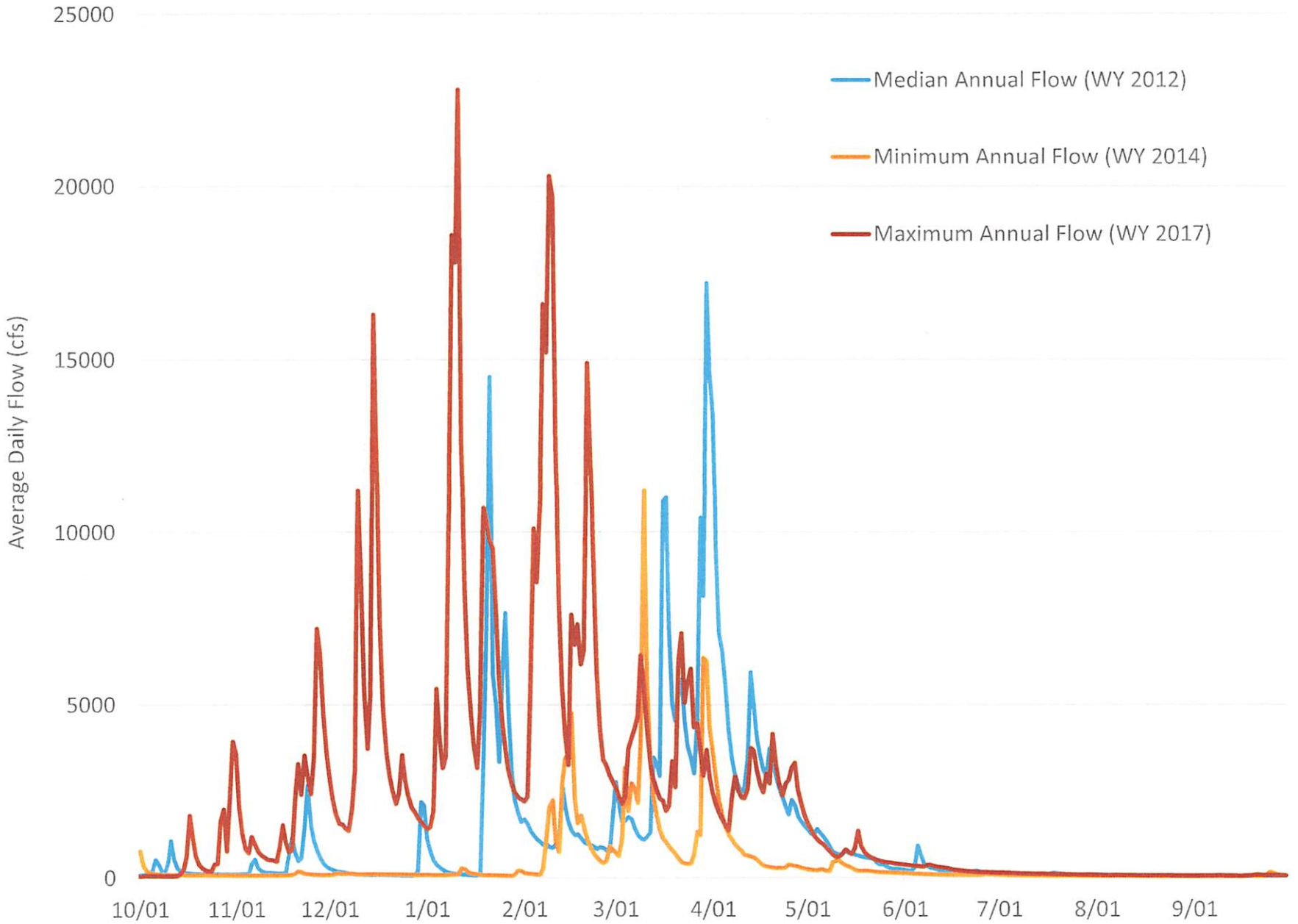

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Exhibit B: eWRIMS Water Rights Information

Exhibit B: eWRIMS Water Rights Information

Application Number	Latitude	Longitude	Water Right Type	Pre-1914	Riparian	Acceptance Date[1]	Priority[2]	POD Direct Diversion Rate	POD Direct Diversion Rate Units	Face Value (AFY)	Direct Diversion Beg Month/ Day	Direct Diversion End Month/Day	Storage Beg Month/Day	Storage End Month/Day
A007545	40.88202722	-124.01127277	Appropriative			04/27/1933	Senior	0.12	Cubic Feet per Second	29.5	1-May	1-Sep		
A007898	40.67130193	-123.7862058	Appropriative			04/09/1934	Senior	1000.0	Gallons per Day	1.1	1-Jan	31-Dec		
A009292	40.65276019	-123.82175897	Appropriative			05/16/1938	Senior	7000.0	Gallons per Day	7.8	1-Jan	31-Dec		
A009486	40.27722089	-123.35128564	Appropriative			01/16/1939	Senior	150.0	Gallons per Day	0.1	1-May	30-Oct		
A011983	40.27722089	-123.35128564	Appropriative			07/14/1947	Senior	850.0	Gallons per Day	0.7	15-Mar	1-Dec		
A013523	40.44762334	-123.51249011	Appropriative			12/29/1949	Senior	110.0	Gallons per Day	0.1	1-Jan	31-Dec		
A014677	40.85877782	-123.99031772	Appropriative			02/14/1952	Senior	0.38	Cubic Feet per Second	116.1	1-May	1-Oct		
A015328A	40.96853905	-124.04124353	Appropriative			05/01/1953	Senior	0.05	Cubic Feet per Second	12.1	1-Jun	30-Sep		
A015328B	40.96350989	-124.04615981	Appropriative			05/01/1953	Senior	0.03	Cubic Feet per Second	7.3	1-Jun	30-Sep		
A015328C	40.96267382	-124.04685845	Appropriative			05/01/1953	Senior	0.01	Cubic Feet per Second	2.4	1-Jun	30-Sep		
A015328D	40.95717906	-124.04705118	Appropriative			05/01/1953	Senior	0.04	Cubic Feet per Second	9.7	1-Jun	30-Sep		
A015328E	40.95634939	-124.04738777	Appropriative			05/01/1953	Senior	0.01	Cubic Feet per Second	2.4	1-Jun	30-Sep		
A015336	40.45264894	-123.5061345	Appropriative			05/11/1953	Senior	2200.0	Gallons per Day	2.5	1-Jan	31-Dec		
A015997	40.76246832	-123.88867614	Appropriative			08/13/1954	Senior	100.0	Gallons per Day	0.1	1-Apr	1-Nov		
A016562	40.43531713	-123.48777905	Appropriative			08/31/1955	Senior	500.0	Gallons per Day	0.6	1-Jan	31-Dec		
A017510	40.4342239	-123.48739544	Appropriative			3/14/1957	Junior	150.0	Gallons per Day	0.2	1-Jan	31-Dec		
A017540	40.4342239	-123.48739544	Appropriative			04/04/1957	Junior	100.0	Gallons per Day	0.1	1-Jan	31-Dec		
A017552	40.74436383	-123.87083458	Appropriative			04/17/1957	Junior	1500.0	Gallons per Day	1.7	1-Jan	31-Dec		
A017824	40.40068589	-123.46941264	Appropriative			09/16/1957	Junior	400.0	Gallons per Day	0.5	1-Jan	31-Dec		
A017996	40.86259794	-123.99169789	Appropriative			02/11/1958	Junior	0.41	Cubic Feet per Second	78	1-May	1-Oct		
A018206	40.88808944	-124.0413047	Appropriative			07/02/1958	Junior	0.03	Cubic Feet per Second	11	1-May	1-Nov		
A019466	40.3277295	-123.35194507	Appropriative			06/01/1960	Junior	0.047	Cubic Feet per Second	14.4	1-Jan	31-Dec		
A019919	40.98033221	-124.02638964	Appropriative			01/13/1961	Junior	4425.0	Gallons per Day	2.8	1-Jan	31-Dec	1-Nov	30-Apr
A022694	40.66169315	-123.83840817	Appropriative			01/31/1967	Junior	100.0	Gallons per Day	0.1	1-Jan	31-Dec		
A023034	40.32675587	-123.38743846	Appropriative			04/25/1968	Junior	500.0	Gallons per Day	0.6	1-Jan	31-Dec		
A023209	40.916383	-124.044818	Appropriative			01/16/1969	Junior	600.0	Gallons per Day	0.7	1-Jan	31-Dec		
A023957	40.9549988	-123.88473771	Appropriative			01/04/1972	Junior	8300.0	Gallons per Day	5.2	1-Jan	31-Dec		
A027463	40.62125718	-123.73730213	Appropriative			07/30/1982	Junior	700.0	Gallons per Day	0.1	1-Jan	31-Dec		
C005478	40.91234182	-123.95681609	Stockpond			12/29/1997	Junior	0.0	Gallons per Day	4			1-Jan	31-Dec
C005479	40.90876859	-123.97317746	Stockpond			12/29/1997	Junior	0.0	Gallons per Day	7			1-Jan	31-Dec
C005480	40.92373557	-123.96493449	Stockpond			12/29/1997	Junior	0.0	Gallons per Day	6			1-Jan	31-Dec
C005481	40.90881106	-123.95454067	Stockpond			12/29/1997	N/A	0.0	Gallons per Day	3			1-Jan	31-Dec
C005482	40.9146499	-123.95833183	Stockpond			12/29/1997	N/A	0.0	Gallons per Day	3			1-Jan	31-Dec
D030029	40.39884559	-123.44136172	Registration Domestic			11/04/1991	N/A	1350.0	Gallons per Day	1.2	1-Jan	31-Dec		
D030274	40.33848913	-123.37063926	Registration Domestic			08/11/1993	N/A	294.0	Gallons per Day	0.3	1-Jan	31-Dec		
D030576	40.86220786	-123.99837678	Registration Domestic			09/19/1996	N/A	3000.0	Gallons per Day	1.5	1-Jan	31-Dec		
D030651	40.51660423	-123.55433135	Registration Domestic			10/10/1997	N/A	4500.0	Gallons per Day	10	1-Jan	31-Dec	1-Nov	30-Apr
D030716	40.32292186	-123.35220681	Registration Domestic			06/17/1998	N/A	4500.0	Gallons per Day	2.5	1-Jan	31-Dec		
D030783	40.34929582	-123.4298895	Registration Domestic			10/02/1998	N/A	4500.0	Gallons per Day	3	1-Jan	31-Dec		
D030816	40.40293109	-123.44396358	Registration Domestic			11/23/1998	N/A	4500.0	Gallons per Day	5	1-Jan	31-Dec		
D030916	40.5165	-123.5547	Registration Domestic			07/01/1999	N/A	400.0	Gallons per Day	0.5	1-Jan	31-Dec		
F003655C	40.52189539	-123.52244563	Federal Stockponds			05/05/1982	N/A	0.0	Gallons per Day	0.21			1-Oct	30-Jun
F003659C	40.49390256	-123.56244595	Federal Stockponds			05/05/1982	N/A	0.0	Gallons per Day	0.28			1-Oct	30-Jun
F003977S	40.36964119	-123.40537671	Federal Claims			10/23/1967	N/A	360.0	Gallons per Day	0.19	1-May	31-Oct		
F003978S	40.36664832	-123.40316033	Federal Claims			1/1/1967	N/A	720.0	Gallons per Day	0.39	1-May	31-Oct		
F003980S	40.41275439	-123.49158786	Federal Claims			01/01/1967	N/A	2880.0	Gallons per Day	0.215	1-May	31-Oct		
F003990S	40.40318604	-123.46713313	Federal Claims			01/01/1967	N/A	2000.0	Gallons per Day	1.22	1-May	15-Nov		
F003992S	40.34167525	-123.40227868	Federal Claims			01/01/1967	N/A	2000.0	Gallons per Day	0.94	1-May	30-Sep		
F003993S	40.39074621	-123.43041545	Federal Claims			01/01/1967	N/A	720.0	Gallons per Day	0.37	15-May	31-Oct		

[1]Acceptance date not available for Registration Cannabis water rights
[2]Priority date not applicable for riparian and pre-1914 water rights

Exhibit B: eWRIMS Water Rights Information

Application Number	Latitude	Longitude	Water Right Type	Pre-1914	Riparian	Acceptance Date[1]	Priority[2]	POD Direct Diversion Rate	POD Direct Diversion Rate Units	Face Value (AFY)	Direct Diversion Beg Month/ Day	Direct Diversion End Month/Day	Storage Beg Month/Day	Storage End Month/Day
F007913S	40.52936471	-123.53880751	Federal Claims			01/01/1972	N/A	350.0	Gallons per Day	0.18	16-May	31-Oct		
F007921S	40.40179181	-123.4900867	Federal Claims			01/01/1972	N/A	500.0	Gallons per Day	0.269	10-May	31-Oct		
F007923S	40.34788767	-123.3767522	Federal Claims			01/01/1972	N/A	500.0	Gallons per Day	0.269	10-May	31-Oct		
F010768S	40.40649927	-123.44404053	Federal Claims			03/16/1982	N/A	450.0	Gallons per Day	0.157	1-May	31-Oct		
H500272	40.2237	-123.3058	Registration Cannabis				-	10.0	Gallons per Minute	1.89	1-Nov	31-Mar	1-Nov	31-Mar
H500321	40.4435	-123.4971	Registration Cannabis				-	10.0	Gallons per Minute	0.18	1-Nov	31-Mar	1-Nov	31-Mar
H500465	40.9695	-124.0843	Registration Cannabis				-	10.0	Gallons per Minute	0.2	1-Nov	31-Mar	1-Nov	31-Mar
H500552	40.375	-123.44	Registration Cannabis				-	10.0	Gallons per Minute	0.12	1-Nov	31-Mar	1-Nov	31-Mar
H500602	40.5126	-123.5612	Registration Cannabis				-	10.0	Gallons per Minute	0.2	1-Nov	31-Mar	1-Nov	31-Mar
H500642	40.5124	-123.6358	Registration Cannabis				-	10.0	Gallons per Minute	0.17	1-Nov	31-Mar	1-Nov	31-Mar
H500670	40.4531	-123.5027	Registration Cannabis				-	10.0	Gallons per Minute	0.57	1-Nov	31-Mar	1-Nov	31-Mar
H500711	40.4384	-123.4918	Registration Cannabis				-	10.0	Gallons per Minute	0.46	1-Nov	31-Mar	1-Nov	31-Mar
H500712	40.6039	-123.6807	Registration Cannabis				-	10.0	Gallons per Minute	0.17	1-Nov	31-Mar	1-Nov	31-Mar
H500771	40.53453663	-123.64212431	Registration Cannabis				-	0.0		0.75	1-Nov	31-Mar	1-Nov	31-Mar
H500793	40.75599067	-123.88611358	Registration Cannabis				-	0.0		0.05	1-Nov	31-Mar	1-Nov	31-Mar
H500815	40.5245	-123.6454	Registration Cannabis				-	10.0	Gallons per Minute	0.12	1-Nov	31-Mar	1-Nov	31-Mar
H500854	40.4397	-123.4927	Registration Cannabis				-	10.0	Gallons per Minute	0.28	1-Nov	31-Mar	1-Nov	31-Mar
H500868	40.6558	-123.8537	Registration Cannabis				-	0.0		0.59	1-Nov	31-Mar	1-Nov	31-Mar
H500877	40.8638	-123.9191	Registration Cannabis				-	10.0	Gallons per Minute	1.45	1-Nov	31-Mar	1-Nov	31-Mar
H502014	40.7205	-123.7666	Registration Cannabis				-	10.0	Gallons per Minute	0.4	1-Nov	31-Mar	1-Nov	31-Mar
H502019	40.1479	-123.2129	Registration Cannabis				-	10.0	Gallons per Minute	0.18	1-Nov	31-Mar	1-Nov	31-Mar
H502200	40.515822	-123.55419	Registration Cannabis				-	10.0	Gallons per Minute	0.48	1-Nov	31-Mar	1-Nov	31-Mar
H502323	40.5147	-123.6462	Registration Cannabis				-	10.0	Gallons per Minute	0.54			1-Jan	31-Dec
H502385	40.5475	-123.565	Registration Cannabis				-	10.0	Gallons per Minute	0.27	1-Nov	31-Mar	1-Nov	31-Mar
H502425	40.24423852	-123.31861288	Registration Cannabis				-	0.0		0.63	1-Nov	31-Mar	1-Nov	31-Mar
H502514	40.7196	-123.904	Registration Cannabis				-	10.0	Gallons per Minute	0.77	1-Nov	31-Mar	1-Nov	31-Mar
H503581	40.584	-123.6293	Registration Cannabis				-	10.0	Gallons per Minute	0.18	1-Nov	31-Mar	1-Nov	31-Mar
H504249	40.601169	-123.690375	Registration Cannabis				-	10.0	Gallons per Minute	0.18	1-Nov	31-Mar	1-Nov	31-Mar
H504313	40.448317	-123.501399	Registration Cannabis				-	10.0	Gallons per Minute	0.12	1-Nov	31-Mar	1-Nov	31-Mar
H504319	40.440207	-123.489497	Registration Cannabis				-	10.0	Gallons per Minute	0.06	1-Nov	31-Mar	1-Nov	31-Mar
H504422	40.511523	-123.628245	Registration Cannabis				-	10.0	Gallons per Minute	0.34			1-Jan	31-Dec
H504601	40.667644	-123.865233	Registration Cannabis				-	10.0	Gallons per Minute	0.21	1-Nov	31-Mar	1-Nov	31-Mar
H504663	40.510906	-123.636565	Registration Cannabis				-	10.0	Gallons per Minute	0.61	1-Nov	31-Mar	1-Nov	31-Mar
H505143	40.85407373	-123.91326389	Registration Cannabis				-	0.0		0.23	1-Nov	31-Mar	1-Nov	31-Mar
H505373	40.505901	-123.575507	Registration Cannabis				-	10.0	Gallons per Minute	0.41	1-Nov	31-Mar	1-Nov	31-Mar
S003981	40.40649927	-123.44404053	Statement of Div and Use		Y	01/01/1967	N/A	0.0	Gallons per Day	0	1-May	31-Oct		
S004938	40.85828126	-124.00314079	Statement of Div and Use		Y	01/01/1970	N/A	0.0	Gallons per Day	0	1-May	30-Sep		
S007914	40.52104335	-123.52458485	Statement of Div and Use		Y	01/01/1972	N/A	0.0	Gallons per Day	0	16-May	31-Oct		
S007925	40.49390256	-123.56244595	Statement of Div and Use		Y	01/01/1972	N/A	0.0	Gallons per Day	0	1-May	31-Oct		
S008799	40.66709548	-123.79186228	Statement of Div and Use	Y	Y	05/26/1976	N/A	0.044	Cubic Feet per Second	0	1-Jan	31-Dec		
S010329	40.27622422	-123.34266286	Statement of Div and Use		Y	05/13/1981	N/A	0.0	Gallons per Day	0	1-Jan	31-Dec		
S010387	40.27675214	-123.34446567	Statement of Div and Use		Y	05/29/1981	N/A	300.0	Gallons per Day	0	1-Jan	31-Dec		
S010424	40.27649029	-123.34338508	Statement of Div and Use		Y	06/23/1981	N/A	150.0	Gallons per Day	0				
S011457	40.29163232	-123.36304891	Statement of Div and Use		Y	01/22/1985	N/A	400.0	Gallons per Day	0	1-Jan	31-Dec		
S012962	40.85494521	-123.98966055	Statement of Div and Use		Y	03/30/1987	N/A	30.0	Cubic Feet per Second	0	1-Jan	31-Dec		
S015530	40.32931641	-123.41764909	Statement of Div and Use	Y		06/25/2004	N/A	0.07	Cubic Feet per Second	0	1-May	31-Oct		
S016794	40.4075	-123.4724	Statement of Div and Use		Y	04/19/2012	N/A	0.0	Acre-feet per Year	0				
S017691	40.8762	-123.9734	Statement of Div and Use		Y	04/19/2012	N/A	0.042	Cubic Feet per Second	0				
S017892	40.4549	-123.51	Statement of Div and Use		Y	05/18/2012	N/A	0.009	Cubic Feet per Second	0				

[1]Acceptance date not available for Registration Cannabis water rights
[2]Priority date not applicable for riparian and pre-1914 water rights

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Application Number	Latitude	Longitude	Water Right Type	Pre-1914	Riparian	Acceptance Date[1]	Priority[2]	POD Direct Diversion Rate	POD Direct Diversion Rate Units	Face Value (AFY)	Direct Diversion Beg Month/ Day	Direct Diversion End Month/Day	Storage Beg Month/Day	Storage End Month/Day
S018254	40.4091	-123.4764	Statement of Div and Use		Y	07/03/2012	N/A	0.011	Cubic Feet per Second	0				
S019715	40.4121	-123.4738	Statement of Div and Use		Y	01/27/2012	N/A	0.0	Cubic Feet per Second	0				
S019894	40.9186	-124.0445	Statement of Div and Use		Y	02/02/2012	N/A	0.1	Cubic Feet per Second	0				
S019897	40.9181	-124.044	Statement of Div and Use		Y	02/02/2012	N/A	0.0	Cubic Feet per Second	0				
S019940	40.4551	-123.5096	Statement of Div and Use		Y	07/11/2012	N/A	0.004	Cubic Feet per Second	0				
S020162	40.9408	-123.8763	Statement of Div and Use		Y	02/15/2012	N/A	0.11	Cubic Feet per Second	0				
S020233	40.6956	-123.8631	Statement of Div and Use		Y	02/10/2012	N/A	0.06	Cubic Feet per Second	0				
S021481	40.9817	-124.0353	Statement of Div and Use		Y	08/15/2012	N/A	0.0	Cubic Feet per Second	0				
S021535	40.4529	-123.5068	Statement of Div and Use		Y	08/20/2012	N/A	0.007	Cubic Feet per Second	0				
S021578	40.2767	-123.3416	Statement of Div and Use			08/22/2012	N/A	0.03	Cubic Feet per Second	0				
S022343	40.3603	-123.424	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022344	40.3599	-123.4238	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022345	40.3586	-123.4238	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022347	40.3584	-123.4232	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022349	40.358	-123.4229	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022351	40.3575	-123.4213	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022353	40.3573	-123.421	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022354	40.3557	-123.4204	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022355	40.3555	-123.4203	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022356	40.3537	-123.4195	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022357	40.3527	-123.419	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022358	40.3516	-123.415	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022359	40.3516	-123.415	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022360	40.3516	-123.415	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022361	40.3516	-123.415	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022362	40.349	-123.4111	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022363	40.332	-123.3943	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022364	40.3351	-123.3978	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022365	40.3358	-123.3982	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022366	40.335	-123.3972	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022367	40.335	-123.397	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022368	40.3349	-123.3969	Statement of Div and Use		Y	11/27/2012	Junior	0.0	Cubic Feet per Second	0				
S022369	40.334	-123.3965	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022370	40.3313	-123.3939	Statement of Div and Use		Y	11/27/2012	Junior	0.0	Cubic Feet per Second	0				
S022371	40.3297	-123.3932	Statement of Div and Use		Y	11/27/2012	N/A	0.0	Cubic Feet per Second	0				
S022372	40.3306	-123.3934	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				
S022373	40.3293	-123.389	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				
S022374	40.3223	-123.3889	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				
S022375	40.3195	-123.3834	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				
S022376	40.3189	-123.3834	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				
S022377	40.3178	-123.3817	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				
S022378	40.3563	-123.427	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				
S022380	40.3364	-123.4195	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				
S022381	40.3385	-123.4113	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				
S022382	40.3152	-123.3683	Statement of Div and Use		Y	11/28/2012	Junior	0.0	Cubic Feet per Second	0				
S022383	40.3076	-123.3542	Statement of Div and Use		Y	11/28/2012	Junior	0.0	Cubic Feet per Second	0				
S022385	40.3075	-123.3542	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				
S022387	40.3076	-123.354	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				
S022388	40.3076	-123.354	Statement of Div and Use		Y	11/28/2012	N/A	0.0	Cubic Feet per Second	0				

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Exhibit B: eWRIMS Water Rights Information

Application Number	Latitude	Longitude	Water Right Type	Pre-1914	Riparian	Acceptance Date[1]	Priority[2]	POD Direct Diversion Rate	POD Direct Diversion Rate Units	Face Value (AFY)	Direct Diversion Beg Month/ Day	Direct Diversion End Month/Day	Storage Beg Month/Day	Storage End Month/Day
S022389	40.4582	-123.5106	Statement of Div and Use		Y	11/28/2012	N/A	1.12	Cubic Feet per Second	0				
S022696	40.9807	-124.0366	Statement of Div and Use		Y	05/31/2013	N/A	0.11	Cubic Feet per Second	0				
S023449	40.7189	-123.8455	Statement of Div and Use		Y	10/11/2013	N/A	0.0		0				
S023497	40.8759	-123.9917	Statement of Div and Use		Y	10/16/2013	Junior	1.11	Cubic Feet per Second	0				
S023751	40.6933	-123.7903	Statement of Div and Use	Y	Y	11/22/2013	N/A	0.23	Cubic Feet per Second	0				
S023752	40.6887	-123.8167	Statement of Div and Use	Y	Y	11/22/2013	N/A	0.23	Cubic Feet per Second	0				
S023756	40.7012	-123.8328	Statement of Div and Use	Y	Y	11/25/2013	N/A	0.78	Cubic Feet per Second	0				
S023778	40.7329	-123.8806	Statement of Div and Use	Y	Y	11/26/2013	N/A	0.0		0				
S023798	40.8019	-123.9552	Statement of Div and Use	Y	Y	11/27/2013	Junior	0.0		0				
S023800	40.8153	-123.9715	Statement of Div and Use	Y	Y	11/27/2013	N/A	0.0		0				
S023801	40.8148	-123.97	Statement of Div and Use	Y	Y	11/27/2013	N/A	0.0		0				
S023802	40.8114	-123.9189	Statement of Div and Use	Y	Y	11/27/2013	N/A	0.0		0				
S023815	40.7122	-123.7803	Statement of Div and Use	Y	Y	12/02/2013	N/A	0.23	Cubic Feet per Second	0				
S023820	40.7614	-123.8189	Statement of Div and Use	Y	Y	12/03/2013	N/A	0.0		0				
S023821	40.9521	-123.8663	Statement of Div and Use	Y	Y	12/03/2013	N/A	0.0		0				
S023826	40.7288	-123.8341	Statement of Div and Use	Y	Y	12/03/2013	N/A	0.5	Cubic Feet per Second	0				
S023836	40.8308	-123.9411	Statement of Div and Use	Y	Y	12/03/2013	N/A	0.0		0				
S023857	40.9486	-123.9879	Statement of Div and Use	Y	Y	12/05/2013	N/A	0.5	Cubic Feet per Second	0				
S023858	40.942	-123.992	Statement of Div and Use	Y	Y	12/05/2013	N/A	0.23	Cubic Feet per Second	0				
S023864	40.9191	-123.8716	Statement of Div and Use	Y	Y	12/05/2013	N/A	0.23	Cubic Feet per Second	0				
S023865	40.938	-123.9347	Statement of Div and Use	Y	Y	12/05/2013	Junior	0.78	Cubic Feet per Second	0				
S023873	40.7095	-123.8171	Statement of Div and Use	Y	Y	12/09/2013	N/A	0.23	Cubic Feet per Second	0				
S023875	40.86	-123.9871	Statement of Div and Use	Y	Y	12/09/2013	N/A	0.78	Cubic Feet per Second	0				
S023877	40.7486	-123.7814	Statement of Div and Use	Y	Y	12/09/2013	N/A	0.23	Cubic Feet per Second	0				
S023878	40.9623	-123.9489	Statement of Div and Use	Y	Y	12/09/2013	N/A	0.78	Cubic Feet per Second	0				
S023881	40.6262	-123.736	Statement of Div and Use	Y	Y	12/09/2013	Junior	0.5	Cubic Feet per Second	0				
S023898	40.5801	-123.623	Statement of Div and Use		Y	12/12/2013	N/A	0.0		0				
S024107	40.9025	-124.0591	Statement of Div and Use		Y	01/09/2014	N/A	0.0		0				
S024185	40.5021	-123.5682	Statement of Div and Use		Y	01/17/2014	N/A	0.007	Cubic Feet per Second	0				
S024429	40.528	-123.646	Statement of Div and Use		Y	06/02/2014	N/A	0.0	Cubic Feet per Second	0				
S024675	40.4416	-123.5012	Statement of Div and Use		Y	10/10/2014	N/A	10.0	Gallons per Minute	0				
S024695	40.5264	-123.6397	Statement of Div and Use		Y	11/20/2014	N/A	0.005	Cubic Feet per Second	0				
S024717	40.851	-123.8852	Statement of Div and Use		Y	01/21/2015	N/A	0.005	Cubic Feet per Second	0				
S024803	40.4446	-123.4976	Statement of Div and Use		Y	04/28/2015	N/A	500.0	Gallons per Day	0				
S024861	40.5193	-123.5806	Statement of Div and Use		Y	06/12/2015	N/A	0.0	Cubic Feet per Second	0				
S024906	40.7163	-123.7652	Statement of Div and Use			07/03/2015	N/A	8.0	Gallons per Minute	0				
S024980	40.4382	-123.4919	Statement of Div and Use		Y	07/14/2015	N/A	5.0	Gallons per Minute	0				
S025026	40.7191	-123.7675	Statement of Div and Use			07/21/2015	N/A	7.0	Gallons per Minute	0				
S025054	40.4748	-123.5293	Statement of Div and Use		Y	07/24/2015	N/A	60.0	Gallons per Day	0				
S025061	40.5988	-123.6947	Statement of Div and Use		Y	07/24/2015	N/A	6.6	Gallons per Minute	0				
S025118	40.5135	-123.5764	Statement of Div and Use		Y	08/04/2015	N/A	1800.0	Gallons per Day	0				
S025121	40.5266	-123.614	Statement of Div and Use		Y	08/05/2015	N/A	4.0	Gallons per Minute	0				
S025124	40.3761	-123.4456	Statement of Div and Use		Y	08/05/2015	N/A	2.0	Gallons per Minute	0				
S025125	40.3747	-123.4397	Statement of Div and Use		Y	08/05/2015	N/A	2.0	Gallons per Minute	0				
S025129	40.3748	-123.4408	Statement of Div and Use		Y	08/05/2015	N/A	2.0	Gallons per Minute	0				
S025130	40.6022	-123.69	Statement of Div and Use		Y	08/06/2015	N/A	2.0	Gallons per Minute	0				
S025131	40.6012	-123.6904	Statement of Div and Use		Y	08/06/2015	N/A	2.0	Gallons per Minute	0				
S025189	40.3693	-123.4282	Statement of Div and Use		Y	09/04/2015	N/A	0.0122	Cubic Feet per Second	0				
S025221	40.9747	-124.0088	Statement of Div and Use			10/02/2015	Junior	350.0	Gallons per Day	0				

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S025260	40.7227	-123.886	Statement of Div and Use			11/10/2015	Junior	4.0	Gallons per Minute	0				
S025299	40.7129	-123.7587	Statement of Div and Use		Y	12/29/2015	Junior	7.0	Gallons per Minute	0				
S025331	40.7264	-123.9036	Statement of Div and Use		Y	01/19/2016	N/A	6.0	Gallons per Minute	0				
S025341	40.7449	-123.9493	Statement of Div and Use		Y	01/22/2016	N/A	20.0	Gallons per Minute	0				
S025382	40.7654	-123.8773	Statement of Div and Use		Y	03/04/2016	N/A	0.0		0				
S025421	40.5126	-123.5612	Statement of Div and Use		Y	04/08/2016	N/A	2.0	Gallons per Minute	0				
S025422	40.5117	-123.5627	Statement of Div and Use		Y	04/11/2016	N/A	10.0	Gallons per Minute	0				
S025475	40.8472	-123.908	Statement of Div and Use			05/31/2016	N/A	4.0	Gallons per Minute	0				
S025480	40.5184	-123.6239	Statement of Div and Use		Y	06/06/2016	N/A	2.0	Gallons per Minute	0				
S025506	40.5301	-123.6456	Statement of Div and Use		Y	06/17/2016	N/A	100.0	Gallons per Day	0				
S025531	40.7568051	-123.8759046	Statement of Div and Use		Y	07/11/2016	N/A	20.0	Gallons per Minute	0				
S025705	40.7437	-123.8759	Statement of Div and Use		Y	08/22/2016	N/A	5.0	Gallons per Minute	0				
S025786	40.5267	-123.614	Statement of Div and Use			09/02/2016	N/A	4.0	Gallons per Minute	0				
S025835	40.524532	-123.645466	Statement of Div and Use		Y	10/10/2016	N/A	1.04	Gallons per Minute	0				
S025839	40.5099	-123.5925	Statement of Div and Use		Y	10/11/2016	N/A	4.0	Gallons per Minute	0				
S025840	40.7253	-123.8879	Statement of Div and Use		Y	10/11/2016	N/A	4.0	Gallons per Minute	0				
S025867	40.8615	-123.9127	Statement of Div and Use		Y	10/31/2016	N/A	3.0	Gallons per Minute	0				
S025877	40.7565	-123.8864	Statement of Div and Use		Y	11/02/2016	N/A	250.0	Gallons per Day	0				
S025878	40.7558	-123.8858	Statement of Div and Use		Y	11/02/2016	Junior	500.0	Gallons per Day	0				
S025879	40.6672	-123.8653	Statement of Div and Use		Y	11/02/2016	N/A	10.0	Gallons per Minute	0				
S025951	40.3233	-123.3725	Statement of Div and Use		Y	12/16/2016	N/A	800.0	Gallons per Day	0				
S025999	40.61867477	-123.743169	Statement of Div and Use		Y	02/06/2017	N/A	4.0	Gallons per Minute	0				
S026001	40.45311971	-123.5026899	Statement of Div and Use		Y	02/06/2017	N/A	10.0	Gallons per Minute	0				
S026005	40.61867477	-123.743169	Statement of Div and Use		Y	02/14/2017	N/A	4.0	Gallons per Minute	0				
S026007	40.8528999	-123.9223546	Statement of Div and Use			02/14/2017	N/A	4.0	Gallons per Minute	0				
S026068	40.4027	-123.4568	Statement of Div and Use		Y	03/07/2017	N/A	1.0	Gallons per Minute	0				
S026117	40.6347	-123.7739	Statement of Div and Use		Y	05/16/2017	N/A	6.0	Gallons per Minute	0				
S026147	40.8638	-123.9191	Statement of Div and Use		Y	05/24/2017	N/A	16.0	Gallons per Minute	0				
S026148	40.8601	-123.9205	Statement of Div and Use		Y	05/24/2017	N/A	14.0	Gallons per Minute	0				
S026149	40.8615	-123.9128	Statement of Div and Use			05/24/2017	N/A	15.0	Gallons per Minute	0				
S026150	40.862	-123.9141	Statement of Div and Use		Y	05/24/2017	N/A	10.0	Gallons per Minute	0				
S026167	40.51470327	-123.6461934	Statement of Div and Use		Y	05/30/2017	N/A	0.0		0				
S026198	40.59665751	-123.7052254	Statement of Div and Use		Y	06/13/2017	N/A	4.0	Gallons per Minute	0				
S026210	40.649348	-123.856826	Statement of Div and Use		Y	06/15/2017	N/A	2880.0	Gallons per Day	0				
S026241	40.51754006	-123.6431716	Statement of Div and Use		Y	06/26/2017	N/A	16.0	Gallons per Minute	0				
S026249	40.440042	-123.492906	Statement of Div and Use		Y	06/26/2017	N/A	150.0	Gallons per Day	0				
S026250	40.43861909	-123.49903182	Statement of Div and Use		Y	06/26/2017	N/A	150.0	Gallons per Day	0				
S026273	40.846	-123.917	Statement of Div and Use		Y	07/07/2017	N/A	2.0	Gallons per Minute	0				
S026297	40.7711	-123.951	Statement of Div and Use		Y	07/11/2017	N/A	0.0		0				
S026324	40.603301	-123.699619	Statement of Div and Use		Y	07/12/2017	N/A	0.0		0				
S026334	40.5144178	-123.5867626	Statement of Div and Use		Y	07/13/2017	N/A	1.0	Gallons per Minute	0				
S026361	40.7196	-123.904	Statement of Div and Use		Y	07/14/2017	N/A	0.0		0				
S026374	40.511975	-123.582302	Statement of Div and Use		Y	07/14/2017	N/A	55.0	Gallons per Day	0				
S026377	40.5113041	-123.5859615	Statement of Div and Use		Y	07/17/2017	N/A	10.0	Gallons per Minute	0				
S026392	40.5038	-123.558	Statement of Div and Use		Y	07/17/2017	N/A	5.0	Gallons per Minute	0				
S026408	40.7193	-123.894	Statement of Div and Use		Y	07/18/2017	N/A	0.0		0				
S026409	40.7193	-123.894	Statement of Div and Use		Y	07/18/2017	N/A	0.0		0				
S026463	40.506287	-123.57714	Statement of Div and Use		Y	07/24/2017	N/A	7.0	Gallons per Minute	0				
S026492	40.512122	-123.628538	Statement of Div and Use		Y	07/25/2017	Junior	2.0	Gallons per Minute	0				

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S026493	40.509208	-123.629348	Statement of Div and Use		Y	07/25/2017	N/A	2.0	Gallons per Minute	0				
S026494	40.511505	-123.628575	Statement of Div and Use		Y	07/25/2017	N/A	5.0	Gallons per Minute	0				
S026495	40.50590556	-123.57551944	Statement of Div and Use		Y	07/25/2017	Junior	0.0		0				
S026523	40.5874	-123.7012	Statement of Div and Use			07/27/2017	Junior	0.0		0				
S026526	40.88954	-123.991595	Statement of Div and Use			07/27/2017	Junior	0.0		0				
S026527	40.88545	-124.03536	Statement of Div and Use			07/27/2017	N/A	0.0		0				
S026541	40.5311341	-123.622244	Statement of Div and Use		Y	07/28/2017	Junior	1.0	Gallons per Minute	0				
S026542	40.531919	-123.62666	Statement of Div and Use		Y	07/28/2017	Junior	1.0	Gallons per Minute	0				
S026543	40.603873	-123.680689	Statement of Div and Use		Y	07/28/2017	Junior	6.0	Gallons per Minute	0				
S026549	40.511	-123.6176	Statement of Div and Use		Y	07/28/2017	Junior	3.0	Gallons per Minute	0				
S026559	40.65354444	-123.80150556	Statement of Div and Use		Y	07/31/2017	Junior	9.0	Gallons per Minute	0				
S026570	40.66114722	-123.81495	Statement of Div and Use		Y	07/31/2017	Junior	0.0		0				
S026578	40.75512	-123.87521	Statement of Div and Use		Y	08/01/2017	Junior	0.0		0				
S026617	40.980698	-124.02156	Statement of Div and Use		Y	08/01/2017	Junior	0.0		0				
S026618	40.980698	-124.02156	Statement of Div and Use		Y	08/01/2017	Junior	0.0		0				
S026671	40.6512	-123.8017	Statement of Div and Use		Y	08/04/2017	Junior	5.0	Gallons per Minute	0				
S026672	40.65139167	-123.80180556	Statement of Div and Use		Y	08/04/2017	Junior	5.0	Gallons per Minute	0				
S026763	40.511503	-123.628119	Statement of Div and Use		Y	08/10/2017	Junior	1.0	Cubic Feet per Second	0				
S026765	40.50938959	-123.6225148	Statement of Div and Use		Y	08/10/2017	Junior	2.0	Gallons per Minute	0				
S026779	40.50518421	-123.5858306	Statement of Div and Use		Y	08/11/2017	Junior	500.0	Gallons per Day	0				
S026836	40.773697	-123.840974	Statement of Div and Use		Y	08/16/2017	Junior	5.0	Gallons per Minute	0				
S026867	40.72211389	-123.77476944	Statement of Div and Use		Y	08/17/2017	Junior	20.0	Gallons per Minute	0				
S026902	40.5075	-123.5444	Statement of Div and Use			08/21/2017	Junior	0.0		0				
S026942	40.51242875	-123.6358109	Statement of Div and Use		Y	08/22/2017	Junior	0.0		0				
S026944	40.7274542	-123.8908287	Statement of Div and Use		Y	08/22/2017	Junior	0.0		0				
S026949	40.59895176	-123.6947915	Statement of Div and Use		Y	08/23/2017	Junior	0.0		0				
S027053	40.531375	-123.61409444	Statement of Div and Use		Y	08/29/2017	Junior	0.0		0				
S027065	40.521497	-123.638286	Statement of Div and Use		Y	08/30/2017	Junior	0.0		0				
S027068	40.528061	-123.608378	Statement of Div and Use		Y	08/30/2017	Junior	0.0		0				
S027104	40.528792	-123.608997	Statement of Div and Use		Y	09/01/2017	Junior	0.0		0				
S027116	40.371247	-123.441717	Statement of Div and Use		Y	09/05/2017	Junior	0.0		0				
S027118	40.507915	-123.567391	Statement of Div and Use		Y	09/05/2017	Junior	150.0	Gallons per Day	0				
S027123	40.509221	-123.571854	Statement of Div and Use		Y	09/05/2017	Junior	600.0	Gallons per Day	0				
S027125	40.507034	-123.569708	Statement of Div and Use		Y	09/05/2017	Junior	150.0	Gallons per Day	0				
S027128	40.508633	-123.568507	Statement of Div and Use		Y	09/05/2017	Junior	80.0	Gallons per Day	0				
S027142	40.524342	-123.617973	Statement of Div and Use		Y	09/05/2017	Junior	2000.0	Gallons per Day	0				
S027149	40.374941	-123.448861	Statement of Div and Use		Y	09/06/2017	Junior	300.0	Gallons per Day	0				
S027175	40.511881	-123.557447	Statement of Div and Use		Y	09/08/2017	Junior	0.0		0				
S027177	40.512384	-123.557996	Statement of Div and Use		Y	09/08/2017	Junior	0.0		0				
S027217	40.521667	-123.652944	Statement of Div and Use		Y	09/12/2017	Junior	20.0	Gallons per Minute	0				
S027347	40.521509	-123.639127	Statement of Div and Use		Y	09/26/2017	Junior	0.0		0				
S027356	40.85556667	-123.90985556	Statement of Div and Use		Y	09/26/2017	Junior	1.5	Gallons per Minute	0				
S027357	40.85556667	-123.90985556	Statement of Div and Use		Y	09/26/2017	Junior	2.0	Gallons per Minute	0				
S027412	40.978644	-124.018611	Statement of Div and Use		Y	10/10/2017	Junior	150.0	Gallons per Day	0				
S027424	40.317191	-123.35757	Statement of Div and Use		Y	10/18/2017	Junior	0.0		0				
S027490	40.737232	-123.95321	Statement of Div and Use		Y	11/01/2017	Junior	0.0		0				
S027492	40.72616261	-123.90355383	Statement of Div and Use		Y	11/01/2017	Junior	0.0		0				
S027562	40.6489	-123.8517	Statement of Div and Use		Y	11/16/2017	Junior	5.0	Gallons per Minute	0				
S027568	40.675896	-123.866928	Statement of Div and Use		Y	11/17/2017	Junior	600.0	Gallons per Day	0				

[1]Acceptance date not available for Registration Cannabis water rights
[2]Priority date not applicable for riparian and pre-1914 water rights

Exhibit B: eWRIMS Water Rights Information

Application Number	Latitude	Longitude	Water Right Type	Pre-1914	Riparian	Acceptance Date[1]	Priority[2]	POD Direct Diversion Rate	POD Direct Diversion Rate Units	Face Value (AFY)	Direct Diversion Beg Month/ Day	Direct Diversion End Month/Day	Storage Beg Month/Day	Storage End Month/Day
S027623	40.471873	-123.516841	Statement of Div and Use		Y	01/04/2018	Junior	0.0		0				
S027733	40.58405345	-123.6293609	Statement of Div and Use		Y	05/24/2018	Junior	0.0		0				
S027753	40.75780675	-123.8842037	Statement of Div and Use		Y	06/15/2018	Junior	500.0	Gallons per Day	0				
S027764	40.677959	-123.818833	Statement of Div and Use			06/20/2018	Junior	0.0		0				
S027795	40.679436	-123.815815	Statement of Div and Use		Y	07/16/2018	Junior	0.0		0				
S027801	40.456549	-123.495343	Statement of Div and Use		Y	07/16/2018	Junior	4.0	Gallons per Minute	0				
S027881	40.677959	-123.818833	Statement of Div and Use			08/20/2018	Junior	0.0		0				
S027890	40.58405345	-123.6293609	Statement of Div and Use			08/24/2018	Junior	4.0	Gallons per Minute	0				
S027928	40.516526	-123.554519	Statement of Div and Use			09/18/2018	Junior	2.2	Gallons per Minute	0				
S028027	40.531381	-123.616567	Statement of Div and Use		Y	11/28/2018	Junior	0.0		0				

[1]Acceptance date not available for Registration Cannabis water rights
[2]Priority date not applicable for riparian and pre-1914 water rights

Exhibit C: Estimated Monthly Water Use for eWRIMS Water Rights

Application Number	Diversion Volume (gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
A007545	0	0	0	0	1,922,390	1,922,390	1,922,390	1,922,390	1,922,390	0	0	0	9,611,950
A007898	29,868	29,868	29,868	29,868	29,868	29,868	29,868	29,868	29,868	29,868	29,868	29,868	358,412
A009292	210,000	210,000	210,000	210,000	210,000	210,000	210,000	210,000	210,000	210,000	210,000	210,000	2,520,000
A009486	0	0	0	0	4,500	4,500	4,500	4,500	4,500	4,500	0	0	27,000
A011983	0	0	22,808	22,808	22,808	22,808	22,808	22,808	22,808	22,808	22,808	22,808	228,080
A013523	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	32,583
A014677	0	0	0	0	7,367,501	7,367,501	7,367,501	7,367,501	7,367,501	0	0	0	36,837,504
A015328A	0	0	0	0	0	969,408	969,408	969,408	969,408	0	0	0	3,877,632
A015328B	0	0	0	0	0	581,645	581,645	581,645	581,645	0	0	0	2,326,579
A015328C	0	0	0	0	0	193,882	193,882	193,882	193,882	0	0	0	775,526
A015328D	0	0	0	0	0	775,526	775,526	775,526	775,526	0	0	0	3,102,106
A015328E	0	0	0	0	0	193,882	193,882	193,882	193,882	0	0	0	775,526
A015336	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	792,000
A015997	0	0	0	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	0	24,000
A016562	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	180,000
A017510	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	54,000
A017540	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	32,583
A017552	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	540,000
A017824	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	144,000
A017996	0	0	0	0	7,949,146	570,200	570,200	570,200	570,200	0	0	0	10,229,947
A018206	0	0	0	0	512,017	512,017	512,017	512,017	512,017	512,017	512,017	0	3,584,117
A019466	390,995	390,995	390,995	390,995	390,995	390,995	390,995	390,995	390,995	390,995	390,995	390,995	4,691,935
A019919	76,027	76,027	76,027	76,027	76,027	76,027	76,027	76,027	76,027	76,027	76,027	76,027	912,321
A022694	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	32,583
A023034	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	180,000
A023209	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	216,000
A023957	141,192	141,192	141,192	141,192	141,192	141,192	141,192	141,192	141,192	141,192	141,192	141,192	1,694,310
A027463	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	2,715	32,583
C005478	3,095	2,802	3,095	2,998	0	0	0	0	0	0	0	0	11,990
C005479	0	0	0	0	0	0	0	0	0	0	0	0	0
C005480	1,238	1,108	1,238	1,206	0	0	0	0	0	0	0	1,238	6,028
C005481	3,095	2,802	3,095	2,998	0	0	0	0	0	0	0	3,095	15,086
C005482	6,191	5,539	6,191	5,865	0	0	0	0	0	0	0	6,191	29,976
D030029	32,583	32,583	32,583	32,583	32,583	32,583	32,583	32,583	32,583	32,583	32,583	32,583	390,995
D030274	8,146	8,146	8,146	8,146	8,146	8,146	8,146	8,146	8,146	8,146	8,146	8,146	97,749
D030576	40,729	40,729	40,729	40,729	40,729	40,729	40,729	40,729	40,729	40,729	40,729	40,729	488,743
D030651	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	1,620,000
D030716	67,881	67,881	67,881	67,881	67,881	67,881	67,881	67,881	67,881	67,881	67,881	67,881	814,572
D030783	81,457	81,457	81,457	81,457	81,457	81,457	81,457	81,457	81,457	81,457	81,457	81,457	977,486
D030816	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	135,000	1,620,000
D030916	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	144,000
F003655C	0	0	0	8,999	9,299	8,999	9,299	9,299	8,999	9,299	0	0	64,196
F003659C	7,603	7,603	7,603	7,603	7,603	7,603	7,603	7,603	7,603	7,603	7,603	7,603	91,231
F003977S	0	0	0	0	10,318	10,318	10,318	10,318	10,318	10,318	0	0	61,907
F003978S	0	0	0	0	21,179	21,179	21,179	21,179	21,179	21,179	0	0	127,073
F003980S	0	0	0	0	11,676	11,676	11,676	11,676	11,676	11,676	0	0	70,053
F003990S	0	0	0	0	56,787	56,787	56,787	56,787	56,787	56,787	56,787	0	397,511
F003992S	0	0	0	0	60,000	60,000	60,000	60,000	60,000	0	0	0	300,000
F003993S	0	0	0	0	20,093	20,093	20,093	20,093	20,093	20,093	0	0	120,557

Adjusted because outside of diversion window

Values obtained from Statement of Diversion and Use

Adjusted because total diversion volume exceeded the face value

Exhibit C: Estimated Monthly Water Use for eWRIMS Water Rights

Application Number	Diversion Volume (gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
F007913S	0	0	0	0	9,775	9,775	9,775	9,775	9,775	9,775	0	0	58,649
F007921S	0	0	0	0	14,608	14,608	14,608	14,608	14,608	14,608	0	0	87,648
F007923S	0	0	0	0	14,608	14,608	14,608	14,608	14,608	14,608	0	0	87,648
F010768S	0	0	0	0	8,526	8,526	8,526	8,526	8,526	8,526	0	0	51,155
H500272	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H500321	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H500465	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H500552	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H500602	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H500642	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H500670	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H500711	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H500712	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H500771	48,809	48,809	48,809	0	0	0	0	0	0	0	48,809	48,809	244,046
H500793	3,258	3,258	3,258	0	0	0	0	0	0	0	3,258	3,258	16,291
H500815	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H500854	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H500868	38,448	38,448	38,448	0	0	0	0	0	0	0	38,448	38,448	192,239
H500877	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H502014	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H502019	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H502200	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H502323	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	5,184,000
H502385	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H502425	41,054	41,054	41,054	0	0	0	0	0	0	0	41,054	41,054	205,272
H502514	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H503581	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H504249	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H504313	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H504319	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H504422	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	5,184,000
H504601	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H504663	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
H505143	14,988	14,988	14,988	0	0	0	0	0	0	0	14,988	14,988	74,941
H505373	432,000	432,000	432,000	0	0	0	0	0	0	0	432,000	432,000	2,160,000
S003981	0	0	0	15,000	15,000	15,000	15,000	15,000	15,000	15,000	0	0	105,000
S004938	0	0	0	0	198,000	198,000	198,000	198,000	198,000	0	0	0	990,000
S007914	0	0	0	9,000	9,000	9,000	9,000	9,000	9,000	9,000	0	0	63,000
S007925	0	0	0	15,000	15,000	15,000	15,000	15,000	15,000	15,000	0	0	105,000
S008799	853,079	853,079	853,079	853,079	853,079	853,079	853,079	853,079	853,079	853,079	853,079	853,079	10,236,948
S010329	2,500	2,500	2,500	3,000	3,000	4,000	8,000	9,000	5,000	3,000	2,500	2,500	47,500
S010387	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	108,000
S010424	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	54,000
S011457	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	144,000
S012962	105000000	120000000	135000000	51000000	51000000	51000000	54000000	60000000	75000000	75000000	75000000	90000000	942,000,000
S015530	0	0	0	0	1,357,171	1,357,171	1,357,171	1,357,171	1,357,171	1,357,171	0	0	8,143,027
S016794	0	0	0	0	1,296,000	1,944,000	1,944,000	1,944,000	1,944,000	1,944,000	0	0	11,016,000
S017691	814,303	814,303	814,303	814,303	814,303	814,303	814,303	814,303	814,303	814,303	814,303	814,303	9,771,633
S017892	174,493	174,493	174,493	174,493	174,493	174,493	174,493	174,493	174,493	174,493	174,493	174,493	2,093,921

Adjusted because outside of diversion window

Values obtained from Statement of Diversion and Use

Adjusted because total diversion volume exceeded the face value

Exhibit C: Estimated Monthly Water Use for eWRIMS Water Rights

Application Number	Diversion Volume (gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
S018254	213,270	213,270	213,270	213,270	213,270	213,270	213,270	213,270	213,270	213,270	213,270	213,270	2,559,237
S019715	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	16,157
S019894	1,938,816	1,938,816	1,938,816	1,938,816	1,938,816	1,938,816	1,938,816	1,938,816	1,938,816	1,938,816	1,938,816	1,938,816	23,265,792
S019897	3,960	3,960	3,960	3,960	3,960	3,960	3,960	3,960	3,960	3,960	3,960	3,960	47,520
S019940	77,553	77,553	77,553	77,553	77,553	77,553	77,553	77,553	77,553	77,553	77,553	77,553	930,632
S020162	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	25,592,371
S020233	1,163,290	1,163,290	1,163,290	1,163,290	1,163,290	1,163,290	1,163,290	1,163,290	1,163,290	1,163,290	1,163,290	1,163,290	13,959,475
S021481	10,461	10,461	10,461	10,461	10,461	10,461	10,461	10,461	10,461	10,461	10,461	10,461	125,535
S021535	135,717	135,717	135,717	135,717	135,717	135,717	135,717	135,717	135,717	135,717	135,717	135,717	1,628,605
S021578	581,645	581,645	581,645	581,645	581,645	581,645	581,645	581,645	581,645	581,645	581,645	581,645	6,979,738
S022343	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022344	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022345	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022347	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022349	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022351	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022353	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022354	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022355	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022356	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022357	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022358	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022359	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022360	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022361	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022362	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022363	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022364	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022365	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022366	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022367	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022368	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022369	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022370	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022371	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022372	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022373	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022374	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022375	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022376	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022377	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022378	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022380	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022381	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022382	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022383	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022385	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022387	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600
S022388	0	0	0	0	1,200	2,400	2,400	2,400	1,200	0	0	0	9,600

Adjusted because outside of diversion window

Values obtained from Statement of Diversion and Use

Adjusted because total diversion volume exceeded the face value

Exhibit C: Estimated Monthly Water Use for eWRIMS Water Rights

Exhibit C: Estimated Monthly Water Use for eWRIMS Water Rights

Application Number	Diversion Volume (gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
S022389	21,714,739	21,714,739	21,714,739	21,714,739	21,714,739	21,714,739	21,714,739	21,714,739	21,714,739	21,714,739	21,714,739	21,714,739	260,576,870
S022696	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	2,132,698	25,592,371
S023449	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	120,000
S023497	21,520,858	21,520,858	21,520,858	21,520,858	21,520,858	21,520,858	21,520,858	21,520,858	21,520,858	21,520,858	21,520,858	21,520,858	258,250,291
S023751	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	53,511,322
S023752	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	53,511,322
S023756	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	181,473,178
S023778	0	0	0	0	0	0	0	0	0	0	0	0	0
S023798	0	0	0	0	20,000	140,000	28,000	92,000	16,000	0	0	0	296,000
S023800	0	0	0	0	0	0	0	0	0	0	0	0	0
S023801	0	0	0	0	8,000	48,000	44,000	108,000	16,000	0	0	0	224,000
S023802	0	0	0	0	0	0	0	0	0	0	0	0	0
S023815	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	53,511,322
S023820	0	0	0	0	0	0	40,000	280,000	20,000	16,000	0	0	356,000
S023821	0	0	0	0	0	0	132,000	320,000	260,000	128,000	0	0	840,000
S023826	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	116,328,960
S023836	0	0	0	0	0	0	0	0	0	0	0	0	0
S023857	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	116,328,960
S023858	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	53,511,322
S023864	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	53,511,322
S023865	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	181,473,178
S023873	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	53,511,322
S023875	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	181,473,178
S023877	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	4,459,277	53,511,322
S023878	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	15,122,765	181,473,178
S023881	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	9,694,080	116,328,960
S023898	0	0	0	0	0	1,000	1,000	1,000	1,000	1,000	0	0	5,000
S024107	1,400	1,400	1,400	1,600	1,800	1,800	2,000	2,200	2,200	200	1,600	1,400	19,000
S024185	135,717	135,717	135,717	135,717	135,717	135,717	135,717	135,717	135,717	135,717	135,717	135,717	1,628,605
S024429	0	0	0	0	0	0	0	1,500	1,500	1,500	0	0	4,500
S024675	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	5,184,000
S024695	96,941	96,941	96,941	96,941	96,941	96,941	96,941	96,941	96,941	96,941	96,941	96,941	1,163,290
S024717	96,941	96,941	96,941	96,941	96,941	96,941	96,941	96,941	96,941	96,941	96,941	96,941	1,163,290
S024803	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	180,000
S024861	0	0	0	34,000	55,500	55,500	55,500	55,500	55,500	55,500	20,250	0	387,250
S024906	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	4,147,200
S024980	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	2,592,000
S025026	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	3,628,800
S025054	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	21,600
S025061	285,120	285,120	285,120	285,120	285,120	285,120	285,120	285,120	285,120	285,120	285,120	285,120	3,421,440
S025118	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000	648,000
S025121	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S025124	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S025125	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S025129	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S025130	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S025131	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S025189	236,536	236,536	236,536	236,536	236,536	236,536	236,536	236,536	236,536	236,536	236,536	236,536	2,838,427
S025221	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500	126,000

Adjusted because outside of diversion window

Values obtained from Statement of Diversion and Use

Adjusted because total diversion volume exceeded the face value

Exhibit C: Estimated Monthly Water Use for eWRIMS Water Rights

Application Number	Diversion Volume (gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
S025260	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S025299	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	3,628,800
S025331	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	3,110,400
S025341	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	10,368,000
S025382	0	0	0	0	8,000	0	0	0	0	0	0	0	8,000
S025421	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S025422	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	5,184,000
S025475	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S025480	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S025506	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	36,000
S025531	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	10,368,000
S025705	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	2,592,000
S025786	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S025835	44,928	44,928	44,928	44,928	44,928	44,928	44,928	44,928	44,928	44,928	44,928	44,928	539,136
S025839	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S025840	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S025867	129,600	129,600	129,600	129,600	129,600	129,600	129,600	129,600	129,600	129,600	129,600	129,600	1,555,200
S025877	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	90,000
S025878	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	180,000
S025879	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	5,184,000
S025951	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	288,000
S025999	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S026001	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	5,184,000
S026005	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S026007	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S026068	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	518,400
S026117	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	3,110,400
S026147	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	8,294,400
S026148	604,800	604,800	604,800	604,800	604,800	604,800	604,800	604,800	604,800	604,800	604,800	604,800	7,257,600
S026149	648,000	648,000	648,000	648,000	648,000	648,000	648,000	648,000	648,000	648,000	648,000	648,000	7,776,000
S026150	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	5,184,000
S026167	4,650	4,200	21,235	20,415	4,650	21,095	4,650	4,650	4,500	4,650	4,500	4,650	103,845
S026198	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S026210	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S026241	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	8,294,400
S026249	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	54,000
S026250	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	54,000
S026273	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S026297	23,215	23,215	23,215	23,215	0	0	0	0	0	0	23,215	23,215	139,290
S026324	0	37,250	37,750	52,500	127,750	127,500	157,750	97,750	97,500	97,750	22,500	0	856,000
S026334	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	518,400
S026361	45,000	45,000	20,000	25,000	30,000	0	0	0	0	0	45,000	45,000	255,000
S026374	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	19,800
S026377	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	432,000	5,184,000
S026392	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	2,592,000
S026408	0	0	37,500	37,500	37,500	50,000	50,000	50,000	0	18,750	0	0	281,250
S026409	10,000	10,000	20,000	20,000	20,000	20,000	1,750	57,500	57,500	38,750	20,000	47,000	322,500
S026463	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	302,400	3,628,800
S026492	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800

Adjusted because outside of diversion window

Values obtained from Statement of Diversion and Use

Adjusted because total diversion volume exceeded the face value

Exhibit C: Estimated Monthly Water Use for eWRIMS Water Rights

Application Number	Diversion Volume (gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
S026493	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S026494	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	2,592,000
S026495	26,250	26,250	26,250	8,750	8,750	34,375	40,000	30,000	34,375	13,750	26,250	26,250	301,250
S026523	0	0	16,500	11,500	18,500	27,500	48,500	28,500	38,500	28,500	7,500	0	225,500
S026526	0	0	2,500	2,500	2,500	2,500	12,500	12,500	10,000	0	0	0	45,000
S026527	5,000	5,000	10,000	10,000	10,000	10,000	30,000	30,000	25,000	5,000	5,000	5,000	150,000
S026541	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	518,400
S026542	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	518,400
S026543	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	3,110,400
S026549	129,600	129,600	129,600	129,600	129,600	129,600	129,600	129,600	129,600	129,600	129,600	129,600	1,555,200
S026559	388,800	388,800	388,800	388,800	388,800	388,800	388,800	388,800	388,800	388,800	388,800	388,800	4,665,600
S026570	0	0	0	0	1,500	1,500	1,500	1,500	1,500	0	0	0	7,500
S026578	15,000	15,000	18,000	20,000	20,000	20,000	24,000	24,000	24,000	20,000	18,000	15,000	233,000
S026617	15,000	15,000	15,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	15,000	15,000	390,000
S026618	15,000	15,000	15,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	15,000	15,000	390,000
S026671	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	2,592,000
S026672	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	2,592,000
S026763	19,388,160	19,388,160	19,388,160	19,388,160	19,388,160	19,388,160	19,388,160	19,388,160	19,388,160	19,388,160	19,388,160	19,388,160	232,657,920
S026765	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S026779	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	180,000
S026836	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	2,592,000
S026867	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	10,368,000
S026902	0	0	0	0	0	0	0	0	0	0	0	0	0
S026942	22,000	22,000	22,000	22,000	17,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	147,000
S026944	0	0	0	600	6,250	12,500	12,500	14,285	14,285	12,500	0	0	72,920
S026949	3,000	3,000	3,000	3,750	4,500	6,000	10,500	12,000	10,500	9,000	4,500	3,000	72,750
S027053	0	0	0	0	31,000	45,000	46,500	46,500	45,000	46,500	0	0	260,500
S027065	38,700	35,400	29,100	15,100	7,500	0	0	0	0	0	28,000	62,400	216,200
S027068	46,900	42,900	35,200	18,300	9,100	0	0	0	0	0	33,900	75,600	261,900
S027104	12,000	12,000	12,000	4,000	0	0	0	0	0	0	0	0	40,000
S027116	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	60,000
S027118	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	54,000
S027123	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	216,000
S027125	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	54,000
S027128	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	28,800
S027142	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	720,000
S027149	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	108,000
S027175	4,000	3,000	2,000	0	0	0	0	0	0	0	3,000	4,000	16,000
S027177	4,000	3,000	3,000	3,000	1,000	0	0	0	0	0	4,000	4,000	22,000
S027217	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	864,000	10,368,000
S027347	8,900	8,100	6,700	3,500	1,700	0	0	0	0	2,600	6,400	11,800	49,700
S027356	64,800	64,800	64,800	64,800	64,800	64,800	64,800	64,800	64,800	64,800	64,800	64,800	777,600
S027357	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	86,400	1,036,800
S027412	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	54,000
S027424	3,000	3,000	6,000	9,000	12,000	15,000	15,000	15,000	15,000	14,000	13,000	9,000	129,000
S027490	8,100	8,100	8,100	8,100	8,000	8,100	8,100	8,100	9,000	9,000	8,100	8,100	98,900
S027492	0	0	800	2,000	14,000	22,400	22,400	22,400	14,000	2,000	0	0	100,000
S027562	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	2,592,000
S027568	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	216,000

Adjusted because outside of diversion window

Values obtained from Statement of Diversion and Use

Adjusted because total diversion volume exceeded the face value

Exhibit C: Estimated Monthly Water Use for eWRIMS Water Rights

Application Number	Diversion Volume (gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
S027623	0	0	0	0	0	0	0	0	0	0	0	0	0
S027733	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	72,000
S027753	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	180,000
S027764	25,660	25,660	25,660	25,660	25,660	25,660	25,660	25,660	25,660	25,660	25,660	25,660	307,920
S027795	6,696	6,696	6,696	6,696	6,696	6,480	6,696	6,696	0	0	0	6,696	60,048
S027801	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S027881	25,660	25,660	25,660	25,660	25,660	25,660	25,660	25,660	25,660	25,660	25,660	25,660	307,920
S027890	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	2,073,600
S027928	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	1,140,480
S028027	5,466	5,466	5,468	0	0	0	0	0	0	0	0	0	16,400

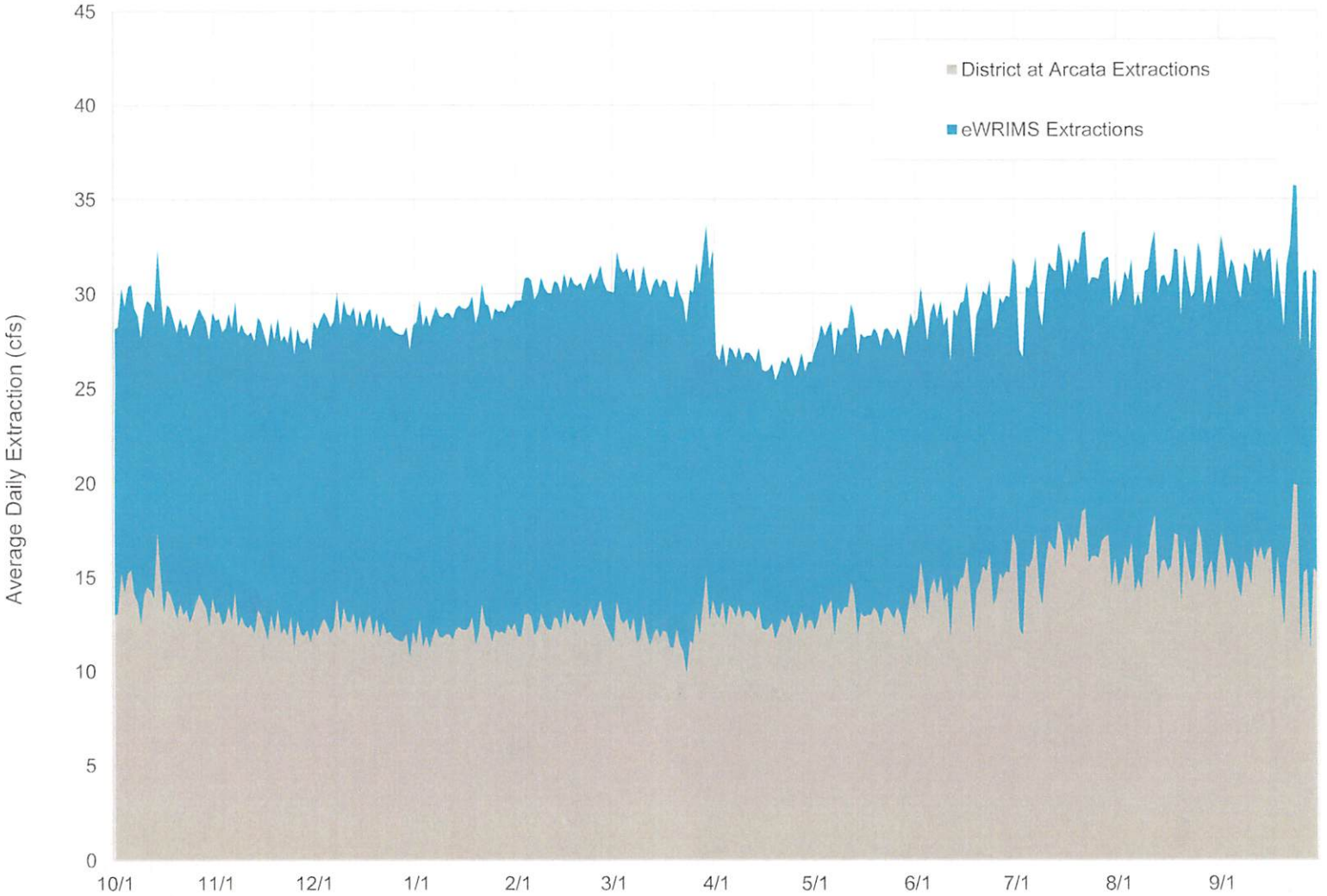
Adjusted because outside of diversion window

Values obtained from Statement of Diversion and Use

Adjusted because total diversion volume exceeded the face value

Exhibit D: Extractions for HBMWD at Essex and eWRIMS Water Rights

Exhibit D: Extractions for HBMWD at Essex and eWRIMS Water Rights



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Appendix C

Temperature & DO Modeling Report

Section 3. Water Quality

3.1 Introduction

The North Coast Regional Water Quality Control Board has listed the Mad River as impaired for sediment, turbidity, and temperature under Section 303(d) of the California Clean Water Act, and water quality is a critically important factor with regard to the conservation of salmonids and other special-status species. This project would dedicate instream flows to the Mad River for environmental benefit purposes. However, stream flow enhancement has the potential to affect the quality of the water downstream from the point of discharge, but is anticipated to benefit fish and wildlife. The District and its partners monitored water temperature, air temperature, turbidity, and discharge between May 1 and October 31, 2018, to analyze the relationships among these factors. The goal of the 2018 monitoring was to determine whether the instream flow dedication could improve water quality over existing conditions, which may be a limiting factor for salmonids and other special-status species in the Mad River.

3.2 Methods and Results

3.2.1 Sources of Information

Water and air temperature data on the Mad River were collected by the Mad River Alliance (MRA) from May 1 to September 26, 2018, using Onset HOBO temperature loggers. The deployment locations for the temperature loggers were selected on the basis of: (1) accessibility; (2) capability to provide an accurate representation of ambient creek/river temperatures; (3) avoidance of known springs and seeps; and (4) ability to conceal the data loggers to reduce vandalism and ensure instrument and data recovery (Pounds pers. comm. 2019). Mainstem water temperature data were recorded every 30 minutes at 17 sites, but unfortunately three of the mainstem HOBO temperature loggers were lost or stolen. Tributary water temperature data were collected at 8 sites (Table 14, Figure 8). H. T. Harvey & Associates examined the data set and determined that some of the temperature data were collected prior to the HOBO logger being deployed; these data were subsequently cropped. We also removed temperature data from the Mad River upstream of Cañon Creek (MRUSCanon) between July 7 at 7:00 p.m. and July 19 at 6:30 a.m. because there was a 10°F decrease in recorded temperatures that was not observed at neighboring sites. Additional water temperature data from the Ruth Lake Marina (at surface) and the Matthews Dam tailrace, as well as turbidity, rainfall and discharge data at the dam (tailrace), were provided by the District for May 1 to October 31, 2018. Stream gage data from the U.S. Geological Survey were checked against the District data but were not included in the analyses.

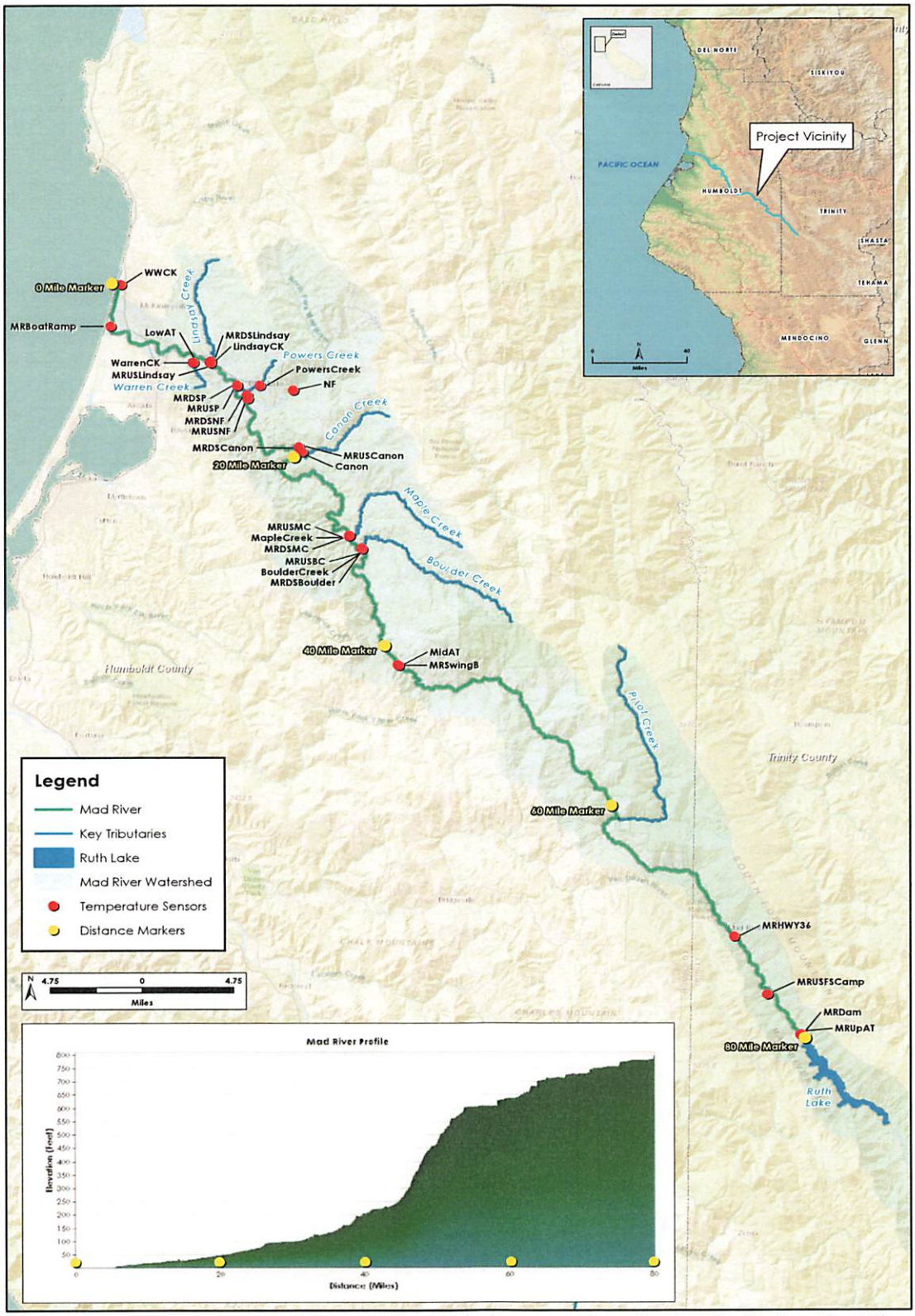

Figure 1. Temperature Monitoring Sites, Tributaries, and Elevation Profile for the Mad River, Humboldt County, California

Table 1. Water and Air Temperature Monitoring Sites on the Mad River

RM	ID	Reach	Category	Name	Lat	Lon
0.7	WWCK	E	TR	Widow White Creek	40.9623443	-124.1203722
3.1	MRBoatRamp	E	MS	Mad River Boat Ramp	40.92896818	-124.1297681
9.5	LowAT	LR	AT	Lower Mad River Air Temp	40.90131994	-124.0469784
9.5	WarrenCK	LR	TR	Warren Creek	40.90138535	-124.0471489
10.3	MRDSLindsay	LR	MS	Mad River downstream of Lindsay Creek	40.90174272	-124.0304291
10.3	LindsayCK	LR	TR	Lindsay Creek	40.90277703	-124.0296433
10.4	MRUSLindsay	LR	MS	Mad River upstream of Lindsay Creek	40.90116693	-124.0297067
12.4	MRDSP	LR	MS	Mad River downstream of Powers Creek	40.88395270	-124.0028767
12.4	PowersCreek	LR	TR	Powers Creek	40.88407803	-123.9802949
12.4	MRUSP	LR	MS	Mad River upstream of Powers Creek	40.88339983	-124.0028903
13.7	MRDSNF	LR	MS	Mad River downstream of North Fork	40.87623962	-123.9926627
13.7	NF	LR	TR	North Fork Mad River	40.88102512	-123.9473143
13.9	MRUSNF	LR	MS	Mad River upstream of North Fork	40.87343792	-123.9919857
19.6	MRDSCanon	LR	MS	Mad River downstream of Cañon Creek	40.83528060	-123.9403968
19.6	Canon	LR	TR	Cañon Creek	40.83136258	-123.9370303
19.6	MRUSCanon	LR	MS	Mad River upstream of Cañon Creek	40.83477073	-123.9401075
31.2	MRDSMC*	LR	MS	Mad River downstream of Maple Creek	40.76495528	-123.8887041
31.3	MapleCreek	LR	TR	Maple Creek	40.76459488	-123.8886667
31.3	MRUSMC*	LR	MS	Mad River upstream of Maple Creek	40.76446717	-123.8891854
32.6	MRDSBoulder	MR	MS	Mad River downstream of Boulder Creek	40.75471003	-123.8765421
32.6	BoulderCreek	MR	TR	Boulder Creek	40.75523691	-123.8763601
32.6	MRUSBC*	MR	MS	Mad River upstream of Boulder Creek	40.75435072	-123.8755169
41.6	MidAT	MR	AT	Middle Mad River Air Temperature	40.66226768	-123.8381917
41.6	MRSwingB	MR	MS	Mad River at Swinging Bridge	40.66176464	-123.8372687
72.7	MRHWY36	UR	MS	Mad River at Highway 36 Bridge	40.44925597	-123.5023560

RM	ID	Reach	Category	Name	Lat	Lon
77.0	MRUSFSCamp	UR	MS	Mad River at USFS Campground	40.40264200	-123.4688680
80.2	MRUpAT	UR	AT	Upper Mad River Air Temperature	40.37083274	-123.4347936
80.2	MRDam	UR	MS	Mad River at Matthews Dam	40.37068642	-123.4359363

RM is river mile, ID is the site code, and Reach identifies each site as estuarine (E), lower reach (LR), middle reach (MR), or upper reach (UR). Name provides the site name with some location information. Lat stands for latitude; Lon for longitude. Category is either mainstem (MS), tributary (TR), or air temperature (AT).

* HOBO lost or stolen from this site; no data recovered.

The time series from the MRA 2018 temperature monitoring data are depicted collectively in Figure 9.

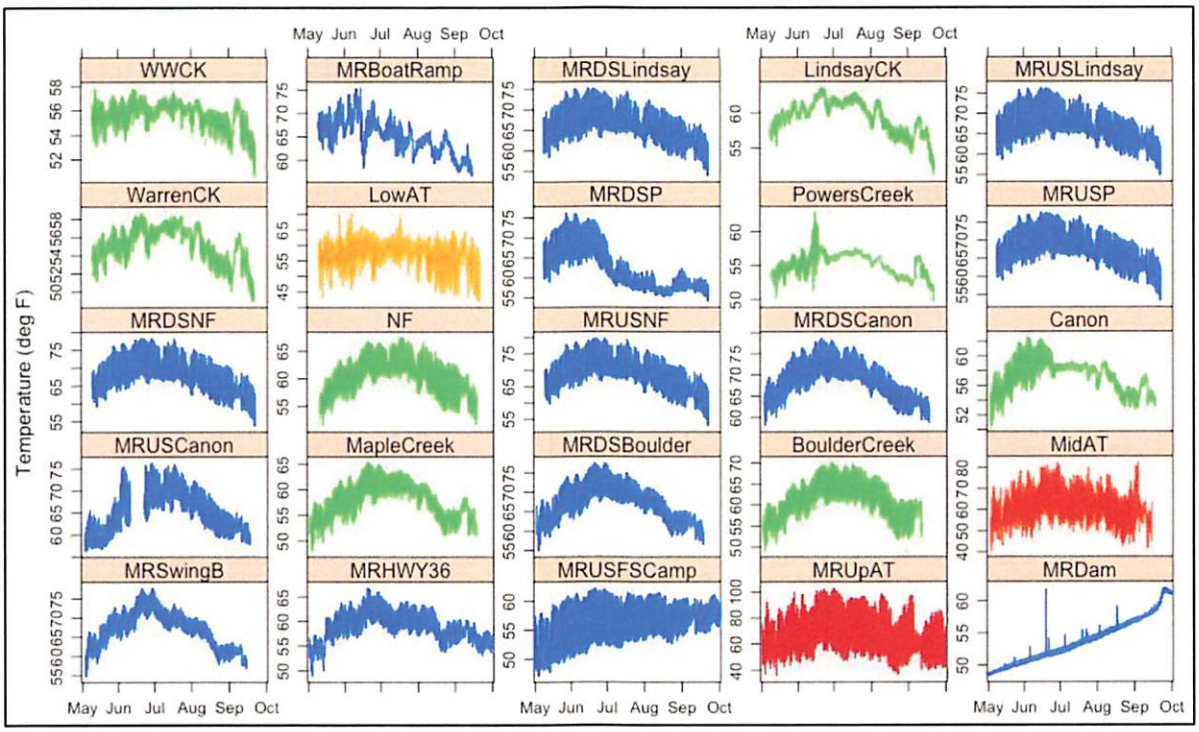

Figure 2. Mad River Water and Air Temperatures (May 1–September 26, 2018), Recorded Using HOBO Temperature Loggers at Multiple Mainstem (Blue), Tributary (Green), and Air Temperature (Orange-Red) Sites

3.2.2 Analytical Approach

We used graphical analyses, permutation distribution clustering (pdc), multiple regression with ARIMA[1] errors, and cross correlation functions (CCF) to explore the potential relationship between: (1) water temperatures at the point of discharge at Matthews Dam and downstream; (2) water temperatures from tributaries and the

[1] Auto Regressive Integrated Moving Average

mainstem downstream from the tributary confluence; (3) air temperatures and local or downstream mainstem water temperatures; and (4) dam discharge rates and downstream water temperatures. We had originally intended to use the Multiple Regression Stream Temperature Model[2] (MRSTM) developed by the U.S. Forest Service (USFS), but determined that this approach required data that we were unable to acquire, particularly discharge time series from tributaries. Instead, we retained the basis for the analysis used by the MRSTM (i.e., multiple regression) and employed additional statistical methods to refine this approach (Fellman et al. 2015). The MRSTM was not capable of implementing the ARIMA error terms associated with non-stationary time series data, such as what was collected during the 2018 monitoring on Mad River. Time series manipulation, analyses, and modelling were performed using R (R Core Team 2019), particularly the astsa (Stoffer 2019), lattice (Sarker 2008), lubridate (Grolemund and Wickham 2011), pdc (Brandmaier 2015), tseries (Trapletti and Hornik 2019), and zoo packages (Zeileis and Grothendieck 2005).

Mad River mainstem water temperatures and the associated water quality may be affected by or correlated with multiple factors. The factors that we evaluated were: (1) the temperature of upstream sites; (2) the temperature of tributaries to the Mad River; (3) local air temperature; and (4) the temperature and volume of water released at Matthews Dam. The volume of water contributed by tributaries also has the potential to affect water quality in the mainstem. Because we lacked flow data from these tributaries, we could not analyze the influence of tributary discharge on mainstem temperature. Similarly, while the range of discharge volumes observed in the mainstem during the monitoring period ranged from 41 to 227 cubic feet per second (cfs), the highest releases were limited to relatively short intervals in June and early July, which restricted our ability to model the effects of lower or higher discharge rates from Matthews Dam on downstream water temperature.

Maximum Weekly Average Temperature (MWAT) and Maximum Weekly Maximum Temperature (MWMT) were calculated from the HOBO temperature logger data. MWAT is the average daily temperature for the warmest 7-day period, and MWMT is the 7-day average of the daily maximum temperatures. These indices are useful to compare with temperature thresholds developed for different salmonid species and their life stages to assess the potential for chronic temperature effects (Stillwater Sciences 2010, Carter 2008).

3.2.2.1 Graphical Analyses and Permutation Distribution Clustering

The MRA 2018 temperature monitoring data time series (Figure 9) show a broad range of water and air temperatures between May 1 and September 26, 2018. Water temperatures ranged from the mid-40s to the mid-70s (°F) in both the mainstem Mad River and the tributaries. The corresponding air temperatures varied from 35 to 103°F (Figures 9 and 10). Both air and water time series displayed a strong diel component (i.e., 24-hour period), with a more limited range observed at lower elevation sites compared to their counterparts at higher elevations and closer to Matthews Dam. Most of these time series had the same general structure whereby average temperatures peaked around the end of June and gradually declined, with the lowest mean temperatures occurring near the end of the study period. The time series that did not exhibit this pattern were the two mainstem sites at the highest elevations: Mad River at USFS Campground (MRUSFSCamp) and Mad

[2] https://www.fs.fed.us/rm/boise/AWAE/projects/stream_temp/multregression_model.shtml

River at Matthews Dam (MRDam). Both of these sites showed a steady increase in average water temperature over the course of the 2018 monitoring period. MRUSFSCamp displayed the greatest diel temperature fluctuations, and MRDam exhibited the lowest diel temperature fluctuations. The two sites are 3.2 river miles (RMs) apart (2.8 miles straight-line distance) (Table 14). The mainstem site lowest in elevation, the Mad River Boat Ramp (MRBoatRamp), displayed the smallest diel fluctuations, probably due to its estuarine setting and the influences of ocean water temperatures and cooler coastal air temperatures.

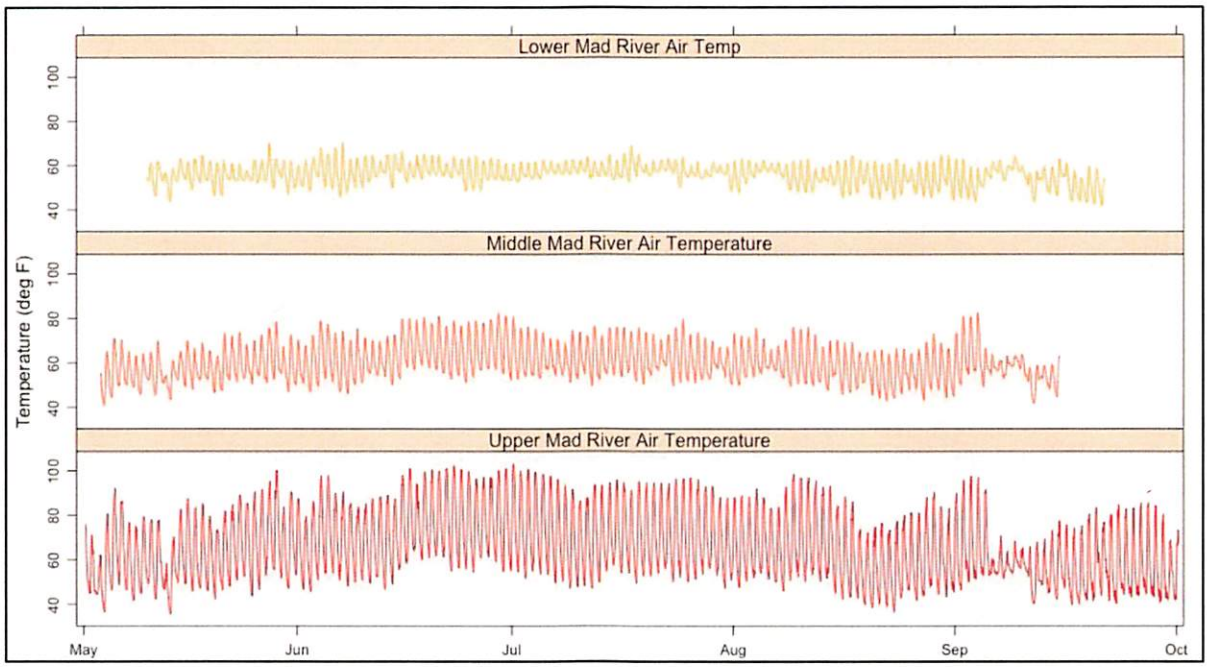

Figure 3. Air Temperatures along the Mad River (May 1–September 26, 2018), Recorded Using HOBO Temperature Loggers

Based on the general pattern of mainstem water temperatures over the 2018 monitoring period, it appeared that temperature in the upper reaches was predictive of temperature further downstream; however, both tributaries and local air temperature also affected mainstem water temperature. Tributary effects were most apparent when we compared the mainstem temperatures upstream and downstream of each confluence. Paired site data were collected for four tributaries in the lower reach of the Mad River: Lindsay Creek, Powers Creek, North Fork Mad River, and Cañon Creek. Temperature loggers were deployed in each of these tributaries upstream of their confluences with the mainstem, and in the mainstem immediately (less than 30 feet) upstream and downstream of each confluence. We also evaluated the tributary effect of Boulder Creek, except that the upstream mainstem temperature logger was lost or stolen. Therefore, we used time series data from the next site upstream at Swinging Bridge (MRSwingB), 9.0 RMs above the Boulder Creek confluence (Table 14, Figure 8). We generated time series of the temperature differentials for each of the five tributaries (Figure 11). Not all tributaries affected mainstem temperatures; the effects of Lindsay Creek, North Fork Mad River, and Boulder Creek were essentially undetectable in the mainstem. However, Powers Creek and, to a lesser extent, Cañon Creek affected (locally reduced) the mainstem temperature. During July and August, Powers Creek reduced the

water temperature in the Mad River by more than 10°F; the maximum difference was 15.0°F on August 13, 2018; Powers Creek typically is subsurface at its confluence with the Mad River during this time of year, contributing cool water via a seep to the mainstem.

The diel water and air temperature fluctuations demonstrated that changing levels of solar heat energy directly affect both measurements, but the differences in heat capacity between water and air are also evident from the time series data. The fluctuations in diel air temperatures spanned wider ranges than the fluctuations for diel water temperatures. Seasonal changes in temperature suggested that multiple factors determine mainstem water conditions—the air temperature time series showed a similar initial climb and gradual decline observed in most water temperature time series, but the pattern was comparatively muted, which was indicative that local solar heat energy (evidenced by the air temperature time series) was only one of multiple contributing factors.

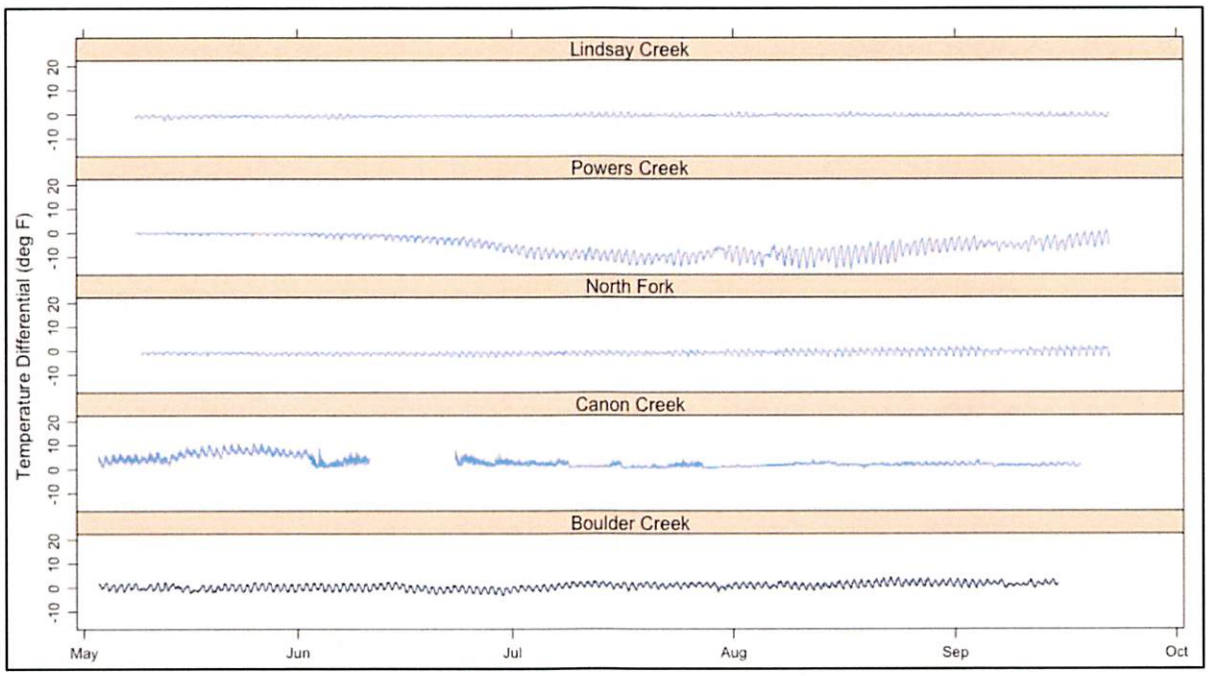

Figure 4. Mad River Mainstem Temperature Differences Measured Upstream and Downstream of Selected Tributaries (May 1–September 26, 2018)

Similar temperature time series are indicative of similar environmental conditions, connectivity between sites, or both (Brown 1969, Johnson 2004, Ferencz and Cardenas 2017). We used permutation distribution clustering (pdc) analysis to examine the similarities among time series. This analysis is a complexity-based clustering method developed specifically for time series, and uses the permutation distribution of those series to compare their differences.

Clustering generally provides a means to distinguish hierarchical, meaningful subgroups within a population of data sets (Altman and Krzywinski 2017, Caruso et al. 2018). If conditions at downstream sites closely resemble upstream sites, we would expect time series from adjoining sites to exhibit only minor differences and to have

a relatively close association in the resulting tree structure (Figure 12). In fact, the pdc results of comparisons among Mad River water temperature time series identified incremental but informative differences among the monitoring sites and suggested that sites tended to become progressively less similar as the downstream distance from the highest elevation sites increased, with some exceptions (Figure 12).

The pdc analysis generated two well-defined groups (note the 'height' of the legs separating these groups in Figure 12). The smaller group (MRDam, MRBoatRamp, MRUSCanon, and Mad River downstream of Powers Creek [MRDSP]) was composed of somewhat dissimilar time series, and the larger group contained well-ordered series that ranged from the blue sites high in the river system to the green sites closer to the river mouth. The primary findings of the pdc analysis were that: (1) while not exact, the pattern was very close to that of the sequential order of the sites and strongly supported the hypothesis that, the closer a site may be to an upstream site, the more similar the diel and seasonal patterns of water temperature; and (2) the smaller group was striking because it included the time series for the highest (MRDam) and lowest (MRBoatRamp) elevation sites. The MRDam time series was substantially different from the others, with a steady, seasonal climb in temperatures that displayed two kinds of anomalies: periodic spikes in water temperature and an unusual increase near the end of the 2018 monitoring period (roughly September 14–26). Two of the higher mainstem sites (MRUSFSCamp and Mad River at Highway 36 Bridge [MRHWY36]) were the only additional sites monitored during the September 14–26 period, and exhibited subtler versions of the increase, but the pdc analysis strongly suggested that water temperatures immediately below Matthews Dam had essentially no predictive value for downstream sites. We suggest that the other three sites clustered with MRDam because they each had a distinctive pattern; the rest of the sites displayed similar patterns. MRBoatRamp was the mainstem site closest to the river mouth and was strongly estuarine. The temperatures at this site were affected by tidal action, the presence of ocean water, and coastal air temperatures. As noted in the methods discussion, MRUSCanon had a period of anomalous temperature data between July 7 and July 19 that was excluded from the analysis after consulting the MRA; that gap in the time series sets this site apart. MRDSP was unusual because the previously strong diel fluctuations in water temperature were abruptly and severely muted, beginning on July 30, 2018.

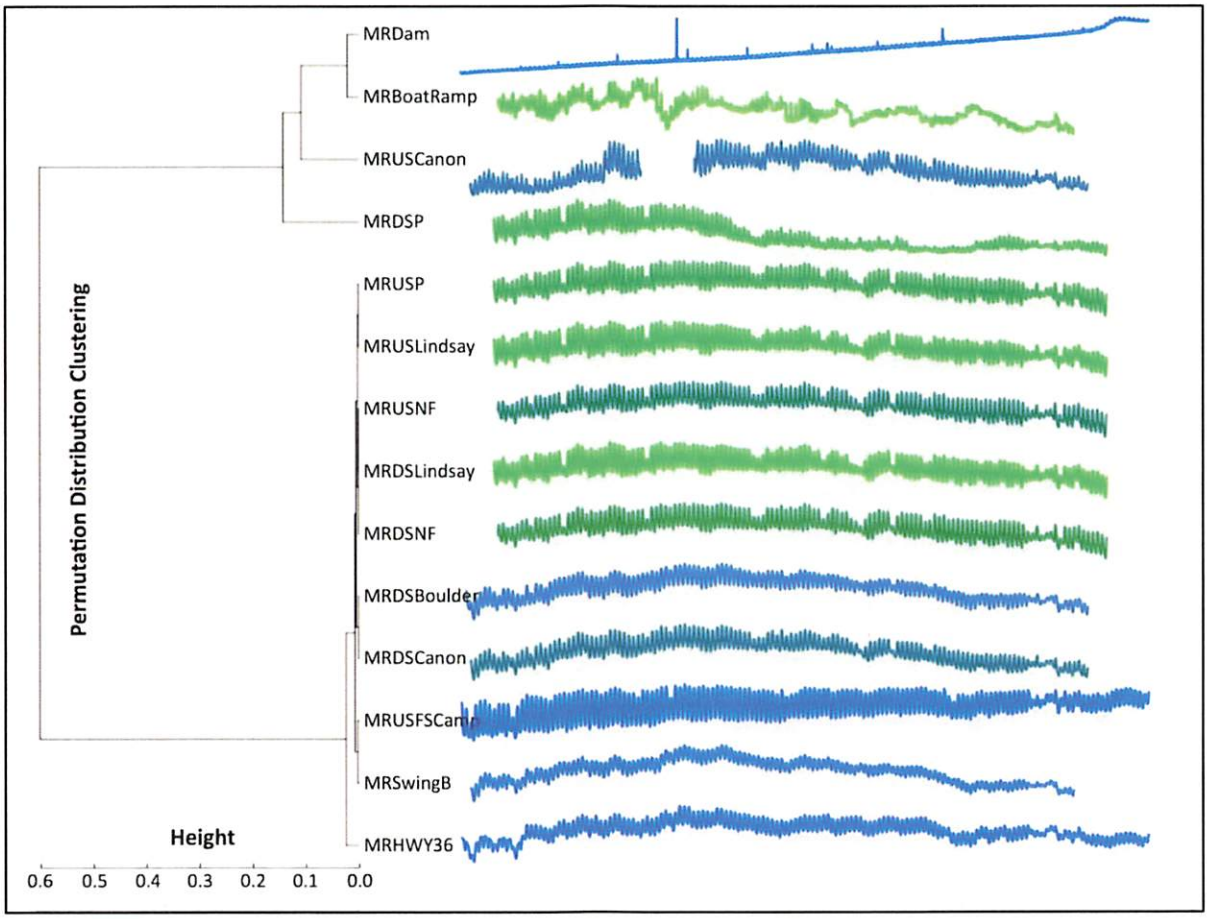

Figure 5. Permutation Distribution Clustering (PDC) of Mad River Mainstem Temperature Time Series (May 1–September 26, 2018) Showing their Relative Similarity
Note: Colors range from blue to light green, with the bluest colors from the highest elevation sites

3.2.2.2 Cross Correlation Functions

To further explore the potential effects of upstream sites on lower portions of the river and determine the predictive power of these observations, we used CCF to relate pairs of temperature time series. We tested the Matthews Dam (MRDam) time series against three downstream sites (Figure 13). Because of the apparently unusual series presented by the Matthews Dam data, we also used the MRUSFSCamp time series as the standard, but no pairs evolve concurrently, probably due to non-stationarity of the time series, and the sum of all autocorrelation functions (acf) for each analysis approaches 0 (Figure 13). We anticipated that the lag would correlate with the site separation in RMs, but no such relationship was detected.

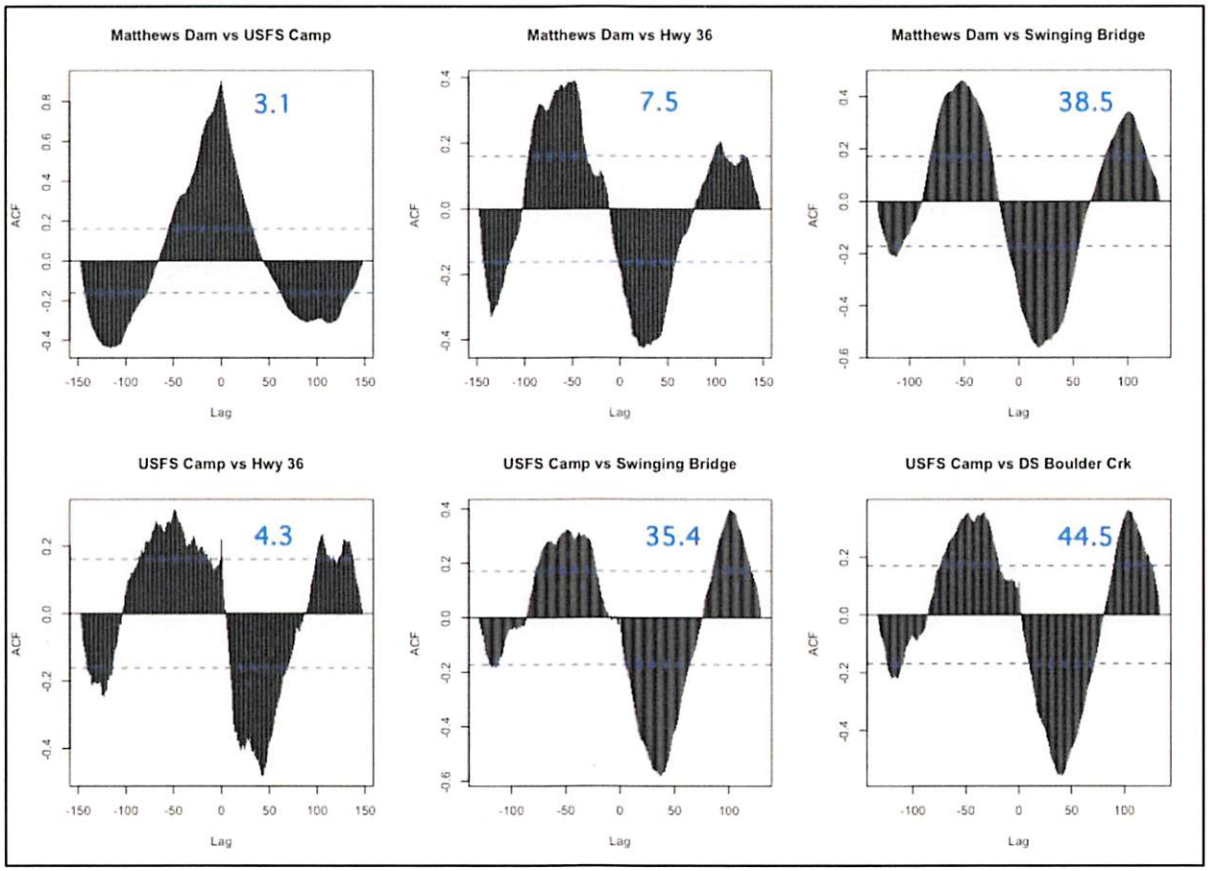

Figure 6. Autocorrelation and Lag in Upstream-Downstream Pairs of Time Series
Note: River miles separating pairs of sites are shown in blue. ACF= autocorrelation function, USFS Camp=MRUSFSCamp, Matthews Dam=MRDam, Hwy 36=MRHWY36, Swinging Bridge=MRSwingB, DS Boulder Crk=MRDSBoulder.

3.2.2.3 Modeling

We initially used lagged linear regression to model the relationship between mainstem water temperatures and multiple explanatory variables. This approach was selected based on published estimates of delayed events in comparable river systems; however, this approach was unsuccessful, leading to the use of CCF (discussed above). The CCF results suggested that hysteresis (e.g., lag) was probably not a strong factor, and led to the switch to a standard linear regression approach. Modeling efforts were focused on mainstem water temperatures in the middle and upper reaches of the Mad River, where water quality issues appeared to be most critical. We selected MRSwingB for the middle reach and MRHWY36 for the upper reach. The explanatory variables used in the initial models were middle and upper air temperatures (noon only); water temperatures from the MRDam site (3:00 p.m. only), the dam tailrace, and Ruth Lake; and the dam discharge rates supplied by the District. We chose a single temperature value from each day available to avoid the potential confounding effects of diel fluctuations and selected the time of day when these values were likely to be near their maximum.

The regression models with temperatures in the middle reach (MRSwingB) and upper reach (MRHWY36) as the dependent variables were not able to resolve the changing seasonal conditions (peaking summer air temperatures) and the steady increase in the dam discharge temperatures, despite the application of ARIMA errors. The progression of temperature profiles that were identified with the permutation distribution clustering (Figure 12) appeared to be a result of the reduction in the influence of dam discharge temperatures as the downstream distance increased, as well as the increased influence of ambient air temperature and other environmental factors. Mainstem water temperatures in the upper reach at MRUSFSCamp, which was 3.2 RMs below Matthews Dam, were strongly affected by the temperature of the discharged water and, to a lesser extent, by local air temperatures; these relationships were successfully modeled (Table 15). Even this close to Matthews Dam, however, retention of discharge volume in the models was never strongly supported, and therefore it is not possible to evaluate the effects of change in discharge on water temperature with the model given the available data.

Table 2. Multiple Linear Regression with ARIMA Errors, Relating Mad River Mainstem Water Temperatures at the MRUSFSCamp Site in the Upper Reach to Temperatures at Matthews Dam and Air Temperatures Recorded at the Upper Reach

Residuals				
Min	**1Q**	**Median**	**3Q**	**Max**
-1.00693	-0.20120	-0.03405	0.19353	1.28234
Coefficients				
	Estimate	**Std. Error**	**t value**	**Pr(>|t|)**
(Intercept)	6.172110	0.776089	7.953	4.88e-13 ***
MRDam	0.443359	0.024024	18.455	< 2e-16 ***
Tailrace	0.295129	0.030162	9.785	< 2e-16 ***
UpAir	0.130033	0.006452	20.153	< 2e-16 ***
Model Fit				
Residual standard error	0.399 on 144 degrees of freedom*			
Multiple R-squared	0.9693	Adjusted R-squared	0.9686	
F-statistic	1513 on 3 and 144 DF	p-value	< 2.2e-16	

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

*36 observations deleted due to missingness

Model: USFS ~ MRDam + tailrace + UpAir

Because of the importance of discharge levels to the management of this river system, we ran multiple models again using data from June 1 to October 31 only, when dam release was entirely controlled by the District (e.g., no spill was occurring) and showed the greatest variance. Because of the comparatively extended period during late summer and early fall when dam releases were low and fairly constant, we anticipated that the greater variability in discharge volume and a quasi-monotonic increase in mean air temperature during this period would permit detection of a discharge volume effect, but the results were essentially the same: ambient air

temperature and the temperature of the discharged water were far more important to the model outcome than discharge rates in determining mainstem water temperature (Figure 14).

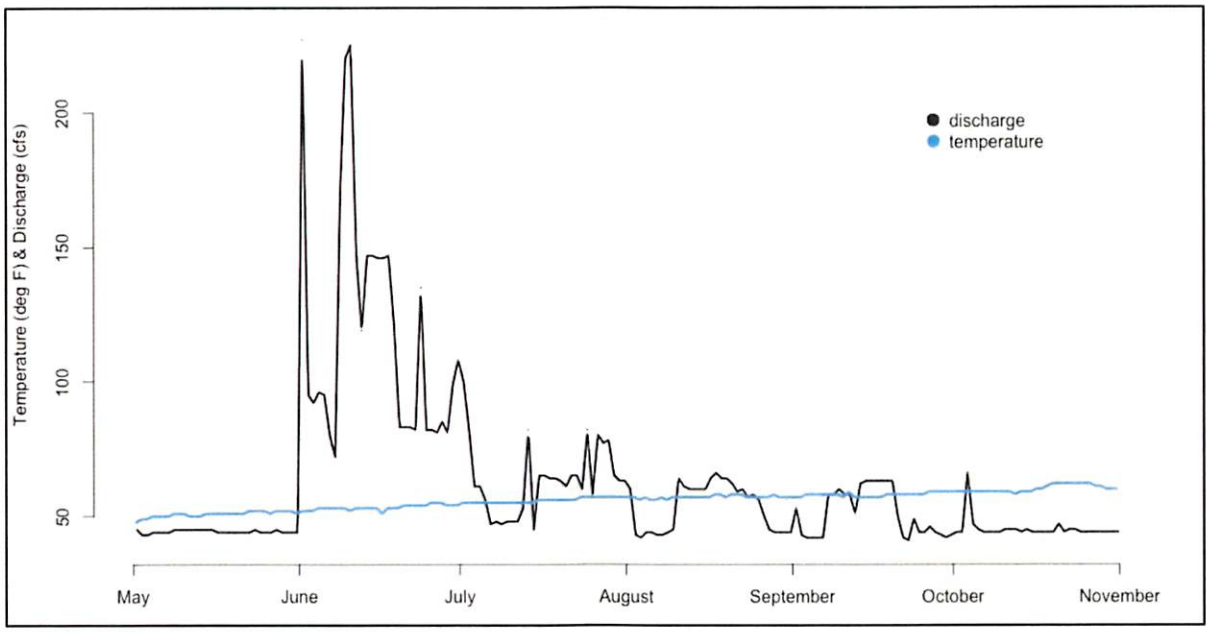

Figure 7. Time Series (June 1–October 31, 2018) of Matthews Dam Discharge Rates (Black) and Water Temperature at the Tailrace (Blue) (Daily Values)

The warmest water temperature recorded during the 2018 monitoring was 76.4°F at MRUSCanon in the lower reach on June 27. The coolest water temperature recorded during the 2018 monitoring was 47.1°F at MRUSFSCamp in the upper reach on May 4. Effects on mainstem water temperatures attributable to discharge temperatures diminished with distance downstream from Matthews Dam (Figure 15); these are discernable at MRHWY36 (7.5 RMs below the dam), but are no longer detectable under the conditions observed at MRSwingB (RM 41.6). Thus, the upper reach is influenced by discharge water temperatures, but not the middle or lower reaches. Figure 15, which includes representative sites from the lower (Mad River downstream of North Fork [MRDSNF], Mad River downstream of Boulder Creek [MRDSBoulder]), middle (MRSwingB), and upper (MRHWY36, MRUSFSCamp) reaches, clearly illustrates these results.

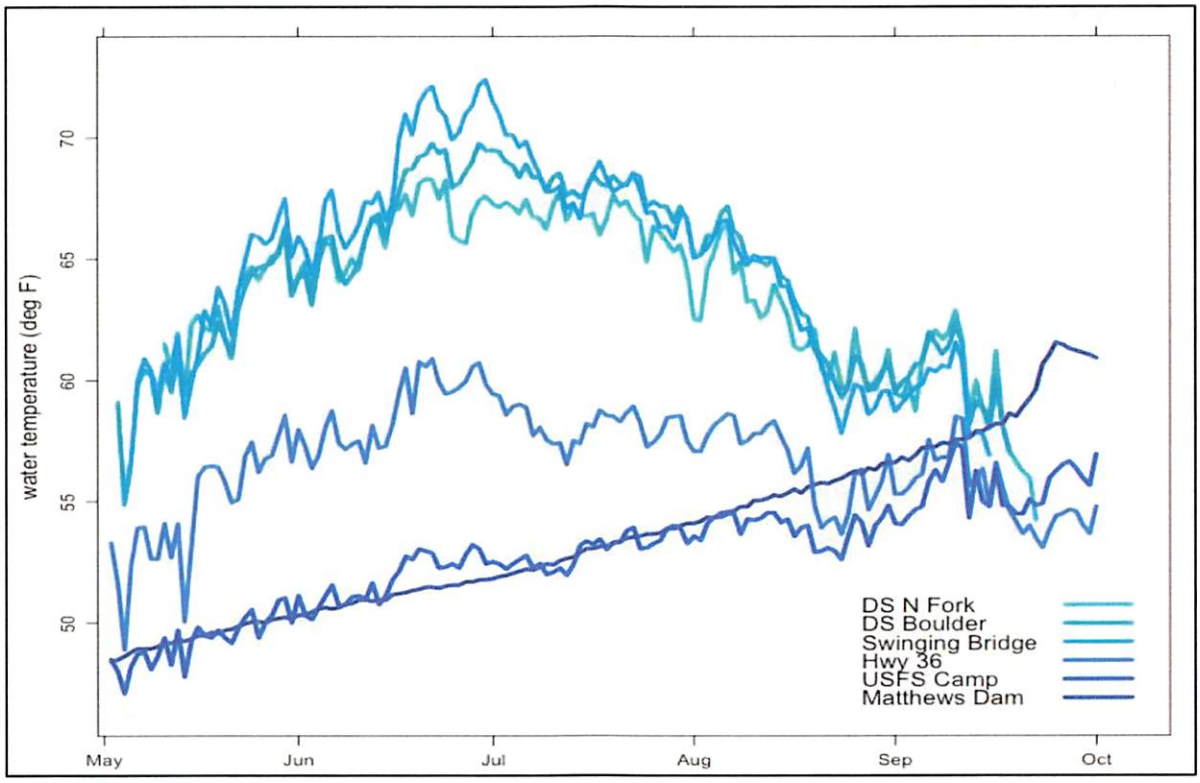

Figure 8. Lower Reach of the Mad River (DS N Fork, DS Boulder) and the Middle Reach (Swinging Bridge RM 41.6) had Similar Temperatures
Note: Here, daily values only, distinctly warmer than those recorded from the Upper Reach (Hwy 36, USFS Camp, Matthews Dam). Matthews Dam=MRDam, USFS Camp=MRUSFSCamp, Hwy 36=MRHWY36, Swinging Bridge=MRSwingB, DS Boulder=MRDSBoulder, DS N Fork=MRDSNF.

3.2.2.4 Temperature Indices

Tributaries to the lower Mad River (e.g., Widow White, Warren, Lindsay, and Powers Creeks) had MWAT and MWMT values that were consistently lower than the mainstem Mad River and contributed cooler water to the mainstem, as evidenced by slightly lower MWAT and MWMT values upstream and downstream of Warren, Lindsay, and Powers Creeks (Table 15). MWAT and MWMT temperatures in the mainstem were coolest downstream of Matthews Dam, and warmest in the middle and upper reaches (Table 15).

Table 3. Water Temperature Indices (Maximum Weekly Average Temperature [MWAT], Maximum Weekly Maximum Temperature [MWMT] in Degrees Celsius) at Monitoring Sites on the Mad River

RM	ID	Reach	Category	Name	MWAT	MWMT
0.7	WWCK	E	TR	Widow White Creek	13.6	14.1
3.1	MRBoatRamp	E	MS	Mad River Boat Ramp	21.2	23.1
9.5	WarrenCK	LR	TR	Warren Creek	14.2	14.6

RM	ID	Reach	Category	Name	MWAT	MWMT
10.3	MRDSLindsay	LR	MS	Mad River downstream of Lindsay Creek	20.8	23.9
10.3	LindsayCK	LR	TR	Lindsay Creek	17.1	17.4
10.4	MRUSLindsay	LR	MS	Mad River upstream of Lindsay Creek	21.2	24.5
12.4	MRDSP	LR	MS	Mad River downstream of Powers Creek	20.4	23.8
12.4	PowersCreek	LR	TR	Powers Creek	14.2	15.9
12.4	MRUSP	LR	MS	Mad River upstream of Powers Creek	21.7	25.3
13.7	MRDSNF	LR	MS	Mad River downstream of North Fork	22.1	25.5
13.7	NF	LR	TR	North Fork Mad River	17.4	19.3
13.9	MRUSNF	LR	MS	Mad River upstream of North Fork	22.8	26.3
19.6	MRDSCanon	LR	MS	Mad River downstream of Cañon Creek	22.9	25.6
19.6	Canon	LR	TR	Cañon Creek	15.2	16.5
19.6	MRUSCanon	LR	MS	Mad River upstream of Cañon Creek	21.6	24.0
31.2	MRDSMC*	LR	MS	Mad River downstream of Maple Creek	NA	NA
31.3	MapleCreek	LR	TR	Maple Creek	16.4	18.2
31.3	MRUSMC*	LR	MS	Mad River upstream of Maple Creek	NA	NA
32.6	MRDSBoulder	MR	MS	Mad River downstream of Boulder Creek	22.8	24.9
32.6	BoulderCreek	MR	TR	Boulder Creek	18.4	20.5
32.6	MRUSBC*	MR	MS	Mad River upstream of Boulder Creek	NA	NA
41.6	MRSwingB	MR	MS	Mad River at Swinging Bridge	23.3	24.9
72.7	MRHWY36	UR	MS	Mad River at Highway 36 Bridge	17.1	18.9
77.0	MRUSFSCamp	UR	MS	Mad River at USFS Campground	14.7	16.5
80.2	MRDam	UR	MS	Mad River at Matthews Dam	16.3	16.5

RM is river mile, ID is the site code, and Reach identifies each site as estuarine (E), lower reach (LR), middle reach (MR), or upper reach (UR). Name provides the site name with some location information. NA= not applicable. Note: Conversion from degrees Celsius to Fahrenheit is F = (Cx9/5) +32

* HOBO temperature logger lost or stolen from this site; no data recovered.

3.2.2.5 Turbidity and Other Factors

The Mad River was added to the California Clean Water Act Section 3030(d) impaired water list in 1992, partially due to elevated turbidity levels (Stillwater Sciences 2010). Turbidity, a measure of water opacity due to suspended solids, is an important factor in water quality assessments, and has demonstrable effects on salmonid ecology (Fellman et al. 2015, McElroy et al. 2018). The Mad River Watershed Assessment (MRWA) report (Stillwater Sciences 2010) noted that "mainstem sites showed a downstream increase in turbidity...with the highest values measured at Mad River near Arcata." The MRWA also reported that tributaries in the middle and lower reaches of the Mad River are the principal contributors to elevated mainstem turbidity levels and that the "Ruth Lake Reservoir reduces peak turbidity downstream of the dam but prolongs the event by slowly releasing turbid water" (Stillwater Sciences 2010). Data available for our report was limited to 2018 District measurements of Mad River turbidity at the dam tailrace. Turbidity at the tailrace ranged from a maximum of 13.84 nephelometric turbidity units (NTU) (May 1) to a minimum of 1.35 NTU (October 21) during the 2018 monitoring period (Figure 16). Turbidity increased in the fall in response to the first fall rain event (Figure 17).

The multiple linear regression analysis suggested that temperature at the dam tailrace is negatively correlated with turbidity at the same location (not a causative relationship); discharge fit the model reasonably well (adjusted R^2=0.54) but the relationship is weak (Table 16, Figure 17).

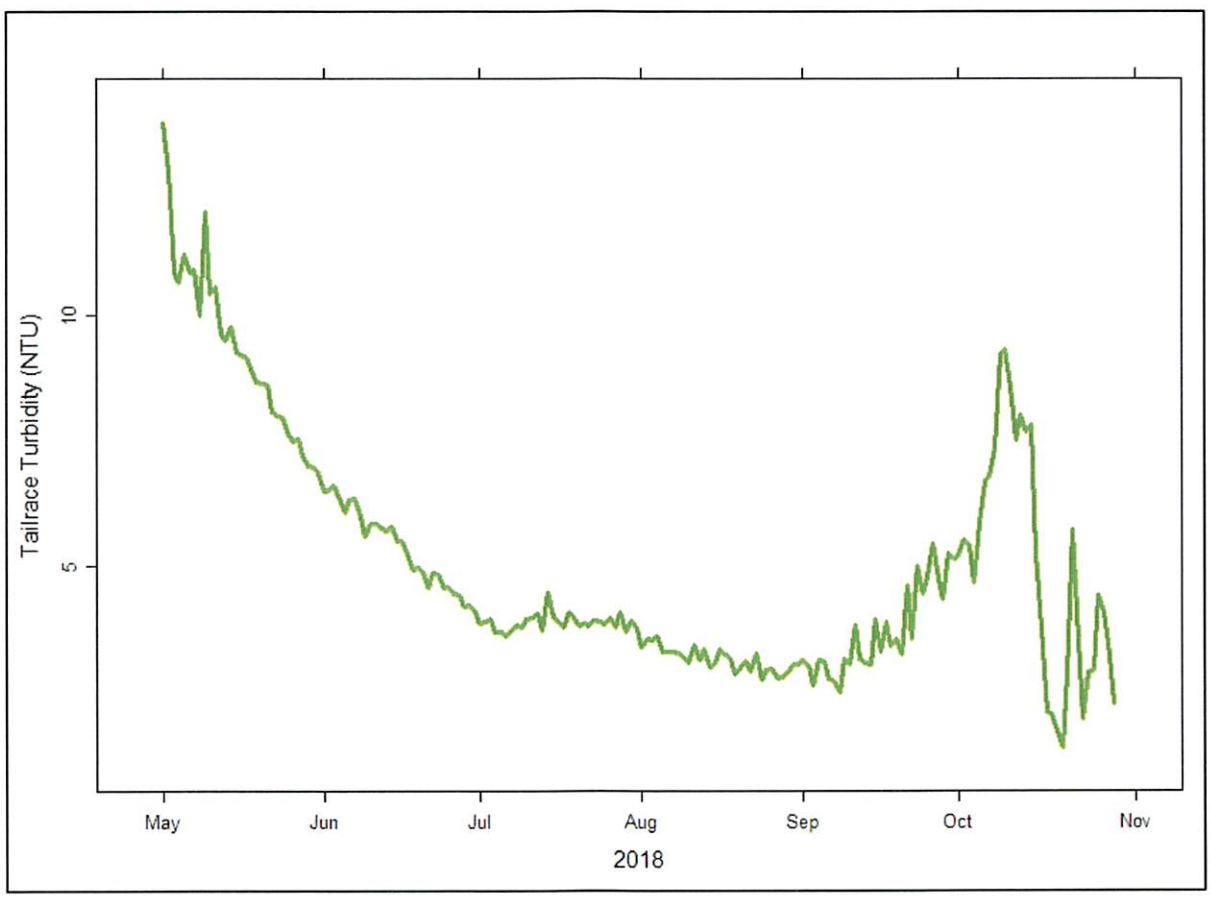

Figure 9. Turbidity Measurements at Matthews Dam (Daily Values)

Table 4. Linear Regression Model Output Relating Turbidity to Water Temperature and Discharge at the Matthews Dam Tailrace

Residuals				
Min	**1Q**	**Median**	**3Q**	**Max**
-2.4654	-1.0940	-0.6566	0.4176	5.8590
Coefficients:				
	Estimate	**Std. Error**	**t value**	**Pr(>|t|)**
(Intercept)	21.911302	3.103333	7.061	3.43e-11 ***
temperature	-0.333805	0.051566	-6.473	8.73e-10 ***
discharge	0.028703	0.005098	5.630	6.77e-08 ***
Model Fit				
Residual standard error	1.662 on 181 degrees of freedom			
Multiple R-squared	0.5495	Adjusted R-squared	0.5445	
F-statistic	110.4 on 2 and 181 DF	p-value	< 2.2e-16	

Significance codes: 0 '***'; 0.001 '**'; 0.01 '*'; 0.05 '.' 0.1 ' ' 1

Model: turbidity ~ temperature + discharge

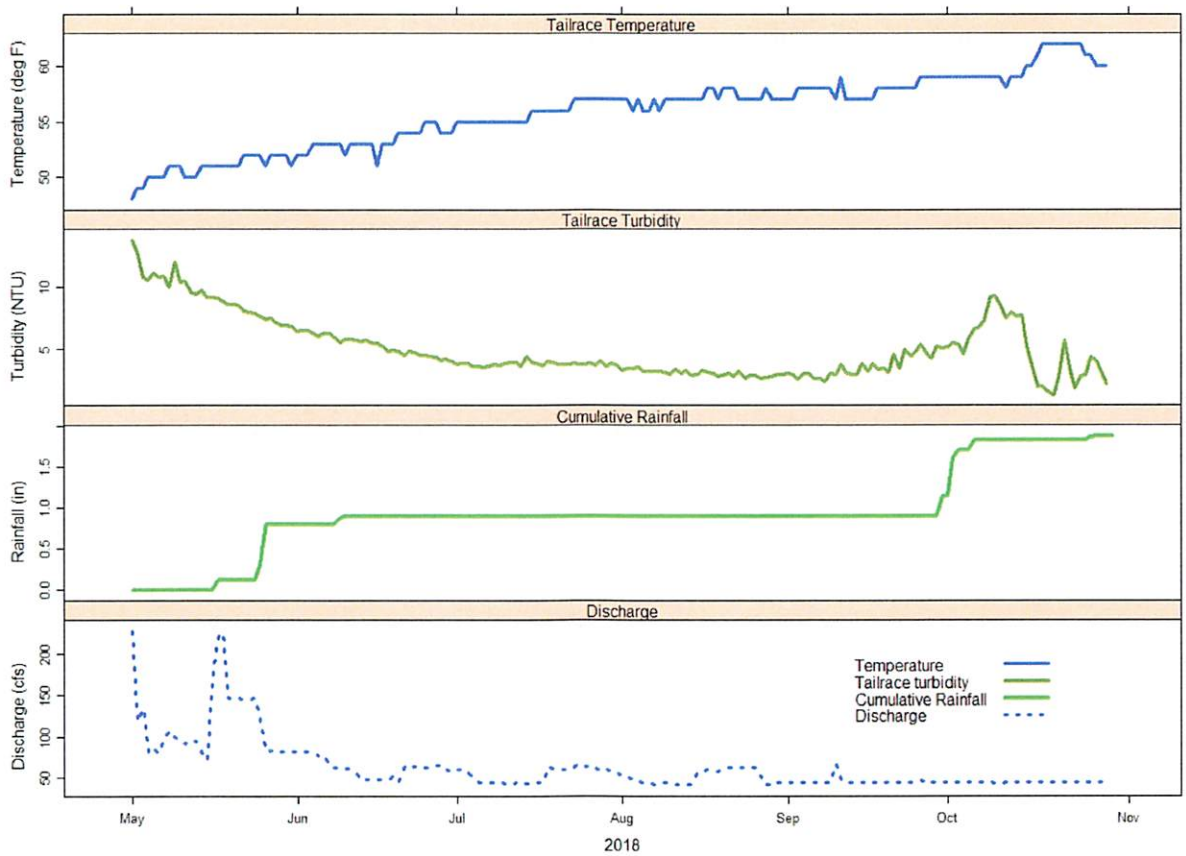

Figure 10. Temperature, Turbidity, Rainfall and Discharge Volume at Matthews Dam (Daily Values)

3.3 Discussion

Summer temperatures in the mainstem Mad River, especially downstream of the upper reach, continued to remain at levels considered "stressful" for salmonids, based on temperature thresholds developed for specific life stages (Stillwater Sciences 2010, Carter 2008). Summer high temperatures can limit distribution and growth of rearing juvenile coho salmon and steelhead (Carter 2008). MWMT values considered limiting for rearing juvenile coho salmon are generally 18.1 or greater, and MWAT values above 16.8 may preclude juvenile coho salmon from rearing in streams (Carter 2008). Many of the tributaries to the lower Mad River had MWAT and MWMT levels below those considered stressful or limiting, and their cooler water contributions to the mainstem Mad River may provide relief (e.g., locally decreased temperatures) for juveniles rearing in the mainstem. MWAT values for rearing juvenile steelhead are considered to be stressful above 19 (i.e., higher than for coho salmon), as are MWMT values above 24 (Carter 2008). The mainstem temperatures were warmer than these thresholds for steelhead in the middle and lower reaches but suitable in the upper reach, likely due to the

cooling contribution of discharge from Matthews Dam even though summer air temperatures were highest in the upper watershed.

For the 2018 monitoring period, it appeared that temperature effects attributable to dam discharges did not extend far downstream, but did exert an influence at least 7.5 RMs downstream to MRHWY36 (Figure 8). The greatest change in the temperature profiles was observed in the river segment between temperature loggers at RMs 41.6 and 72.7: in this river segment, the channel gradient is the steepest (Figure 1) and a series of boulder falls occurs on the mainstem between Bug Creek and Deer Creek (RMs 50–53) that blocks upstream access for anadromous salmon and in many years, for most steelhead (Stillwater Sciences 2010). However, groundwater and hyporheic influences in the mainstem Mad River may affect local water temperatures (Pounds pers. comm. 2019), which may be important for summer steelhead that hold over the summer. Future efforts to monitor water temperatures should include sites in this difficult-to-access area[3] between RMs 41.6 and 72.7: this portion of the Mad River includes particularly important habitat where summer steelhead hold (RMs 41.6–48.8) (Pounds pers. comm. 2019, Naman et al. 2014).

Foothill yellow-legged frog oviposition typically begins in the beginning of May and continues to mid-June when stream temperatures are at least 50°F. In 2018, mainstem water temperatures were generally above 50°F after May 1: colder temperatures were only recorded once at the MRUSFSCamp in early May, and none were detected downstream of that site. Upstream of the MRUSFSCamp site, temperatures never fell below 50°F after mid-June. Therefore, discharge temperatures have the potential to shift suitable early-season reproductive conditions for the foothill yellow-legged frog to later in spring, based on the 2018 monitoring data and our modeling results, in the 3–4 RMs below Matthews Dam.

[3] Access is difficult due to the terrain and private land holdings.

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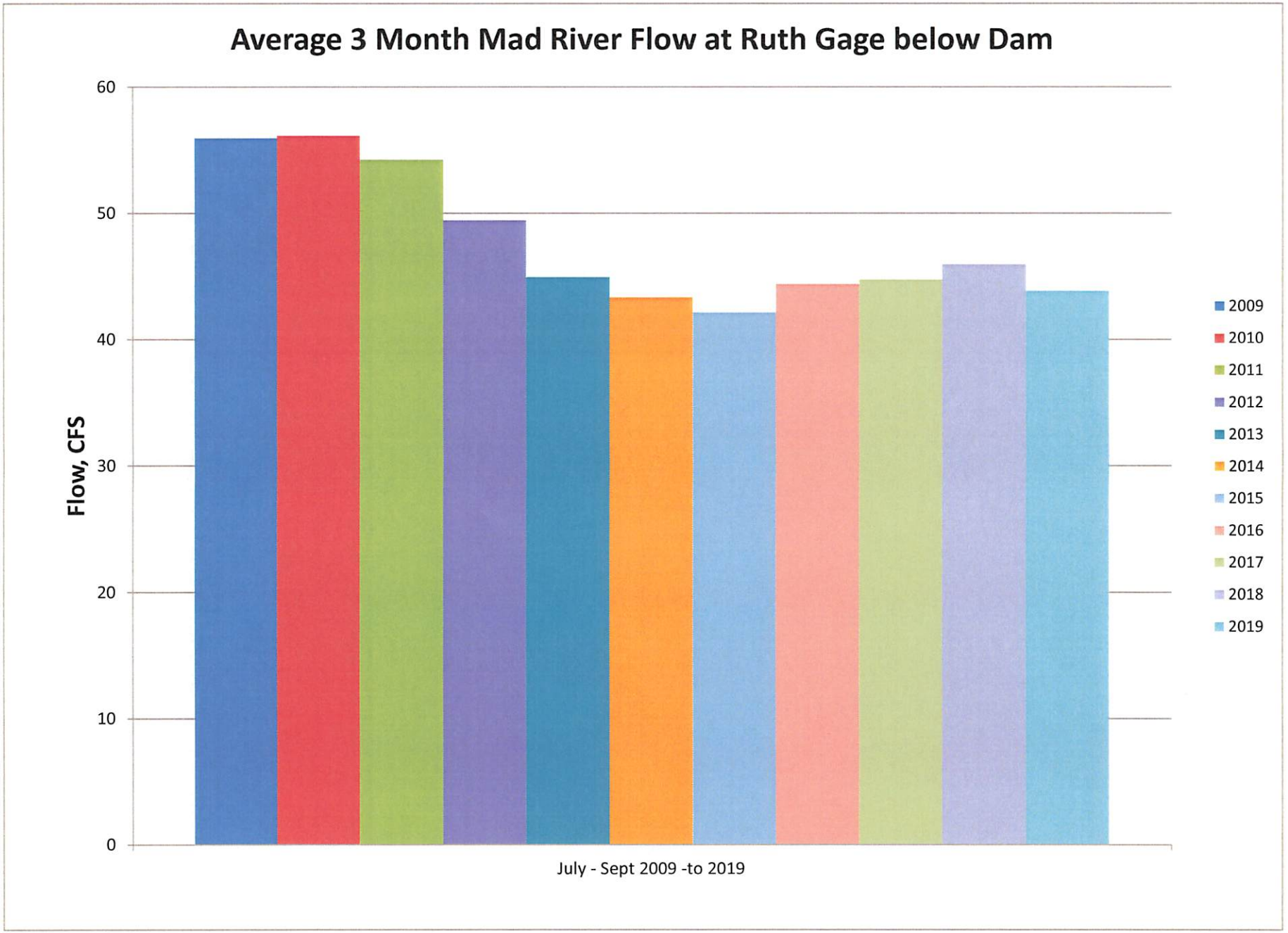

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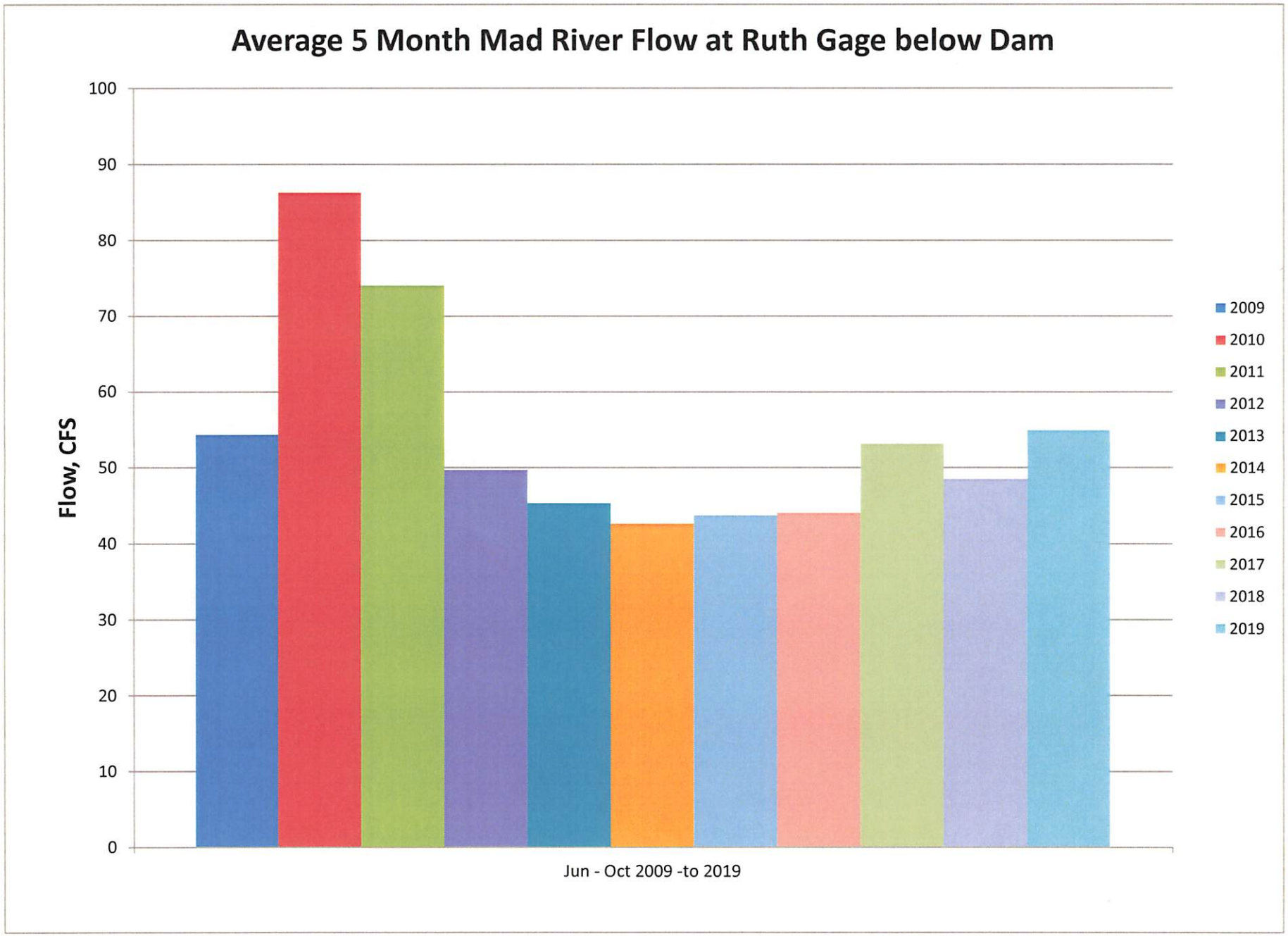

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Humboldt Bay Municipal Water District
Urban Water Management Plan
2015

Humboldt Bay Municipal Water District
828 Seventh Street
Eureka, CA 95501

June 9, 2016

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DWR also said in the report that the mean seasonal runoff of the Mad River as measured at Arcata at the time (1958) was 750,000 AFY, which is far more than the District's permitted 84,000 AFY and the actual projected water demands from its customers as shown in Table 7-4 W.

The U.S. Army Corps of Engineers also discusses the mean seasonal runoff of the Mad River in their 1968 report titled, "Interim Review Report for Water Resources Development, Mad River, California." The report states that the variation in annual runoff has ranged from a low of 280,000 AFY in the lowest year recorded at the time, to a high of 1,746,000 AFY in the year of the highest runoff recorded at the time. It also states that the minimum five-year average annual runoff was 650,000 AFY. These average annual runoff amounts show that the District has ample supply to support its customer demands. The report also describes the local climate in that it is typical of coastal areas of California with a large percentage of the rainfall occurring during major storms during the winter months of November through March. It reports that the average annual precipitation over the basin ranges from about 40 inches along the coastal plains to more than 70 inches in the central part of the basin, with an estimated basin average of approximately 63 inches.

In 1977, Winzler and Kelly Engineering did a drought deficiency analysis of R.W. Matthews Dam with then current data (including the drought of 1977) and determined the safe yield to be approximately 67 MGD (75,040 AFY), 8 MGD less than projected by Bechtel. Although the safe yield projected by Winzler and Kelly was slightly less than the one projected by Bechtel Corporation, it still far exceeds the District's current and projected demands from its wholesale customers (Table 7-4 W).

Furthermore, the results from the above studies by DWR, U.S. Army Corps of Engineers, Bechtel Corporation, and Winzler and Kelly Engineering are supported by the District's historical data. From the District's historical data, on average, Ruth Lake begins the water year on October 1 with approximately 31,000 AF of water, 64% of its 48,030 AF capacity. Most rainfall in the area occurs between November and April. In every year but one since 1969, there has been at least one large storm during this period, bringing 3 to 9 inches of rain over a seven-day period. This is almost always sufficient to fill the reservoir to capacity. There has only been one water year (1976/77) in which the reservoir was not filled to capacity. The average reservoir volume on May 1 (the end of the usual rainy season) is approximately 47,700 AF, over 99% of capacity. This storage allows the District to supplement low flows until the rains begin again in the fall. Seasonal or climatic shortages are only likely to occur after two consecutive rainy winter seasons with severely reduced rainfall and runoff (well below 50% of normal). This has not happened in the history of the District.

8 Water Shortage Contingency Planning

8.1 Plan Overview and Coordination

8.1.1 Overview

HBMWD is a regional water wholesaler and is capable of delivering both potable water (through its Domestic Water System) and untreated surface water (through its Industrial Water System).

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The District delivers potable water to seven municipalities via its Domestic Water System, who in turn serve the residents, businesses, and industries in the greater Humboldt Bay region. The seven municipalities include the City of Arcata, City of Blue Lake, City of Eureka, Fieldbrook-Glendale CSD, Humboldt CSD, Manila CSD, and McKinleyville CSD. Retail water service is provided to less than 200 customers who are generally located closer to the District's transmission system than to any other municipal water service. The District's Domestic Water System is capable of supplying approximately 20 million gallons per day (MGD) of treated drinking water. Current production of treated drinking water for municipal purposes averages approximately 10 MGD. This municipal use includes residential, commercial, industrial, and agricultural uses of the water. Per capita water use rates in this region are low and likely benefit greatly from the moderate climate and abundant rainfall, as needs for agriculture and landscaping are often met with rainfall rather than municipal water.

The District's Industrial Water System is separate and distinct from its Domestic Water System and has been used for supplying untreated surface water to industrial customers. This Industrial Water System is capable of supplying 60 MGD of untreated water. The District has delivered untreated water to two large industrial customers (pulp mills) for the majority of the time since the 1960s. However, one of the pulp mills closed in the 1990s, and the remaining pulp mill ceased operation in 2009. With no existing industrial customers, the District has the capability of supporting future water supply needs, which they are currently exploring.

Wholesale water is provided to the District's customers under long-term contracts. These contracts specifically assert the District's right, in accordance with the California Water Code, to suspend the water delivery requirements of the contracts if the District's Board declares that an actual or potential water shortage exists, or if all wholesale customers and the District mutually agree to implement the Water Shortage Contingency Plan (plan). During the 1976-77 drought, which was the only declared water emergency in the history of the District, it was the policy and practice of the District to set maximum use targets for its wholesale municipal customers, allowing them to choose how to meet those targets. Since the wholesale industrial customers could not operate effectively at significantly reduced water consumption levels, they were required to repair leaks and increase the efficiency of their water use. A reservoir capacity was set at which all deliveries to the industrial customers would cease. Fortunately, capacity did not fall to that level. The current plan operates on these principles. The municipalities retain responsibility for control of allotments provided under the provisions of the plan. Any potential wholesale industrial customers will face the reductions outlined in each action stage, and the District's approximately 200 retail customers will be treated in accordance with the action stages of the plan.

The water that HBMWD provides to its customers, both domestic and industrial, ultimately comes from the Ruth Lake Reservoir and the Mad River watershed located below R.W. Matthews Dam at Ruth. The reservoir was design for a safe yield of 75 MGD per year, using the 1923-24 drought of record. To calculate the safe yield of the reservoir, the original Bechtel design report used the "Mad River runoff during the period October 1922 to September 1954...using available short term flow records at the Forest Glen and Arcata gaging stations, supplemented by the long term records for the Eel River at the Scotia gaging Station." After the 1976-77 drought, which was the only declared water emergency in the history of the District, the safe yield value of 75 MGD came into question and Winzler & Kelly re-evaluated the safe yield of the reservoir based on the '76-'77 drought data. That study came up with a safe yield of 67 MGD of the reservoir. That study was also hampered by

the lack of accurate inflow data from above Ruth Lake. The recent drought (2013-2015) caused the District to revisit this safe yield value as further detailed in Section 8.2.

8.1.2 Coordination

Coordination in implementing this Water Shortage Contingency Plan is assured through the activation of the Water Task Force. The first task force was formed in 1977. This task force would be convened as necessary to address drought conditions or other significant events which could result in a supply shortfall. It is composed of representatives of the District and each of its wholesale customers. The committee's responsibilities include:

1. Review the status of the water supply and forecasts.
2. Recommend specific actions in accordance with this plan and each entity's own water shortage plan.
3. Assure that priority of allocations meets legal requirements of consistency and non-discrimination.
4. Coordinate media releases and public announcements.
5. Coordinate interaction with regulatory agencies such as the California Department of Water Resources, Fish and Wildlife, and California Department of Public Health.
6. Review and make recommendations about requests for waivers from, or exceptions to, actions taken pursuant to this plan.

8.2 Safe Reservoir Yield During a Drought

A Rippl mass diagram can be used to plot the cumulative inflow to the reservoir against time for the drought of record to assist in determining safe yield from the reservoir during an extended drought. The inflow and resulting cumulative storage volume can then be compared to the cumulative storage required for various draft (demand) rates to establish a maximum, constant draft rate that could be achieved over the course of the drought planning period (in this case, four consecutive years of drought).

The development of a Rippl mass diagram for this analysis incorporates the following assumptions:

- The reservoir begins full with 48,030 acre-ft of water on May 17 (based on the drought of record, the time period from May 1976 to November 1977);
- Inflow to the reservoir during the drought of record can be repeated multiple times to extend the 1-year drought to a 4-year planning period;
- The total inflow to the reservoir can be estimated by scaling the inflow at the Zenia Bridge gage station by a factor equal to the ratio of watershed area contributing to the gage station site to the watershed area contributing to the reservoir spillway (1.2 or 121 mi^2/93.8 mi^2);
- Evaporative losses can be estimated based on reservoir levels during the drought of record;
- Demand is taken directly from the reservoir (i.e. there are no contributing flows downstream of the reservoir).

The drought of record storage was determined using Equation 1.

$$S_i = S_{i-1} + I \quad \text{(EQ-1)}$$

where:
S_i = Storage (MG)
i_{1-730} = Time Step (day)
I = Net Inflow (MG)

$$where: I = \left(I_{zenia} * \left(\frac{121mi^2}{93.8mi^2}\right) - Evap\right)$$

Cumulative storage required for draft rates were determined using Equation 2.

$$S_i = S_{i-1} + D \quad \text{(EQ-2)}$$

where:
S_i = Storage (MG)
i_{1-730} = Time Step (day)
D = Demand (MG)

A maximum allowable constant draft rate of 36.5 MGD over the four-year planning period was calculated based on the drought of record inflow (see Figure 6).

The Rippl diagram shows that a maximum constant draft rate of 36.5 MGD could be achieved (reservoir would never be empty) based on the mass budget during the drought of record. This was determined based on the assumption that the inflow to the reservoir and evaporation volumes from the drought of record could be repeated to achieve a 4-year planning cycle. Inflow for the second through fourth years may overestimate the actual inflow that would occur in this period of the drought. Inflow during the second year of drought may be lower than the first year due to decreased runoff/increased soil uptake over the course of the previous year, and the case could be similar for the third and fourth year. However, this overestimation is likely more than offset by the very conservative assumption that the demand is taken directly from the reservoir with no contribution from the watershed below Ruth Lake.

The maximum constant cumulative draft volume comes within approximately 570 MG of cumulative storage volume in February of the fourth drought year. At this point, approximately 15 days of storage remains at the maximum constant draft rate. This storage volume likely falls below the desired planning volume, and in actuality, conservation measures likely would have been implemented to reduce the constant draft and increase storage.

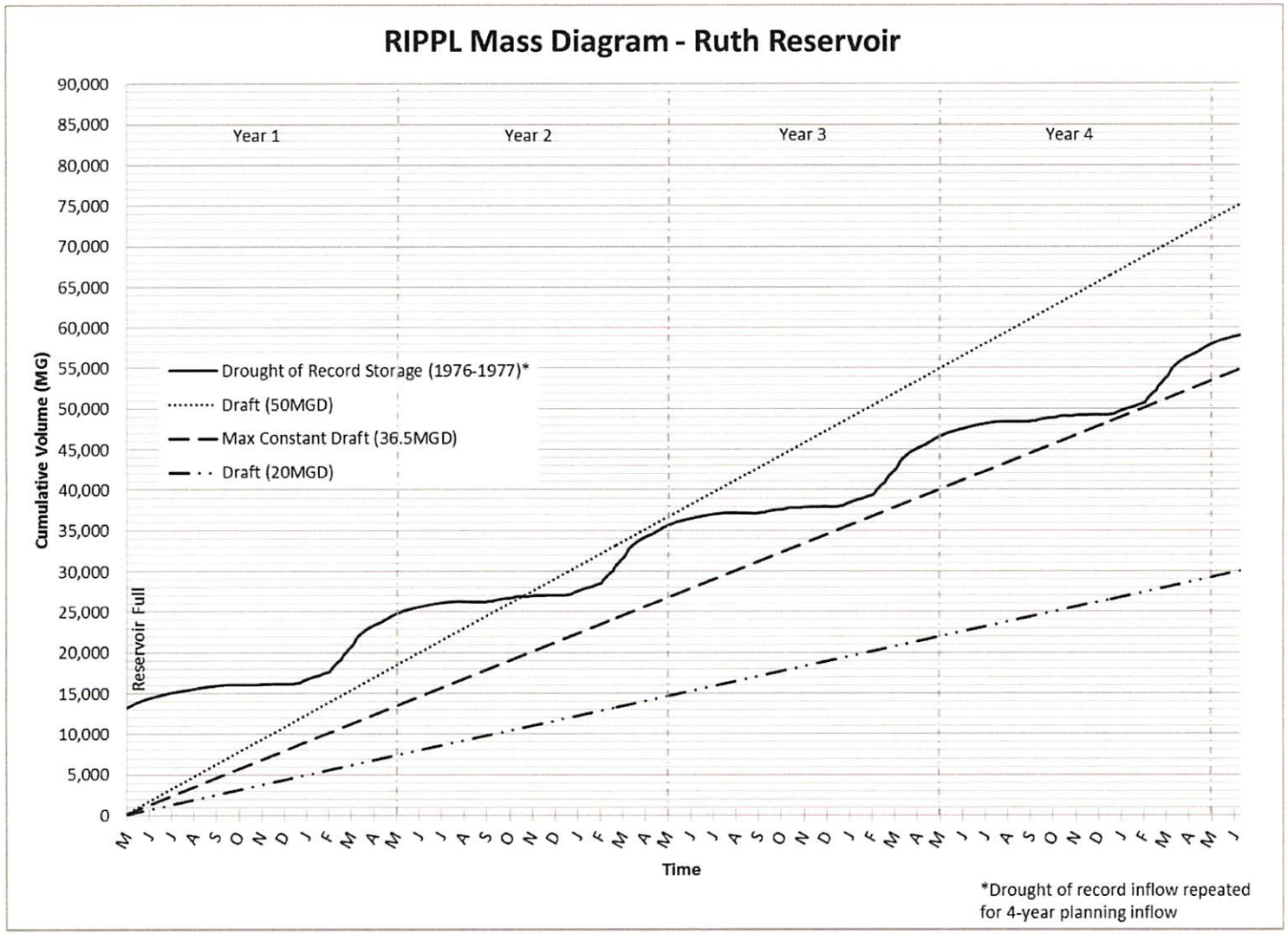


Figure 6. Rippl Mass Diagram

8.3 Stages of Action

There are five defined drought action stages (see Tabl). These stages may be implemented with or without a formal declaration of a water emergency by the District's Board of Directors. In the event circumstances merit or require a declaration of a water shortage emergency, it is the intent of the District to rely on this plan to provide the primary framework to deal with such an emergency. The triggers attached to each stage are not intended to be absolute. Circumstances not currently foreseeable may dictate moving to a higher action stage before the trigger levels for that stage are reached. Conversely, action stage implementation may be postponed or suspended if there is sufficient natural flow in the river to meet downstream needs. Action stages will be terminated, in consultation with the Water Task Force, as rain, runoff, and lake levels permit.

8.3.1 Stages and Conditions

An analysis was performed to develop updated reservoir operating curves and establish "action stages" or "trigger levels" that prompt various responses, dependent upon reservoir levels at various times of the year. The analysis established five drought action stages and associated maximum draft rates in the form of an Operating Curve (Figure). This Operating Curve outlines the specific water supply conditions that are applicable to each stage. Stage implementation will occur as a result of the reservoir level at a given time of year, as shown in Figure. For example, if the reservoir storage level was at 25,000 acre-feet in November, Stage 2 would be implemented.
Portions of water demand that need to be included when considering draft from the reservoir include domestic use, industrial use, and instream flow dedications. The municipalities that HBMWD serves currently use an average of approximately 10 MGD of District water. There are currently no industrial customers; however, there is potential for industrial customers in the future. There is also a minimum of 5 cfs that is to be released from the dam for fish flows. The District's Habitat Conservation Plan and Water Rights permit also establish fish flows that must always be present in the river (see Table 8-1).

Table 8-1: Mad River Flow Requirements for Fish

Period	Flow at Hwy 299 Bridge (cfs)
October 1 – October 15	30
October 16 – October 31	50
November 1 – June 30	75
July 1 – July 31	50
August 1 – August 31	40
September 1 – September 30	30

The flow values given in Table 8-18-1 are the flows that need to be measured at the Highway 299 bridge near the District's operation facilities at Essex, and they do not necessarily reflect flows that need to be released from the reservoir, as there are contributing flows to the Mad River below the reservoir. Furthermore, flows at the Highway 299 bridge are permitted to be as low as the "natural flow" calculation if that value is lower than those given in Table 8-18-1. The District will always maintain the minimum of 5 cfs as required, and has historically endeavored to meet the minimum flows as established in Table 8-18-1 to support healthy fish life. However, it is likely that in the event of a longer-term drought and during periods of the higher conservation Stages being enacted, the District may resort to the natural flow requirement and reduce discharges accordingly.

For the purpose of determining trigger responses, the following assumptions were made:

- The District is operating both its domestic and industrial systems.
- A domestic water delivery of 10 MGD and an industrial water delivery of 40 MGD were used. Although the industrial water system is not currently in use, this assumption accounts for the potential for future industrial water demand. It should also be noted, however, that the Operating Curve is based on total flow released from the reservoir (e.g. in Stage 2, 50 MGD can be released), and this flow can be apportioned based on domestic and industrial water consumption at that point in time.
- Because instream flow dedication requirements vary throughout the year, and can vary depending upon natural flow conditions, these flows were not included. However, flows released from the dam during the various action stages are generally above the flows that are required per Table 8-18-1.

Table 8-2: Drought Triggers Action Table

Stage	Domestic Reduction	Industrial Reduction	Total Percent Supply Reduction	Delivered Water (Municipal, MGD)	Delivered Water (Industrial, MGD)	Total Delivered (MGD)	Maximum Draft (MGD)
1	0%	0%	0%	10	40	50	75
2	5%	5%	5%	9.5	38	47.5	50
3	10%	50%	42%	9	20	29	30
4	20%	70%	60%	8	12	20	20
5	30%	95%	82%	7	2	9	10

The operating curves that were established (Figure 7) give maximum draft rates for each of the five different drought action stages. The conservation action boundaries were developed based on these maximum draft rates, the amount of storage remaining over time at a given draft rate, drought of record (1976-1977) inflow, typical evaporation losses, and common reservoir level trends during the period of record (1969-2013). Throughout the period of record, reservoir levels have generally been lowest from October to January, and highest from March to May. The trigger levels have been established to account for these seasonal variations (e.g. a storage level of 30,000 AF would be in Stage 1 in November, but it would be in Stage 3 in May).

To give a context of historical trends of Ruth Lake storage levels, the reservoir levels during the 1976-1977 drought are also shown on Figure7. The storage during the drought follows the general pattern of the operating curves that have been generated. During the drought, reservoir storage never dropped below 10,800 AF.

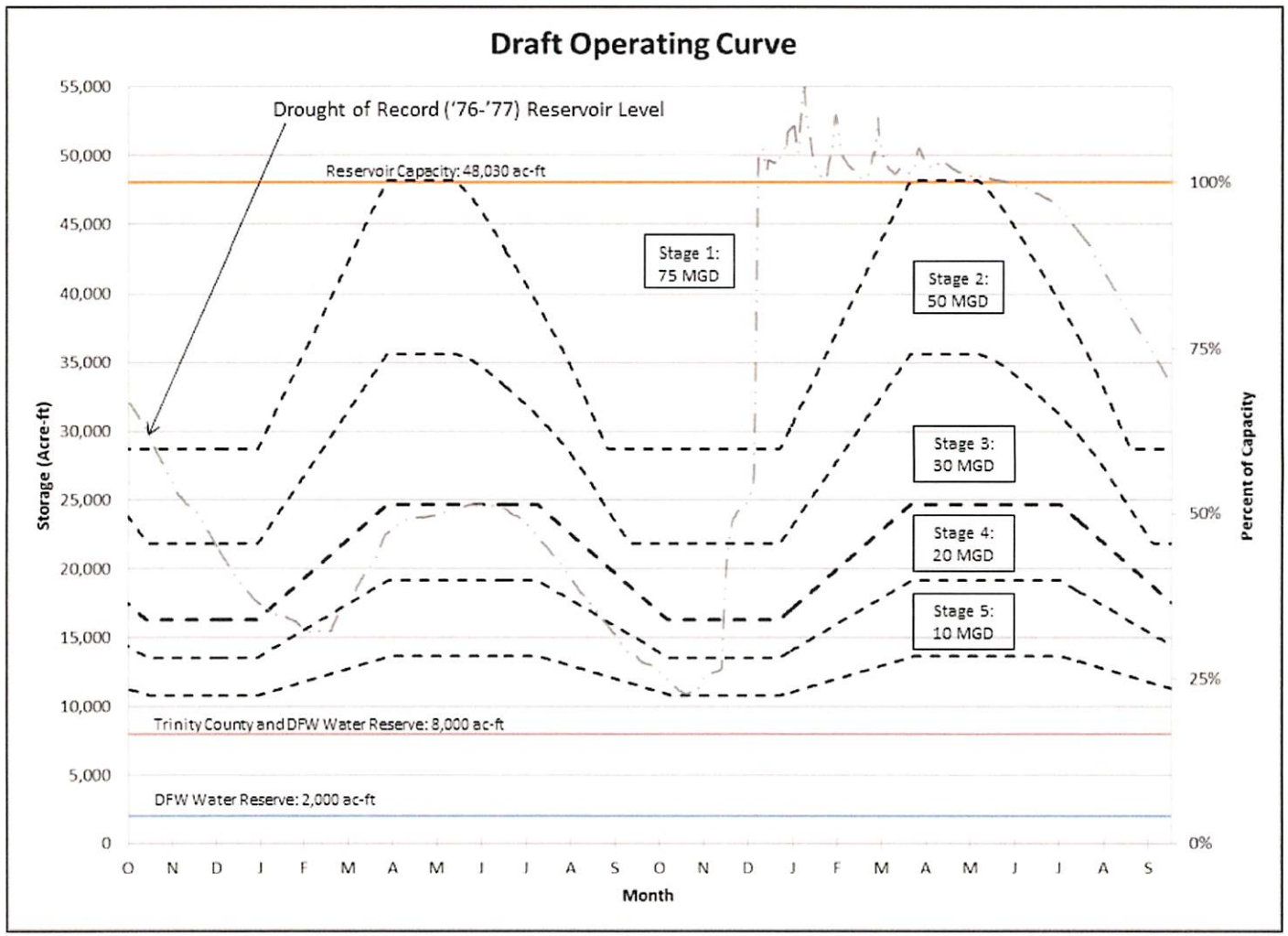


Figure 7: Ruth Lake operating curves

As the District, through its Water Resource Planning efforts, plans to service wholesale industrial water users in the future, the action stages and conditions are given with the assumption that the District is still operating at normal levels prior to loss of its wholesale industrial customers (i.e. 40 MGD is being supplied to industrial customers, and 10 MGD is being supplied to domestic customers). Without wholesale industrial customers, triggering of these stages would not occur as quickly and may not occur at all. Following is a narrative describing the stages given in Tabl in further detail.

Stage 1 – Controlled Release from Storage
If the reservoir level is within the Stage 1 boundaries, only the amount of water needed for instream flow dedication and water supply purposes will be released from the reservoir.

Stage 2 – Optimizing Available Supply
Consideration to implement Stage 2 (50 MGD maximum draft rate) will be triggered when the storage in Ruth Lake falls below the 75 MGD operating curve. Other triggers to be considered for entering into the Stage 2 requirements include are damage to the system by flood, earthquake, or other system failures; and accidental or intentional toxic spills in the supply. The Water Task Force will review the trigger data and make recommendations regarding actual implementation of Stage 2.

In this stage, the draft rate will be limited to 50 MGD or less. Given current water consumption rates, reductions in water delivery may not need to be made to achieve this; however, entering Stage 2 means that awareness needs to be raised and customers need to begin public outreach and education, and potentially voluntary conservation measures. Customers will be notified of potential future reductions, and public education efforts encouraging water conservation should take place. If required, industrial and domestic deliveries will each be reduced by 5% (down to 38 MGD and 9.5 MGD, respectively). Shutting down hydro-electric production should also be considered, as hydro-electric production is incidental to water supply needs and not justification for releases.

Stage 3 – General Reduction
Consideration to implement Stage 3 will be triggered when the storage in Ruth Lake falls below the 50 MGD operating curve. The Water Task Force will review the trigger data and make recommendations regarding actual implementation of Stage 3.

If the reservoir storage level is within the Stage 3 boundaries, the draft rate will be limited to a maximum draft rate of 30 MGD. Based on current demand, domestic use will be reduced by 10% (down to 9 MGD), and delivery to industrial customers will be reduced by 50% (down to 20 MGD). Changes to the specific reduction will be determined on a biweekly basis based on rate of supply reduction, weather, and other relevant factors.

Stage 4 – Usage Allocations
Consideration to implement Stage 4 will be triggered when the storage in Ruth Lake falls below the 30 MGD operating curve. The Water Task Force will review the trigger data and provide input regarding actual implementation of Stage 4.

If the reservoir storage level drops into Stage 4, all of the District's wholesale and retail customers will be required to reduce usage by the amount necessary to limit consumption to 20 MGD. Domestic use will be reduced by 20% (down to 8 MGD), and industrial deliveries will be reduced

by 70% (down to 12 MGD). Furthermore, each wholesale industrial customer will provide certification that water use is being optimized and that wasteful use of water is not occurring. Changes to the specific reduction will be determined on a biweekly basis based on rate of supply reduction, weather, and other relevant factors.

Stage 5 – Rationing

Consideration to implement Stage 5 will be triggered when the storage in Ruth Lake falls below the 20 MGD operating curve. The Water Task Force will review the trigger data and provide input regarding the actual implementation of Stage 5.

If the reservoir storage level reaches Stage 5, the District's wholesale and retail customers will be limited to a total usage of 10 MGD. Wholesale industrial water usage will be limited to the amounts required for human consumption, sanitation, and fire protection. No water will likely be available for industrial processes. Domestic reduction will be approximately 30%. Municipal and retail customer usage will be reassessed on a bi-weekly basis and may be adjusted as determined by the rate of use of available supply and weather conditions.

8.4 Prohibitions on End Uses

The District does not have the ability to impose use restriction or other requirements directly on end users of the wholesale municipal customers' water. Each wholesale customer is responsible for adopting plans to implement the reductions in water use called for by the action stages outlined above. Effectiveness of this plan will be monitored on a daily basis using continuously metered data from Ruth Lake and the metered connections to all wholesale municipal and industrial customers.

8.5 Penalties, Charges, Other Enforcement of Prohibitions

As noted earlier in this plan, each wholesale customer is responsible for adopting plans to implement the reductions in water use called for by the action stages outlined above. Effectiveness of this plan will be monitored on a daily basis using continuously metered data from Ruth Lake and the metered connections to all wholesale municipal and industrial customers.

Table 8-1 shows examples of prohibitions and the stage when those prohibitions become

Examples of Prohibitions	Stage when Prohibition Becomes Mandatory
Domestic use limited to 9 MGD, and industrial use limited to 20 MGD	3
Domestic use limited to 8 MGD, and industrial use limited to 12 MGD	4
Domestic use limited to 7 MGD, and industrial use limited to only the amounts required for human consumption, sanitation, and fire protection	5

mandatory. These prohibitions assume that the District is operating at normal levels prior to loss of its industrial customers.

Table 8-1: Water Shortage Contingency – Mandatory Prohibitions

Examples of Prohibitions	Stage when Prohibition Becomes Mandatory
Domestic use limited to 9 MGD, and industrial use limited to 20 MGD	3
Domestic use limited to 8 MGD, and industrial use limited to 12 MGD	4
Domestic use limited to 7 MGD, and industrial use limited to only the amounts required for human consumption, sanitation, and fire protection	5

8.6 Consumption Reduction Methods

As previously mentioned, the District does not have the ability to impose use restriction or other requirements directly on end users of the wholesale customers' water. Each wholesale customer is responsible for adopting plans to implement the reductions in water use called for by the action stages outlined above. The District will also perform general voluntary water conservation measures in conjunction with its wholesale customers, as well as perform public education efforts to encourage water conservation. As storage levels in the reservoir drop, the District will work closely with its wholesale customers to attempt to minimize water consumption in the area, as well as minimize their own internal use. However, their internal usage is minimal, but items such as line flushing will be discontinued or kept to a bare minimum as required.

While the District does not have the ability to limit the amount of water delivered to its wholesale customers, the District does have the ability to limit water delivered to potential industrial customers. Should a drought situation arise where action is required, delivery to industrial customers will be reduced as outlined in Section 8.1. Table 8-2 gives a summary of the consumption reduction methods and the stages when the method will take effect.

Table 8-2: Consumption Reduction Methods

Consumption Reduction Methods	Stage when Method Takes Effect
Release from storage only amount of water needed for in-stream and water supply purposes	1
General voluntary water conservation measures with wholesale customers	2
Public education efforts encouraging water conservation	2
Encourage all wholesale and retail customers to reduce usage. Require industrial customers to reduce usage.	3
Encourage all wholesale and retail customers to reduce usage further. Require industrial customers to further reduce usage.	4
No water for industrial processes and reduce wholesale and retail customer usage up to 50%	5

8.7 Determining Water Shortage Reductions

The District has water meters in place at all of the connections to the systems of each of its seven wholesale municipal customers. There are also meters at every residential connection, and a meter will be installed at any future industrial customer connection. To determine the actual reductions in use of water during a water shortage, the District will use its Supervisory Control and Data Acquisition (SCADA) system to monitor distribution to its customers on a daily basis. In the event of a power outage, the District has two auxiliary power generators as standby power sources. The first generator is a 35 kW (kilowatt) generator and the second is a 2 MW (megawatt) generator. Therefore, the SCADA system will continue operating during power outages and continue monitoring distribution. Water shortage reductions will be determined by subtracting post-drought consumption rates from pre-drought consumption rates.

8.8 Revenue and Expenditure Impacts

Each wholesale customer must gage the revenue and expenditure impact of the action stages. The expenditure and revenue impacts on the District are negligible since the wholesale rates are designed to cover costs incurred by the District in producing and distributing the water. With less water to produce, there would be less expense incurred by the District. Therefore, expenditures and revenues for costs directly related to the amount of water produced (e.g. costs for power for pumping) will both decrease as deliveries of water are curtailed. If the shortage were to continue for

a prolonged period, the District could reduce staff in order to cut costs as the District would not be producing and distributing water at normal levels. The District also has a reserve account to act as a buffer to cover fixed costs for a short period of time if the District were to need it.

8.9 Resolution or Ordinance

A copy of the District's draft Water Shortage Contingency Resolution for declaring a water shortage emergency and implementing the District's Water Shortage Contingency Plan is attached as Appendix F.

8.10 Catastrophic Supply Interruption

The District's Emergency Operations Plan (EOP) provides the overall response procedures for catastrophic supply interruptions. The EOP further provides specific procedures for power outages and for security incidents. The District's Emergency Action Plan (EAP) provides response procedures for catastrophic supply interruptions involving the R.W. Matthews Dam and Reservoir (Ruth Lake), such as an earthquake. The District's Operations Plan (OP) provides procedures for system failures. Hazardous materials incidents are covered by numerous response plans depending on the nature of the incident. Table 8-3 summarizes possible catastrophe events and the actions that would be taken or plans that would be implemented for each scenario.

Table 8-3: Preparation Actions for a Catastrophe

Possible Catastrophe	Summary of Actions/Plans
Regional Power Outage	Emergency Operations Plan-Power Outage Procedures
System Failure	Operations Plan for Water Supply, Treatment, and Distribution System
Earthquake	Emergency Operations Plan/ Emergency Action Plan (R.W. Matthews Dam at Ruth)
Hazardous Material Spill	Hazardous Materials Response Plans
Acts of Terrorism	Emergency Operations Plan-Security Procedures/ Emergency Action Plan (R.W. Matthews Dam at Ruth)

8.11 Minimum Supply Next Three Years

The three water years between October 1989 and September 1992 represent the driest three-year period recorded for the District:

- Rainfall for this period averaged 42 inches per year (60% of normal).
- Of the three water years, the driest year for rainfall was water year 1990/1991 with 37 inches (53% of normal).
- Flows into Ruth Lake above Zenia averaged 69,000 AFY, or 40% of normal (173,000 AFY).
- The runoff for the watershed above the District's diversion facilities was 371,300 AFY, or 39% of normal (959,071 AFY).
- Despite the diminished rainfall and runoff, rainfall was more than sufficient to refill the reservoir each year.
- Reservoir volume during this period averaged 37,000 AF which is 77% of capacity (48,030 AF) and 90% of normal (41,000 AF).

A plot of reservoir levels over the course of each respective water year from October 1989 through September 1992 is given as Figure 8. This figure shows that even in the three driest consecutive years of record, the reservoir still reached maximum capacity for each of the respective years and generally remained full for months each year. Furthermore, the District was still supplying industrial water during this time, whereas the District is currently only supplying domestic water. Given this, in the event that the next three years are hydrologically the same as the driest three consecutive years of record, the minimum available supply would be greater than the full reservoir level of 48,030 acre-feet for each year, as shown in Table 8-6.

Table 8-4: Minimum Supply Next Three Years

	2016	2017	2018
Available Water Supply	> 48,030 AF	> 48,030 AF	> 48,030 AF

A Rippl mass diagram was generated (Figure9) using the same assumptions as given in Section 8.2 to plot the cumulative inflow to the reservoir (less evaporation) and various cumulative draft rates. As seen in the figure, a constant draft rate of 38.5 MGD could be achieved if the hydrologic conditions of the drought of record (1976-77) were to be synthetically repeated for a three-year planning period. Current usage is approximately 10 MGD. Therefore, even if the single-year drought of record were repeated for three years, the District would still have a more than adequate water supply to serve its current customers' needs.

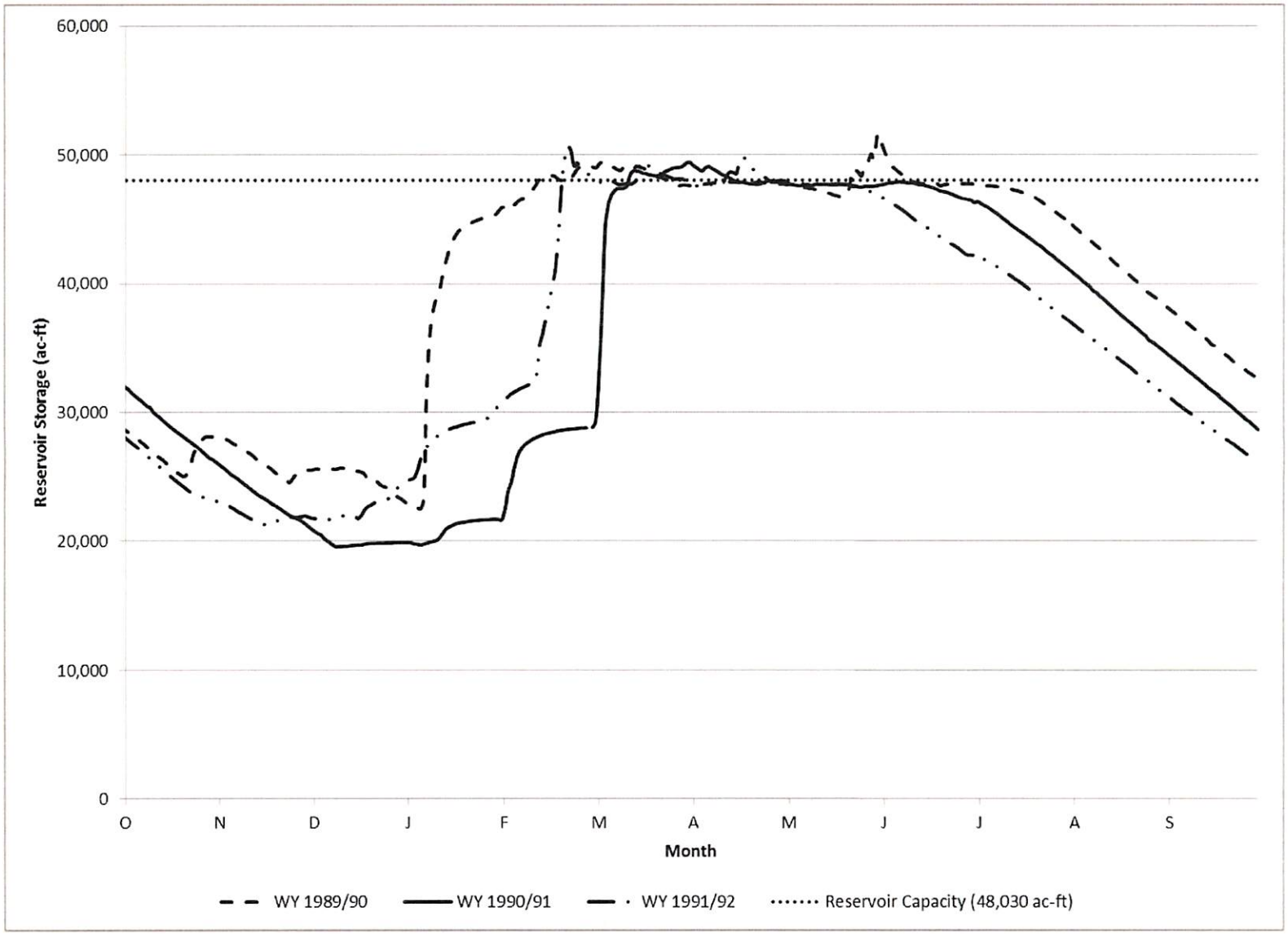


Figure 8: Ruth reservoir water storage levels for the driest three consecutive years of record

SECTION 5.2, PAGE NO. 111

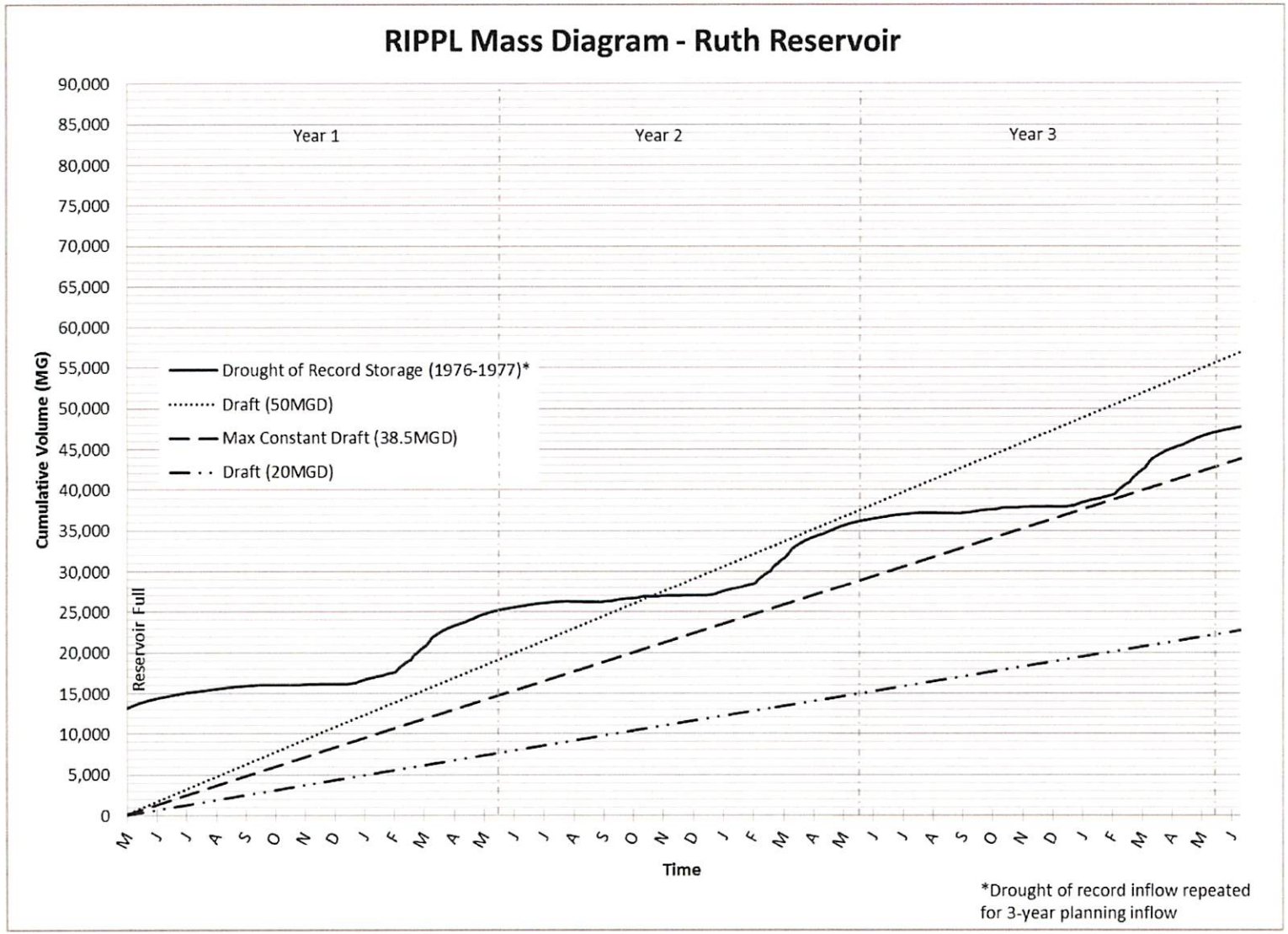
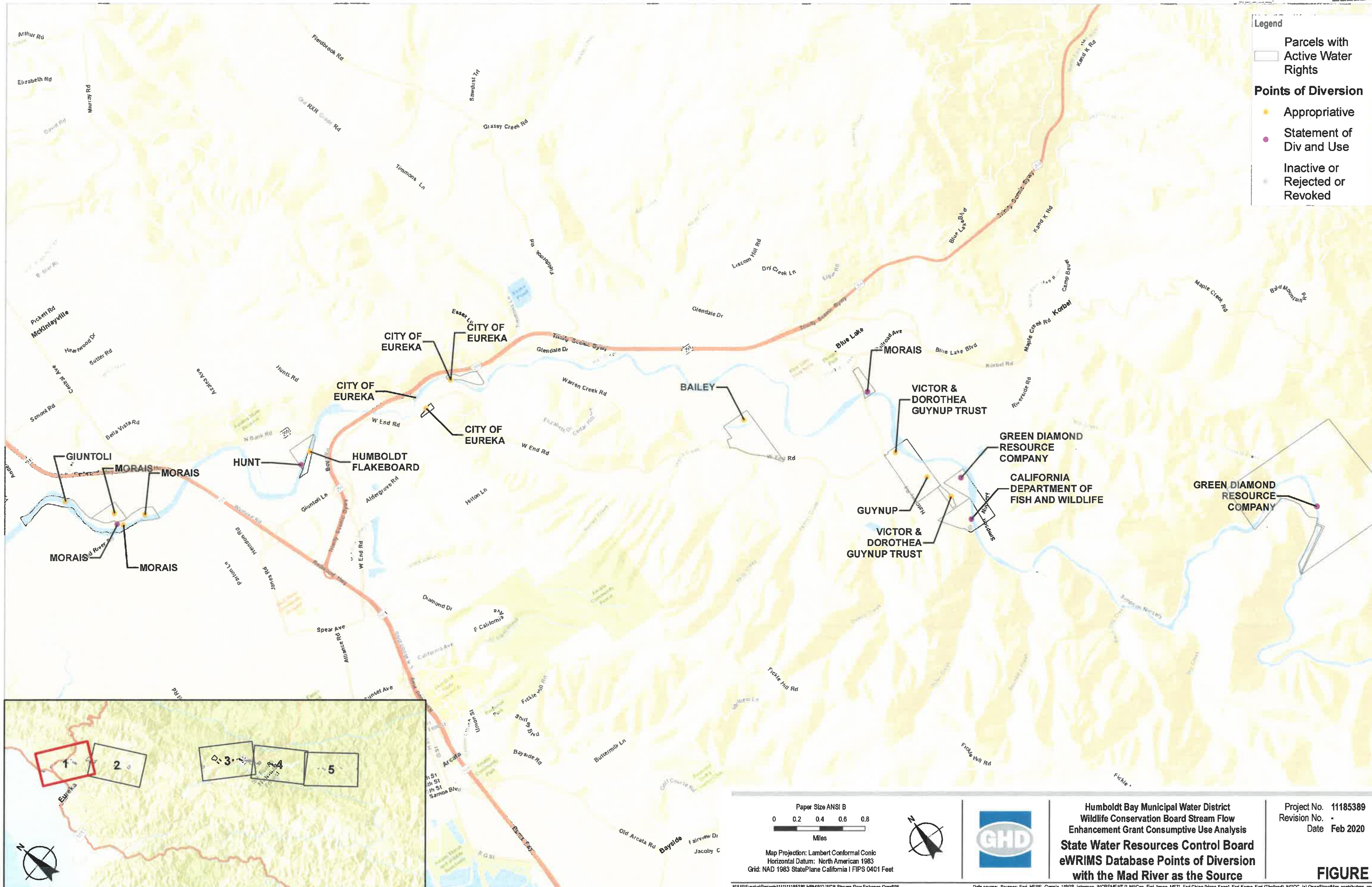


Figure 9: Rippl Mass Diagram with '76-'77 drought hydrologic information repeated for a three-year planning period

SECTION 5.2, PAGE NO. 112



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Humboldt Bay Municipal Water District
Wildlife Conservation Board Stream Flow Enhancement Grant Consumptive Use Analysis

State Water Resources Control Board eWRIMS Database Points of Diversion with the Mad River as the Source

Project No. 11185389
Revision No. -
Date Feb 2020

FIGURE 1

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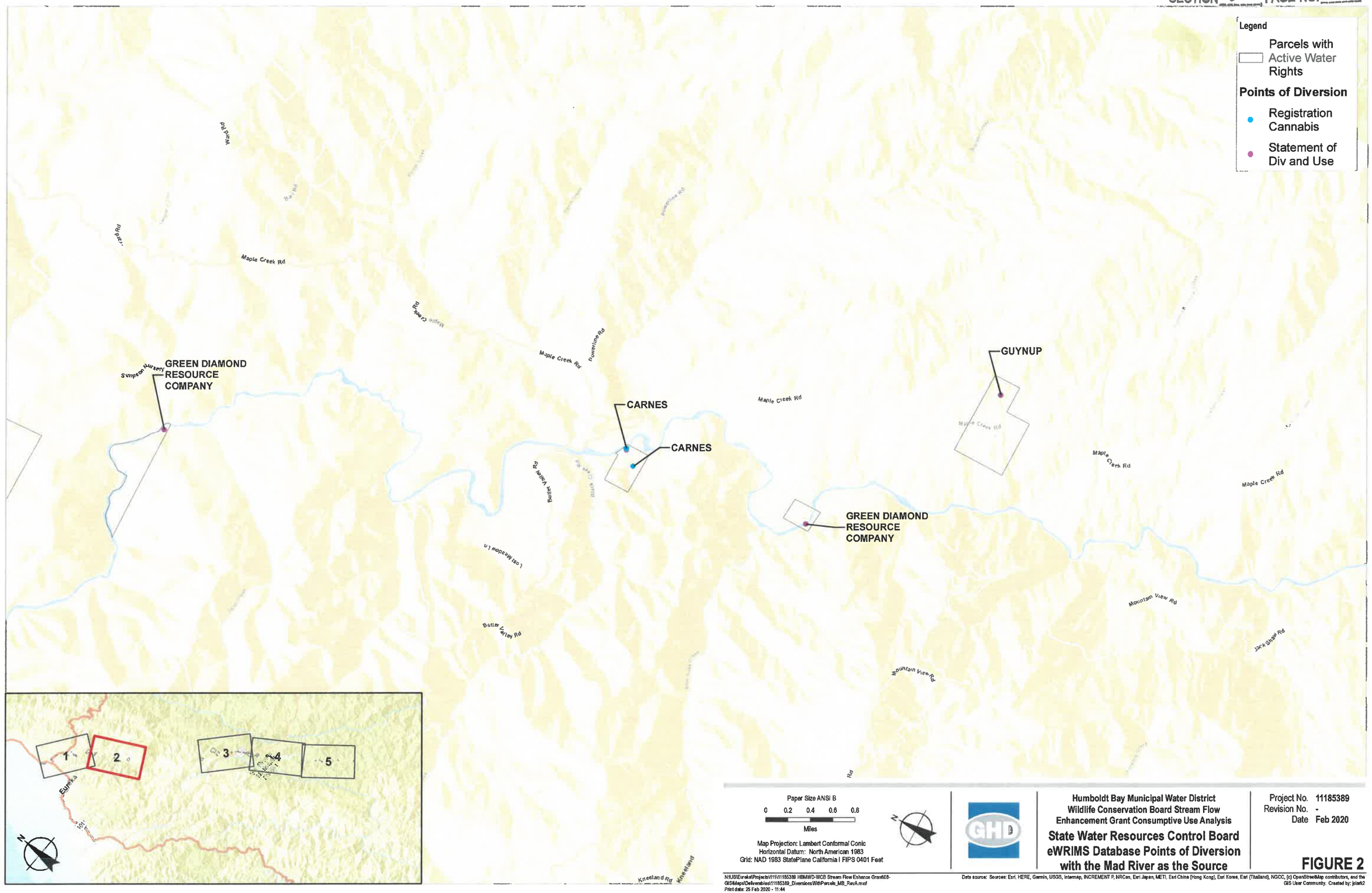
Data source: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community. Created by: jclark2



Humboldt Bay Municipal Water District
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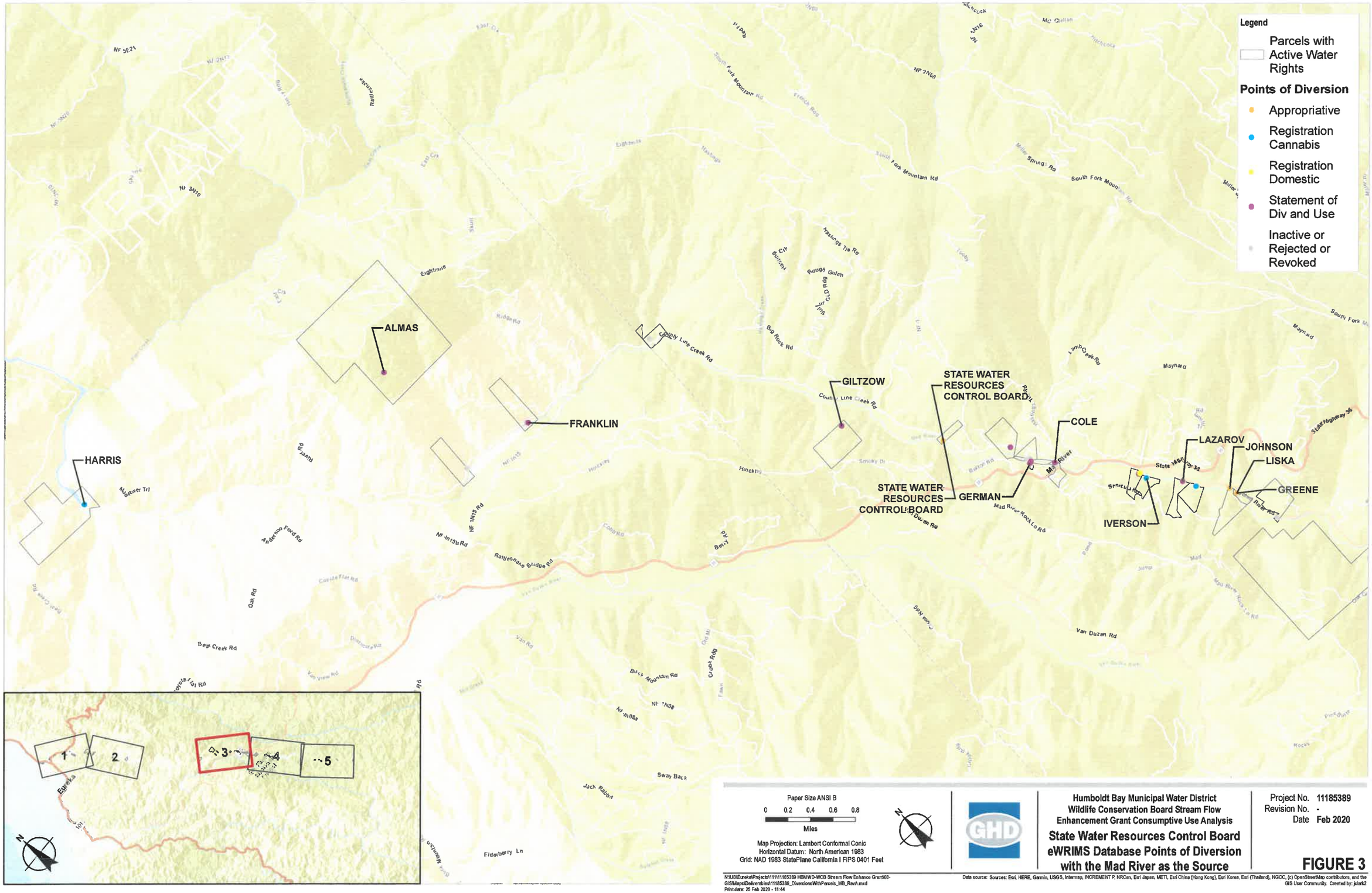
FIGURE 2



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Humboldt Bay Municipal Water District
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State Water Resources Control Board eWRIMS Database Points of Diversion with the Mad River as the Source

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FIGURE 3

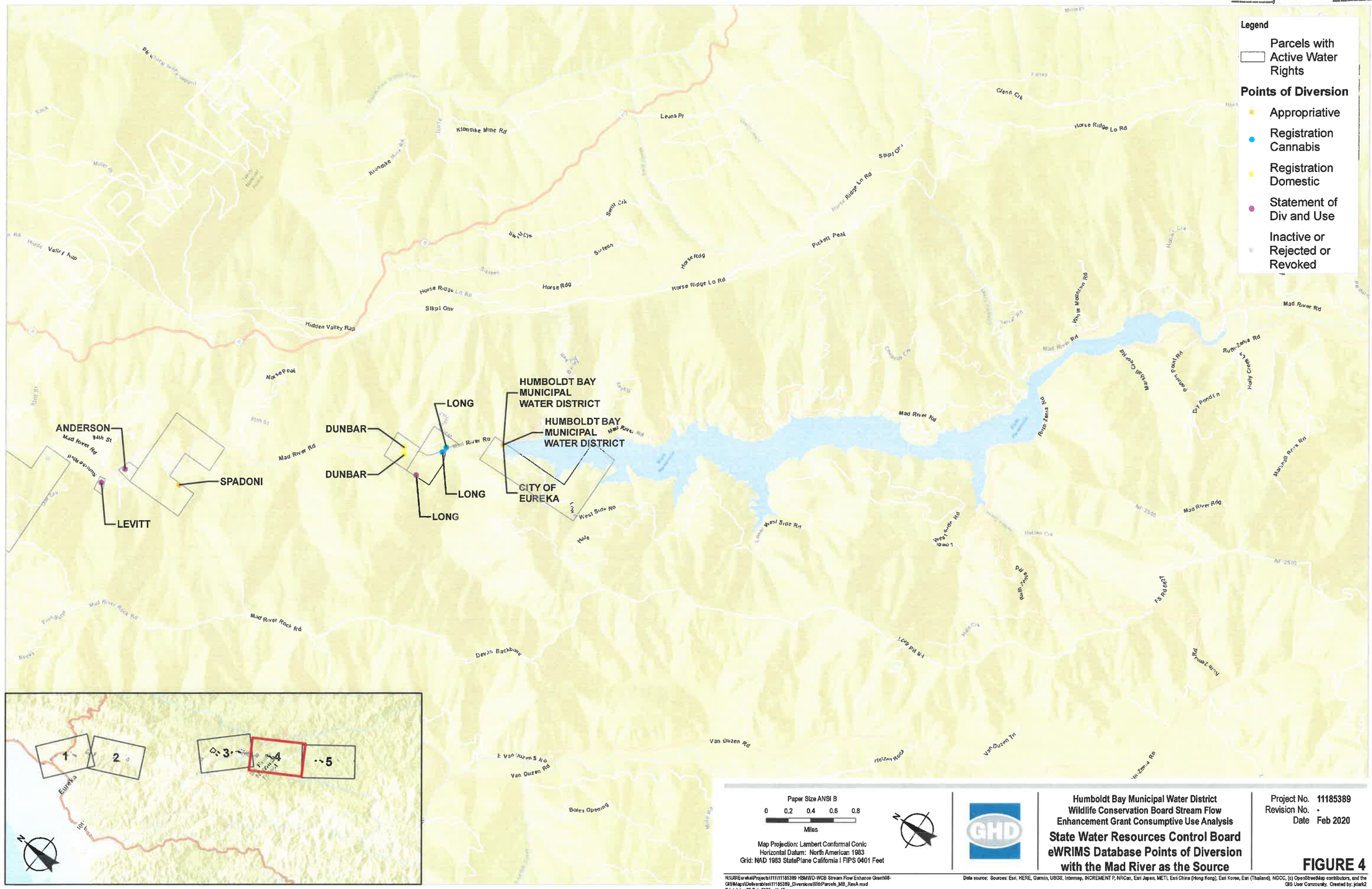

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FIGURE 4

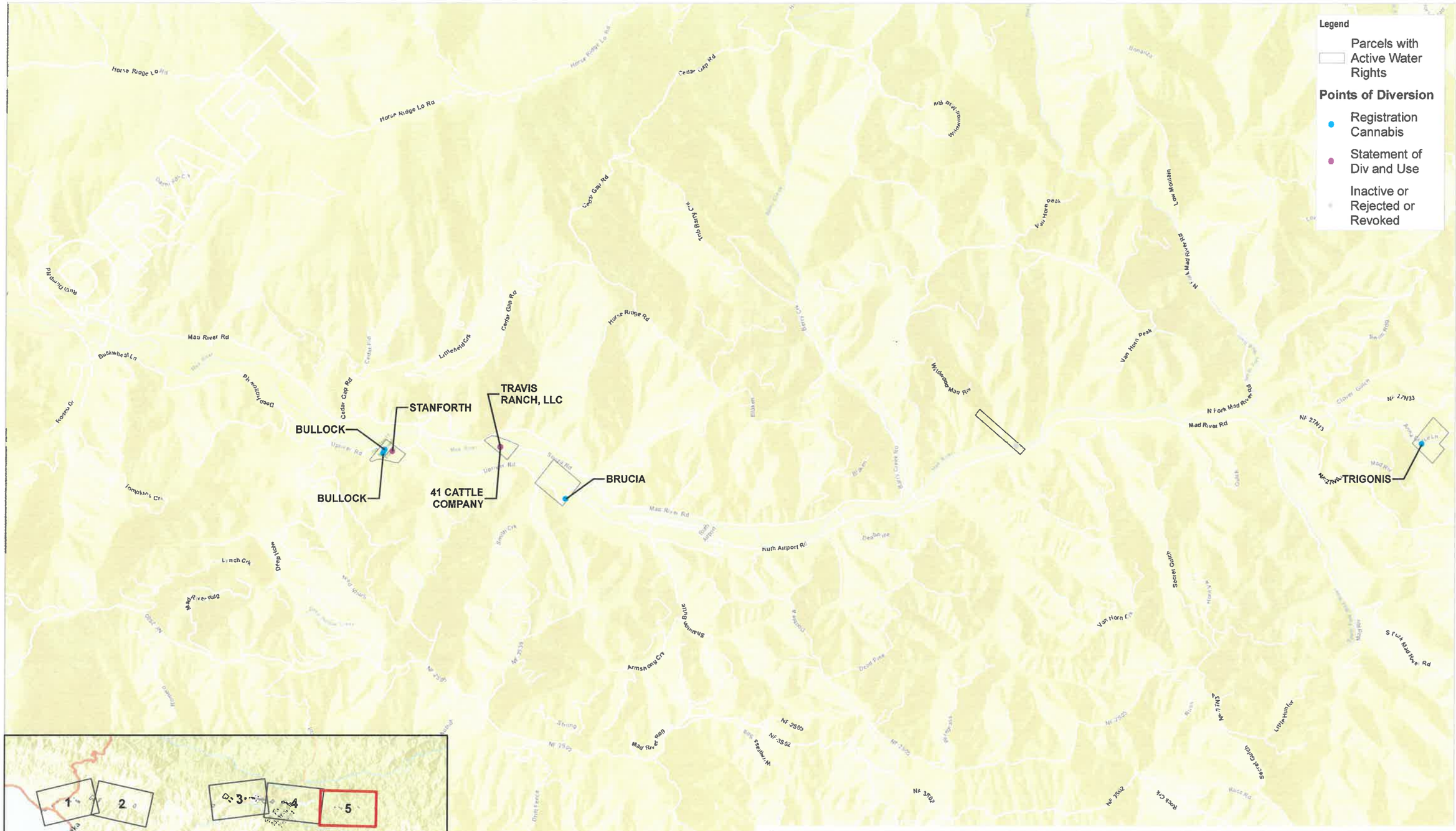

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FIGURE 5