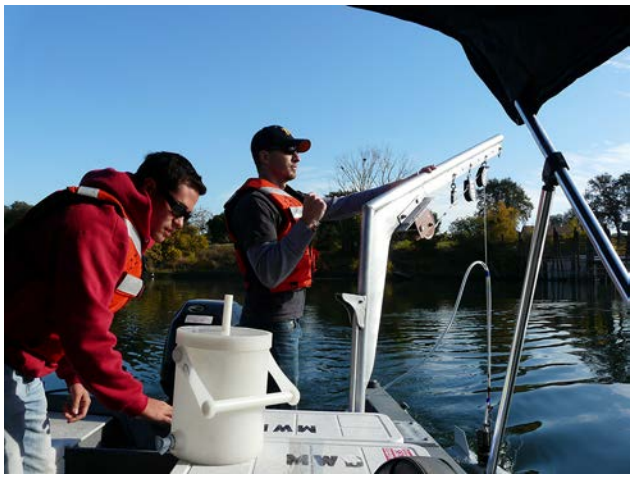
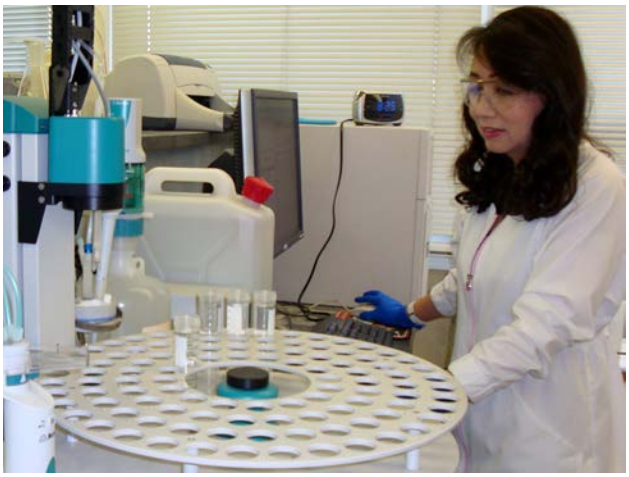
Municipal Water Quality Investigations Program
2015-2016 Annual Work Plan





State of California
Natural Resources Agency
DEPARTMENT OF WATER RESOURCES

Final – July 27, 2015

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Municipal Water Quality Investigations Program 2015-2016 Annual Work Plan

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Cover:
Left: MWQI Program staff collecting water quality samples. Right: Bryte Laboratory staff analyzing water quality samples.

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List of Acronyms and Terms

ANN	Artificial Neural Network
AMS	Accelerated Mass Spectrometry
BCP	Budget Change Proposal
BDCP	Bay Delta Conservation Plan
BDO	Department of Water Resources Bay Delta Office
BMP	Best Management Practices
Br	Bromide
Ca	Calcium
CBDA	California Bay Delta Authority
CBOD	Chemical Biological Oxygen Demand
CCWD	Contra Costa Water District
CDEC	California Data Exchange Center
CIWQS	California Integrated Water Quality System
CUWA	California Urban Water Agencies
CVP	Central Valley Project
CVDWPWG	Central Valley Drinking Water Policy Work Group
CWQMC	California Water Quality Monitoring Council
DBP	Disinfection by-product
DDT	Dichloro-Diphenyl-Trichloroethane (insecticide)
DDW	State Water Resources Control Board’s Division of Drinking Water
DES	Division of Environmental Services
DFW	California Department of Fish and Wildlife
DMC	Delta-Mendota Canal

DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DOE	DWR Division of Engineering
DSIWM	Division of Statewide Integrated Water Management
DSM2	Delta Simulation Model 2
DWR	California Department of Water Resources
DWR EMC	Department of Water Resources Emergency Management Committee
EEM	Excitation-Emission Matrix
EC	Specific Electric Conductivity
EPA	U.S. Environmental Protection Agency
FDOM	Fluorescence of Dissolved Organic Matter
FRPA	Fish Restoration Program Agreement
FSR	Feasibility Status Report, used in information technology planning
FY	Fiscal Year
GC-MS	Gas Chromatography Mass Spectrophotometer
GIS	Geographic Information System
HAA	Haloacetic Acid
HAAFP	Haloacetic Acid Formation Potential
IC	Ion Chromatography, Inorganic Carbon (e.g., dissolved carbon dioxide)
IEP	Interagency Ecological Program
IO	Internal Order number
IT	Information Technology
KHP	Potassium hydrogen phthalate

LC-MS	Liquid Chromatography Mass Spectrometry
MEO	Mobile Equipment Operations
MWDSC	Metropolitan Water District of Southern California
MGD	Million Gallons per Day
MWDSC	Metropolitan Water District of Southern California
MWQI	Municipal Water Quality Investigations
MWQI SPC	Municipal Water Quality Investigations Specific Projects Committee
Na	Sodium
NALMS	North American Lake Management Society
NCRO	North Central Regional Office
NEMDC	Natomas East Main Drainage Canal
NDBA	N-nitroso-di-n-butylamine
NDMA	N-nitroso-dimethylamine
NDPA	N-nitroso-di-n-propylamine
NHD	National Hydrography Dataset
NMEA	N-nitroso-methylethylamine
NMOR	N-nitrosomorpholine
NPDES	Non-Point Discharge Elimination System
NPYR	N-nitroso-pyrrolidine
NMR	Nuclear Magnetic Resonance (analysis)
O&M	DWR Division of Operations and Maintenance
O&M WQ	Division of Operations and Maintenance Water Quality Section
OC	Organic carbon

OCO	Operation Controls Office (DWR O&M)
OEE	Operating Expenses and Equipment
QA/QC	Quality Assurance/Quality Control
P/G	Pumping/Generation
PCB	polychlorinated biphenyls
PY	Position Year
QA/QC	Quality Assurance, Quality Control
QC	Quality Control
RTD	Real-time Data
RTDF	Real-time Data and Forecasting Program
RTDF-CP	Real-time Data and Forecasting – Comprehensive Program
RTM	Real Time Monitoring
SBA	South Bay Aqueduct
SCWA	Solano County Water Agency
SDIP	South Delta Improvement Program
SLDMWA	San Luis and Delta-Mendota Water Authority
SOP	Standard Operating Procedure
SPC	Specific Project Committee
SUVA	Specific ultraviolet absorbance
SWC	State Water Contractors
SWP	State Water Project
SWPCA	State Water Project Contractors Authority
SS	Sanitary Survey Update

TAC	Technical Advisory Committee
TBD	To Be Determined
TDS	Total Dissolved Solids
THM	Trihalomethane
THMFP	Trihalomethane formation potential
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TOC	Total (dissolved and suspended particulate) Organic Carbon
UCD	University of California at Davis
USBR	U.S. Bureau of Reclamation
USGS	United States Geological Survey
UVA *n*	Ultraviolet absorbance at wavelength *n*
VAMP	Vernalis Adaptive Management Program
WARMF	Watershed Analysis Risk Management Framework
WDL	California Water Data Library
WWTP	Waste Water Treatment Plants

1. MISSION STATEMENT and STRATEGIC PLAN

The mission of the Municipal Water Quality Investigations (MWQI) Program is to:

a) Support the effective and efficient use of the State Water Project (SWP) as a source water supply for municipal purposes through monitoring, forecasting, and reporting of the Sacramento San Joaquin Delta and the SWP water quality;
b) Provide early warning of changing conditions in source water quality used for municipal purposes;
c) Provide data and knowledge-based support for operational decision-making on the SWP;
d) Conduct scientific studies of drinking water importance; and
e) Provide scientific support to the Department of Water Resources (DWR), the State Water Project Contractors Authority (SWPCA) MWQI Specific Project Committee (MWQI SPC), and other governmental entities.

The current MWQI 5 Year Strategic Plan, effective through June 2017, can be found at:
http://www.water.ca.gov/waterquality/drinkingwater/

2. INTRODUCTION

2.1. MWQI Program Background

The MWQI Program routinely conducts water quality monitoring in the Sacramento-San Joaquin Delta (Delta) for municipal and industrial uses, as the Delta is considered part of the SWP. The MWQI Program incorporates their Delta water quality monitoring data along with that of the Division of Operations and Maintenance's (O&M) SWP monitoring, and produces and disseminates daily and weekly Real-Time Data Forecasting Comprehensive Program (RTDF-CP) reports. The MWQI Program provides data and knowledge-based data support to the MWQI SPC, DWR modeling for DWR operations on the SWP, and other programs within DWR. For example, staff provide scientific drinking water expertise to local municipal water agencies, other State and Regional Boards, and State and federal agencies, other non-governmental entities, and stakeholders.

The Delta is a vital surface water source and the SWP facilities are a vital conveyance system for the SWP Contractors (SWC) treating raw surface water for residential, commercial, and industrial uses. In the MWQI Program, highly technical and complex water quality studies are undertaken in order to develop understanding of the sources of drinking water pollutants which affect the quality, treatability, and reliability of treatment of the water supplied to drinking water purveyors. One such study is the fluorescence of dissolved organic matter (FDOM) study. This special study investigates the use of an FDOM sensor as a proxy for organic carbon measurements. When chlorine is added during the disinfection process, the chlorine reacts with organic carbon in the water to produce disinfection byproducts which are carcinogenic. Another example is called the MWQI Limnology of the SWP program which consists of many complex sub-projects. Several of the sub-projects have begun on the South Bay Aqueduct (SBA) to understand the aquatic biology, chemistry, physics, and ecology of the SWP. Understanding this complex aquatic system within the SWP is important to balancing operational needs to meet demand versus providing high-quality water to SWC.

The MWQI Program managers and supervisors participate in various drinking water quality activities external to the Program. For example, regulatory activities that occur in the Delta through the SWRCB and the SWRCB's Division of Drinking Water (DDW), and the Central Valley Regional Water Quality Control Board (CVRWQCB) that can affect drinking water quality and operations of the SWP. For example, staff is participating in the CVRWQCB's Nutrient Stakeholder and Technical Advisory Group's

(STAG) activities to determine if nutrient objectives are needed for the Delta, and are assisting with the Pathogen monitoring under the Delta Regional Monitoring Program (RMP).

Currently MWQI Program managers and supervisors are assisting with the drought turbidity transect study and the ongoing 2015 Temporary Urgency Change Petition (TUCP) efforts. Staff are also participating in the West False River emergency drought barrier efforts with support for equipment installation at several of the 10 new water quality stations, and will help support the long-term monitoring and station operations and maintenance (how much support for the monitoring and station operations and maintenance has not yet been determined). MWQI management is leading the way to have 3 FDOM sensors installed: one in Frank's Tract, one at Holland Cut near Bethel Island, and one at Middle River at Union Point. The goal of adding these continuous monitoring organic carbon surrogate sensors at these key locations in the Delta is to: provide a real-time early warning of the organic carbon concentrations from the Delta entering into the South Delta pumps; monitor the chronic carbon input from the San Joaquin River/Stockton deep water ship channel through Columbia and Empire cuts; and to take advantage of drought funds to cover the equipment costs.

Finally, the MWQI Program staff support: data and database infrastructure management and sharing in order to enhance and improve the long-term storage and retrieval of RTDF-CP data; the administration of essential program management activities mandated by DWR's policies and procedures including implementing quality control measures; and the efforts to ensure the health and safety of staff in the workplace.

2.2. MWQI Program Special Projects

In a professional and consistent manner the MWQI Program staff will continue to use the required SWP Project Management Plan (PMP) process per the Water Resources Engineering Memorandum 65a (WREM65a) when planning and documenting their scientific special projects. Principal Investigators (PI) will also incorporate the DWR's required safety and quality assurance and quality control (QA/QC) principles into their projects. By incorporating the knowledge of the PI, Safety Engineers, and the DWR QA/QC Officer, the PI use the basic steps of project management to integrate principles of sound scientific study design along with safety and data quality objectives into their project planning process. By following the PMP process, PI develop their project planning documentation that needs to be accomplished prior to conducting any work on the project.

When a special project commences, and to complement the use of the required SWP PMP documents when planning their scientific special projects, and to further refine and develop their project details, the MWQI Program staff will develop a list of study questions to be answered by their project and a study outline. Early in a project the PI will develop and manage a Project Technical Team (PTT) which will include project partners and subject matter experts (SME). PTT members are involved to deliver their expertise and ensure project success. For example, the Bryte Lab director will offer advice on which method of analysis should be used, how samples should be collected, and how and when the data output will be provided. PI are responsible for project design, communication, including status reporting, elevation of issues that cannot be resolved in the PTT, and, in general, making sure the project is conducted safely, meets project data quality objectives and is delivered in budget, on schedule, and within scope. Therefore, it is important for a PI to meet regularly with the project's team. The PTT may also assist the PI will the development and documentation of the required PMP documents and with peer reviewing the project technical documents and reports.

Some projects in this work plan have not yet been thoroughly discussed and developed with the MWQI Program staff and the MWQI SPC members; therefore PI do not yet possess enough information to develop the PMP forms. These not yet developed studies will be noted in this work plan under the

appropriate sections. When sufficient information is developed and if there are sufficient staff resources, the special project may be included in the next work plan cycle, and the project charter and plan will be included in the appendix also during the next work plan cycle.

The MWQI SPC is committed to ensuring the success of the MWQI Program's planned work and therefore, has identified SME that will serve as the project partner, or technical scientist on several of the special projects. SME will participate on the PTT to guide and give advice to PI during their projects through completion. Throughout the life of the special projects, PI will meet regularly with their SME and may provide periodic updates during monthly MWQI Technical Advisory Committee (TAC) meetings.

2.3. MWQI Program – Program Partners

The MWQI Program has several Program Partners who work in other DWR Divisions (see the organization chart below). Program Partners include staff working in the O&M's Environmental Assessment Branch (EAB), in the Operations Control Office (OCO), and the Bay-Delta Office (BDO). Each Program Partner provides vital services, data, and reports to the MWQI Program, MWQI SPC, other State and Regional Boards, and stakeholders. For example, seasonal forecasts from the O&M OCO Program Partner supports the information provided by the RTDF-CP to stakeholders, and data from the Gianelli Water Quality Station comes from the support of the O&M EAB Program Partner; this is also incorporated into the RTDF-CP, CDEC, and the MWQI web site.

The MWQI Program and its Program Partners use Program Partnering Agreements to manage the workloads, staff resources, and budgets across DWR Divisions in the respective programs. Each individual Program Partnering Agreements (PPA) is prepared, reviewed, approved, and kept on-file by the program managers involved in the agreement. Typically, the duration of the PPA is one to three years, and agreements are renewed easily and when the workload changes. Currently for this work plan cycle, the MWQI Program has developed 1-year draft agreements for the following Program Partners:

1. O&M EAB
2. OCO
3. BDO

2.4. MWQI Program Core Elements

Staff time may shift occasionally from the work described in this work plan due to situations that may arise, such as the need to work on drought activities, TUCP, CA WaterFix, EcoRestore, or other DWR priority activities. MWQI Program core elements will receive priority throughout this work plan. If it becomes apparent that there are demands on the core elements, the water quality monitoring, and the RTDF-CP and support will continue as the highest planned priorities.

Core elements are listed in priority of importance to the MWQI SPC:

1. Water quality monitoring (both real-time and discrete) at existing stations and sites
2. Modeling duties associated with real-time forecasting used in the RTDF daily and weekly reports
3. Production and dissemination of daily and weekly RTDF reports
4. Data management activities pertaining to database infrastructure enhancement and development in order to improve long-term storage and retrieval of RTDF data
5. Special Studies
6. Program management activities listed in the MWQI agreement and those mandated by DWR required for health and safety of the MWQI Program staff. This includes monthly MWQI TAC meetings and budget updates.

7. Other required Program activities that are mandated by DWR and/or essential to the MWQI Program (i.e. purchasing, contracts, budgeting, 2015 DWR Environmental Scientist Workshop, safety and policy training, specific meetings and conferences).

2.5. MWQI Program Special Project Published Reports

Through the previous work plan cycle, the MWQI Program has completed and published the following special studies report:

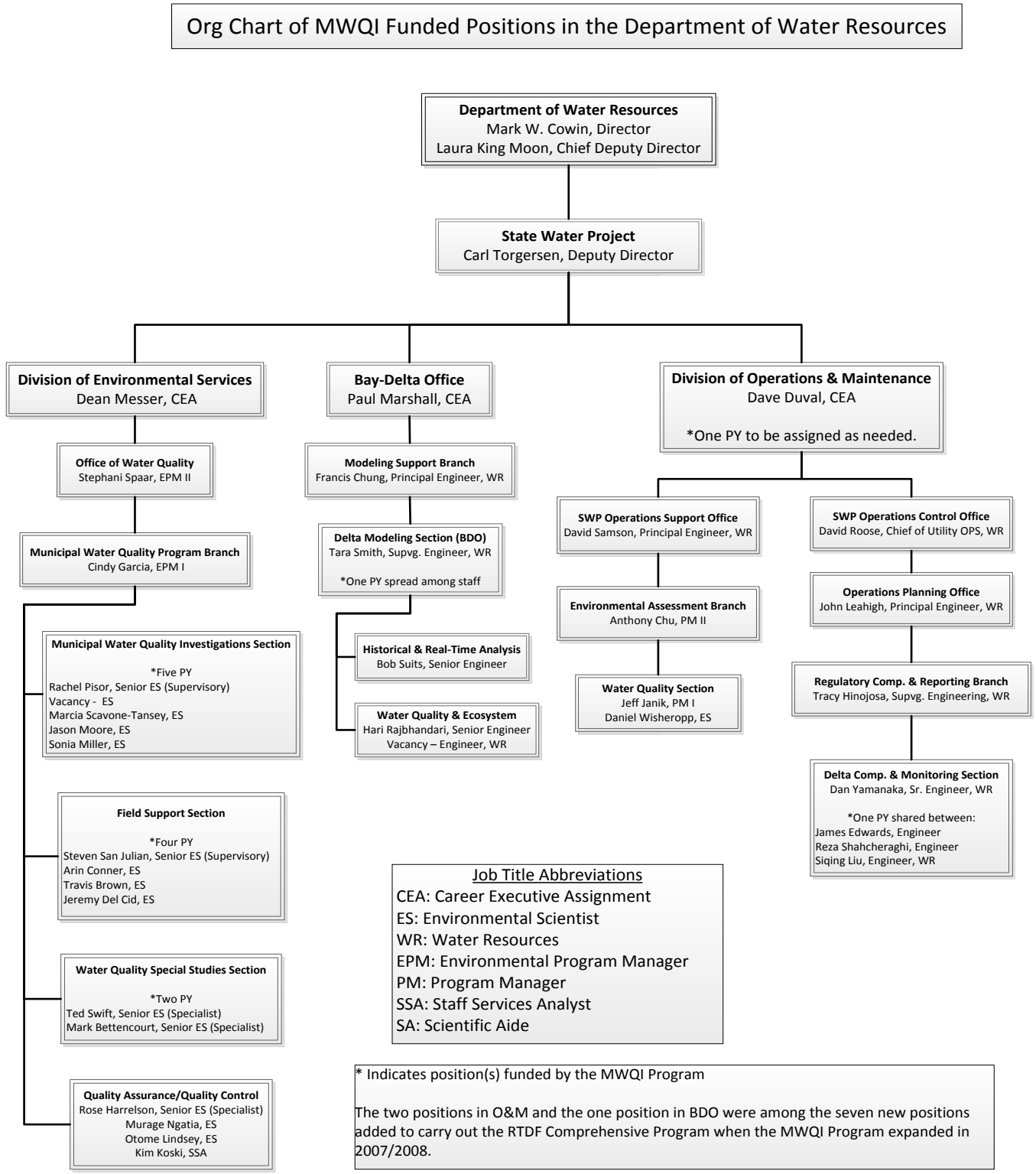
- Lathrop Urban Runoff Report

Special project final reports will be posted on the MWQI Program's website at: http://www.water.ca.gov/waterquality/drinkingwater/.

Before publication and posting on the MWQI Program's website, some special project final reports will follow DWR's publication policy. The MWQI Program management and MWQI SPC will jointly determine which special project final reports will be published. Before publication, final reports are initially peer-reviewed by the MWQI staff and then MWQI Program management, followed by the project partners, SME, and MWQI SPC, and finally by DWR's upper management. Some of the completed reports may also be published as journal articles.

2.6. DWR MWQI Program Organization Chart

Figure 1. DWR org chart showing positions funded by MWQI Program funds.



3. **PROGRAM FUNDING NEEDS**

3.1. MWQI and MWQI SPC Funds

The three-year MWQI Funding Agreement (FA) between the MWQI Program, SWPCA, and 16 SWP Contractors who receive municipal and industrial (M&I) water from the SWP, remains in effect until December 31, 2016. At the writing of this work plan, the FY 15-16 budget total is $3,128,105 with $2,784,013 for the DWR MWQI Program, and $344,092 for the MWQI SPC fund.

The DWR MWQI Program portion of the budget will fund staff salaries including benefits, assessments, operating expenses, Real-Time Data Forecasting, support for the DWR modelers, and special projects research in the Delta and SWP. The MWQI SPC portion will provide funds to retain consultants, and purchase certain goods and services deemed necessary and desirable for station operation and research by both the MWQI TAC and the MWQI SPC. The estimated budget expenses for this work plan cycle are shown in Table 1.

The MWQI Program budget is funded by the SWPCA MWQI SPC through the Statement of Charges. SWPCA provides additional funds for some items that the MWQI Program is unable to purchase without conservable hardship and paperwork causing long delays. For example, two YSI Sondes (water quality sensors) for the limnology project entitled “Wide Swings in Canal pH Study” and a service agreement for the Metrohm at the Gianelli water quality station. The Contra Costa Water District also provides funding to the MWQI SPC to help with the expenses involved with the Water Quality Assessment efforts shown in Table 6.

The FY 15-16 MWQI Program and MWQI SPC budget is presented in Table 1 below, and followed by an updated explanation of MWQI SPC and MWQI expenditures in Table 2 and Table 3. Partner staffing in this budget reflects 1 Position Year (1 PY = 1778 hours/year = 221 working days) each for the BDO and OCO, and 0.6 PY for the Division of O&M EAB.

NOTE - For budgeting purposes, Table 1 labor hours are displayed as 85% of 2080 hours (the total number of hours in 1 year). 85% is used because on average, 15% of the year staff are out of the office and thus not working. For example, sick leave, vacation, holidays, etc.

Table 1. FY 15-16 Program Element Costs for MWQI and MWQI SPC Funds

Work Plan Element		Program Element	2015/16 IO#	Labor Hours	Labor Cost	Contract costs	OE&E[c]	Total Cost	MWQI SPC Fund	Total Budget
5		**Water Quality Assessment**								
	5.1	Routine Monitoring Program	VWQASSMENT13	2409	$254,240		$85,000	$339,240		$339,240
	5.2	Short-term Monitoring (included with 5.1)	VWQASSMENT13							
		5.2.1 DSM2 Nutrient Study	VWQASSMENT13	0	$0			$0		$0
		5.2.2 Cache Slough Baseline Monitoring	VWQASSMENT13	44	$8,360			$8,360		$8,360
		5.2.3 Pathogen Special Project Monitoring	VWQASSMENT13							
6		**RTDF-Comprehensive Program**								
	6.1	RTDF-CP Real Time Monitoring		0						
		6.1.1[a] MWQI Real Time Stations	VRTMONITOR13	2456	$254,240	$43,272	$36,000	$333,512	$25,000	$358,512
		6.1.2 Gianelli WQ Station	VGIANNELLI13	975	$101,100	$4,536	$102,000	$207,636		$207,636
	6.2	RTDF-CP Water Quality Forecasting		0						
		6.2.1 BDO- Bay Delta Office Modeling	VRTBDOMODL13	1778	$245,364			$245,364		$245,364
		6.2.2 OCO- Operations Control Office Modeling	VRTOCOMODL13	1778	$245,364			$245,364		$245,364
		6.2.3 Improve Aqueduct Pump-in Dynamics	VPUMPINDYN15	0	$0			$0		$0
		6.2.4 Assessment, Collection & Archival of Aqueduct Pump-in Data	VMANPUMPIN15	0	$0			$0		$0
		6.2.5 Comparison of Water Quality Forecasts to Actual Conditions	VCOMPAREWQ15	175	$17,500			$17,500		$17,500
		6.2.6 Improvement of the DSM2 Nutrient Model	VIMDSM2NUT15	0						
		6.2.7 Potential Planning Studies	VPOTPLANST15	0						
		6.2.8 Adding Additional WWT Plant to the Fingerprint	VWWTPFNGPT15	0						
	6.3	RTDF-CP Information Management and Data Dissemination		0						
		6.3.1 RTDF Data Dissemination & Reporting	VRTDDISRPT13	785	$78,500			$78,500	$1,500	$80,000
		6.3.2 Administration and Database Activities[b]		0				$0	$62,400	$62,400
7		**Science Support (Special Studies)**								
	7.1	7.1 Limnology of the SWP	VLIMNOLOGY13	56	$5,600			$5,600	$116,992	$122,592
		7.1.1 Nutrient Budget Study	VNTDYNSTDY13	1470	$147,000			$147,000		$147,000
		7.1.2 Nutrient Limitation Study	VLIMNUTLIM14	320	$32,000			$32,000		$32,000
		7.1.3 Nutrient and Nutrient Ratio Influence on Community Species Composition	VLIMNRATIO14	340	$34,000			$34,000		$34,000

Table 1 (cont'd.) FY 15-16 Program Element Costs for MWQI and MWQI SPC Funds

Work Plan Element		Program Element	2015/16 IO#	Labor Hours	Labor Cost	Contract costs	OE&E[c]	Total Cost	MWQI SPC Fund	Total Budget
		7.1.4 Light Limitation in the SWP	VLIMLIGHTL14	710	$71,000			$71,000		$71,000
		7.1.5 Algal and Macrophyte Growth Study	VLIMAMGROW14	226	$22,600			$22,600		$22,600
		7.1.8 Wide Swings in Canal pH Study	VLIMPHSTUD14	1030	$103,000		$3,637	$106,637		$106,637
		7.1.9 San Luis Reservoir Study	VLIMSLRSRV14	0	$0			$0		$0
		7.1.10 Dyer Reservoir Study	VLIMDYRSRV14	0	$0			$0		$0
		7.1.11 Del Valle Reservoir Study	VLIMDLRSRV14	0	$0			$0		$0
	7.2	7.2.1 Cattle Impacts to SWP Water Quality	VSANSURVEY14	220	$22,000			$22,000		$22,000
	7.3	7.3 FDOM Phase II	VFDOMPOCS013	428	$51,800			$51,800		$51,800
8		**Other MWQI Funded Program Activities**								
	8.1	Administration Work	VDWRRQDDPC13	1548	$180,640		$9,000	$189,640		$189,640
	8.2	Field Unit Office Duties	VFUOFCWORK13	1072	$141,200		$3,000	$144,200		$144,200
	8.3	O & M WQ other duties	VOMWQHQ00013	0	$0		$0	$0		$0
	8.4	MWQI Annual Work Plan	VWORKPLAN013	40	$6,160			$6,160		$6,160
	8.5	DWR Bulletin 132	VBULL132WQ13	20	$3,440			$3,440		$3,440
	8.6	Workplace Safety	VSAFTYDOCS13	30	$4,440		$1,000	$5,440		$5,440
	8.7	Emergency Response	V911RESPNS13	40	$4,000			$4,000		$4,000
	8.8	Miscellaneous meetings attended by staff	VOTHERWQPA13	60	$10,320			$10,320		$10,320
9		**Program Management-Status Reporting**	VPROGMMGMT13	2140	$406,600			$406,600	$88,200	$494,800
10		**Non-MWQI Funded Program Management**		0	$0			$0		$0
11		**Other Required Program Costs**						$0	$50,000	$50,000
	11.1	**MEO Insurance & Fuel & Maintenance**					$36,100	$36,100		$36,100
		Total		20,150	$2,450,468	$47,808	$275,737	$2,774,013	$344,092	$3,118,105
			Unallocated staff hours & costs at $100/hour =	2,253	$225,300					

[a] 6.1.1 Includes contracts with San Luis & Delta-Mendota Water Authority, Area Restroom and maintenance contracts for WQ Station analyzers.

[b] Includes Dennis's time (funded by the MWQI SPC).

[c] Operating Equipment & Expenses

*** DWR assessments are equally charged to programs to cover costs of Departmental overhead expenses. For example, administration, legal, and executive offices.**

**** The MWQI Program includes 10 PY for staff and 3 PY for program partners in OCO, BDO, and O&M.**
ES Staff time has been calculated at $100 per hour, and Engineer Staff time at $138 per hour and ES Supervisor time has been calculated at $190 per hour.

3.2. Explanation of Program Element Costs for FY 15-16 Work Plan Projects

Table 2. FY 15-16 Program Element Costs for MWQI SPC Activities

Work Plan Element	Program Element	Cost	Description
6.1.1	MWQI Real Time Stations	$25,000	Real-time station and special study equipment (if needed)
6.3.1	RTDF Data Dissemination & Reporting	$1,500	Technical consultant (Rich Losee)
6.3.2	Administration and Database Activities	$62,400	Technical consultant (Dennis Huff)
7.1	Limnology of the SWP	$58,500	Technical consultant and program manager (Rich Losee)
7.1	Limnology of the SWP	$58,492	Equipment
9	Program Management	$80,000	Program management consultant (Elaine Archibald) and SWPCA General Manager
9	Program Management	$8,200	Program management expenses
11	Other Required Program Costs	$50,000	SWP Sanitary Survey
	Total	$344,092	

Table 3. FY 15-16 Program Element Costs for MWQI Program Activities

Work Plan Element	Program Element	Cost	Description
5.1	Routine Monitoring Program	$85,000	
5.2	Short-term Monitoring		5.2 is $54,000 but this amount has been added in 5.1 above
6.1.1	MWQI Real Time Stations	$36,000	Equipment repairs and replacement, filters, reagents, etc.
6.1.1	MWQI Real Time Stations	$2,000	SLDMWA - Minor repairs and phone service at Jones real time station
6.1.1	MWQI Real Time Stations	$1,000	All Cal Services - portable toilet at Hood real time station
6.1.1	MWQI Real Time Stations	$22,128	Thermo Fisher- service contract for Dionex IC analyzers
6.1.1	MWQI Real Time Stations	$18,144	GE/Sievers - service contract for organic carbon analyzers
6.1.2	Gianelli Water Quality Station	$4,536	GE/Sievers - service contract for organic carbon analyzers
6.1.2	Gianelli Water Quality Station	$102,000	Equipment repairs and replacement, filters, reagents, etc. & Dionex
7.1.8	Wide Swings in Canal pH Study	$3,637	Turbidity Sensor
8.1	Administration Work	$9,000	Meetings, conferences, training for MWQI staff
8.2	Field Unit Office Duties	$3,000	Maintenance of Field Section offices and needed office equipment
8.6	Workplace Safety	$1,000	Safety equipment.
11.1	Mobile Equipment Office	$36,100	Vehicle maintenance, fuel, and insurance.
	Total	$323,545	

4. **WORKLOAD ASSESSMENT**

For this work plan cycle, FY 15-16, the MWQI Program management staff conducted a workload assessment to assess whether their staff had work that would occupy 100% of their staff's work time. This assessment is based on 13 staff members which includes MWQI staff and our MWQI funded partner staff in OCO, BDO, and O&M. The assessment is also based on Position Year (1 PY) hours, or 1778 committed staff hours per work year which is equal to 221 days. The assessment does not use the total hours in a year (2080) because total hours includes vacation, holidays, sick, etc, where staff do not produce work. The workload assessment has proved to be a vital tool in managing staff workloads, shifts in workloads, and impacts to the MWQI budget. The current workload assessment can be found in Appendix 1.

5. **WATER QUALITY ASSESSMENT**

Water quality assessment has been a key feature of the MWQI Program since its inception in 1983. MWQI data are used by many groups including DWR, the MWQI SPC, non-governmental organizations, the public, and numerous other federal, State, and local agencies. MWQI data are used in drinking water supply studies, to identify long-term trends in drinking water quality, and to help DWR and other agencies develop research and mitigation measures to reduce drinking water contaminants in Delta waters and the SWP. Additionally, in collaboration with the BDO, O&M EAB, and OCO, monitoring data obtained from the Delta and SWP are used to further develop the "early warning" system that provides advance notice to Delta water users of possible drinking water quality problems. Monitoring data are collected through two different monitoring strategies, 1) discrete *grab* samples, and 2) continuous *real-time* monitoring via remotely located instrumentation. This section focuses on discrete or 'grab sample' monitoring for FY 15-16. Section 6.1 focuses on continuous, remote real-time monitoring.

In spring 2015, the MWQI Program took possession of its two new water quality monitoring vans. These vehicles are essential to completing the routine tasks of conducting discrete sampling and have been outfitted with the necessary equipment to provide a safe, clean, and efficient working space for staff.

Discrete monitoring in the FY 15-16 work plan is similar to the FY 14-15 work plan. The only difference from FY 14-15 is the addition of Delta RMP Pathogen monitoring which commenced in April 2015. Information about this new monitoring can be found in Section 5.2.3. Pathogen monitoring occurs at sites the MWQI Program staff already monitor, so the total number of MWQI monitoring locations will stay unchanged at 28 during FY 15-16. For example, 12 of the existing MWQI monitoring locations are part of the MWQI Program's routine monitoring program (Section 5.1), all of which are used to sample for pathogens. The other 16 monitoring sites are associated with short-term modeling support and other approved special studies, some of which are used to sample for pathogens. The pathogen sites are noted in Table 4 and Figure 2.

Table 4 lists all of the monitoring locations planned for FY 15-16 while Figure 2 is a map of the discrete and real-time sampling sites, and Table 7 lists the routine and special project discrete grab sample deliverables and timelines.

Table 4. MWQI Discrete Grab Sampling Stations

#	Stations	WDL Stations (ID)	Analytes Collected	Frequency	Study
1	Natomas East Main	NATOMAS EMDC at EL CAMINO RD (A0V83671280)	Std. Mineral, nutrients, TOC, DOC,	Monthly	Routine, Pathogens

#	Stations	WDL Stations (ID)	Analytes Collected	Frequency	Study
	Drainage Canal		UVA, turbidity, bromide, metals, pathogens		
2	American River at E.A. Fairbairn WTP Intake	American River at W.T.P. (A0714010)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, bromide	Monthly	Routine
3	Sacramento River at West Sacramento WTP Intake	Sacramento River at W. Sac Intake Structure (A0210451)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, and bromide, metals	Monthly	Routine
4	Sacramento River at Hood	Sacramento R A Hood (B9D82211312)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, bromide, Mn, pathogens	Once every two weeks	Routine, RTDF, Pathogens
5	Sacramento River at Mallard Island[1]	Sacramento River at Mallard Island (E0B80261551)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, bromide, CBOD, BOD	Once every two weeks[1]	Routine, DSM2 Nutrient
6	San Joaquin River near Vernalis	San Joaquin R. nr. Vernalis (B0702000)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, bromide, Mn, CBOD, BOD, pathogens	Once every two weeks	Routine, RTDF, DSM2 Nutrient, Pathogens
7	Old River at Bacon Island	Old River at Bacon Island (B9D75811344)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, bromide, pathogens	Monthly	Routine, Pathogens
8	Old River at Station 9	Old R. nr. Bryon (St 9) (NEAR HWY 4 BRIDGE) (B9D75351342)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, bromide, Mn	Monthly	Routine
9	Banks Pumping Plant at Headworks	Delta P.P. Headworks at H.O. Banks PP (KA000331)	Anions, TOC, DOC , pathogens (MWQI); Std. Mineral, turbidity, UVA, TOC, DOC, bromide, total phosphorous, total suspended solids, phytoplankton, purgeable organics, taste and odor (MIB & geosim), asbestos, and radiological, pesticides and herbicides (O&M)	Depending on analyte, Bi-weekly (MWQI), Monthly (O&M), or Quarterly (O&M)	Routine, RTDF, Pathogens

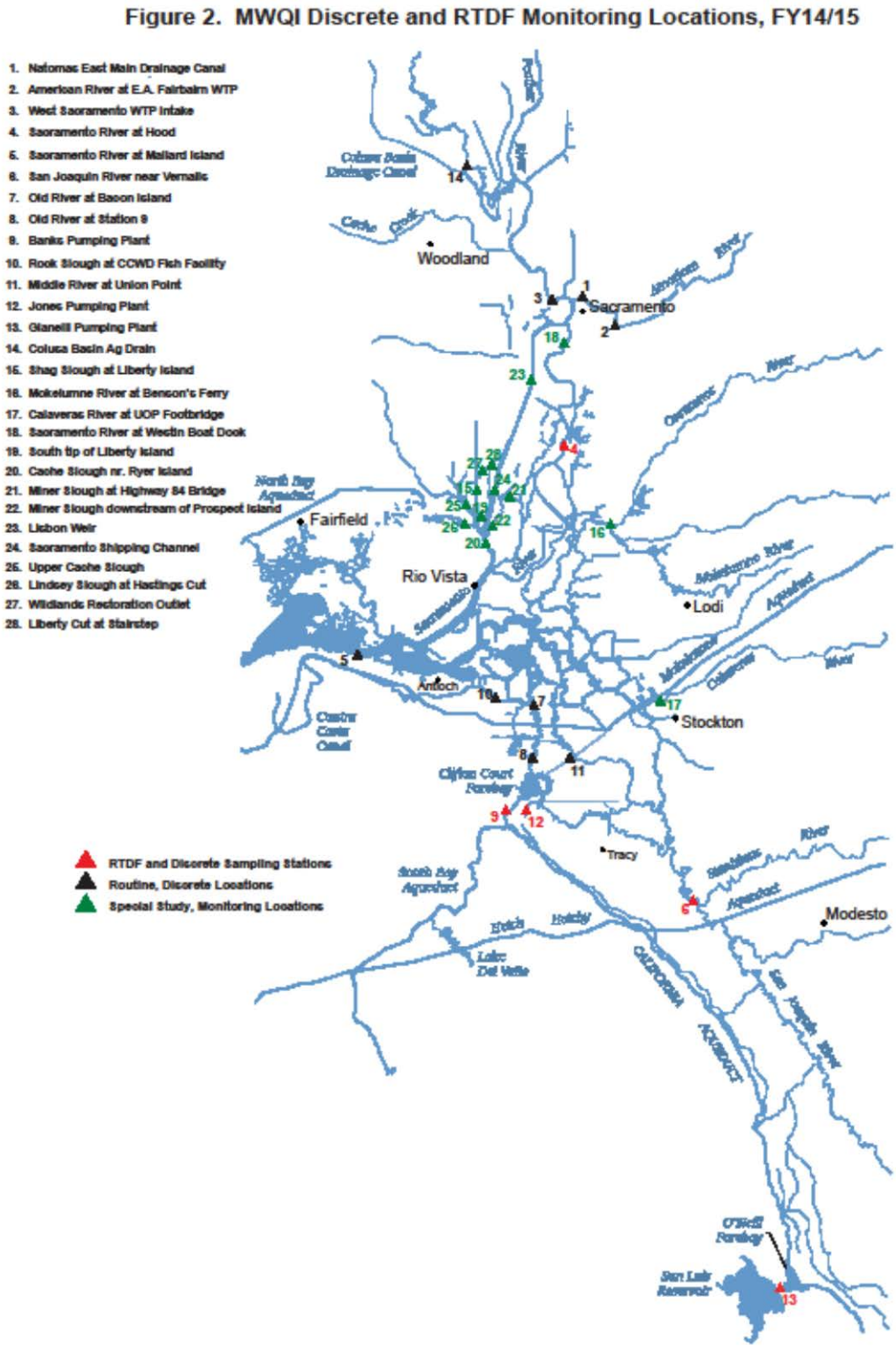
#	Stations	WDL Stations (ID)	Analytes Collected	Frequency	Study
10	Contra Costa Canal @ Rock Slough	Contra Cost Canal at Rock Slough Fish Screen (B9C75861385)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, and bromide, pathogens	Monthly	Routine, Pathogens
11	Middle River @ Union Point	Middle River A Union Point (B9D75351292)	Std. Mineral, Turbidity, UVA, TOC, DOC, Bromide, nutrients, Mn	Monthly	Routine
12	Jones Pumping Plant at DMC	Eastside Delta Mendota Canal intake at Jones PP (B9C74781351)	Anions, TOC, DOC, pathogens	Once every two weeks	RTDF, Pathogens
13	Gianelli Pumping/Generating Plant	Gianelli WQ Station near Pumping Plant (ON003050)	Anions, TOC, DOC	Once every two weeks	RTDF
14	Colusa Ag Drain near. Sacramento River	Ag Drain on Colusa Basin Main Drain (A0294500)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, bromide, Suspended Solids, pathogens	Monthly	Routine, Pathogens
15	Shag Sl. @ Liberty Island (Yolo Bypass West Toe Drain)	ShagSl@LibIslBr (B9S81841416)	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, CBOD, BOD, THMFP, HAAFP	Biweekly	Cache Slough Complex; DSM2 Nutrient
16	Mokelumne River @ Benson's Ferry	Benson's Ferry (B9D81371295)	Std. Mineral, nutrients, TOC, DOC, UVA, turbidity, bromide, suspended solids, chlorophyll, CBOD, BOD, pathogens	Biweekly	DSM2 Nutrient, Pathogens
17	Calaveras River @ UOP Footbridge	Calaveras R @ UOP (B9D75851208)	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, CBOD, BOD, pathogens	Biweekly	DSM2 Nutrient, Pathogens
18	Sacramento River @ Westin Boat Dock	SacR. @ Westin BtDoc (B9D832212010)	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, CBOD, BOD, pathogens	Biweekly	DSM2 Nutrient, Pathogens

#	Stations	WDL Stations (ID)	Analytes Collected	Frequency	Study
19	Southern tip of Liberty Island	S. Liberty Is. (B9D81461410)	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, THMFP, HAAFP	Biweekly	Cache Slough Complex
20	Cache Slough nr Ryer Island (Lower Cache Slough)	Cache Sl nr. Ryer Is (B9D81281401)	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, THMFP, HAAFP, pathogens	Biweekly	Cache Slough Complex, Pathogens
21	Miner Slough above Prospect	Miner Sl @ Hwy84 Br (B9D81751379)	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, THMFP, HAAFP	Biweekly	Cache Slough Complex
22	Miner Slough below Prospect (but above confluence with Cache Slough)	Miner Sl below P (B9D814103910)	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, THMFP, HAAFP	Biweekly	Cache Slough Complex
23	Lisbon Weir (Yolo Bypass East Toe Drain)	YOLOBYLISBON (B9D82851352)	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, THMFP, HAAFP	Biweekly	Cache Slough Complex
24	Sacramento Shipping Channel above Prospect Island	SDWC (B9D81621397)	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, THMFP, HAAFP	Biweekly	Cache Slough Complex
25	Upper Cache Slough (below Ulatis Creek)	Upper Cache Sl (B9S81841416)	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, THMFP, HAAFP	Biweekly	Cache Slough Complex
26	Lindsey Slough at Hastings Island Bridge	Lindsey Sl. at Bridge (B9D81481421)	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, THMFP, HAAFP	Biweekly	Cache Slough Complex
27	Wildlands Restoration outfall at Stair-step	Wildlands B9D82011403	Std. Mineral and nutrients, TOC, DOC,	Biweekly	Cache Slough Complex

#	Stations	WDL Stations (ID)	Analytes Collected	Frequency	Study
			UVA, suspended solids, chlorophyll, THMFP, HAAFP		
28	Liberty Cut at Stair-step	LibertyCut at StairStep B9D82011400	Std. Mineral and nutrients, TOC, DOC, UVA, suspended solids, chlorophyll, THMFP, HAAFP	Biweekly	Cache Slough Complex

- [1] Mallard Island is a monthly *routine* monitoring location, but for the DSM2 Nutrient study samples will be collected every two weeks.
- Physical Parameters collected at all sites: Temperature, pH, Turbidity, Dissolved Oxygen, and Specific Conductance
- Standard Mineral analysis includes: Ca, Mg, Na, K, B, Alkalinity, Chloride, Bromide, Nitrate, Sulfate, Dissolved Solids, Specific Conductance
- Standard Nutrient analysis includes: Nitrate + Nitrite, Ammonia, Organic Nitrogen and Ammonia, Total Phosphorus (unfiltered), and Orthophosphorus

Figure 2. MWQI Discrete and RTDF Monitoring Locations



5.1. Routine Monitoring Program

The collection at long-term monitoring locations remains mostly unchanged from FY 14-15 (Table 4); the exception being the slight relocation of the Rock Slough site to the Contra Costa Water District's (CCWD) fish screen facility which is less than 300 feet from the original canal bridge location. In March 2014, the site was moved to the fish screen because the original sampling location lost connectivity to Rock Slough during CCWD construction project to convert their open canal to an underground pipe. There are some access issues sampling at the fish screen location, so once the pipeline construction is complete, sampling will shift back to the original location.

As part of real-time instrument quality control, representative discrete samples are collected bi-weekly at the Banks Pumping Plant, Jones Pumping Plant, Gianelli Pumping Plant, and Hood and Vernalis river stations. These river and canal samples are collected to examine instrument performance, but since they are collected from the appropriate location in the waterways. Discrete sample data are available through DWR's Water Data Library (WDL). Deliverables and timelines associated with discrete sample collection are shown in Table 7.

5.2. Short-term Monitoring

Aside from MWQI's routine monitoring, other samples are collected for what is termed "short-term monitoring". In past years, short-term monitoring activities have been limited to sample collection in years past, but this year written reports will be due from MWQI staff for the DSM2 Nutrient and Cache Slough Baseline Monitoring Studies to reassess whether monitoring needs to continue. Report due dates are shown in the deliverable and timeline tables shown below the narrative for each project. Project management documentation for the projects can be found in Appendix 2.

Short-term monitoring is listed here in Section 5 along with the routine monitoring. Monitoring activities tied to special studies are covered in Section 7. The continuing short-term monitoring projects are described below.

5.2.1 DSM2 Nutrient Study

Principle Investigator – Steven San Julian and Otome Lindsey
Project Partners – Elaine Archibald

The Delta Simulation Model 2 (DSM2) nutrient monitoring study was originally included in MWQI's FY 13-14 work plan. The goal of this monitoring is to define water quality conditions at seven DSM2 nodes located at the river and San Francisco Bay boundaries for the model, so that the DSM2 nutrient model can be improved. MWQI Program staff have sampled the DSM2 locations (*nodes)* twice per month since September 2013 for a list of key constituents identified by a consultant and BDO modelers. The key constituents include physical parameters, nutrients, biological oxygen demand (BOD), carbonaceous biological oxygen demand (CBOD), chlorophyll, and pheophytin. In some cases, a new monitoring location was added to the MWQI Program because monitoring had not previously been done at the node. In other cases, the same DSM2 constituents were added to the monitoring at an existing location where monitoring was already occurring at the node.

In FY 15-16, field monitoring activities will continue. At the same time, the data collected between September 2013 and June 2014 will be analyzed to determine if DSM2 monitoring should continue, or if there is now sufficient data to improve the DSM2 nutrient model. The data analysis task will include looking at the variability of each constituent over time at each of the seven nodes. It will also include a comparison of data collected at each node to nearby routine monitoring stations to determine if the data are comparable. This will help to determine if the longer-term data set at the routine monitoring stations can be used as a surrogate for water quality at the node. All of this

information will be summarized in a memorandum report.

The DSM2 Nutrient Study project deliverables and timelines for the memorandum report are shown in Table 5.

Table 5. DSM2 Nutrient Study Memorandum Report Deliverables and Timelines

Deliverables	Participants	Estimated Start Date	Estimated Completion Date
Download data from WDL	**MWQI Program**	**Mar 2016**	**Mar 2016**
Develop list of questions	**MWQI Program MWQI SPC**	**Mar 2016**	**Mar 2016**
Determine analytical approach	**MWQI Program MWQI SPC**	**Mar 2016**	**Mar 2016**
Conduct data analysis	**MWQI Program MWQI SPC**	**Mar 2016**	**Apr 2016**
Develop draft memorandum report	**MWQI Program MWQI SPC**	**Apr 2016**	**Apr 2016**
Meet with modelers	**MWQI Program MWQI SPC**	**May 2016**	**May 2016**
Develop final memorandum report	**MWQI Program MWQI SPC**	**May 2016**	**Jun 2016**

5.2.2 Cache Slough Baseline Monitoring and Data Analysis

Principle Investigator – Otome Lindsey and Steven San Julian
Project Partners – Alex Rabidoux and Elaine Archibald

In the coming years, numerous ecologically driven restoration projects are planned to be constructed in the Cache Slough Complex. The Cache Slough Complex drains into the Sacramento River near Rio Vista, and includes the Yolo Bypass, Liberty Island, Sacramento Deep Water Ship Channel and other north-west Delta tributaries (see Figure 3). Planned restoration projects are of varying sizes but cumulatively could total over 8000 acres. These planned habitat restoration activities will have unknown impacts to in-stream drinking water quality; and therefore, may result in additional costs to drinking water municipalities treating thru-Delta water. The Fish Restoration Program Agreement (FRPA) is an agreement between DWR and the Department of Fish and Wildlife to implement habitat restoration actions for listed fish species under the Biological Opinions and Incidental Take Permit for SWP operations in the Delta. The proposed FRPA monitoring program is still in the initial phase of development and it is unclear if drinking water quality concerns will be covered by the FRPA monitoring plan and when monitoring might commence.

Due to the uncertainty regarding FRPA monitoring, and with the backing of the MWQI SPC, MWQI will conduct a two-phased approach to help define baseline, pre-restoration water quality in the Cache Slough Complex. Phase 1 involves working with FRPA to make sure that drinking water quality monitoring concerns are addressed in future FRPA monitoring. If this is successful, the MWQI Program may be able to step-back from its monitoring responsibilities tied to Phase 2 of this

study. Phase 2 is the MWQI Program led field monitoring of key locations in the Cache Slough Complex. Both phases will run concurrently.

The Cache Slough monitoring described above will continue indefinitely, but there is now interest in revaluating the site selection and constituents monitored. Revaluating now will help ensure that monitoring activities are providing the correct data for a robust analysis. Depending on the results of this report, recommendations could be to add or delete sites, to change sampling frequency, or to alter constituents analyzed. In order to make these determinations, this data analysis project will look at the data collected between September 2013 and June 2015, to determine:

- If upstream and downstream sites are statistically the same for key constituents, such as EC, DOC, Trihalomethane Formation Potential (THMFP), and Haloacetic Acid Formation Potential (HAAFP)
- If adjacent sites are statistically the same for key constituents, such as EC, DOC, THMFP, and HAAFP
- If twice monthly monitoring is a sufficient collection frequency, or if a different interval is warranted
- If data, which has been collected at random tidal states, is lacking any value that would require tide specific sampling
- If restoration project staff have data needs that should be taken into account and if monitoring should be adjusted based on those needs
- new recommendations based on these findings

This study is receiving assistance from a staff member from the Municipal Water Quality Program's QA/QC Section. It is planned that this staff member would conduct the vast majority of the work for this study, with intermittent input from senior MWQI staff and other interested parties. The time requirements for these peripheral staff are not figured in the Table 1 labor because time will be charged to the QA/QC Section budget.

The Cache Slough Complex Study deliverables and timelines are shown in Table 6.

Table 6. Cache Slough Complex Pre-Restoration Baseline Monitoring Deliverables and Timelines

Deliverables	Participants	Estimated Start Date	Estimated Completion Date
Assess data needs of Restoration Groups and interested parties	**MWQI Program MWQI SPC FRPA & others**	**Jul 2015**	**Jul 2015**
Develop list of questions	**MWQI Program MWQI SPC**	**Jul 2015**	**Jul 2015**
Determine analytical approach	**MWQI Program MWQI SPC**	**Jul 2015**	**Jul 2015**
Download data from WDL	**MWQI Program**	**Aug 2015**	**Aug 2015**
Analyze data	**MWQI Program**	**Aug 2015**	**Aug 2015**
Develop project summary report	**MWQI Program MWQI SPC**	**Aug 2015**	**Sept 2015**

Meet with Restoration Groups and interested parties	**MWQI Program MWQI SPC**	**Sep 2015**	**Sep 2015**
Develop final report	**MWQI Program MWQI SPC**	**Sep 2015**	**Sep 2015**

5.2.3 Pathogen Special Project Monitoring

Drinking water municipalities have been tasked with conducting monitoring to comply with the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), which was adopted by the State of California on July 1, 2013. This study, looking at pathogen levels at drinking water treatment facilities and key surface water locations, is being performed as a joint collaboration between the MWQI Program, the Central Valley Drinking Water Policy Workgroup, and the Delta RMP. The RMP approved the monitoring plan, and MWQI's role is solely to collect the pathogen samples and deliver them to the laboratory for analysis. Monitoring began in April 2015 and will end in March 2017. MWQI staff will collect samples at 12 locations monthly and deliver these samples to the contract laboratories. All 12 sites are already monitored by MWQI staff so the time commitment associated with this study is minimal.

Samples are collected following the general field procedures described in MWQI's *Field Manual*. Specific sampling protocols are also used for *Cryptosporidium* and *Giardia* per EPA Method 1623. Sites at which the pathogen samples are collected can be found in Table 6.

Figure 3. The Cache Slough Complex Station Name, Type, and Location.

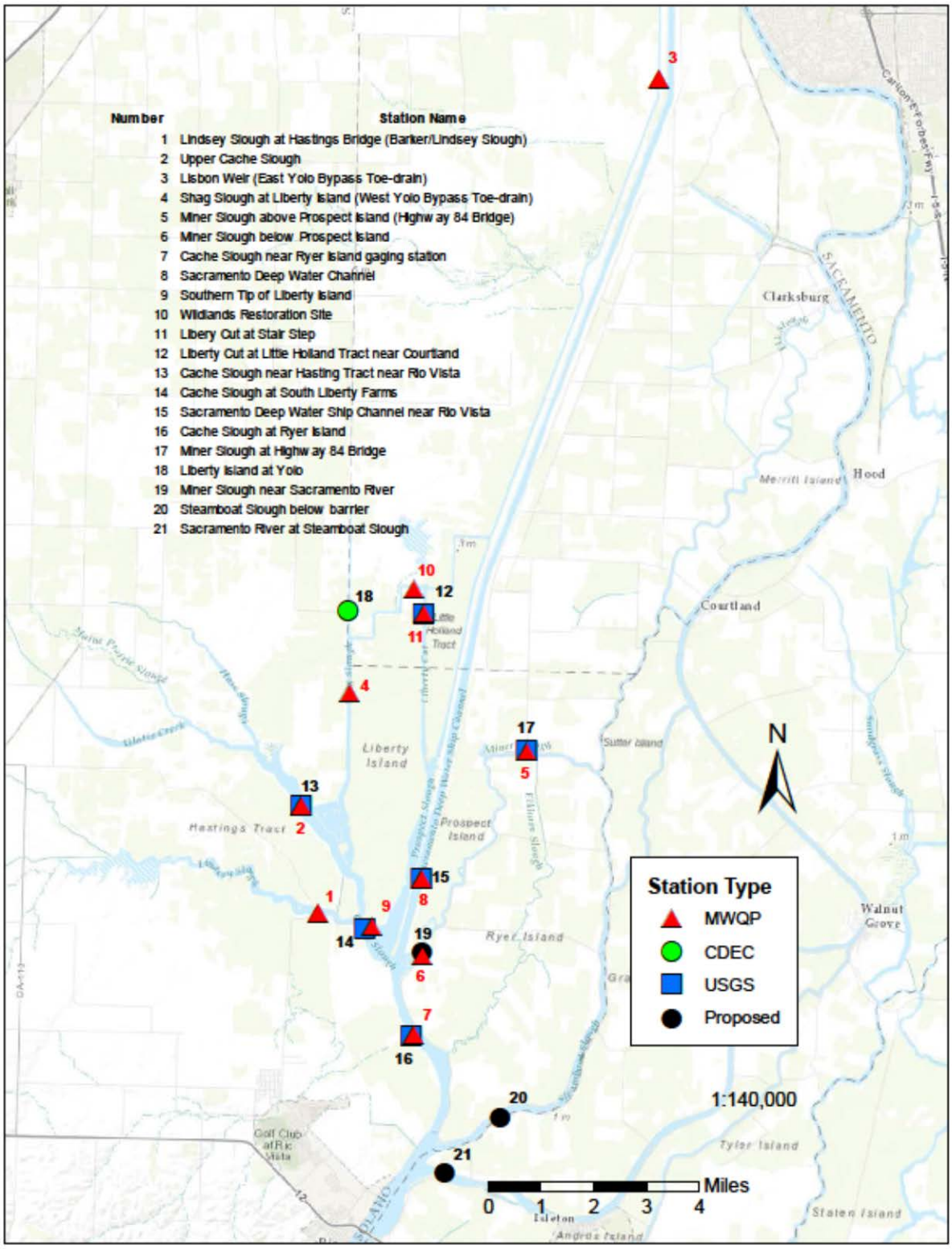


Table 7. Routine and Special Project Discrete Grab Sample Deliverables and Timelines

Deliverable	Participants	Start Date	Estimated Completion Date
Records of monthly and bi-weekly monitoring data.	**MWQI**	**N/A**	**Currently available upon request**
Records of periodic calibration of field monitoring equipment	**MWQI**	**N/A**	**Currently available upon request**
Records demonstrating consistent and timely application of QA/QC procedures	**MWQI**	**N/A**	**Currently available upon request**
Timely analysis and posting of results to the WDL	**MWQI**	**N/A**	**Monthly Available on-line**
Eastside Streams WARMF and Yolo DSM2 Monitoring	**MWQI**	**Oct 2010**	**Complete**
DSM2 Nutrient Monitoring	**MWQI**	**Sep 2013**	**Reassess Feb 2016**
Cache Slough Complex, Fish Restoration Passage Act (FRPA) Engagement	**MWQI**	**Jun 2013**	**Reassess Feb 2016**
Cache Slough Complex Monitoring	**MWQI**	**Sep 2013**	**Reassess Feb 2016**

N/A = not applicable or available

6. REAL-TIME DATA AND FORECASTING COMPREHENSIVE PROGRAM

The RTDF-CP focuses on providing a single location that compiles and disseminates real-time water quality data and related information gathered from multiple sources, enabling water managers to make operational decisions based on observed and forecasted changes in water quality. The RTDF-CP includes a network of real-time water quality monitoring stations that provide interested parties with current water quality conditions, and a modeling component that provides both historical and predictive water quality descriptions. Monitoring done by the RTDF-CP encompasses the Delta, watersheds of the Delta, the SWP, and portions of the federal Central Valley Project (CVP) that are interconnected to the SWP. As a result, funded positions within the MWQI Program are also found within DWR's BDO, OCO, O&M EAB as well as a contract with the San Luis Delta-Mendota Water Authority (SLDMWA).

The RTDF-CP Consists of Three Principle Activities:

1. Remote instrumentation that provides real-time water quality data
2. Modeling that provides historical water quality fingerprints and water quality forecasting
3. Information management and data dissemination

(Emergency response is also part of the RTDF-CP, but is treated separately in this work plan. See section 8.7.)

Real-time monitoring, forecasting and data dissemination activities are guided by the RTDF Steering Committee, a group of technical experts composed of MWQI Program staff, CCWD staff and participating MWQI SPC agencies. The RTDF Steering Committee reports to the MWQI TAC.

6.1. Real-Time Monitoring

The real-time monitoring section of the RTDF-CP produces water quality data that can be used by drinking water treatment plant operators to make informed operational decisions, supports the development of water quality forecasting tools, provides early warning of changing water quality conditions, and provides information for water quality and water supply planning studies.

This program element is comprised of:

1. Instrumentation installed at key remote locations in the Delta.
2. Field operations that provide timely repair and maintenance of all station equipment.
3. Timely dissemination of real-time data.
4. Standard Operating Procedure documentation and instrument QA/QC documentation.
5. Implementation and documentation of data QA/QC.

6.1.1 MWQI Real Time Stations

Field office labor associated with real-time monitoring (RTM) includes: ordering RTM supplies, phone consultation with instrument manufacturers, creation of RTM Quality Control (QC) sampling runs, creation of instrument-specific chemical standards, solutions and reagents, in-office repairs to the water quality station's peripheral components such as pumps, maintenance of equipment used on RTM field runs, analysis of RTM QC data, and remote operation of instruments. Commodity and service charges will also continue to be charged to the RTDF Charge number.

Table 8 summarizes station locations, MWQI Program and non-MWQI Program water quality parameters, and the automated analyzers used by the MWQI Program RTM element. Figure 2 shows the location of the RTM stations.

The RTDF-CP continues to operate four remote real-time stations located in the Delta and one south of the Delta (Table 8). The Delta stations include Hood located on the Sacramento River near the town of Hood, Banks Pumping Plant located at the head of the SWP, Jones Pumping Plant located at the head of the Delta-Mendota Canal (part of the CVP) and Vernalis located on the San Joaquin River near the town of Vernalis. The southern station, at the Gianelli Pumping Plant, is located within O&M's San Luis Field Division on O'Neill Forebay below San Luis Reservoir.

To reduce costs associated with organic carbon analysis, new organic carbon sampling manifolds were installed at all five real-time monitoring stations. In conjunction with Campbell Scientific data loggers, the new manifold systems control the amount of sample water used for organic carbon analysis by reducing the number of samples analyzed within a specific time period. Previously, the analyzers monitored TOC and DOC continuously; now, five TOC and five DOC samples are analyzed every four hours. By reducing the number of samples, reagent use is minimized and the amount of sample water that would normally move through the filter system is reduced, decreasing reagent and filter replacement intervals.

Recently, a new electronic QC worksheet, developed by the QA/QC Section staff, was placed on each station computer, giving the Field Support Section staff the ability to enter instrument QC sample results. Once the results are entered, the Excel based application checks multiple QC criteria simultaneously to ensure that instrument performance is within acceptable limits. In addition, Field Support Section staff continue to enter station visit details into the electronic Field Journal which is also installed on all station computers.

Finally, station SOP's for each of the five real-time stations and their associated instruments were developed and reviewed by QC staff. They are stored internally on a DWR server.

Table 8. MWQI Real-Time station locations, parameters, and equipment

MWQI Program Station/CDEC Station	MWQI Program Parameters & Instruments	Non-MWQI Program Parameters
Sacramento River at Hood (CDEC = SRH)	TOC, DOC (Sievers 900-oxidation)	Water: chlorophyll, EC, DO, pH, temperature and turbidity. Atmospheric: solar radiation, temperature, wind speed and direction.
San Joaquin River near Vernalis (CDEC = SJR)	TOC, DOC (Sievers 5310-oxidation) bromide, chloride, nitrate, sulfate, (Dionex ICS-2100)	Water: chlorophyll, DO, EC, pH, river flow and stage, temperature and turbidity.
Banks Pumping Plant - Delta Headworks (CDEC = HRO)	TOC, DOC (Sievers 5310-oxidation), bromide, chloride, nitrate, sulfate, (Dionex ICS-2100)	Water: EC, fluorescence, pH, pump discharge, temperature, turbidity, UVA 254. Atmospheric: temperature, wind speed and direction.
Jones Pumping Plan (CDEC = TRP)	TOC, DOC, (Sievers 5310-oxidation), bromide, chloride, nitrate, sulfate, (Dionex ICS-2100)	Water: EC, pump discharge, temperature.
Gianelli P/G Plant (CDEC = ONG)	TOC, DOC (Sievers 5310), EC, temp, turbidity, DO, pH (YSI 6600) bromide, chloride, nitrate, sulfate (Metrohm IC 850)	N/A

N/A = not applicable or available

6.1.2 Gianelli WQ Station

In order to track time and expenditures related to the Gianelli water quality station, a separate IO was created (VGIANNELLI13). The funding for this station goes largely toward the salary for an Environmental Scientist position held within the O&M EAB. The responsibilities remain the same as those from the previous work plan, and are similar to those at the other MWQI Program real-time water quality stations.

MWQI real-time station locations, parameters, and equipment are shown in Table 8.

Table 9 summarizes the deliverables and timelines associated with real-time monitoring.

Table 9. Real-Time Monitoring Deliverables and Timelines

(Lead organization(s) are shown in bold)

Deliverable	Participants	Estimated Start Date	Estimated Completion Date
Continue operation of automated stations at Hood, Banks, Jones, Vernalis, and Gianelli	**MWQI Program, O&M Water Quality**	**Ongoing**	**Ongoing**
A) Update SOPs: documenting maintenance, operation and quality assurance/quality control of all in-situ equipment.	**MWQI Program, O&M Water Quality**	**Jul 2013**	**A) First draft completed Oct 2014/Ongoing**

B) Continue to work towards standardizing, streamlining, and consolidating DWR's in-situ equipment, data quality control, and data dissemination.	**MWQI Program, O&M Water Quality, North Central Regional Office, IEP**	**N/A**	**B) Ongoing**
Evaluate the need, and planning for, other installations per the RTDF-CP (together with RTDF Steering Committee).	**RTDF SC MWQI TAC**	**Jul 2008**	**Ongoing**

N/A = not applicable or available

6.2. RTDF-CP Water Quality Forecasting

The modeling/forecasting component of the RTDF-CP continues to update and improve existing models to further develop their capabilities; these include the Watershed Analysis Risk Management Framework (WARMF) tributary watershed models, the DSM2 Delta and DSM2 Aqueduct Extension models. The objective of this effort is to better incorporate modeling insight with water quality monitoring to maximize the use of modeling results by water quality managers.

During the previous fiscal year, the MWQI program focused on Historical representations, Short-Term Forecasts and on tasks associated with Seasonal Forecasts. These efforts are scheduled to continue through this work plan cycle. For FY 15-16, the modeling sub-group of the RTDF Steering Committee suggested seven new areas of model development which would/could provide beneficial information to interested parties and improve modeling capabilities. In addition, the Artificial Neural Network (ANN) model developed by Tetra Tech was completed and distributed with training in January 2015.

Oversight tracking of modeling work is documented through PPA which is an agreement between the two divisions explaining work to be performed. New 1 year PPA will be developed to manage the ongoing work. These agreements will be developed by program staff and reviewed by the RTDF Steering Committee. PPA are approved and signed by the MWQI Program Branch Chief and the program managers in the respective Divisions of BDO, OCO, and O&M.

Below are descriptions of projects that are underway or that have yet to begin. In some cases the PI identified is a "placeholder" until vacancies are filled or staff are assigned to the project(s).
The modeling sub-group of the RTDF Steering Committee will continue to work on implementing these ideas and review of the new tasks will continue at the monthly RTDF Steering Committee meetings or at future modeling sub-group meetings.

6.2.1. BDO Modeling

Principal Investigator – TBD
Project Partner –Tony Liudzius

The models are continuously and routinely updated by BDO modelers. For example, the ArcMap application is allowing modelers to develop and add stage animations features in DSM2, refine DSM2 scripts, and organize historical simulations for Delta and Aqueduct models. Also, DWR water quality monitoring data has been compared to data in the Sacramento watershed WARMF model, but upstream sources are a limiting factor. Additional work is needed to support short-term modeling in the Delta, and to provide timely updates on drought related EC effects therefore, throughout this work plan cycle the modeling sub-group will meet periodically to develop this work.

6.2.2. OCO Modeling

Principal Investigator – TBD (BDO) and Dan Yamanaka's (OCO) Staff Member is TBD
Project Partner –Tony Liudzius

The models are continuously updated and refined by DWR OCO modelers. Within this section, a potential new project was identified by the modeling sub-group that would/could improve the forecasting capability of Delta consumptive use. Improvements include preparing up-to-date annual Delta land use surveys, installing flow gauges at key Delta locations and improving the collection of Delta precipitation data by adding new monitoring sites. Further review by the modeling sub-group is needed before a new project is developed.

6.2.3. Improve Aqueduct Pump-in Dynamics in MWQI Water Quality Forecasts

Principal Investigator – Dan Yamanaka's (OCO) Staff Member is TBD and MWQI Staff is TBD
Project Partner –Tony Liudzius

Short-Term Forecasts
Interested SWP urban contractors and MWQI staff will investigate whether data for scheduled near-term aqueduct pump-ins (defined here as less than 2 months) are available, and whether obtaining this information on an ongoing basis is feasible. If this information is available, the effort will include establishing procedures for acquiring the information and determining if any support tools are needed to help automate and process the data. The goal would be to include accurate, up-to-date pump-in information in the MWQI Program short-term water quality forecasts.

Seasonal Forecasts
This task is the same as described above for the short-term forecasts except that the desired pump-in information will be for the current year (or slightly longer) in order to conform to the timeframe used in the seasonal water quality forecasts.

6.2.4. Assessment, Collection and Archival of Aqueduct Pump-in Data

Principal Investigator – MWQI Staff is TBD
Project Partner – Tony Liudzius

This project consists of identifying and cataloging all known sources of aqueduct pump-in data (both flows and water quality). If this information proves useful to the MWQI Program or in producing water quality forecasts, the task will include data gathering/input into an appropriate database or archive which will be made available to interested parties. This project will begin with the initial step of identifying the data and then determine the next steps. Eventual forecast comparisons may lead to model improvements because models could be adjusted so they're more effectively assessing the water quality impacts from the pump-ins.

6.2.5. Comparison of Water Quality Forecasts to Actual Conditions

Principal Investigator – Dan Yamanaka's (OCO) Staff Member is TBD and Mark Bettencourt
Project Partner – Elaine Archibald

Once forecasts are prepared, this project would compare short-term and long-term model output with actual water quality conditions over a specified time period to gain a better understanding of model efficiency. The structure, goals and deliverables of this study and the specific time period to be examined will be established by the study work group. One possibility is to examine the first three to four months of 2014 when water quality conditions declined due to drought conditions. Forecasts comparisons may lead to model improvements because models could be adjusted so they're more effectively modeling the water quality impacts from the pump-ins.

6.2.6. Improvement of the DSM2 Nutrient Model

Principal Investigator – Hari Rajbhandari
Project Partner – Elaine Archibald

In 1995, DWR BDO developed the capability of simulating nutrient dynamics and primary production using the DSM2 QUAL model and in 2009, under contract to MWDSC, RMA refined the model. Since that time, additional data have been collected by the MWQI Program, and others that could be used for further refinement. To continue to improve the model, four areas need investigation:

1. Gain a better understanding of nutrient dynamics in the Delta;
2. Determine the questions that need to be answered;
3. Which models can answer the questions; and,
4. What data are needed to refine or calibrate the models?

These four areas are all initial components that need defining. (It may be that the DSM2 Nutrient Model is sufficient to answer some questions; however, a more sophisticated nutrient model may be needed to answer other questions.)

6.2.7. Potential Planning Studies

Principal Investigator – TBD
Project Partner – Tony Liudzius

The RTDF Steering Committee will investigate the need to conduct planning studies based on project operations under assumed hydrology, water demands, institutional constraints and project operation goals. Using different scenarios, planning studies could be a great tool for determining potential drought related issues. For example, for future drought planning the CalSIM model can be run to look at possible hydrology for dry conditions in the fall of 2015.

6.2.8. Adding Additional Wastewater Treatment Plants to the Fingerprint

Lead Investigator – TBD and MWQI Staff is TBD
Project Partner – Elaine Archibald

The Delta Modeling Section of the BDO developed a fingerprint model that displays the percent of treated wastewater at various locations in the Delta and the contributions of EC and DOC from these wastewater treatment plants. The fingerprint includes input from the Sacramento Regional Wastewater Treatment Plant, the Stockton Regional Wastewater Control Facility and the Manteca-Lathrop Wastewater Control Facility. There are however, nine other wastewater treatment plants that discharge into the Delta making the addition of data from these sites beneficial to the model.

Effluent data will be obtained from the CIWQS database and Central Valley Regional Water Board files.

6.3. RTDF-CP Information Management and Data Dissemination

This program element includes data dissemination and information management tasks associated with the synthesis of real-time data and related information that comes from the RTDF-CP and a variety of federal and state water quality monitoring programs. The element produces, gathers, organizes and disseminates the information and results via the WDL (http://wdl.water.ca.gov/), the California Data Exchange Center (CDEC) (http://cdec.water.ca.gov/) and the RTDF-CP web page (http://water.ca.gov/waterquality/drinkingwater/rtdf_rprt.cfm).

In addition, daily and weekly summary emails containing a subset of information including real time data, Delta commentary, weather updates and hydrological conditions are sent to interested parties. (This information is also posted on the RTDF-CP web site.) Also, the RTDF-CP web page includes new graphics and more information, allowing users to search for related water quality information in one place, and continue to be updated with additional drought information.

6.3.1. RTDF Data Dissemination and Reporting

Information management and data dissemination tasks include:

1. Continued refinement of the WDL data set.
2. Continued refinement of the MWQI Program database.
3. Continued development and enhancement of online tools for editing, evaluating, and interpreting MWQI Program water quality data (QA/QC and data visualization).
4. Improving means to distribute daily and weekly water quality reports via the internet.
5. Improving database functionality.

Tasks and deadlines for the data dissemination portion of the RTDF program are shown below in Table 10.

Table 10. Information Management and Data Dissemination Deliverables and Timelines

(Lead organization(s) is (are) shown in bold)

Task	Participants	Start Date	Estimated Completion Date
Improve/Upgrade database infrastructure	**MWQI Program**		
A) Continue to implement updates and patches as appropriate.		**A) Began Jan 2009**	**A) Ongoing**
B) Continued enhancement of manual and automated QA/QC processes		**B) Began Jan 2009**	**B) Ongoing**
C) Continue to develop the station journal database and applications.		**C) Began Jan 2010**	**C) Ongoing**

Task	Participants	Start Date	Estimated Completion Date
D) Continue to develop desktop data management tools, enhance plotting capabilities, link time series and QA/QC.		**D) Began Jan 2010**	**D) Ongoing**
E) Continue to document and maintain infrastructure.		**E) Began Jul 2009**	**E) Ongoing**
F) Add new sensors to the database as needed		**F) Began Jan 2010**	**F) Ongoing**
Improve Field Data Communications	**MWQI Program**		
A) Continue to develop, test and enhance intranet/ internet components.		**A) Began Jan 2011**	**A) Ongoing**
B) Develop and implement as feasible procedures, practices and standards for supporting the reliability of field data systems.		**B) Began Jul 2011**	**B) Ongoing**
Development and enhancement of RTDF data dissemination products	**MWQI Program**		
A) As needed, add new stations & sensors to the website or daily summary table.		**A) N/A**	**A) Ongoing as needed**
B) As needed, enhance the website presentation.		**B) N/A**	**B) Ongoing as needed**
C) Enhance procedures for emailing the daily summary report.		**C) N/A**	**C) Ongoing as needed**

N/A = not applicable or available

7. **SCIENCE SUPPORT (SPECIAL STUDIES)**

The Special Studies described in this MWQI Program FY 15-16 work plan have been identified by the MWQI Program in consultation with the MWQI SPC as valuable contributions to improving drinking water quality through improved understanding of processes affecting source waters, storage, and conveyance. Some studies from the previous work plan are ongoing and updated summaries of these studies are discussed below, along with summaries of proposed new special project work.

7.1. Limnology of the SWP

MWQI SPC Project Manager – Elaine Archibald
MWQI SPC Lead Scientist & Technical Advisor – Rich Losee
DWR Project Management Administrative Lead – Cindy Garcia
DWR Project Coordination – Mark Bettencourt

This project was originally conceived in the FY 13-14 Work Plan, as a long-term limnological and ecological study of the SWP. It has evolved into a program to more directly address the SWC specific issues and concerns with the goal of demonstrably improving the management of the SWP, particularly in regard to drinking water quality, through the application of limnological and ecological principles. The SWC have identified an extensive list of problems, issues and concerns associated with drinking water quality of the SWP. These issues range from the occurrence of objectionable levels of algal produced Taste and Odor (T&O) compounds, to indirect impacts on drinking water quality through the obstruction of Contractor aqueduct turnouts by aquatic plant material. Improved management of these problems will be achieved by gaining an understanding of the limnology and ecology of the organisms involved and applying this knowledge to develop optimal control and treatment strategies. To be successful, the entire project will require cooperation and collaboration across Divisions within DWR, including O&M EAB, OCO, and the Field Divisions, as well as the MWQI SPC, consultants and academics. An important function of the MWQI staff will be to coordinate and collaborate the efforts of the participating entities.

The various Delta water quality problems and issues are often related to a common parameter that causes or exacerbates the problem. For example, Delta water has eutrophic to hypereutrophic nutrient levels that support the excessive growth of filter-clogging algae on the South Bay Aqueduct, taste and odor producing cyanobacteria throughout the SWP, and submersed macrophytes in several parts of the system. Therefore, a study of nutrients in the SWP will contribute to the solution of multiple problems reported by the Contractors. The limnology sub-project studies will be designed in such a way as to efficiently provide information that can be applied to multiple MWQI SPC member problems. In the Work Plan, the sub-project studies are organized as follows: nutrient-related, organism growth and growth-rate related, the spatial and temporal distribution of problem organisms in the aqueduct, photosynthesis driven pH excursions, and reservoir limnology.

The MWQI SPC has contracted with Rich Losee to serve as the Lead Scientist and the technical advisor on the projects, while others on this project team will provide project management, administrative assistance, and coordination and technical support.

This Limnology of the SWP conveyances project originally consisted of an overarching Limnology Project which included 9 sub-projects. Because of the volume and complexities of the sub-projects, and to better manage this ambitious multi-year effort the original project will now be referred to as the MWQI Limnology of the SWP Program.

To date, the Limnology sub-projects are:

1. Nutrient Budget Study
2. Nutrient Limitation Study
3. Nutrient and Nutrient Ratio Influence on Community Species Composition
4. Light Limitation in the SWP
5. Algal and Macrophyte Growth Study
6. Wide Swings in Canal pH Study
7. San Luis Reservoir Limnology Study

8. Dyer Reservoir Limnology Study
9. Del Valle Reservoir Limnology Study

For any MWQI sub-project where a mid-study report, called a Project Summary Report is expected, staff will provide their project's summary report to the MWQI SPC. MWQI staff that complete their projects will provide a final report to the MWQI SPC. Report due dates are shown in the deliverable and timeline tables shown below the narrative for each project. Project management documentation for each sub-project can be found in Appendix 2.

7.1.1. Nutrient Budget Study

Principle Investigator – Marcia Scavone-Tansey
Project Partners – Rich Losee and Elaine Archibald

The goals of this study are to understand the nutrient sources to the SWP and their fate and transport in the SWP. This work involves the assembly of an extensive dataset from which nutrient budget and other analyses will be performed. Nutrient budgets will be developed for key locations to gain a better understanding of the sources of nutrients in various SWP facilities.

The first phase of this project was comprised of a data analysis of the SWP starting with the North Bay Aqueduct, Banks Pumping plant, the South Bay Aqueduct, O'Neill Forebay outlet, the Coastal Branch, the California Aqueduct, and the bifurcation of the Aqueduct with the West Branch.

The second phase of the project involves a data analysis of the Delta, the West Branch (Pyramid and Castaic Lakes) and the East Branch (Lake Silverwood). This phase is in progress and the Delta analysis has been completed. This work will continue through FY 15-16. A final report will be completed after the data analysis for the whole project has been conducted.

The Nutrient Budget Study deliverables and timelines are shown in Table 11.

Table 11. Nutrient Budget Study Deliverables and Timelines

Deliverables	Participants	Estimated Start Date	Estimated Completion Date
Analyze Silverwood Lake data	**MWQI Program**	**Jul 2015**	**Aug 2015**
Obtain water quality and flow data for Pyramid and Castaic Lake	**MWQI Program**	**Aug 2015**	**Aug 2015**
Analyze Pyramid and Castaic Lake Data	**MWQI Program**	**Sep 2015**	**Sep 2015**
Conduct additional data analysis and prepare draft final report	**MWQI Program**	**Oct 2015**	**Jun 2016**

7.1.2. Nutrient Limitation Study

Principal Investigator – Ted Swift
Project Partner – Rich Losee

The objective of this study is to investigate the theoretical nutrient limitation as it might occur over

space and time in the SWP. This is a paper study using the nutrient data assembled in the Nutrient Budget Study (Project 7.2.1) and literature information on limiting nutrients for the algal and macrophyte species that occur in the Delta and aqueducts and lakes of the SWP. Nutrient ratios will be calculated at locations of problematic algal or macrophyte growth in the SWP to determine which nutrients may be limiting during different seasons of the year. The next step will be to explore the feasibility of developing a nutrient status index for key locations in the SWP that could be updated after each sampling event when the data are available from the WDL and reported, possibly in the RTDF update. A final report will be completed after the data analysis and feasibility of developing a nutrient status index have been conducted.

The Nutrient Limitation Study deliverables and timelines are shown in Table 12.

Table 12. Nutrient Limitation Study Deliverables and Timelines

Deliverables	Participants	Estimated Start Date	Estimated Completion Date
Conduct literature review and examine data	**MWQI Program MWQI SPC**	**Mar 2015**	**Apr 2015**
Examine nutrient ratios, develop time series analysis and nutrient status index	**MWQI Program MWQI SPC**	**May 2015**	**Jun 2015**
Prepare draft final report including: lit review; time series analysis; and nutrient status index	**MWQI Program MWQI SPC**	**Jun 2015**	**Jul 2015**
Submit draft final report to DWR management and MWQI SPC for review	**MWQI Program MWQI SPC**	**Jul 2015**	**Jul 2015**
Respond to comments and provide final report	**MWQI Program MWQI SPC**	**Aug 2015**	**Aug 2015**

7.1.3. Nutrient and Nutrient Ratio Influence on Community Species Composition

Principle Investigator – Ted Swift
Project Partner – Rich Losee

The primary objective of this literature review is to follow the progress of Irwin van Nieuenhuyse's work and the Dick Dugdale group's work on nutrients and nutrient ratios as they affect benthic and planktonic algal community composition, respectively. After conducting the literature review and interviews with each researcher, and reviewing the information developed in the Nutrient Budget Study (Project 7.1.1) and the Nutrient Limitation Study (Project 7.1.2), hypotheses of SWP community algal species composition will be developed. These hypotheses will be tested in future studies of algal species composition. The work product from this study will be a final report summarizing the key findings from the literature review and a list of hypotheses to be tested in the next phase of work.

The Nutrient and Nutrient Ratio Study deliverables and timelines are shown in Table 13.

Table 13. Nutrient and Nutrient Ratio Influence on Community Species Composition Study Deliverables and Timelines

Deliverables	Participants	Estimated Start Date	Estimated Completion Date
Prepare and submit a study outline	**MWQI Program MWQI SPC**	**Jan 2016**	**Jan 2016**
Conduct literature review	**MWQI Program MWQI SPC**	**Feb 2016**	**Feb 2016**
Develop hypotheses of SWP community algal species composition	**MWQI Program MWQI SPC**	**Mar 2016**	**Mar 2016**
Submit draft final report to DWR management and MWQI SPC for review	**MWQI Program MWQI SPC**	**Apr 2016**	**Apr 2016**
Respond to comments and provide final report	**MWQI Program MWQI SPC**	**Jun 2016**	**Jun 2016**

7.1.4. Light Limitation in the SWP

Principle Investigator – Ted Swift
Project Partner - Rich Losee

The objective of this study will be to determine the amount of light reduction necessary to sufficiently reduce the growth of algae and submersed macrophytes in order to control the problems they cause in the SWP. This study will support the development of strategies and treatments to control filter-clogging diatoms on the SBA, T&O producing algae throughout the SWP, and submersed macrophytes in the SWP aqueducts.

The first step in this study is to conduct a literature review of light limitation of filamentous diatoms (*Melosira*), benthic cyanobacteria (T&O producers if available) and submersed macrophytes (particularly of the problematic species in the SWP). Note that Maggie Spoo-Chupka of MWDSC should be used as a primary resource for the T&O producers. Another task in this study will be to refine the turbidity versus light attenuation regression using the existing Interagency Ecological Program (IEP) database of turbidity and photic depth. The work product from this study will be a final report summarizing the key findings from the literature review and the analysis of the turbidity and photic depth data. The final report will address the practicality of using light reduction to control algal or macrophyte growth.

The next step will be to develop a protocol to measure light and light attenuation in the SWP aqueducts. After the protocol has been developed and reviewed, the purchased sensors will tested at locations as determined later when the next phase of this study is further developed. The Light Limitation Study deliverables and timelines are shown in Table 14.

Table 14. Light Limitation in the SWP Study Deliverables and Timelines

Deliverables	Participants	Estimated Start Date	Estimated Completion Date
Prepare and provide study outline	**MWQI Program**	**Aug 2015**	**Aug 2015**
Conduct, prepare and provide literature review	**MWQI Program MWQI SPC**	**Aug 2015**	**Aug 2015**

Refine the turbidity versus light attenuation regression	**MWQI Program MWQI SPC**	**Sep 2015**	**Sep 2015**
Develop light measuring protocol and submit draft final report to DWR management and MWQI SPC for review	**MWQI Program MWQI SPC**	**Oct 2015**	**Oct 2015**
Respond to comments and provide final report	**MWQI Program MWQI SPC**	**Dec 2015**	**Dec 2015**
Further develop and provide design for light limitation study	**MWQI Program MWQI SPC**	**Jan 20156**	**Jan 2016**

7.1.5. Algal and Macrophyte Growth Study

Principal Investigator – Jason Moore
Project Partner - Rich Losee

The objective of this study will be to develop methods to measure algal and macrophyte growth rates in the laboratory and in the field. The first step in this study is to conduct a literature review on the following topics:

- Laboratory methods for measuring growth and primary production of algae in culture to assess the response of species of interest to manipulated parameters affecting growth, such as light and nutrient levels.
- Field method to estimate primary production for whole reaches of the aqueduct.

The work product from this study will be a final report summarizing the key findings from the literature review. The Algal and Macrophyte Growth Study deliverables and timelines are shown in Table 15.

Table 15. Algal and Macrophyte Growth Study Deliverables and Timelines

Deliverables	Participants	Estimated Start Date	Estimated Completion Date
Prepare and provide a study outline	**MWQI Program MWQI SPC**	**Dec 2015**	**Dec 2015**
Conduct literature review	**MWQI Program MWQI SPC**	**Jan 2016**	**Jan 2016**
Submit draft final report to DWR management and MWQI SPC for review	**MWQI Program MWQI SPC**	**Feb 2016**	**Feb 2016**
Respond to comments and provide final report	**MWQI Program MWQI SPC**	**Apr 2016**	**Apr 2016**

7.1.8. Wide Swings in Canal pH Study

Principal Investigator – Jason Moore
Project Partner – Rich Losee

The goal of this effort is to apply limnological principles to decrease the drinking water treatment plant difficulties resulting from photosynthetically driven diurnal variations in pH in the SBA. The objectives of this study are to 1) understand the magnitude of the problematic pH diurnal swing events and the inorganic carbon chemistry and buffering capacity of the SBA; and 2) to quantify the magnitude and diurnal dynamics of specific pH excursion events before, during, and after algaecide

treatment. The first phase of this study was to conduct a literature review, refine the sampling methods, and conduct a pilot study.

Phase I of this study has been extended into FY 2015-16 to include a second pilot study. The purposes of this pilot study will be to refine the sampling methods and will include the use of artificial substrates for the estimation of biomass.

Phase II of the project will begin in January 2016 and the objectives are to conduct monitoring during pH excursion events for one full year. This will involve continuous measurement of pH and oxygen both upstream and downstream of the reach of interest on the SBA; before, during, and after treatments to control algae in the SBA. Inorganic carbon and alkalinity of the water will be monitored to assess the buffering capacity. The monitoring will be conducted from January 2016 through December 2016 and will encompass the algal growth season of February to November. A final report will be completed after the data analysis has been conducted.

The Wide Swings in Canal pH Study deliverables and timelines are shown in Table 16.

Table 16. Wide Swings in Canal pH Study Deliverables and Timelines

Deliverables	Participants	Estimated Start Date	Estimated Completion Date
Conduct pilot study monitoring	**MWQI Program**	**Jul 2015**	**Nov 2015**
Prepare and provide phase II sampling plan to DWR management and MWQI SPC for review	**MWQI Program MWQI SPC**	**Nov 2015**	**Jan 2015**
Respond to comments and finalize phase II sampling plan	**MWQI Program**	**Feb 2016**	**Feb 2016**
Prepare and provide pilot study II draft final report to DWR management and MWQI SPC for review	**MWQI Program**	**Jan 2016**	**Feb 2016**
Respond to comments and finalize pilot study II final report	**MWQI Program**	**Mar 2016**	**Mar 2016**
Conduct phase II sampling	**MWQI Program**	**Jan 2016**	**Dec 2016**

7.1.9. San Luis Reservoir Limnology Study

Principal Investigator – TBD
Project Partner - TBD

This study may be addressed in this work plan cycle, and will involve conducting profiles in San Luis Reservoir to better understand the water quality implications of drawing down the reservoir levels.

7.1.10. Dyer Reservoir Limnology Study

Principal Investigator – TBD
Project Partner – TBD

This study may be addressed in this work plan cycle, and investigate the water quality impacts from

bird roosting and operations of Dyer Reservoir.

7.1.11. Del Valle Reservoir Limnology Study

Principal Investigator – TBD
Project Partner – TBD

This study may be addressed in this work plan cycle, and will investigate the limnological conditions in Del Valle Reservoir and potential methods of controlling methyl mercury.

7.2. State Water Project Watershed Sanitary Survey Update

Since 1990, the water agencies treating water from the SWP have been required to conduct a watershed sanitary survey every five years. This is a requirement based on the California Surface Water Treatment Rule, and is administered by the SWRCB DDW. In Title 22 of the California Code of Regulations, a sanitary survey is defined as "a physical and hydrogeological description of the watershed, a summary of source water quality monitoring data, a description of activities and sources of contamination, a description of any significant changes that have occurred since the last survey which could affect the quality of the source water, a description of watershed control and management practices, an evaluation of the system's ability to meet requirements of this chapter, and recommendations for corrective actions."

The current format of the sanitary surveys is to complete surveys annually. The first four sanitary surveys will focus on a particular issue or region of interest. The fifth survey will be a review of water quality data for the entire SWP. The five annual reports will be submitted to DDW as they are completed and will be packaged together in the 5th year. This new format has been developed with the approval of DDW, and will satisfy the requirement of a sanitary survey every 5 years.

7.2.1 Status of Cattle Grazing on the SWP

Principal Investigator – Sonia Miller
Project Partner – Elaine Archibald

This project is the second annual sanitary survey and the focus is on the impacts of cattle grazing in the watershed areas of various SWP facilities. This report is being written and will be reviewed by committee prior to going through the approval to print process. Once printed this report will be provided to the SWRCB DDW. The Status of Cattle Grazing on the SWP deliverables and timelines are shown in Table 17.

Table 17. Status of Cattle Grazing in the SWP Deliverables and Timelines

Deliverables	Participants	Estimated Start Date	Estimated Completion Date
Prepare and provide draft report to DWR Management and Sanitary Survey Subcommittee for review	**MWQI Program & MWQI SPC**	**Apr 2015**	**Aug 2015**
Respond to comments and provide final report to Sanitary Survey Subcommittee for review	**MWQI Program & MWQI SPC**	**Sep 2015**	**Sep 2015**
Respond to comments and provide final report to DWR Editors for review	**MWQI Program & DWR PSO**	**Oct 2015**	**Nov 2015**

Respond to comments and provide final report to DWR management for review	**MWQI Program**	**Nov 2015**	**Dec 2015**
Respond to comments and approval to print	**MWQI Program**	**Jan 2016**	**Jan 2016**

7.3. Fluorescence of Dissolved Organic Matter (FDOM) Project

Principal Investigator – Jeremy Del Cid with assistance from Steven San Julian
Project Partner – Alex Rabidoux

The purpose of this project is to investigate the use of FDOM as a proxy for organic carbon measurements. Literature reviews have shown significant relationships between FDOM and DOC and it may be possible to use FDOM as a proxy for DOC measurements. For this project, a custom-built fluorometer (a Turner Designs Cyclops 7) is installed on the SWP at the Banks Pumping Plant (Banks).

Phase I of this project, FDOM Proof of Concept study, will continue into FY 15-16 while it goes through the review and editing process. Phase I investigated the relationships between FDOM and DOC, and FDOM and UVA_{254}. Deliverables and timelines for Phase I are included in Table 18.

Phase II of the project will expand on the FDOM and DOC relationship investigated in Phase I which used filtered samples. This second phase will expand on the correlation between FDOM and DOC using filtered samples to include running samples of unfiltered water through the FDOM and determine how those values correlate with the TOC concentrations. This is essential to the real world application of FDOM sensors which will be deployed in the field without the benefits of filtering.

As demonstrated by the MWQI field unit during Phase I, proper maintenance is required for FDOM data consistency. Cleaning of the FDOM's lens and flow through cap will need to be made bi-weekly at a minimum. After two weeks, bio-fouling may occur, affecting the quality of the data. It may be necessary to repair the instrument if the sensor is found to be damaged in some way throughout the term of Phase II.

The FDOM will be deployed at Banks for one year to encompass seasonal changes. Phase II data collection will run from October 2014 to October 2015. A project summary report was developed after Phase I and a final report will be provided at the end of the project. The FDOM Phase II project deliverables and timelines are shown below in Table 19.

Table 18. FDOM Phase I Study Deliverables and Timelines

Deliverables	Participants	Estimated Start Date	Estimated Completion Date
Submit revised draft final report to DWR management for review	**MWQI Program & MWQI SPC**	**May 2015**	**Jun 2015**
Respond to comments	**MWQI Program**	**Aug 2015**	**Aug 2015**
Approval to print	**MWQI Program**	**Aug 2015**	**Oct 2015**

Table 19. FDOM Phase II Study Deliverables and Timelines

Deliverables	Participants	Estimated Start Date	Estimated Completion Date
Collect data	**MWQI Program**	**Oct 2014**	**Oct 2015**
Prepare project summary report and provide to DWR Management and MWQI SPC for review	**MWQI Program & MWQI SPC**	**Sep 2015**	**Oct 2015**

Respond to comments and provide final project summary report	**MWQI Program**	**Oct 2015**	**Nov 2015**
Analyze data for final report and provide final report to DWR Management and MWQI SPC for review	**MWQI Program**	**Nov 2015**	**Nov 2015**
Respond to comments and provide final report to DWR Editors for review	**MWQI Program**	**Feb 2016**	**Mar 2016**
Respond to comments and provide final report to DWR Management for review	**MWQI Program**	**Apr 2016**	**Apr 2016**
Respond to comments and approval to print	**MWQI Program**	**May 2016**	**Jun 2016**

8. OTHER MWQI FUNDED PROGRAM ACTIVITIES

MWQI staff work on some tasks that seem peripheral to the approved projects, but are actually an inescapable part of the job. For this reason the following descriptions are intended to explain these types of tasks and help define the associated time requirements. In this section administrative activities, employee safety, and other *overhead* type requirements are discussed.

In addition to these, MWQI staff is occasionally requested to support other DWR activities. For example, MWQI staff may be asked to provide technical assistance, review and revise plans, or provide support that improves workplace safety practices. Such assistance by the MWQI staff may directly or indirectly benefit the MWQI Program stakeholders and the MWQI SPC, and therefore is funded by the MWQI budget.

As they have done in the past, MWQI Program staff will continue to inform the TAC and MWQI SPC members about work on these tasks. MWQI will achieve this through updates during the monthly TAC meetings, by providing details in this and future work plans, and through expenditure reports presented monthly at TAC meetings.

8.1. Administration Work

In general, the Administrative Work covers meetings, conferences, training, and certain office duties of all MWQI staff. Each of these duties are described below.

MWQI Program staff attend training classes focused on drinking water quality, but also attend classes outside of water quality to develop their skills and prepare for career advancement. Another form of training is workshop and conference attendance, such as the annual Environmental Scientist Workshop; the IEP Workshop, CWEMF Annual Meeting, Bay Delta Science Conference, etc.

Other required program activities include office duties such as preparing training and travel expense claim forms; general email activities; preparing MWQI Program meeting agendas, handouts, and meeting minutes; and preparing equipment maintenance contracts. Also, most in-house meetings attended by staff are charged to this IO, including the TAC and Branch meetings. Administration work also covers preparing for and attending the MWQI Annual Meeting.

8.2. Field Support Section Office Duties

The Field Support Office Duties IO number tracks the cost of the Field Section by tracking time and expenses charged for attending section and Branch meetings, maintaining the Bryte Trailer offices, and other general office activities. This IO information will be a valuable planning tool for the senior staff member leading the Field Section, which will allow for the budgeting of facility repairs, as needed.

8.3. O&M Water Quality Other Duties

The MWQI Program funds 60% of one position (0.6 PY) within O&M that is managed under a PPA . The billing for this position is split between two Divisions: 60% worktime covers the Gianelli water quality station operation and is explained in Section 6.1.2. The remaining 40% of the worktime is funded by O&M and covers tasks such as the development of the O&M annual turn in reports, and participating in the MWQI monthly meetings.

8.4. MWQI Annual Work Plan

This year's annual work plan will be developed by MWQI Program management so that line staff can concentrate on completing their work. Charges to this effort are all work plan development activities including work plan meetings, work plan text and workload assessment development, and budget and timeline development, all of which is included in the annual work plan document.

8.5. DWR's Bulletin B132, Chapter 4 - Water Quality

The MWQI Program staff will actively participate in writing the appropriate portions of the DWR Bulletin 132, Chapter 4 - Water Quality for version 132-15 (Calendar Year 2014). Bulletin 132, Management of the SWP, is a series of annual reports that describe the status of SWP operations and water deliveries. Each annual report updates information regarding project costs and financing, water supply planning, power operations, and significant events that affect the management of the SWP. Each report also presents hydrologic information for the water year, capital construction information for the fiscal year, and water delivery, operations, maintenance, and other activities for the calendar year.

The cost of staff time spent revising and reviewing specific sections within chapter 4-water quality that pertain to the MWQI Program will be tracked so that management staff and the MWQI SPC can gain an understanding of the time and cost involved in producing our contributions to this document that is required by DWR to be provided annually to the SWP Contractors. This information will provide a valuable management tool for planning, organizing, managing, and controlling staff's work time on the production of future bulletins.

8.6. Workplace Safety

The DWR Safety Officer is responsible for leading DWR's implementation of a world-class workplace safety program. The workplace safety program is beginning to provide uniformity and consistency across DWR, and involves every staff member contributing to a safer workplace. DES is committed to supporting DWR's workplace safety program with its total quality management approach; commitment to the health and safety of its employees, partners and visitors; and values workplace safety through leadership, recognition, and education.

DES' Safety Sub-committee continues to enhance and refine its comprehensive workplace safety program both in office and field locations; ensure compliance with all applicable federal, State, and local laws and regulations; provide the required inspections, assessments, corrective actions, training, and reporting; and make recommendations that will elevate the DES workplace safety program to meet DWR's goals of a world-class level.

MWQI staff will contribute to this broader workplace safety program effort by contributing staff time in the division level efforts. On the project/study level, MWQI staff will ensure that safety equipment, safety protocols and documentation, and required training are part of every project. All of the work on safety program development, safety meeting attendance, and project specific safety activities and equipment will be charged to the Workplace Safety IO number.

8.7. Emergency Response

Any staff involvement with emergency response (ER) during this work plan cycle will include: attending ER meetings, restocking of drinking water quality ER kits, providing emergency assistance for drinking water quality monitoring as requested by emergency responders and assisting the DWR's Emergency Management Committee (EMC) as needed in the development of a DWR Drinking Water Quality ER Plan.

8.8. Miscellaneous Meetings Attended by Staff

The MWQI Program staff will continue to provide support as needed to numerous DWR support activities that pertain to the MWQI Program. The cost of staff time spent on these support activities will be tracked so that management and the MWQI SPC will gain an understanding of the time and cost involved. This information will provide a valuable management tool for planning, organizing, managing, and controlling staff's workloads, project time allocations, and overall costs to the MWQI Program.

9. PROGRAM MANAGEMENT - STATUS REPORTING

The MWQI Program Senior Environmental Scientists are responsible for these following specific management tasks:

- Supervise and direct the work of the MWQI Environmental Scientists and other technical staff assisting with MWQI projects.
- Assign and distribute staff work, then monitor staffing levels, project schedules, monitor and evaluate work performance, and conduct staff workload assessments to improve efficiency, save time, resources and money.
- Conduct routine staff meetings, prepare staff's annual appraisal and development (A&D) reports, determine staff training needs, approve staff's training and time-off requests, and verify and approve staff attendance.
- Coordinate the preparation, or prepare and provide the appropriate MWQI Program meeting agendas, monthly status report, budget expenditure reports, and meeting minutes.
- Coordinate the MWQI Annual Meeting.
- Ensure MWQI TAC members continue to receive all draft materials, and that committee members continue to have the opportunity to participate in technical meetings of interest.
- Monitor progress on MWQI Program elements outlined in work plan.
- Address personnel, contracted services, and equipment related issues for the MWQI Program.
- Conduct interviews and hire qualified staff to backfill vacancies.
- Provide technical support to management for meetings, conference and workshops related to drinking water quality issues.
- Prepare correspondence as needed to provide information to the MWQI SPC.

All time spent on these tasks is charged to the *Program Management* IO number (VPROGMMGMT13). Only Senior Environmental Scientists in the MWQI branch charge to Program Management.

10. **NON-MWQI FUNDED PROGRAM MANAGEMENT**

Since DWR is a matrix management organization, staff may be requested to assist with supporting various DWR activities by providing technical support, evaluations and analysis of data, timely document and plan reviews, and may occasionally attend meetings. Some of these support activities are not funded by the MWQI Program budget. For example, the MWQI Program staff who assist with the turbidity transects, drought barriers and drought monitoring plans, or curtailment inspections will charge their work time to the respective program's budget.

The amount of work time that staff spends on these types of non-MWQI funded activities is infrequent, and rarely impacts their normal workloads. MWQI Program staff members serve as DWR's technical drinking water quality experts. Work done on non-MWQI projects is beneficial to DWR and is indirectly beneficial to the MWQI stakeholders.

11. **OTHER REQUIRED PROGRAM COSTS**

DWR's Mobile Equipment Operation's (MEO) provides insurance and fuel to support the vehicles used by the Field Support Section staff for their routine water quality assessment efforts. The MEO office staff will continue to support the MWQI Program by providing customer support through cost effective fleet management and maintenance of mobile equipment owned by DWR. The MWQI Program allocated $36,100 for this work plan cycle to cover costs incurred for this support.

In addition to fuel & insurance, this cost allocation allows for the recommended annual services on each vehicle at 6K and 12K, for miscellaneous incidental costs (such as towing, flat repair, etc.), and includes an amount for catastrophic repairs that the older vehicles may require.

Expenditures for these types of services not assigned to any specific program element will be tracked and reported as MEO, line item 11.1, is in the column entitled "Operating Equipment and Expenses" in Table 1, and on the monthly expenditure reports. These monthly expenditure report will be provided as handouts prior to the monthly TAC meetings.