



Marin Municipal Water District

Draft Report

Appendix A. Previous Investigations and Reports

January 2023

This page is intentionally left blank.

Contents

Previous Investigations and Reports	A-1
A.1 Introduction	A-1
A.2 Available Reports	A-1
A.3 Summary of Reports.....	A-2
A.4 Additional Studies	A-5
A.5 References	A-9

Tables

A-1 Additional Studies Reviewed.....	A-6
--------------------------------------	-----

This page is intentionally left blank.



Previous Investigations and Reports

A.1 Introduction

The Marin Municipal Water District (MMWD or District) serves the populous eastern corridor of Marin County from the Golden Gate Bridge northward up to, but not including Novato. The district covers approximately 147 square miles and serves a population of approximately 190,000 customers with surface water supplies from seven local reservoirs, augmented with Russian River supplies imported from the Sonoma County Water Agency (Sonoma Water). Historically, MMWD has successfully met demands during periods of extreme drought with a combination of rationing, conservation, and increased Sonoma Water supplies. However, recent drought conditions that severely threatened water supply reliability have prompted MMWD to explore various water supply options to enhance resiliency for its customers.

The Strategic Water Supply Assessment (SWSA) is intended to be additive to past planning efforts and is designed to fill in the gaps on new water supply alternatives. Many reports and studies have been produced by MMWD describing the feasibility and capacity of many different water supplies for long and short time periods. This appendix captures the published relevant information about water supplies that were reviewed and informed the development of the SWSA.

A.2 Available Reports

An extensive list of documents was provided by MMWD for review. The list below indicates the primary documents provided by MMWD for review that were included in the project proposal:

- Water Supply Master Plan (1989)
- SASM-MMWD Recycled Water Feasibility Study (2014)
- CMSA-MMWD Recycled Water Feasibility Study (2016)
- Water Resources Plan 2040 (2017)
- North Bay Water Reuse Plan Phase 2 (2018)
- Marin Municipal Water District Desalination Plan EIR (2008) and Unpublished Updates (2021)
- Water Shortage Contingency Plan (2021)

- Urban Water Management Plan (2021)
- CMSA-MMWD Briefing Document Evaluating Direct Potable Reuse in Marin
- Kastania Pump Station Operations (2022)
- EBMUD-MMWD Intertie EIR (2022, in progress)
- MMWD’s In-System “Bottleneck” Study (2022, as available).

Additional documents were collected by Jacobs or provided by MMWD during the course of the SWSA. These documents were also reviewed but considered secondary documents with respect to relevance.

A.3 Summary of Reports

This section summarizes the most relevant water resources and supply reports for the development of the SWSA.

Water Supply Master Plan (Bookman-Edmonston Engineering, 1989)

The purpose of the report is to identify water supply sources to meet water demands. The report assesses the quality and treatment of current water supplies, determines the adequacy of available supply sources, and identifies alternative methods to provide future water supply treatment and conveyance. Alternative supply sources discussed include additional reservoir storage at Tolay Lake, Los Vaqueros Dam, and at the Sacramento River Facilities. Supply alternatives discussed include convergence facilities such as the North Bay Aqueduct Extension, Tolay Pipeline, Russian River Aqueduct, and Richmond-San Rafael Bridge Pipeline. The report provides recommendations for supplemental supplies (Yuba River Development and Russian River), desalinization, conveyance (North Bay Aqueduct and Russian River Aqueduct), and water treatment for the region.

SASM-MMWD Recycled Water Feasibility Study (Carollo 2014)

The SASM-MMWD Recycled Water Feasibility study evaluates the feasibility of constructing a new recycled water (RW) system to replace or increase existing irrigation supplies. The development of RW service within the Sewerage Agency of Southern Marin (SASM) service area would offset potable water use and promote the beneficial use of RW for irrigation, cooling tower use, and/or wetlands enhancement. The project alternatives are developed by combining the existing and potential RW use sites into several pipeline alignment alternatives that serve RW to large users in the service area. From the analysis, the recommended alternative includes maintaining the existing sites and implementing urban reuse along the SASM-South proposed pipeline while routing and the necessary infrastructure to meet the RW demands.

CMSA-MMWD Recycled Water Feasibility Study (Carollo 2016)

The purpose of the CMSA-MMWD Recycled Water Feasibility study is to determine the feasibility of developing a recycled water system to augment water supplies for MMWD. Currently, the CMSA wastewater treatment plant has an average dry weather permit capacity of 10 million gallons per day. The average flow rate of the treatment facility is currently 7.9 million gallons per day. During peak wet weather, the treatment plant was expanded to treat up to 125 million gallons. The report evaluated recycled water uses such as for irrigation, commercial reuse, dual plumbing at San Quentin Prison, and direct potable reuse. The recommended project for the CMSA-MMWD Recycled Water Feasibility Study is Alternative 1B San Quentin Prison with microfiltration treatment. The San Quentin Prison alternative includes the treatment of recycled water with microfiltration and chlorine disinfection. This treatment allows for the easy addition of reverse osmosis if MMWD or CMSA decide to expand the program to fit other recycled water options.

Water Resources Plan 2040 (RMC and W&C, 2017)

In the Water Resources Plan, a total of 40 resiliency options were developed to improve the District's resiliency and ability to meet demands in times of potential supply shortages. The resiliency options ranged water use efficiency, reuse, expanding SCWA facilities, expanding storage, water and groundwater purchases, and desalination. Each option included a preliminary description, required facilities, cost, yield, reliability, implementation considerations, and conceptual maps or schematics. The analysis found that the District's current supply portfolio is sufficient to meet demands in each of the reliability threats modeled except for the Six-Year Severe Drought.

North Bay Water Reuse Plan Phase 2 (Brown and Caldwell, 2018)

The North Bay Water Reuse Authority (NBWRA) establishes Phase 1 and Phase 2 programs to develop, capture, and use 25,000 AFY of recycled water that is discharged into San Pablo Bay. Phase 1, includes upgrading wastewater treatment plants, distribution pipelines, and small storage reservoirs to deliver recycled water for urban uses. Phase 1 provides 3,800 AFY for urban/agricultural water use, and 1,400 for environmental enhancement. The report also discusses Phase 2, which further develops recycled water as part of the region's water supply portfolio. Phase 2 of the report describes sixteen different projects to deliver an additional yield of 5,364 AFY of water.

Marin Municipal Water District Desalination Project EIR (URS, 2008) and Unpublished Updates (URS, 2021)

The 2008 report describes an Environmental Impact Report (EIR) of the proposed desalination plant in San Rafael. The project would be constructed in multiple phases to supply up to 15 MGD of water to the region. The first phase of the project consists of constructing a 5 MGD desalination facility. Subsequent phases plan to increase the capacity of the desalination facility to 15 MGD. In the EIR, eight different project alternatives were analyzed ranging from,

expandable desalination plants, water conservation methods, a non-expandable desalination plant with conservation methods, alternative pre-treatment methods, alternative desalination plant sites, alternative intake structure sites, and the no project alternative. Alternatives were categorized based on different environmental conditions such as aesthetics, air quality, and other factors.

The 2021 updates present the overall design parameters for two approaches to a supplemental desalination supply. The report summarizes the availability, capacity, construction costs, and potential schedule for a short-term (12-month) leased seawater desalination facility with a capacity of approximately 3.6 million gallons per day (mgd). The report also presents the construction costs and the potential schedule for a long-term full-scale 5, 10, and 15-mgd desalination facility.

MMWD's In-System "Bottleneck" Study (Woodard & Curran, 2022)

The 2022 report describes potential improvements to the District's water conveyance system which would allow excess winter water to be moved from the SCWA (Sonoma County Water Agency) system through Marin Water's system to meet demand and fill existing storage. The report focuses on five different conveyance improvement projects (North Redwood Highway, Santa Margarita, Forbes Hill, San Quentin, and Federal Works) and describes the associated costs for each project. The yearly volume of water available is estimated to range between 1,110 to 12,500 acre-feet. The study does not consider the possible improvements from the East Bay Intertie project and assumes that the Kastania Pump Station upgrades are complete, providing a 14.8 MGD flow rate at the Ignacio Pump Station. The report concludes with a summary describing how different projects can be combined to provide further conveyance improvements.

Water Shortage Contingency Plan (EKI, 2021)

Appendix H of the Water Shortage Contingency Plan (Plan) provides actions that can be implemented in the event of a water shortage event, such as a drought or supply interruption. Attachment 1 of the Plan presents the annual water supply assessment procedures which categorize water shortage levels and associated water conservation actions. The Appendix of the report describes the use of a Drought Risk Assessment (DRT) which calculates potential monthly savings by implementing different procedures discussed in the report. From the plan, the District is expected to have a sufficient water supply from 2021 to 2025 in this multi-year drought scenario. The Plan presents several actions that the District can implement to reduce demands and further ensure supply reliability at various levels of each water shortage.

Urban Water Management Plan (EKI and W&C, 2021)

Based on the comparison of demands and available supplies, the Urban Water Management Plan found that the District's water supply is expected to be sufficient to support the District's projected water demand through 2045 during normal hydrologic years. From the study, the District expects the available supplies to be sufficient to meet projected demands in all

hydrologic conditions, including a five-year drought period, and, under climate change impacts. The report analyzed system water demands, projected water demands, and climate change impacts to predict current and future water demand. The water supply characterization portion of the report analyzes purchased water, groundwater, surface water, stormwater, wastewater, recycled water, desalinated water, and water exchanges and transfers as they relate to the District. The report provides information regarding water supply reliability, water shortage, contingency planning, and demand management measures.

CMSA-MMWD Briefing Document Evaluating Direct Potable Reuse in Marin (Carollo, 2021)

The report presents an analysis of the potential advanced water purification facility (AWPF) under three different production capacities: 2, 4, and 8 million gallons per day (mgd) of water. The purpose of the report is to update the 2016 Study and to recommend the most viable approach to achieve treated water augmentation (TWA). From the study, it was found that the most efficient direct potable reuse (DPR) project is to construct an AWPF at Central Marin Sanitation Agency (CMSA) wastewater treatment plant.

Kastania Pump Station Operations (Kennedy-Jenks, 2022)

The report summarizes the maximum available flow that Kastania Pump Station (KPS) can deliver to Ignacio Pump Station (IPS) through the Petaluma/North Marin Aqueduct (NMA) system without violating the North Marin Water District's minimum pressure and maximum velocity requirements. The report found that the most balanced system operations resulted when the KPS did not exceed 22.9 MGD and the best operation velocity exists between 10 and 14.5 MGD. The system is dependent on pressures through the Petaluma/North Marin Aqueduct (NMA). Higher pressures through the Petaluma/North Marin Aqueduct could result when the San Marin (SM) and Frosty Lane (FL) control valves are closed. The report found that pressure-reducing stations may need to be developed to protect downstream customers from vapor-pressurized water services.

EBMUD-MMWD Intertie EIR (MMWD, 2022 in progress)

The report, prepared by MMWD, discusses three alternatives (Winter Water from SCWA, desalinization, and intertie) to mitigate drought effects on the region. The intertie option is discussed in greater detail, with extra emphasis given to alternatives for location, tie-in, and routes for both the eastern and western pipelines. Specific project elements such as the Richmond Pump Station, Pelican Way Site Improvements, Eastern Pipeline, RSR bridge work, Western Pipelines, and Richmond Distribution System Improvements are discussed. Currently, there is no conclusion of the best-proposed alternative.

A.4 Additional Studies

This section summarizes additional studies that were reviewed during the course of the SWSA.

Table A-1. Additional Studies Reviewed

Study	Summary
Alternative Sources for Supplemental Water Supply Report (MMWD, 1972)	The report discusses 10 alternative sources for water supply for MMWD.
Marin Municipal Water District Adequacy of Existing Water Supply During Dry Weather Cycles (Grant, 1972)	This report describes the effect historic dry weather cycles can have on existing water supplies.
Marin Municipal Water District Water Resources Management Study (CH2M HILL, 1973)	The report analyzes different water supply alternatives and concludes that the best local sources include the Middle Walker Creek, Lagunitas Diversion to Nicasio Reservoir, and the Intertie. For water import sources, the Russian River Alternative is the most economical and has the lowest impact on the environment compared to other alternatives.
Engineering and Economic Feasibility of Various Sites Investigated for the Development of a Natural Water Source within Marin County (Rogers, 1975)	The report discusses the Soulajule Project, which involves constructing an earth fill dam near Arrow Sausal, and concludes that this project is the most feasible site for the development as a water source.
Environmental Assessment of Natural Water Supply Projects (Madrone Associates et al., 1975)	The purpose of the report is to investigate and assess potential environmental constraints on three small water development projects. The report found that the Soulajule Project, raising the present 53-foot dam on Arroyo Sausal by 57 feet, is the only one of three alternatives that does not have a significant impact on the environment.
Supplemental Water Supply Marin Municipal Water District (Dietrich Stroeh, 1975)	The report provides a description of various supplemental short term and long-term water supply projects available to the District based on drought conditions.
Water Demand- Review of Demand and Safe Yield Determinations (CHM2 HILL, 1977)	The report reviews the District's determination of demand and safe yield in terms of water supply and recommends that the District bases its water supply planning based on a need between 5,000- 10,000 ac ft/year.

Study	Summary
New Water Supply Alternatives (Seeman et al., 1978)	The report assesses the major impacts, costs, and engineering requirements for eight alternatives to provide the District's customers with water needs throughout the drought periods.
Groundwater Resources of Ross Valley (Ellis Associates, 1978)	The report investigates Franciscan bedrock as an aquifer and concludes that the Franciscan bedrock is a very limited aquifer at best, however, could be exploited where appropriate.
Net Safe Yield Analysis Study (CH2M HILL, 1982)	The report analyzes the District's reservoir systems to determine the net safe yield available for municipal and industrial use based on existing stream release schedules.
Soulajule Cooperative (MMWD & CDFW, C1985)	The report provides flow requirements for the Soulajule Reservoir to provide for the enhancement of salmon and steelhead fish populations in Walker Creek.
Innovative Approaches to a New Water Supply (Poole et al., 1991)	The report assesses water supply alternatives and concludes that water supply alternatives are becoming limited not only by construction costs but also due to institutional and environmental concerns.
SWRCB Order WR 95-17 (SWRCB, 1995)	This order presents a review the history of water development on Lagunitas Creek and evaluates if the water rights and water diversions practices of Marin Municipal Water District, North Marin Water district, and Waldo Giacomini should be revised in accordance with the provisions of the Order WR 95-17.
Water Supply Planning Model Preliminary Water Supply Option Analyses (MBK, 2002)	The report describes an excel model that simulates system operations through a monthly time step to understand water supply options for the District.
Ground Water Supply Alternatives Upper Lagunitas Creek Catchment (GSi Water, 2004)	The report evaluates potential groundwater supplies near the District's reservoirs in the Mt. Tamalpais Watershed.
Parker Groundwater Technical Memorandum (Parker Groundwater, 2015)	The report summarizes existing groundwater reports to evaluate the potential for groundwater supply in MMWD service area.
West Peal (MMWD, 2018)	The report provides a schematic of proposed wetland treatments, discharge points, solar power systems, for Potrero Meadow and West Peak areas.
Soulajule Reservoir and Arroyo Sausal Methylmercury Control Project: Synthesis of Phase 2 Pilot Studies and Prioritization of Reservoir Management	The report focuses on control strategies to reduce mercury methylation and bioaccumulation potential in the reservoir. The report summarizes and synthesizes key findings from Phases 1–2 of the Soulajule Reservoir and Arroyo Sausal Methylmercury

Study	Summary
Measures (Stillwater Sciences, 2018).	Control Project (Project) and provides recommendations for Phase 3.
Hydrologic monitoring at Potrero Meadows, May 2020 to June 2021 (Balance Hydrologics Inc, 2021)	The report analyzes the creek flow, spring flow, groundwater levels, and water chemistry of Potero Meadows. The study determines that the water table has remained lower than 10 feet during the dry season and in 2020.
Marin Municipal Water District – Evaluation of EBMUD Wheeling Options (Johnson, 2021)	The report summarizes four potential transfer conveyance options to wheel water to Marin Municipal Water District (MMWD) through East Bay Municipal Utility District (EBMUD), as well as associated water purchase options, based on investigative efforts to date.
Direct Potable Reuse Feasibility Study (Carollo, 2022)	The report provides a preliminary evaluation of a potential direct potable reuse (DPR) project which would use an advanced water purification facility at the Central Marin Sanitation Agency water treatment plant for treated water augmentation.

A.5 References

- Balance Hydrologics Inc. (2021). Hydrologic monitoring at Potrero Meadows, May 2020 to June 2021.
- Bookman-Edmonston Engineering, Inc. (1989). Water Supply Master Plan
- Brown and Caldwell. (2021). North Bay Water Reuse Program Phase 2 Feasibility Study
- Carollo. (2014). SASM-MMWD Recycled Water Feasibility Study
- Carollo. (2016). Recycled Water Feasibility Study
- Carollo. (2021). Briefing Document-Evaluating Direct Potable Reuse in Marin
- Carollo. (2021). Central Marin Sanitation Agency Direct Potable Reuse Evaluation Technical Memorandum Direct Potable Reuse Feasibility Study.
- CH2M HILL. (1973). Marin Municipal Water District Water Resources Management Study.
- CHM2 HILL. (1977). Water Demand- Review of Demand and Safe Yield Determinations.
- CHM2 HILL. (1982). Net Safe Analysis Study.
- Dietrich Stroeh, J. (1977). Supplemental Water Supply Report.
- EKI environment & Water. (2021). Briefing Document-Evaluating Direct Potable Reuse in Marin.
- Environment & Water (EKI) & Marin Municipal Water District. (2021). 2020 Urban Water Management Plan for Marin Municipal Water District.
- Grant, B, Heare, B. (1972). Marin Municipal Water District Adequacy of Existing Water Supply During Dry Weather Cycles.
- GSi Water. (2004). Groundwater Supply Alternatives Upper Lagunitas Creek Catchment Results Phase I.
- Johnson, Andree. (2021). Technical Memorandum Marin Municipal Water District – Evaluation of EBMUD Wheeling Options.
- Kennedy Jenks. (2021). Draft Technical Memorandum MMWD Desalination Supply Study.
- Kennedy-Jenks. (2022). Technical Memorandum Kastania Pump Station Evaluation
- Madrone Associates, University at the Pacific Marine Station, Kelley, D.W. (1975). Environmental Assessment of Natural Water Supply Projects.

Marin Municipal Water District (MMWD), State of California Department of Fish and Game (CDFW). (1985). Soulajule Cooperative.

Marin Municipal Water District (MMWD). (1972). Alternative Sources for Supplemental Water Supply Report.

Marin Municipal Water District (MMWD). (2009). West Peak Restoration- Basis of Design Report Volume II.

Marin Municipal Water District (MMWD). (2021). Marin East Bay Water Intertie Project Summary

MBK Engineers. (2002). Water Supply Planning Model & Preliminary Water Supply Option Analyses.

Parker Groundwater, (2015). Technical Memorandum 2015 Conduct Peer Review of Existing Marin County Groundwater Studies and Advise MMWD on Proceeding Actions.

Poole, R., Theisem, R., Roxon, D. (1991). Innovative Approaches to a New Water Supply Case Study Marin Municipal Water District.

RMC Water and Conveyance & Woodard & Curran (W&C). (2017). Water Resources Plan 2040.

Rogers, Richard. (1975). A Summary Report of the Engineering and Economic Feasibility of various sites investigated for the development of a natural water source within Marin County.

Seeman, L., Madrone Associates, Kelley, D.W., Chaves, D., Marliave, B., (1977). Environmental Assessment 1977 New Water Supply Alternatives.

State Water Resources Control Board California Environmental Protection Agency. (1995). Order WR 95-17 Lagunitas Creek.

Stillwater Sciences. (2018). Soulajule Reservoir and Arroyo Sausal Methylmercury Control Project: Synthesis of Phase 2 Pilot Studies and Prioritization of Reservoir Management Measures

State Water Resources Control Board (SWRCB). (1995). Order Amending Water Rights and Requiring Changes in Water Diversion Practices to Protect Fishing Resources and to Prevent Unauthorized Diversion and Use of Water.

URS. (2008). Final Environmental Impact Report (EIR) Marin Municipal Water District Desalination Project.

West Yost. (2022). Draft Local Water Supply Enhancement Study

William C. Ellis and Associates (Ellis Associates). (1978). Groundwater Resources of Ross Valley.

Woodard & Curran (W&C). (2022). Technical Memorandum: Water Conveyance Bottleneck Investigation.

This page is intentionally left blank.