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MEMORANDUM

Presentation and Discussion Item 14A

TO: Board of Directors

FROM: Phil Lauri, P.E., Assistant General Manager

DATE: December 17, 2020

SUBJECT: Water Supply, Energy, and Supply Chain Reliability Assessment

RECOMMENDATION

Receive comments on the Water Supply, Energy, and Supply Chain Reliability Assessment and direct staff to bring back to a future Committee meeting for further discussion.

STRATEGIC PLAN

Goal #1: Provide a safe, abundant, and reliable water supply.
Goal #2: Practice perpetual infrastructure renewal and improvement.
Goal #6: Provide outstanding customer service.

PRIOR BOARD ACTION/DISCUSSION

At its May 14, 2020 meeting, the Board of Directors (Board) awarded on-call professional design services contracts for the Capital Improvement Program Renewal.

BACKGROUND

Mesa Water District (Mesa Water®) owns and operates two reservoirs with a combined maximum storage capacity of approximately 30 million gallons and associated pump stations strategically located within its service area along with 5 clear wells with a total approximate capacity of 14 million gallons per day (MGD). The District also owns and operates two deep production wells that feed the 8.4 MGD Mesa Water Reliability Facility (MWRF) that treats amber-tinted water from the Orange County Groundwater Basin's (Basin) deep aquifer. These aforementioned production, storage, and treatment facilities allow Mesa Water to be the only Orange County water agency to provide 100% local water supply reliability.

Through the 2014 Capital Improvement Program (CIP) Master Plan Update (Master Plan) Mesa Water adopted a 115% water supply reliability requirement which provides for the District to ensure there is production capacity to meet 115% of all demands in any given season. This action resulted in Mesa Water purchasing two new commercial properties within the City of Santa Ana to initiate construction of two new wells and a connecting pipeline.

Mesa Water has taken great strides to provide robust diversification of both its energy and water supply reliability. Examples of this diversification are the construction of the MWRF, which allowed the District to obtain 100% local reliability, use of natural gas engines in both reservoirs and Well 5, and implementation of diesel back-up generators at a majority of the clear water well sites. While the efforts to date have provided a robust, cost-effective operational flexibility, a more systematic approach to the District's water, energy, and supply chain reliability is desired.

In 2017, the Reservoirs 1 & 2 Pumps, Controls, and Chemical System Assessment Project determined that much of the Reservoirs 1 and 2 chemical and mechanical equipment (e.g., pumps, engines, control system, chemical dosing systems, etc.) was at the end-of-life or soon

approaching end-of-life. With the need to replace the mechanical equipment at Reservoirs 1 and 2, there is an opportunity to improve the distribution system. The District wanted to assess the state of its overall energy and water supply reliability from a readiness-to-serve perspective, long-term capital and operating cost approach, maintenance standardization, and regulatory permitting and compliance requirements to determine the best equipment for replacement of mechanical systems at Reservoirs 1 and 2. The idea of reliability expanded to assess the water supply, energy supply, and supply chain interruptions (e.g., materials, services, spare parts, energy supplies, chemicals, etc.) that could occur due to emergency events (e.g., earthquakes, floods, etc.). Knowing that the reservoirs, wells, and MWRF work together as one system, the District wanted to evaluate the entire system in determining the recommended replacements.

To achieve these goals, Mesa Water's staff developed the Water Supply, Energy, and Supply Chain Reliability Assessment. The objectives of this assessment are as follows:

1. Evaluate existing water supply capacities relative to meeting 115% of all demand seasons using local groundwater resources;
2. Evaluate existing Mesa Water energy supply capacities, types, and backup capabilities relative to ensuring reliable groundwater supplies can be pumped and distributed during normal and emergency operations;
3. Identify water supply and energy reliability gaps (from Objective Nos. 1 & 2) and provide recommended solutions;
4. Evaluate Mesa Water's Supply Chain system relative to emergency readiness; and
5. Identify Supply Chain system reliability gaps (from Objective No. 4) and provide recommended solutions.

This project resulted in three technical memorandums (TMs). The key project elements include:

TM-1 Water Supply Reliability: TM-1 analyzes Mesa Water's water supply program if emergency and operational scenarios caused certain water sources to be unavailable.

TM-1 focuses on the following Water Supply Reliability Assessment (WSRA) components:

- Evaluate Mesa Water's current and future water demands;
- Confirm Mesa Water's current and future water supply capacity against demands;
- Conduct GAP analysis applying various emergency and operational scenarios to Mesa Water's water sources; and
- Present cost-efficient solutions to address water supply deficiencies identified in the GAP analysis.

TM-2 Energy Supply Reliability: TM-2 assesses Mesa Water's energy supply reliability, evaluates regulatory and permitting compliance concerns associated with these supplies, forecasts future supply costs, and assesses and recommends the best available equipment technologies for replacement of end-of-life equipment.

TM-2 focuses on the following Energy Supply Reliability Assessment (ESRA) components:

- Evaluate Mesa Water's historic demands for energy usage at well sites and treatment facilities;
- Estimate Mesa Water's future energy demands and costs;
- Provide recommendations for pump drive technologies, considering life cycle costs; and
- Provide recommendations for backup power/fuel requirements.

TM-3 Energy Supply Chain Reliability and Disruption: The purpose of TM-3 is to perform an Emergency Supply Chain Reliability and Disruption Assessment (ESCRDA) to determine Mesa Water's ability to respond to a local or regional emergency event and to provide recommendations that support the reliable and safe delivery of water to its customers. For this purpose, TM-3 focuses on the following ESCRDA tasks:

- Perform Supply Chain Analysis (SCA) of typical materials and services used during routine operation;
- Perform Single Points of Failure Analysis (SPFA) for each core production facility;
- Conduct GAP analysis, with recommendations towards mitigation, for core production facilities after application of emergency scenarios;
- Evaluate suitability of storage at production facilities to accommodate the necessary equipment and parts needed during emergency scenarios; and
- Evaluate diesel fuel storage needed to supply backup power during emergency scenarios.

DISCUSSION

Findings, recommendations, and costs for each of the TMs are summarized below. More detailed information can be found in the Executive Summary (Attachment A) and TMs 1, 2, and 3 (Attachments B, C, and D).

TM-1 Water Supply Reliability

For the GAP analysis, water demands and production capacities are compared in three operational scenarios for both 2020 and 2040 cases. Scenario 1 represents normal operating conditions and establishes a baseline scenario for comparison. Scenario 2 consists of three different emergency situations in which several supply options are impaired or non-operational. Finally, Scenario 3 simulates the condition when several local supply options need critical repairs. Whenever a gap between water supply and demands are identified, various additional supply options are considered to address the deficiency based on the limitations and costs of each option. A summary of the TM-1 recommendations is provided in Table 1. below:

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Table 1. Summary of Scenario Results								
Year	Scenario	Existing Operational Facilities			GAP with Existing Supplies (AF)[1]	Recommended Solution	Annual Cost Over Baseline	Lump Sum Capital Improvement Cost (30-Year Debt Cycle)
		Clear Wells	MWRF Capacity	MWD Import Available				
2020	1	7 of 7	100%	Yes	-	N/A	$-	$-
	2a	6 of 7	0%	No	720	Increased Restrictions	$(88,219)	$-
	2b	4 of 7	100%	No	640	Increased Restrictions	$(41,927)	$-
	2c	2 of 7	0%	Yes	1,661	Import from MWD	$2,147,681	$-
	3	4 of 7	50%	Yes	908	Import from MWD	$1,321,823	$-
2040	1	7 of 7	100%	Yes	-	N/A	$-	$-
	2a	6 of 7	0%	No	1,270	Additional Clear Wells	$1,914,009	$31,821,284
	2b	4 of 7	100%	No	1,189	Additional Clear Wells and MWRF Capacity	$2,348,122	$31,418,604
	2c	2 of 7	0%	Yes	2,211	Import from MWD	$2,828,399	$-
	3	4 of 7	50%	Yes	1,458	Import from MWD	$2,002,541	$-

1. *Monthly supply deficit based on max month demand conditions.*

Due to the high costs to maintain self-sufficiency on local water supplies during an emergency, it is ultimately recommended that Mesa Water purchase imported water in the event of a supply shortage, whenever available. In the event of a rare situational emergency such that Metropolitan Water District of Southern California (MWD) supplies are not available, Mesa Water may offset any supply shortages through the implementation of water usage restrictions if the emergency occurs in the near term (5-10 years). In the long-term, Mesa Water can expand its local production capabilities either by installing additional clear wells, expanding MWRF treatment capacity, or a combination of both.

TM-2 Energy Supply Reliability

The GAP analysis from TM-1 is further expanded by evaluating the availability and deficiencies of backup energy supplies in each of the scenarios. Overall, it is recommended that Mesa Water standardize its operations on electric motors, which offer a long useful life with relatively little maintenance required compared to reciprocating engines. When accounting for maintenance costs, electric motors provide an overall life-cycle cost savings of $2,050,000 for Reservoirs 1 and 2 pump and control systems versus engine driven pump systems. Also, using an electric driver provides flexibility in power sources, which will become more relevant in the shifting energy landscape. Planning level review of the Southern California Edison (SCE) infrastructure substations around both reservoirs indicates there is sufficient electrical capacity to service both reservoirs. Additionally, the cost to bring this enhanced service capacity to Mesa Water's site is SCE's costs. If all facilities used electric drivers, the backup power generation systems can be standardized around diesel fuel as well. The recommended improvements are outlined in Table 2. below:

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Table 2. Summary of Recommended Improvements				
Site	Existing		Recommended	
	Primary	Backup	Primary	Backup
Reservoir 1 BPS	(3) 137 hp natural gas engines	(2) natural gas generators; (1) 1,200 gal propane tank	(3) 150 hp electric motors	(1) 1,000 kW diesel generator; (1) 2,000 gal diesel fuel tank
Reservoir 2 BPS	(4) 369 hp natural gas engines	(1) natural gas generator; (1) 1,200 gal propane tank	(4) 400 hp electric motors	(1) 2,000 kW diesel generator; (1) 3,000 gal diesel fuel tank
MWRF	(2) 400 hp well pumps; (3) 350 hp high lift pumps; (2) 250 hp feed pumps; (4) 100 kW CIP tank heaters; (3) 40 hp product transfer pumps; (2) 30 hp degasifier blowers; (3) 30 hp CO2 booster pumps	Onsite generator for shut-down only	No upgrades necessary	(1) 2,500 kW diesel generator; (1) 4,000 gal diesel fuel tank
Well 1	(1) 400 hp well pump	Connection for portable generator	No upgrades necessary	Truck-Mounted Portable Generator
Well 3	(1) 300 hp well pump	(1) 350 kW diesel generator; (1) 426 gal integral diesel storage tank	No upgrades necessary	No upgrades necessary
Well 5	(1) 450 hp natural gas engine	(1) 1,150 gal propane tank	(1) 450 hp electric motor (at end of useful life)	Diesel generation and fuel tank (at end of useful life)
Well 7	(1) 300 hp well pump	(1) 350 kW diesel generator; (1) 333 gal integral diesel storage tank	No upgrades necessary	No upgrades necessary
Well 9	(1) 300 hp well pump	(1) 350 kW diesel generator; (1) 426 gal integral diesel storage tank	No upgrades necessary	No upgrades necessary
Well 12 (Future)	(1) 600 hp well pump	(1) 600 kW diesel generator (1) 1,000 gal diesel storage tank	No upgrades necessary	No upgrades necessary
Well 14 (Future)	(1) 600 hp well pump	(1) 600 kW diesel generator (1) 1,000 gal diesel storage tank	No upgrades necessary	No upgrades necessary

Additionally, each onsite fuel storage tank is sized for 24 hours of operation. To improve reliability, Mesa Water can install a centralized bulk diesel fuel storage tank to replenish onsite fuel tanks during a prolonged emergency. It is recommended that two - 30,000 gallon tanks be installed at a location to be determined in order to provide 10 days of overall operational capacity. Since the wells and reservoirs work together to meet the various demand conditions, standardization of energy sources and back-up storage can provide a robust and self-reliant system.

TM-3 Energy Supply Chain Reliability and Disruption

For the SCA, Mesa Water's crucial material and service suppliers are categorized as a low, medium, or high risk for failure based on physical constraints, practices, and past history. From the results, it is recommended that Mesa Water identify back-up suppliers for carbon dioxide and water quality analyses. Also, temporary provisions such as diesel, aggregates, pipe repair materials, and street repair materials should be stored in the event of an emergency. For the

SPFA, systems and equipment at each facility are assigned a risk factor based on their ability to interrupt production and their available redundancy. Based on the findings, a number of recommendations are made to mitigate the quantity of single points of failure, ranging from mechanical, electrical, and instrumentation modifications. To further mitigate risks, it is also recommended that Mesa Water stock spare parts for crucial equipment, including but not limited to spare pumps, valves, and PLCs. As there is little additional space for storage at existing facilities, the parts recommended in TM-3 should be stored in a new centralized warehouse, which could be located at either of the proposed sites for new Wells 12 and 14 or at the centralized bulk fuel storage depot site.

Overall Recommendations

The overall recommendations across all technical memorandums are provided in Table 3. The recommendations are categorized as short-term (1 to 5 years) or long-term (greater than 5 years) and are ordered by priority. Prioritization is based on several factors, including criticality, ease of implementation, cost, and return on investment.

Table 3. Overall Recommendations

Priority	Recommendation	Estimated Cost
Short-Term Decisions (1-5 years)		
1	Minimize single points of failure with new equipment and instrumentation. Procure spare parts for critical equipment and instrumentation. Implement asset management system.	$1.1M[1]
	Construct new storage warehouse (Location TBD).	$0.2M
2	Replace pump motors at Reservoirs 1 and 2 with electric motors. Provide backup diesel generators and fuel storage.	$2.8M
3	Provide truck-mounted portable generator system for Well 1.	$0.5M
	Drill new well at Well 5 and provide electrical drives, backup power, and associated electrical improvements.	$1.5M
4	Construct centralized bulk diesel fuel storage tanks to replenish onsite fuel tanks during a prolonged emergency.	$3.5M
Long-Term Decisions (5+ years)		
5	Evaluate installation of additional clear wells or MWRF expansion.	Up to $32M
6	Provide backup power generation and fuel storage for the MWRF.	$1.0M

1. *Costs derived from Table 8-1 in TM-3.*

In the short term, making minor system improvements is the top priority, as it is simple to execute and can quickly eliminate several reliability risks. Additionally, storing spare parts allows these critical system components to remain available even during a supply chain emergency. A new warehouse can be considered to centralize and protect these critical spare parts as well. Replacing the pump drives and providing backup power at Reservoirs 1 and 2 is the next priority. The reservoirs are critical for meeting peak water demands, especially during an emergency. Installing electric motors and diesel powered generators is an improvement in reliability compared to the existing equipment and provides maintenance standardization across all of Mesa Water's sites. Providing backup generation at Well 1 and upgrading the propane back-up equipment at Well 5 is particularly important because the clear wells provide the bulk of water supplies during

an emergency. Once all onsite backup power systems within the supply system are standardized around diesel powered generators, constructing a bulk diesel storage tank would provide an additional level of energy security during prolonged electrical and supply chain outages.

In the long term, Mesa Water can evaluate the feasibility of additional clear wells and MWRF treatment. Providing enough additional infrastructure to account for the worst-case scenarios examined where MWD water is unavailable will cost up to an estimated $32MM in capital improvements. However, this estimate should be viewed as an upper limit. The value and extent of the additional reliability insurance needed is open for discussion and should be examined closer in further assessment. Although much lower in cost, providing additional backup power at the MWRF is the lowest priority recommendation. The MWRF is less critical during an emergency due to its lower overall capacity in comparison to the capacity of the clear well supply system. In addition, the need for chemicals in the treatment process adds another layer of vulnerability to the MWRF during a disaster, which will not be mitigated with the addition of backup power.

The short-term recommendations from the Water Supply, Energy, and Supply Chain Reliability Assessment can be executed through the development of two CIPR projects:

1. **Reservoirs 1 & 2 Motor/Engine, Pump, and Control System Replacement** – End-of-life equipment will be replaced at Reservoirs 1 and 2. The existing natural gas engine-driven pumps and propane backup systems will be replaced using electrically driven motors and diesel backup generators.
2. **Mesa Water Emergency Preparedness Center** – The project would identify locations for and construct a centralized bulk diesel storage facility, procure critical spare parts, design and construct additional warehouse space, and design and procure a truck-mounted portable generator system for Well 1.

The long-term recommendations from the Water Supply, Energy, and Supply Chain Reliability Assessment will be further evaluated in a future assessment.

Overall, Mesa Water has taken great strides to reliably meet typical water demands using exclusively local supplies. With the aforementioned recommendations, Mesa Water can take its objectives to an elite level to remain reliable even during uncertain emergencies and natural disasters.

FINANCIAL IMPACT

Funds for the proposed recommendations are budgeted for Fiscal Year 2021 and are part of the Capital Improvement Program Renewal.

ATTACHMENTS

Attachment A: Executive Summary
Attachment B: TM-1 Water Supply Reliability Assessment
Attachment C: TM-2 Energy Supply Reliability
Attachment D: TM-3 Emergency Supply Chain Reliability and Disruption