

JORDAN VALLEY WATER CONSERVANCY DISTRICT

**REQUEST FOR STATEMENTS OF QUALIFICATIONS TO PROVIDE
PROFESSIONAL ENGINEERING SERVICES FOR THE**

JORDAN AQUEDUCT SEISMIC RESILIENCY STUDY

Project #4341

March 1, 2024

Summary

Jordan Valley Water Conservancy District (JVWCD) invites you to submit a Statement of Qualifications (SOQ) as defined in this request. SOQs shall be submitted in a sealed envelope to JVWCD's project manager, Travis Christensen, at 8215 S.1300 W., West Jordan, UT 84088, no later than 12:00 PM (noon) on Friday, March 22, 2024 for consideration.

Introduction

JVWCD was created under the Water Conservancy Act as a political subdivision of the State of Utah. JVWCD was organized as a regional water supply agency to develop a water supply for rapidly growing areas outside of the Salt Lake City service area. JVWCD currently serves as a wholesale supplier to 17 member agencies and operates a retail distribution system in several parts of Salt Lake County. In 2022, JVWCD delivered approximately 108,000 acre-feet of municipal and industrial water to its wholesale and retail customers.

Project Background

In 2021 Jordan Valley Water Conservancy District (JVWCD) completed a Hazard Mitigation Plan (HMP) which consisted of a planning process, risk assessment, hazard mitigation, and a reoccurrence interval for the plan. The HMP identified several geologic hazards that key JVWCD infrastructure could be at risk due to its location and materials/methods of construction. Specifically, the plan identified that the Jordan Aqueduct, a critical raw and finished water pipeline, should be analyzed further for its potential exposure to risks and that mitigation measures should be developed in response. The Jordan Aqueduct Seismic Analysis will consider the natural hazard risks for earthquake (ground shaking, liquefaction, and fault rupture), landslide, and debris flow covered by the HMP, but in greater detail for Jordan Aqueduct reaches 1-4.

The Jordan Aqueduct is a 40-mile transmission pipeline which delivers surface water to the Jordan Valley Water Treatment Plant and finished water to Salt Lake County. The Aqueduct begins at the discharge of the Don A. Christiansen Water Treatment Plant and terminates at 2100 South 3600 West, South Salt Lake City. The Aqueduct was constructed by the Bureau of Reclamation in the 1970s and is either mortar lined and

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coated steel pipe with Carnegie joints or reinforced concrete pipe with diameters ranging from 78" down to 48". The Jordan Aqueduct is the backbone of Jordan Valley Water Conservancy District's water transmission system with turnouts along for the pipeline for M&I water starting in Bluffdale and ending in City of South Salt Lake.

The Jordan Aqueduct Reaches 1, 2, 3, & 4 are located in zones with a great potential of natural hazards such as landslides and earthquake including liquefaction, fault rupture and ground shaking. JVVCD needs to identify specific mitigation actions and areas that require additional study that the District can employ to reduce the risk of failure of this critical asset which provides nearly 75% of the District's water supply to its customers.

Scope of Services

The scope of services should be executed over eight tasks. Respondents should provide their recommended sequencing, overlap, and modification (if any) of the tasks to meet the project objectives.

Task 1 – Project Management: The purpose of this task is to manage project schedule and budget. Subtasks include contract negotiation with subconsultants, invoicing, progress and schedule updates, management of project team and subconsultants, and general coordination necessary to deliver the required scope of services. The project is anticipated to last 12 months including project closeout.

Task 2 – Kickoff Meeting: The purpose of this task is to hold a kickoff meeting with JVVCD and all key project personnel to discuss the project, background information, scope of work, and schedule.

Task 3 – Initial Workshop: The purpose of this task is to hold a workshop to discuss project goals and where mitigation criteria will be discussed and defined. Work will be accomplished via the following subtasks:

- Study boundary definition – JVVCD has performed an initial investigation which identified several areas along the Jordan Aqueduct which should be evaluated for risks. The project team will evaluate the areas below along with any additional areas of interest. The project team will provide more detailed mapping, including site visits, for the following locations:
 - JA-1 stationing 430+00 to 450+00 (liquefaction zones, landslide potential)
 - JA-2 stationing 1090+00 to 1120+00 (landslide potential near 7800 S)
 - JA-3 stationing 1465+00 to 1509+69.99 (seismic uncertainty zone and fault crossing from approximately 2700 S to the end of the line near 2100 S)
 - JA-3 stationing 1300+00 to 1509+69.99 (liquefaction zones from approximately 4500 S to the end of the line near 2100 S)

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- JA-4 stationing 66+50 (seismic uncertainty zone at the beginning of JA-4)
- JA-4 stationing 500+00 (seismic uncertainty zone in American Fork)
- JA-4 stationing 66+50 to 500+00 (landslide potential)
- Hazards and JA stationing
- Potential alternative alignments

Task 4 – Public Outreach: The purpose of this task is to determine the appropriate level of public outreach required for this seismic analysis. JWCD may look to engage potential affected stakeholders to inform them of the project need, solicit input, and convey the results of the study. The project team shall provide a recommendation as to how the public or stakeholders should best be engaged to provide value and input to the project.

Task 5 – Hazards Assessment: The purpose of this task is to further research each hazard identified and evaluate potential mitigation measures.

- The project team will conduct a literature review of both published material and reports available by request from cities, municipalities, and other public entities that might be a repository for related geotechnical reports.
- The project team will make a site visit to walk each area flagged for seismic special study zones, fault crossings, and landslides to visually inspect known hazards identified in the review and to identify any additional hazards that might be visible at the surface.
- The project team will prepare a gap analysis based off of the literature review and site visits identifying areas of the aqueduct which warrant further investigation to determine if they are at risk for geological hazards. Further investigation includes but is not limited to soiling boring, excavation, additional studies, etc.
- The project team will prepare an initial list of mitigation measures (for areas where sufficient information is available) which will be presented and reduced to a short-list based on JWCD's level of service (LOS) goals:
Long-list analysis: identify a long list of mitigation measures representing a broad range of alternatives. The long list analysis involves the following subtasks:
 - Develop long list of mitigation measures.
 - Rank the long list alternatives relative to LOS goals.
 - Perform a general evaluation of the alternatives based upon cost and non-cost issues and the compatibility with the objectives of the project.
- Short-list analysis: evaluate the top alternatives identified in the long list analysis further and recommend a final mitigation measure.
- A Class V cost estimate (planning level) based on comparable projects and rules-of-thumb.

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Task 6 – Mitigation Selection Workshops: The purpose of this task is to present information gathered during Tasks 2, 3, and 5 evaluate the information based on the criteria established in the kickoff meeting, and select a preferred mitigation action for each affected segment of the Jordan Aqueduct.

Task 7 – Jordan Aqueduct Seismic Technical Memo: Prepare a Technical Memo identifying segments of the Jordan Aqueduct (based on project status at the time of writing) which require further investigation or require immediate mitigation action implementation with cost estimates (Minimum Class V) which will be used to prepare the JVVCD FY 25/26 Annual Budget. This memo will not be required if Task 8 is developed to point to meet this need.

Task 8 – Jordan Aqueduct Seismic Analysis Report: The purpose of this task is to document project work, results, provide recommendations on areas of additional study and mitigation. The Engineer will prepare a draft report, submit to JVVCD for review, incorporate comments and submit a final report of the findings.

Preliminary Schedule

Award of Consulting Contract: on or after Wednesday, March 13, 2024

Contract Preparation: 30 calendar days

Project Milestones:

December 2024 – Technical Memo (Task 7)

April 2025 – Final Report (Task 8)

Statement of Qualification Evaluation

SOQs shall not exceed eight (8) pages in length (excluding resumes, sample reports/documents, and references). Provide three (3) hard-copies and one digital copy on a USB drive of the SOQ for review by the evaluation committee.

The SOQ should include the following information:

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- **Qualifications:** Identify the key members of the team listed by name and role in the format of a Project Team Chart. Indicate the education, experience, expertise, and location of each team member (it is acceptable to provide this in resume format in the appendix). Sample drawing(s) from applicable previous projects may be included in the appendix. Include evidence demonstrating compliance with the Minimum Qualifications section of this Request for SOQ.
- **Work Plan:** Include a detailed work plan which addresses the scope of the work and identifies key issues. A final agreed upon work plan will be incorporated into Schedule A of the Agreement. Include a project schedule of the key tasks and note the availability of project team members with respect to current workload and project start and completion dates.

Include with the work plan a table showing the number of hours planned for each position for each major work task. Include subtotals of all labor hours for the preliminary design, design, and construction management phase. **Do not include any billing rate or cost information in this work plan table.**

- **Past Performance:** Provide information about past completed projects which satisfy the Minimum Qualifications requirements. Information about additional completed projects which the Proposer feels would be relevant may also be submitted. The past project performance information should include:
 - 1) Brief description of project and scope of services performed,
 - 2) Name of owner and owner's contact information,
 - 3) Role which proposed Project Team member(s) fulfilled on past project,
 - 4) Original engineering fee amount, and
 - 5) Final engineering fee amount

Incomplete projects (on-going work) may be used but may result in a lower grade for this section in the evaluation phase.

Professional Consulting Services Agreement

Comment on the acceptability of the enclosed Professional Consulting Services Agreement (Agreement) (Attachment B) with attached Schedule B-Requirements for Engineering Services. Any suggested changes to the Agreement must be identified with

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the proposal (as an attachment), although JWCD reserves the right to reject any suggestions. No changes will be considered after the proposal due date.

Selection Method

Selection of a consultant will be done in accordance with the State of Utah's Procurement Code for Design Professional Services (Utah Code Title 63G, Chapter 6a, Part 15).

Minimum Qualifications

Proposers are required to meet the following minimum experience requirements to be considered responsive to the Request for SOQs:

Project Team must collectively demonstrate the completion of at least:

- Two (2) similar projects involving seismic evaluation and analysis of an in-situ pipeline.

The Project Manager shall have successfully functioned as a Project Manager or Technical Lead on at least:

- One (1) similar project involving seismic evaluation and analysis of an in-situ pipeline.

The project team qualifications are responsive to the needs of the project and include all the disciplines required by the SOQ.

Any proposals not meeting the minimum criteria may be deemed non-responsive and removed from further consideration.

Evaluation Criteria

An evaluation committee appointed by JWCD's Chief Engineer including representatives from JWCD will convene to consider all responsive SOQs submitted and to rank the SOQs based on each criterion stated in this section.

Evaluation criteria are assigned a maximum number of points for evaluation purposes with a cumulative total of 100 points. Each SOQ will be evaluated based on the following evaluation criteria:

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<u>Evaluation Criteria</u>	<u>Grade</u>	<u>Weight</u>	<u>Maximum Points</u>
1. Demonstrated Qualifications to meet the scope of work: a. Firm Resources that satisfy the defined minimum qualifications. Demonstrated availability of firm resources to the project team.	0-5	1	5
b. Key team members with the education, expertise, and experience necessary as required for the project.	0-5	5	25
c. Project Manager with the education, expertise, and experience necessary as required for the project.	0-5	1	5
2. Responsiveness of Work Plan: a. Clearly written work plan responding to the requirements of this SOQ which indicates an understanding of the key issues and deliverables required for this project. Higher scores may be given to proposals which note suggested revisions to the scope of work which would lead to an enhanced outcome.	0-5	6	30
b. Project schedule which identifies completion dates for key milestones and a final completion date.	0-5	1	5
3. Past Performance: a. Positive verified past references for the Proposing Firm indicating successful past performance on similar projects, including projects for JVVCD.	0-5	3	15
a. Positive verified past references for the Project Manager and other key team members indicating successful past performance on similar projects, including projects for JVVCD.	0-5	3	15
TOTAL			100

Each criteria will be graded on a scale of 0-5 with 5 being the highest grade. The grades will be multiplied by the appropriate weighing factor to determine the total score. SOQs shall have a level of effort appropriately matching the requirements, including efforts by key positions. SOQs falling short of an appropriate overall effort and/or effort

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by key positions may be considered non-responsive. JVVCD reserves the right to reject all SOQs.

Fee Proposal Instructions

A fee proposal will be requested from the firm receiving the highest score. The fee proposal will be due 2 days after it is requested by JVVCD. If JVVCD's procurement officer is unable to agree to a satisfactory contract with the highest scoring design professional, at a price the procurement officer determines to be fair and reasonable to the procurement unit, the procurement officer shall formally terminate discussions with that design professional, and undertake discussions with the second highest scoring, qualified design professional. For additional information, see Utah Code Title 63G, Chapter 6a, Part 15, Section 1505.

The fee proposal shall be provided in a spreadsheet format similar to the sample fee proposal template in Attachment B. If the required information is not present, the fee proposal may be considered non-responsive. The hourly billing rate for each position, number of hours per task by position, and any fees for reimbursable expenses and overhead factors shall be clearly indicated. Proposed hourly billing rate increases, if applicable for multi-year projects, should likewise be clearly indicated.

The total proposed fee for the preliminary design and design phases of the project will be considered a maximum not-to-exceed fee amount. The fees submitted for the construction management phase shall be subject to increase/decrease based upon the actual level of effort needed during construction. It has been JVVCD's experience that more detailed designs result in fewer change orders and additional hours during construction.

Upon execution of the Agreement by both parties, the Engineer will receive authorization to proceed with only those services identified in the Agreement. The Engineer must receive prior written authorization before performing any services outside the scope and fee amount identified in the Agreement.

For purposes of preparing the fee proposal make the following assumptions:

1. Increase by 20% the number of hours to be spent on the study for the purpose of establishing a Design Contingency. The increase shall be proportional for each position.
 - a. This 20% increase shall be included as a separate task and released only with written authorization of the District's Engineering

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Department Manager in accordance with Schedule B –
Requirements for Engineering Services.

CONFIDENTIALITY: All information, documents, records and paperwork, including but not limited to SOQs, bids, exhibits, or brochures (collectively, the “Paperwork”) submitted to the District shall not be regarded by the District as secret or submitted in confidence, except as otherwise provided in a writing signed by the District. Please do not mark your Paperwork with legends such as “confidential,” or “proprietary,” or “not to be disclosed to third parties.” The District is a Utah local district and is subject to the provisions of the Utah Government Records and Management Act (“GRAMA,” Utah Code Ann. (1953) §§63-2-101 et seq.). Paperwork submitted to the District may be subject to disclosure to third parties under the District’s interpretation of the provisions of GRAMA.

Questions or Suggestions

Proposers may ask questions or make suggestions to JVVCD on any element of this Request for SOQs. Questions or suggestions should be submitted to JVVCD’s Project Manager, Travis Christensen, at 565-4300 or travisc@jvwcd.org

ATTACHMENT A

PROFESSIONAL CONSULTING SERVICES AGREEMENT

PROFESSIONAL CONSULTING SERVICES AGREEMENT
FOR _____
(PROJECT NO. _____)

This Agreement is made as of _____, _____ (“Effective Date”), by and between the Jordan Valley Water Conservancy District, a Utah local district (“District”), and _____ a Utah corporation **OPTIONAL WORDING: [a Utah _____ / a (State) _____ authorized to do business and doing business in the State of Utah]** (“Engineer”).

RECITALS:

- A. The District desires to obtain professional engineering services relating to the _____;
- B. Engineer represents it has the necessary expertise and experience to perform the services requested by the District and that it is properly qualified and licensed in the State of Utah for this work; and,
- C. Engineer has submitted a proposal outlining its proposed scope of activities for performance and completion of the services, and the Engineer is willing to perform the services requested by the District, consistent with the terms of this Agreement.

TERMS:

The parties agree as follows:

ARTICLE I
DEFINITIONS

- 1.1 Unless the context requires otherwise, the terms defined in this Article shall for all purposes of this Agreement and all schedules, have the following meanings:
 - 1.1.1 **Agreement:** This Professional Consulting Services Agreement, including attachments.
 - 1.1.2 **Contract:** The agreement between the District and the Contractor for the provision of labor, materials and equipment for the construction of the Project.
 - 1.1.3 **Contract Documents:** All documents relating to construction of the Project, issued by or through the Engineer, on behalf of the District to the Contractor, or by the District, including the Notice Inviting Bids,

Instructions to Bidders, Bid, Information Required of Bidder, Bid Bond, Agreement Performance Bond, Payment Bond, General Conditions, Supplemental General Conditions, drawings, specifications, all addenda and change orders executed pursuant to the Contract.

- 1.1.4 Contractor: The party contracting with the District for the provision of labor, materials and equipment for the construction and quality control of the Project.
- 1.1.5 Contract Time: The projected date for substantial completion of the Contract.
- 1.1.6 Engineer's Fee: The Engineer's compensation for performing Services.
- 1.1.7 Phase: A logically separate aspect of the Engineer's Services on the Project which occurs in sequence or concurrently with other such aspects to allow for the orderly progress and management of the Engineer's Services for the Project.
- 1.1.8 Project: The Project is described on attached Schedule A.
- 1.1.9 Project Manager: The individual identified in Schedule D who will administer the performance of the Engineer's Services under this Agreement.
- 1.1.10 Project Representative: The individual identified in Schedule D who will provide observation and inspection of the construction of the Project. The Project Representative is the sole authorized representative of the District in all on-site relations with the Contractor, except as other properly authorized agents are designated by the Engineer and approved by the District.
- 1.1.11 Reimbursable Expenses: Non-salary expenditures made by the Engineer, its employees or its sub-consultants when performing services for the Project. Reimbursable Expenses include:
 - 1.1.11.1 Reasonable expenses of transportation, subsistence and lodging when traveling in connection with the performance of services for the Project.
 - 1.1.11.2 Reasonable expenses of long distance or toll telephone calls, telegrams, messenger service, field office expenses, and fees paid for securing approval of authorities having jurisdiction over the Project.

- 1.1.11.3 Reasonable expenses of all reproduction, postage and handling of drawings, specifications, reports or other Project-related instruments of service of the Engineer.
- 1.1.11.4 Reasonable expense of computer time as described on attached Schedule E.
- 1.1.11.5 Other reasonable reimbursable expenses to which the parties subsequently agree.
- 1.1.12 Hourly Billing Rate: The hourly fee which the Engineer charges for the time expended on the Project. The hourly billing rate shall be considered full compensation for time expended on the Project. Specific hourly billing rates for the Project are identified in Schedule E.
- 1.1.13 Services or Engineer's Services: The Engineer's duties and responsibilities to the District for professional consulting services as set forth in Article II.
- 1.1.14 Sub-Consultant: Any registered professional engineer, architect or other specialist engaged by the Engineer in connection with the Project.
- 1.1.15 Task: An independent and defined service or collection of services to be performed by the Engineer during a Phase(s) of the Project(s), such service or services being more particularly set forth in Schedule A.
- 1.2 Except where the context otherwise requires, words imparting the singular number shall include the plural and vice versa.

ARTICLE II ENGINEER'S SERVICES

- 2.1 Basic Services: The Engineer shall provide the following Services on the Project, as more described and set out in Schedule A.
 - 2.1.1 Pre-design Phase: Complete applicable investigations, evaluations, analyses, surveys, and reports.
 - 2.1.2 Design Phase: Complete all necessary drawings and technical specifications for bidding the construction of the Project.
 - 2.1.3 Construction Phase:
 - 2.1.3.1 The Engineer shall assist the District during bidding and

contract execution, administer the Contract, provide field observation and inspection of the Project, and provide management and reporting during the construction phase of the Project.

2.1.3.2 The Engineer shall designate the individuals named in Article IV as Project Manager and Project Representative to be the representatives of the District in its relations with the Contractor, subject to the requirements and limitations set out in the Contract Documents and this Agreement. Other personnel of the Engineer shall be designated as needed to administer the Contract, as further set forth in Section 2.2 and this Agreement.

2.1.3.3 The Engineer shall provide Project representation at the site, as described in Schedule A, in order to provide experienced inspection and observation of the quality and progress of the Contract construction work to verify it complies with the requirements of the Contract Documents, and to advise the District of defects and deficiencies. The Engineer shall direct its efforts toward verifying that the means, methods, techniques or procedures that are specified in the Contract Documents are faithfully observed and followed by the Contractor during construction of the Project, and, except as hereafter provided, that the completed Project conforms to the Contract Documents. The Engineer shall not be responsible for any means, methods, techniques, or procedures of construction selected by the Contractor not specified in the Contract Documents, or for safety precautions and programs incident to the work of Contractor.

2.1.3.4 The Engineer shall have the following powers and is hereby directed to exercise them as in its professional judgment are required to accomplish the above tasks, objectives and responsibilities:

Examine, review and investigate all material, equipment, work and workmanship for compliance with the Contract Documents, including the examination and investigation of plant, mill and shop facilities; require that work done in the absence of observation and examination be removed and replaced under the proper observation and examination; make such examination

and tests, as in its professional judgment are required, to verify that the work is being accomplished in accordance with the Contract Documents; reject work which does not meet the specifications of the Contract Documents and require the Contractor remove and replace such work according to the Contract Documents.

2.1.3.5 If disputes between the Contractor and the District arise, and/or if the Contractor shall file a claim or protest against the District during construction of the Project, the Engineer shall investigate and analyze all such disputes, claims and protests, and attempt to resolve them to the mutual satisfaction of the parties, and failing such resolution, recommend a course of action for the District.

2.1.3.6 The Engineer's recommendation of any payment requested in an application for payment by the Contractor will constitute a representation by the Engineer to the District, based on the Engineer's on-site observations of the Contractor's work in progress as an experienced and qualified design professional and on the Engineer's review of the application for payment and the accompanying data and schedules, that the work has progressed to the point indicated, that to the best of the Engineer's knowledge, information and belief the performance and quality of the work is in accordance with the Contract Documents (subject to an evaluation of the work by the Engineer as a functioning Project upon Substantial Completion as defined in the Contract Documents, to the results of any subsequent tests called for in the Contract Documents, and to any qualifications stated in the recommendation), and that the Contractor is entitled to payment of the amount recommended. However, by recommending any such payment, the Engineer will not thereby be deemed to have represented that the Engineer acted or performed to a standard of care higher than that required of the Engineer under this Agreement and the Contract.

2.2 Guidelines for Basic Services: The Engineer shall perform the Services in conformance with the District's Guidelines for Engineering Services, as set forth in Schedule B, and in conformance with such other guidelines imposed by the District during the progress of the Services, so long as such guidelines are in conformance with standard professional consulting services.

2.3 Additional Services: The District and the Engineer recognize and agree that services not set forth in Schedule A are not covered by the Engineer's Fee and are considered to be additional services. No additional services may be provided by the Engineer, and no compensation shall be paid therefore by the District, except upon written confirmation by the District as an amendment to this Agreement.

Upon request by the District, the following additional services shall be provided by the Engineer:

2.3.1 Perform work resulting from changes in design criteria made in writing at the direction of the District, after acceptance of the criteria by the Engineer;

2.3.2 Prepare applications and supporting documents for government review or action, other than those which may be specified in Schedule A;

2.3.3 Provide additional services required as a result of delinquency or insolvency of one or more of the Contractors; or as a result of damage to the Project caused by fire, flood, earthquake, or other acts of God, wherein damage was not a direct or indirect result of Engineer's negligence or within Engineer's control;

2.3.4 Provide additional services required as a result of strikes, walkouts, or other acts of trade or labor unions;

2.3.5 Provide expert witness testimony or litigation support at depositions, trials, court appearances, and other similar judicial proceedings and cooperate in formulating and responding to interrogatories and other similar discovery methods; and,

2.3.6 Perform any other item of work not specifically mentioned above, and requested by the District in writing.

ARTICLE III
TIME TO COMPLETE

The Engineer's Services, as defined in Article II, shall be completed within the timeframe set forth in Schedule C. Notwithstanding any term or provision of this Agreement to the contrary, all of the Services shall be completed within ____ calendar days after the Effective Date of this Agreement.

ARTICLE IV
ENGINEER'S PERSONNEL

The key personnel identified in Schedule D shall perform the Engineer's Services in the assigned capacities, as shown. Any substitution of key personnel and/or changes in assignments from those shown must be approved by the District in writing before such substitution or change may be made by the Engineer.

ARTICLE V
DISTRICT-FURNISHED SERVICES

- 5.1 Information: Upon the Engineer's request, the District shall provide to the Engineer or make available for review all information and data contained in record drawings, record documents and other records routinely kept by the District pertaining to the design, construction or operation of its facilities. The District does not warrant the accuracy or completeness of such data and information originating from entities or persons other than the District.
- 5.2 Review of Documents: The District shall review and consider all sketches, drawings, reports, studies, model results, specifications, bids, proposals, contracts, and other documents submitted by the Engineer relative to Engineer's Services. Whenever prompt action is necessary, the District shall within a reasonable time inform the Engineer of its decision regarding the same so as to not unduly delay the Engineer in its performance according to the schedule set forth in this Agreement.
- 5.3 Engineer Access: The District shall, at its expense, arrange and make provision for the Engineer's entry and access to such property (public and/or private) as may be necessary to enable the Engineer to perform the Services.
- 5.4 District Representative: The District shall designate in writing an individual who shall be authorized by the District to act as the District's Representative. The Representative shall have authority to receive reports from the Engineer and give instructions to the Engineer.

OPTIONAL 5.4 District Representative: The District hereby designates and authorizes _____ to act as the District's Representative. The Representative shall have authority to receive reports from the Engineer and give instructions to the Engineer.

- 5.5 Notifications of Defects: The District shall give written notice to the Engineer whenever the District or its Representative becomes aware of any defect or deficiency in the Engineer's Services.
- 5.6 Construction Right-of-Way: Where, based upon the Engineer's design work, rights-of-way are required for construction, the District will, at its expense, obtain such rights-of-way, including appraisals and title searches, utilizing descriptions and maps provided by the Engineer.
- 5.7 Consultation with District: Employees of the District shall be available for consultation with the Engineer at all reasonable times.
- 5.8 Permit Fees: The District shall pay any required permit fees, charges for plan checking, and any other fees charged by any public agency having jurisdiction over any part of the Project, if such charges are made.
- 5.9 Legal Opinions: The District shall, at its expense, furnish legal opinions on laws and the interpretation thereof which may affect the Project, if such opinions are judged by the District to be necessary.

ARTICLE VI
COMPENSATION

- 6.1 Basic Services: The District shall pay to the Engineer as compensation for Services attributable to the Project, the hourly billing rates as set forth in Schedule E multiplied by the number of hours expended on the Project, together with reimbursable expenses attributable to the Project multiplied by ____.
- 6.1.1 Pre-design and Design Phases: In no event shall the total compensation due the Engineer for the Pre-design and Design Phases, including reimbursable expenses, exceed _____ and ____/100 Dollars (\$_____).
- 6.1.2 Construction Phase: The budget authorized for the Engineer's Services and for reimbursable expenses in the Construction Phase is _____ and ____/100 Dollars (\$_____). As work in this Phase reaches seventy-five percent (75%) of the authorized budget set forth in Schedule E, the Engineer shall notify the District, and the Engineer and the District shall thereafter mutually review the extent of work already accomplished, the extent of work remaining to be completed and the past and projected expenses related thereto. At that time, the scope of Services and corresponding compensation for Services for the Construction Phase may be adjusted by the District.

- 6.2 Additional Services: In the event this Agreement is amended to provide for additional services by the Engineer, the Engineer's compensation for additional services shall be the hourly billing rate multiplied by the hours expended for additional services, and reimbursable expenses attributable to the additional services multiplied by ____.

A summary showing estimated cost data for each additional service requested shall be submitted to the District for approval prior to commencement of work on that additional service. The District shall not be obligated to reimburse the Engineer for costs incurred in excess of the estimated cost set forth in that summary, and the Engineer shall not be obligated to continue work or to incur costs in excess of the estimated cost until the District notifies the Engineer in writing that the estimated cost therefore has been increased. Additional sets of Contract Documents and reduced scale drawings shall be charged at actual cost of printing and mailing.

- 6.3 Format for Invoices: Invoices for the Engineer's Services and expenses shall be reviewed and signed by the Engineer's Project Manager before being sent to the District. Each invoice shall include the following information:

- a. Project Name.
- b. Time period of Services (beginning of month to end of month).
- c. Current invoice charges, separated into Pre-design, Design and Construction Phases, with the following breakdown:
 - (i) Charges for Services, further described by:
 - (1) Employee name.
 - (2) Hours worked.
 - (3) Rate charged.
 - (ii) Reimbursable Expenses:
 - (1) Description.
 - (2) Cost.
- d. Account summary, including:
 - (i) Total amount authorized for the Pre-design and Design Phases under this Agreement.

- (ii) Total invoiced to date for the Pre-design and Design Phases.
- (iii) Total amount authorized for the Construction Phase under this agreement.
- (iv) Total invoiced to date for the Construction Phase.

6.4 Progress Payments: The Engineer's invoices for Services performed and for reimbursable expenses shall be delivered to the District after the end of the first calendar month following the Effective Date of this Agreement, and monthly thereafter so long as the Engineer's Services shall continue. The compensation requested on any such invoice shall be itemized to show hourly billing rate multiplied by time charged to the Project and reimbursable expenses which actually were incurred in the month identified in the invoice.

6.5 Payment of Invoice: The amount shown on each invoice for the Engineer's Fee and expenses shall be due and payable by the District after its review and acceptance of the Services itemized in the invoice. The Engineer may levy a simple interest charge of eight percent (8%) per annum on invoice amounts accepted for payment by the District and not paid within forty-five (45) days of the date of delivery of the invoice. Late payments made by the District shall be credited first to accrued interest and then to principal.

6.6 Suspension; Termination: In the event the District fails to submit payment on an invoice within sixty (60) days of the date of delivery to the District of such invoice, the Engineer may, at its discretion and upon ten (10) days written notice to the District, suspend its services or terminate this Agreement.

ARTICLE VII SPECIAL TERMS AND CONDITIONS

7.1 Documents: All completed original reproducible tracings, survey notes, plans, specifications, reports, engineering calculations, and other original documents prepared by the Engineer in the performance of the Engineer's Services shall be the property of the District, and the Engineer shall, upon the request of the District, deliver such documents to the District. The Engineer may retain and use copies of the documents. The District agrees to hold harmless, indemnify and defend the Engineer against all third party damages, claims, expenses and losses arising out of any reuse by the District of the plans, specifications and documents if the District does not obtain the written authorization of the Engineer for their reuse.

7.2 Governmental Immunity: Except for the District's obligations of indemnification as set forth in paragraph 7.1, nothing in this Agreement shall adversely affect any immunity from suit, or any right, privilege, claim or defense, which the District or its employees, officers and trustees may assert under state or federal law, including but not limited to the Utah Governmental Immunity Act, Utah Code Ann. (1953)

§§ 63-30-1 et seq. (the "Act"). All claims against the District or its employees, officers and trustees are subject to the provisions of the Act, which Act controls all procedures and limitations in connection with any claim of liability.

- 7.3 Conflict of Interest: The Engineer shall not establish or otherwise continue any conflict of interest created by virtue of this Agreement, prohibited under state or local laws.
- 7.4 Termination Prior to Completion: This Agreement may be terminated at any time by the District prior to completion of the Engineer's Services upon written notice to the Engineer. Upon receipt of such notice, the Engineer shall immediately stop any further work in progress, and in such event, the Engineer shall be entitled to payment for all of its Services performed by the Engineer and accepted by the District, to the date of cancellation, and for all work required to organize and deliver to the District the materials developed in the course of the Engineer's Services. Payment shall be due to the Engineer within forty-five (45) days after delivery of such materials and receipt of a verified and itemized invoice therefore.
- 7.5 Construction Estimates: Estimates of contract time, construction costs and quantities prepared by the Engineer or its employees represent their best professional judgment as design professionals and are supplied for the general guidance of the District. The Engineer does not guarantee the accuracy of such estimates as the Engineer has no control over the cost of labor and material, competitive bidding, or market or other conditions.
- 7.6 Indemnity and Insurance: The Engineer shall indemnify, and hold the District harmless from any claims under the Workers' Compensation Act, and from any claims, demands, suits, causes of action, costs, fees, judgments, liability for bodily injury and death, and damages to property, real or personal, to the extent caused by or resulting from breach of contract, negligence, recklessness or intentional misconduct by the Engineer or by the negligence of the Engineer's subconsultants, in the performance of the Engineer's Services under this Agreement. During the course of this Agreement, and for a period of four (4) years following Substantial Completion of the Engineer's Services under this Agreement, the Engineer shall maintain both professional errors and omissions liability insurance and general commercial liability insurance providing coverage for all liability arising out of the performance of Services in connection with the Project and this Agreement. The liability insurance required shall include "prior acts" coverage for all services rendered for the Project and shall be written with a limit of liability of \$500,000.00 per claim and a Project aggregate of \$1,000,000.00.
- 7.7 Interpretation: Except as otherwise noted, releases from liability, indemnification against liability, limitations on liability, assumptions of liability and limitations on remedies which may be expressed in this Agreement, shall apply to all possible claims and/or causes of action, including but not limited to those arising under common law, equity, statute, contract, tort or otherwise.

ARTICLE VIII
GENERAL TERMS AND CONDITIONS

- 8.1 Standards of Performance: The Engineer shall perform its Services in a manner consistent with the professional skill and care ordinarily provided by other design professionals with the same or similar professional license, providing the same or similar design professional service in the same or similar locality at the same or similar time under the same or similar circumstances.
- 8.2 Force Majeure: Neither party shall hold the other responsible for damages or delays in performance caused by acts of God, strikes, lockouts, accidents, acts of any governmental entity having jurisdiction over the parties and/or the subject matter of this Agreement (other than those governmental entities named as parties or beneficiaries to this Agreement), or other events beyond the reasonable control of the other or the other's employees and agents. In the event either party claims that performance of its obligation is prevented or delayed by such cause, that party shall promptly notify the other party of that fact and the circumstances preventing or delaying performance.
- 8.3 Assignment: Neither the District nor the Engineer shall delegate and/or assign their respective duties and/or rights under this Agreement without the prior written consent of the other. The Engineer may subcontract, however, portions of the Services as it deems necessary to efficiently accomplish the Basic Services. Nothing in this paragraph shall release the Engineer from full compliance with the terms and conditions of Article IV.
- 8.4 Severability; Waiver: In the event a court, governmental agency or regulatory agency with proper jurisdiction determines that any provision of this Agreement is unlawful, that provision shall terminate. If a provision is terminated, but the parties can legally, commercially and practicably continue to perform this Agreement without the terminated provision, the remainder of this Agreement shall continue in effect. One or more waivers by either party of any provision, term, condition or covenant shall not be construed by the other party as a waiver of any subsequent breach of the same by the other party.
- 8.5 Governing Law: This Agreement shall be governed by, construed and enforced according to the laws of the State of Utah.
- 8.6 Merger; Amendments: This Agreement and the Contract Documents, including all amendments, represents the entire and integrated agreement between the District and the Engineer, and supersedes all prior negotiations, representations or agreements, whether written or oral, regarding the subject matter contained in this Agreement. The Agreement may be amended only by written instrument executed by all parties.

- 8.7 Attorney's Fees: In the event of a default or breach of this Agreement, the defaulting party agrees to pay all costs incurred by the non-defaulting party in enforcing this Agreement or in obtaining damages, including reasonable attorney's fees, whether incurred through legal proceedings or otherwise.
- 8.8 Notice: Any formal notice required to be given under this Agreement shall be deemed given when hand-delivered or when sent by registered or certified mail, return receipt requested, to the parties at their respective addresses stated below or to any other address after notice of such change of address has been given to the parties.
- 8.9 Third Party Beneficiaries: Nothing contained in this Agreement shall create a contractual relationship with a cause of action in favor of a third party against either the District or the Engineer. The Engineer's Services under this Agreement are being performed solely for the District's benefit, and no other entity shall have any claim against the Engineer because of this Agreement or the performance or non-performance of Services hereunder. The District agrees to use reasonable efforts to include a provision in all contracts with other contractors and other entities involved in the Project to carry out the intent of this paragraph.

"District":

Jordan Valley Water Conservancy District
 8215 South 1300 West
 West Jordan, Utah 84088

"Engineer":

By:

 Alan E. Packard
 Its General Manager/CEO

By:

 [Name]
 Its _____

SCHEDULE A
SCOPE OF WORK

SCHEDULE B
GUIDELINES FOR ENGINEERING SERVICES

SCHEDULE B
REQUIREMENTS FOR ENGINEERING SERVICES

1. CONTINGENCY FUNDS

- A. Design Contingency funds shall not be utilized without prior authorization by the District. The use of Design Contingency funds shall be authorized in writing by District management on a task by task basis.

2. PRE-DESIGN/DESIGN PHASE

B. DRAWINGS

- 1.1 Computer-Aided Drafting (CAD) shall be used to prepare construction drawings. The drawings shall be delivered to the District in electronic form (AutoCAD 2016 or more recent) and hard copy on 11 x 17 paper.
- 1.2 Document Format:
- a. Electronic documents shall be prepared in the following versions:
- i. Spreadsheets in Excel version 2013
 - ii. Word processing in Word version 2013
 - iii. Presentations in PowerPoint version 2013
- 1.3 The cover sheet shall not include approval signatures from the District, although names of District officers may be printed.
- 1.4 The drawings shall be submitted to the District for its review and comment in accordance with paragraph E of this schedule, "Review of Contract Documents."
- 1.5 All drawings shall show the District's assigned Project number in the lower, right hand corner of the sheet.

OTHER CONTRACT DOCUMENTS

2.1 Bidding and Contractual Documents: The Engineer shall provide Project-specific information to the District for completion of the District's standard bidding and contractual documents identified below. The Engineer shall provide the bid schedule to the District in hard copy and electronic format (Microsoft Word). The District shall print the documents. The following paper colors and format shall be used by the District when printing these documents:

- 2.1.1 Title Page..... Single, Sided, White
- 2.1.2 Table of Contents..... Double-Sided, Yellow
- 2.1.3 Notice Inviting Bids..... Double-Sided, White
- 2.1.4 Instructions of Bidders..... Double-Sided, White
- 2.1.5 Bid..... Single-Sided, Blue
- 2.1.6 Bid Bond Single-Sided, Blue
- 2.1.1 Information Required of Bidder Single-Sided, Blue
- 2.1.2 Agreement Double-Sided, White
- 2.1.3 Performance Bond Single-Sided, White
- 2.1.4 Payment Bond Single-Sided, White
- 2.1.5 Notice of Award..... Single-Sided, White
- 2.1.6 Notice to Proceed Single-Sided, White
- 2.1.7 Payment Application Single-Sided, White
- 2.1.8 Change Order Single-Sided, White
- 2.1.9 Contractor's Certificate of
Substantial Completion..... Single-Sided, Purple
- 2.1.10 Contractor's Certificate of
Final Completion..... Single-Sided, Purple
- 2.1.11 Consent of Surety for
Final Payment..... Single-Sided, Purple
- 2.1.12 Affidavit of Payment Single-Sided, Purple

- 2.2 General and Supplemental Conditions: The District will provide General and Supplemental General Conditions; to be printed on green and yellow paper, respectively.
- 2.3 Technical Specifications:
- 2.3.1 The Engineer shall prepare technical specifications in electronic form (Microsoft Word). The technical specifications shall be delivered to the District prior to the bidding in electronic form and single-sided on 8 ½ x 11 white paper.
 - 2.3.2 The draft sets of technical specifications shall be submitted to the District for its review and comment in accordance with paragraph E of this Schedule.
 - 2.3.3 The technical specifications shall include, but not be limited to, the following General “Divisions.”
 - 2.3.3.1 General Requirements of the Work.
 - 2.3.3.2 Contract Submittals – Include Submittal procedures requirements for equipment shop-drawings, record drawings, and submission of technical O&M manuals, spare parts lists, etc., prior to final payment.
 - 2.3.3.3 Quality Control, Inspection, Testing.
 - 2.3.3.4 Protection and Restoration of Existing Facilities.
 - 2.3.3.5 Equipment Testing and Startup – Include requirements for testing, startup, certification of installation, and training of District personnel by manufacturer’s representative for complex equipment.
 - 2.3.3.6 Project Closeout Procedures and Requirements – These procedures and requirements must match the requirements, in the District’s General Conditions.
 - 2.3.3.7 Measurement and Payment – This should be explained in a separate section, or in each work item section of the technical specification.

2.3.3.8 Field Staking and Surveying – Include defining whether the Engineer or Contractor shall be responsible for field surveying and staking.

2.4 Addenda: If addenda are to be issued, each addendum will be prepared by the Engineer. The addendum will be approved, signed, and delivered by the District.

C. DOCUMENT BINDING REQUIREMENTS

3.1 With the exception of 11x17 drawings, all documents produced by the Engineer shall be bound in a three ring binder. This shall include pre-design reports, final reports, operation and maintenance manuals, etc. Drawings may be comb-bound during bidding and construction. As-constructed drawings shall be (1) comb-bound and (2) folded and included in three ring bound operation and maintenance manuals.

D. DESIGN REQUIREMENTS

4.1 All engineering designs shall include the following elements.

4.1.1 Adequate seismic bracing/anchorage of piping and equipment.

4.1.2 Provision of flexibility for differential settlement where buried piping and/or electrical conduit penetrates concrete vaults or basements.

4.1.3 All other standard engineering design issues shall be addressed.

E. REVIEW OF DRAWINGS AND TECHNICAL SPECIFICATIONS

5.1 The Engineer shall prepare one electronic set (PDF) and one photo copy ready paper set of drawings and technical specifications for review by the District.

5.1.1 Review documents shall be provided at the following minimum progress landmarks: ten percent (10%), thirty percent (30%), fifty percent (50%), ninety percent (90%) and one hundred percent (100%). If specified in the Scope of Work (Exhibit A) more landmarks may be required. A two-week minimum review period shall be allowed for review of the drawings and technical specifications at each progress landmark. At each progress landmark the Engineer shall

meet with the District for two to four hours to receive its comments and direction.

5.1.2 The Engineer shall return to the District, with each subsequent specification to be reviewed, all documents reviewed by the District during the previous submittal.

F. RIGHT-OF-WAY DESCRIPTIONS

Unless otherwise specified by the District, the Engineer will prepare legal descriptions for right-of-way to be acquired by the District from ownership plats and deeds, rather than by the actual survey. The District will prepare easement and other documents, utilizing legal descriptions prepared by the Engineer. Legal descriptions shall be in a metes and bounds format acceptable to the local County Recorder, which may record the document(s).

3. CONSTRUCTION SERVICES PHASE

A. PROJECT PERSONNEL

1.1 Engineer: The Engineer shall represent and perform Engineering Services for the District within the scope of authority delegated to it by the District as described in this Schedule B.

1.2 The Engineer will appoint, subject to the District's approval, the following personnel:

1.2.1 Project Manager: The individual designated by the Engineer and approved by the District to oversee and manage the administration of the Contract. The Project Manager shall supervise the Project Representative; alternatively, the Project Representative may also serve as the Project Manager as provided in Article IV of the Agreement.

1.2.2 Project Representative: The individual of the Engineer's firm appointed as Project Representative will be the Engineer's chief representative in all construction site relations with the Contractor and will have all authority and responsibility as set forth in the District's General Conditions of the Contract.

1.2.3 Other Personnel: The Project Manager may assign, and will supervise, such portions of contract administration

duties as he deems necessary, such as reviewing submittals, performing design changes, and substituting for the Project Representative on the construction site during brief absences of the appointed Project Representative. During brief absences of the assigned Project Representative the Project Manager will first send written notice to the Contractor and will notify the District.

B. CONTRACT EXECUTION ASSISTANCE

- 2.1 The District will issue the Notice of Award and Notice to Proceed to the Contractor.
- 2.2 Following Contract execution by the District, fully executed Contracts will be distributed by the District as follows:

District One (1) Set
Contractor: One (1) Set
Engineer: One (1) Set

These three (3) sets will be bound in three-ring binders.

C. PRE-CONSTRUCTION CONFERENCE

- 3.1 The Project Manager and Project Representative shall familiarize themselves with the District's General Conditions of the Contract.
- 3.2 The Project Manager will prepare a Pre-Construction Conference agenda, and conduct such a conference with the Contractor and applicable third parties at the District's office or on-site. The Project Representative and District Representative shall be present. The agenda should cover the key points of the Contract Documents, including the General Conditions of the Contract, as well as other Project administration matters.

D. SUBMITTAL/SUBSTITUTIONS

- 4.1 The Project Manager shall review, process, and recommend approval/disapproval of Contractor submittals and substitution requests. Copies of each Contractor submittal and substitution request shall be sent to the District, together with the Project Manager's recommend action.

The District will direct the Engineer to approve/disapprove each submittal and substitution request.

E. INSPECTION/TESTING

- 5.1 The Project Representative will make all on-site inspections, with the general frequency and duration as directed by the District.
- 5.2 The Project Representative is authorized to order such tests as he deems necessary for proper administration and inspection of the Project, however, with respect to any such test to be performed by independent firms presently contracting directly with the District, the firm so contracting will be designated by the District to perform the tests. Reports of all test results, or test summaries, shall be submitted to the District by the Project Representative.
- 5.3 The Project Representative shall keep a daily written log of construction activities at the site during each visit. Copies of the daily log shall be sent to the District on a monthly basis.
- 5.4 The Project Representative's daily log shall include a comment of whether or not any event or circumstance has developed in the Contract or Project, which in the Project Representative's professional judgment may lead to a claim or protest from the Contractor. The Project Representative shall notify the District immediately of such an event or circumstance, receipt of a written claim or protest, or his becoming aware of events which may lead to such a claim, from the Contractor.
- 5.5 The Project Representative shall send to the District copies of notes from telephone calls or meetings with the Contractor that, in the opinion of the Project Manager, are significant.
- 5.6 The Project Representative shall take digital photographs of the construction in progress during each phase of the work. The Project Manager shall prepare a photographic history of the work as described in paragraph 10.3. The format of the digital photographs shall be in accordance with paragraph 10.3. Photographs shall be submitted periodically to the District during the construction phase of the work.

F. CHANGES IN THE WORK

- 6.1 Field Order: The Project Representative is authorized to, and shall issue all field orders in writing, as described in Article 1.14 of the General Conditions of the Contract. The Project Representative shall submit a copy of each field order to the District.
- 6.2 Change Orders: The Project Representative and Project Manager are not authorized to approve Change Orders. Change orders may be initiated by the District, by recommendation from the Project

Manager, or by claim of changed conditions by the Contractor. Change orders will be initially reviewed by the Project Manager, then forwarded with a recommendation to the District. The District shall consider if the recommendation is consistent with the Contract Documents, and if acceptable, the District will prepare the change order form for approval by the authorized District staff.

- 6.3 Emergencies: The District acknowledges that in emergencies immediately affecting the safety or protection of persons or property affected by the construction activities, the Contractor, without special instruction or authorization from the Project Representative or the District, is obligated to act to prevent threatened damage, injury or loss. The Contractor shall give the Project Representative prompt written notice of any significant changes in the Contract construction or deviations from the Contract Documents caused thereby.

G. PROGRESS MEETINGS

- 7.1 The Project Representative and/or the Project Manager shall attend progress meetings conducted by the Contractor, and shall document the content of the meetings with minutes. Progress meetings will be scheduled at a location and frequency suitable to the project needs. A District Representative will normally attend these meetings.

H. PROGRESS PAYMENTS

- 8.1 The Project Representative shall receive applications for payment from the Contractor, review and recommend the applications by signature. The Project Representative's signature recommending a progress payment shall constitute the verification of the representations required by the Agreement and the Contract.
- 8.2 The Project Manager will review the applications, approve them by signature, and submit them to the District within five business days of receipt from the Contractor.
- 8.3 Each application for payment shall contain the Contractor's certification and signature substantially in conformance with the following:

CONTRACTOR'S CERTIFICATION

The undersigned Contractor certifies that: (1) all previous progress payments received from Owner on account of Work done under the

Contract referred to herein have been applied to discharge in full all obligations of Contractor incurred in connection with Work covered by prior Applications for Payment numbered 1 through ____ inclusive; and (2) title to all materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to Owner at time of payment free and clear of all liens, claims, security interests and encumbrances (except such as covered by bond acceptable to Owner).

Contractor (Name of Sole Ownership, Corporation or Partnership)

Signature of Authorized Representative

Title

Date

8.4 In accordance with State Law, the District will retain 5% of progress payments until the final payment and final completion of the Project.

4. PROJECT CLOSEOUT

1.1 The Project Manager shall be responsible to see that closeout procedures and documents, as specified in the District's General Conditions, are carefully observed. The following standard District forms, or similar forms of the Engineer acceptable to the District, will be used.

1.1.1 Contractor's Certificate of Substantial Completion

1.1.2 Engineer's Notice of Substantial Completion

1.1.3 Contractor's Certificate of Final Completion

1.1.4 Engineer's Notice of Final Completion

1.1.5 Consent of Surety for Final Payment

1.1.6 Affidavit of Payment (from Contractor)

1.2 The Project Manager will submit original copies of the Contractor's Certificates of Substantial and Final Completion to the District.

1.3 The Project Manager shall prepare and sign the Engineer's Certificate of Substantial Completion, a copy of which is attached.

- 1.4 The Project Manager will prepare, sign and submit the Engineer's Notice of Final Completion, together with the Final Payment application and all submittals required from the Contractor, when he is satisfied the work is complete. A copy of the Engineer's Notice of Completion is attached. The District's acceptance, as Owner, of the Notice of Final Completion will be evidenced by its making final payment.

5. OPERATION AND MAINTENANCE MANUAL

- 1.1 The Project Manager shall prepare an Operation and Maintenance Manual ("O&M Manual") for the Project. The O&M Manual shall be completed within seven (7) calendar days of Substantial Completion of the work. The intent for the O&M Manual is to be a reference for unfamiliar users of the Project facilities to become familiar with the operation of the facilities, receive direction on how and when to maintain the facilities, and be able to locate technical support reference when necessary.

The District wishes to have the O&M Manual in electronic format as much as possible. Although certain formats of electronic documents are defined in this Agreement, the District recognizes that technology will change and improve over time and encourages the Project Manager to look for creative ways of providing O&M Manuals in electronic versions as much as possible. For example, the Project Manager could require the Contractor to submit O&M Manual information in HTML, PDF or another universal standard electronic format that could be easily accessed by the District in the future.

The format of the O&M Manual shall be as follows:

Volume I (By Engineer):

- Section 1: Description of Facilities, Typical Operating Conditions, Standard Operating Procedures
- Section 2: Description of Proper Maintenance Activities
- Section 3: List of Equipment and Suppliers
- Section 4: Contract Documents and Specifications
- Section 5: Record Drawings (see 10.2)
- Section 6: Project Photo Log (see 10.3)
- Section 7: Other Pertinent Documents
- Section 8: Compact Disc

Volume II (By Contractor):

Section 7: Shop Drawings

Section 8: Manufacturer's Literature and Operations & Maintenance Manuals

All the information in Volume I shall be in an electronic format as well as in paper format.

Unless specifically identified in the request for proposal, the Project Manager shall supply four (4) copies of the O&M Manual complete with electronic versions of information contained in the O&M Manual and one (1) additional copy of the electronic information.

- 1.2 The Project Manager will revise the original drawings to reflect record conditions, from the Contractor's marked-up record drawings and the Project Representative's inspection notes, sign and stamp them as follows:

JVWCD RECORD DRAWINGS:

Revisions drawn by _____ Date: _____

This record drawing has been prepared to reflect conditions as actually constructed, from records compiled during construction by the Contractor and the Engineer.

Project Manager

Date

The record drawings are not intended to show in detail the exact location of minor/latent detail of construction. Instead, they are intended to represent as-built conditions in as much detail as practical and available, and to document substantial changes from the original design. The District recognizes that much of the information required to prepare the record drawings is compiled by the Contractor or others during construction, and therefore holds the Engineer harmless from any errors or omissions which may be incorporated into the drawings as a result.

The record drawings will be delivered to the District following Project completion. The record drawings shall be submitted in electronic ((a) AutoCAD 2016 or more recent and (b) PDF format) and (c) paper (11x17) format.

- 1.3 The Project Manager shall submit the complete photo history of the Project compiled during construction. The photo history shall be in electronic and paper formats. Both versions shall contain all photographs in chronological order with a date and caption below each photo.

The electronic version shall contain 4" x 6" photos in a JPEG format with a resolution of 150 dots per inch (DPI) or higher. If compressed the compression must be a high quality compression.

The paper version shall contain thumbnail-size photographs with no more than twelve (12) photos per 8-1/2" x 11" page.

ENGINEER'S NOTICE OF SUBSTANTIAL COMPLETION

OWNER

ENGINEER

TO: Jordan Valley Water
Conservancy District
8215 South 1300 West
P. O. Box 70
West Jordan, UT 84088-0070

PROJECT NAME: _____

Date of Notice to Proceed: _____ Contract Time: _____
Calendar Days _____

In response to Contractor's Certificate of Substantial Completion dated: _____

This Certification of Substantial Completion applies to all work under the Contract Documents or to the following specified parts thereof:

The work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor and Engineer, and that work is hereby declared to be substantially complete in accordance with the Contract Documents on:

Date of Substantial Completion: _____, 20____.

A list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of the Contractor to complete all the work in accordance with the Contract Documents. In accordance with the General Conditions, the items in the list shall be completed or corrected by the Contractor within 45 days of the above date of Substantial Completion.

Marked-up record drawings and operation and Maintenance technical information has been received from the Contractor.

The recommended responsibilities between the Owner and the Contractor for security, operation, safety, maintenance, heat, utilities and insurance, if any, shall be as follows:

Owner: _____

Contractor: _____

ENGINEER'S NOTICE OF SUBSTANTIAL COMPLETION (Continued)

The following documents are attached to and made a part of this Certificate:

Execution of this Certificate by the Engineer extends the Contractor's release of claims against the Owner to the date of execution hereof, in accordance with Article 14.08 of the General Conditions, except for written claims filed prior to date of execution, of which the following, if any, are known to the Engineer:

Executed by the Engineer on _____, 20__.

_____	_____
Project Representative	Signature

_____	_____
Project Manager	Signature

The Contractor hereby acknowledges receiving this Certificate of Substantial Completion.

Contractor (Name of Sole Ownership, Corporation or Partnership)

Signature of Authorized Representative

_____ _____
Title Date

(Engineer shall submit to the Owner a copy with the Contractor's signature following the Contractor's receipt.)

JORDAN VALLEY WATER CONSERVANCY DISTRICT

ENGINEER'S NOTICE OF FINAL COMPLETION

OWNER

ENGINEER

TO: Jordan Valley Water
Conservancy District
8215 South 1300 West
West Jordan, UT 84088

PROJECT NAME: _____

Date of Notice to Proceed: _____

In response to Contractor's Certificate of Final Completion dated: _____

On the basis of our observation of the work during construction and final inspection, and on our review of the Contractor's application for final payment and accompanying documentation, we are satisfied that the Contractor has fulfilled all his obligations under the Contract Documents requisite to final payment.

The following remaining minor deficiencies in the work are recommended to be exempt from final payment, in accordance with Article 14.09 of the General Conditions of the Contract. Recommended completion time limits, extended warranty requirements, and the value of these exempt deficiencies are listed below:

DEFICIENCY	COMPLETION TIME	VALUE

The Contractor's application for final payment together with the following contractor submittals, which comprise all final submittal requirements under the Contract Documents, are submitted herewith:

1. Affidavit of Payment from the Contractor.
2. Consent of Surety for final payment.

ENGINEER'S NOTICE OF COMPLETION (Continued)

The date of our satisfactory final inspection was _____, 20____. This date marks the beginning of the one-year Maintenance and Guarantee period, in accordance with Article 13.01(B) of the General Conditions of the Contract.

Acceptance of final payment by the Contractor shall be a release of claims against the Owner in accordance with Article 14.12 of the General Conditions of the Contract. Acceptance of this Notice of Completion by the Owner makes the Contractor's release effective on the date of execution hereof by the Engineer, excepting written claims filed by the Contractor prior to said date of execution of which the following are known to the Engineer:

Is the Engineer aware of any unresolved liens against the Contractor from suppliers or subcontractors?

Yes

No

Unresolved Liens (If Applicable):

Executed by the Engineer on _____, 20____.

Project Representative

Signature

Project Manager

Signature

SCHEDULE C
TIME TO COMPLETE

SCHEDULE D
ENGINEER'S PERSONNEL

SCHEDULE E
COMPENSATION

ATTACHMENT B

SAMPLE FEE PROPOSAL

Project Name
Fee Proposal Template Example

Client: Jordan Valley Water Conservancy District

Firm Name:

Date:

Tasks	Project Manager (Name)	Project Engineer (Name)	Project Rep. (Name)				Total Hours	Cost By Task	
Team Member	\$ /hr	\$ /hr	\$ hr	\$ /hr	\$ /hr	\$ /hr			
Pre-Design Phase									
1.									
2.									
Subtotal:									
Design Phase									
1.									
2.									
Subtotal:									
Total Hours by Team Member									
TOTAL PRE-DESIGN/DESIGN COST								\$	
20% CONTINGENCY								\$	
Construction Phase									
1. Bidding Support									
2. Construction Management									
3. Documentation									
Subtotal:									
Total Hours by Team Member									
TOTAL CONSTRUCTION MANAGEMENT COST								\$	
Direct Charges:									
TOTAL DIRECT CHARGES								\$	
TOTAL FEE								\$	

Principal's Name

Principal's Signature

Date

ATTACHMENT C

HAZARD MITIGATION PLAN – 2021

ADOPTED
Hazard Mitigation Plan

Prepared for
Jordan Valley Water
Conservancy District
West Jordan, Utah
September 2021
(Updated November 2021)



JORDAN VALLEY WATER
CONSERVANCY DISTRICT

Prepared by:
ELWELL Consulting Group Team
3014 W. Chimney Rock Circle
Taylorsville, Utah 84129
(801) 870-9709



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Introduction

Created in 1951 under the Water Conservancy Act, JWCD is Primarily a wholesaler of water to cities and improvement districts within Salt Lake County, Jordan Valley Water Conservancy District (JWCD or District) is a political subdivision of the State of Utah and one of the largest water districts in the state. The District also supplies potable water to retail customers within Salt Lake County and is responsible for supplying water for upwards of 750,000 people in the Salt Lake Valley.

JWCD is governed by a board of nine trustees representing eight geographical divisions. They are nominated either by the Salt Lake County Council or a city council, depending upon the division they represent. The Governor then appoints Trustees for a 4-year term from those nominated. The District also has approximately 150 full-time employees.

Jordan Valley Water has a retail service area primarily in unincorporated areas of the county, making up about 10 percent of its deliveries; approximately ninety percent of its municipal water is delivered on a wholesale basis to cities and water districts. Metropolitan Water District of Salt Lake & Sandy (MWDSL) owns 2/7ths of the Jordan Valley Water Treatment Plant (JVWTP) capacity and (in addition to primary) 2/7ths of the Jordan Aqueduct conveyance and storage facilities to get the water from the plant Salt Lake City and MWDSL delivery points. JWCD operates the facilities and delivers to Salt Lake City and MWDSL. Jordan Valley Water also delivers untreated water to irrigators in Salt Lake and Utah Counties to meet commitments under irrigation exchange agreements.

The District has identified its mission, vision and core values as follows:

Mission - Delivering quality water and services every day.

Vision - Our vision is to provide a sustainable water supply to promote individual and community well-being.

Values:

1. Safety – We are committed to employee and public safety.
2. Service - We care about our customers' needs and strive to fulfil them.
3. Respect - We care about our employees and invest in their success.
4. Integrity - We believe in doing the right thing—individually and as an organization.
5. Leadership - Our passion for quality drives us to employ innovative practices.

The Water System

The JWCD water system consists of multiple facilities including pump stations, reservoirs, and treatment plants. There are also conveyance systems (aqueducts, transmission, and distribution pipelines) for moving the raw water sources to the District's treatment plants and through the distribution system to deliver treated water to the District's 17 member agencies and retail service area shown in Figure I.1 JWCD Service Area.



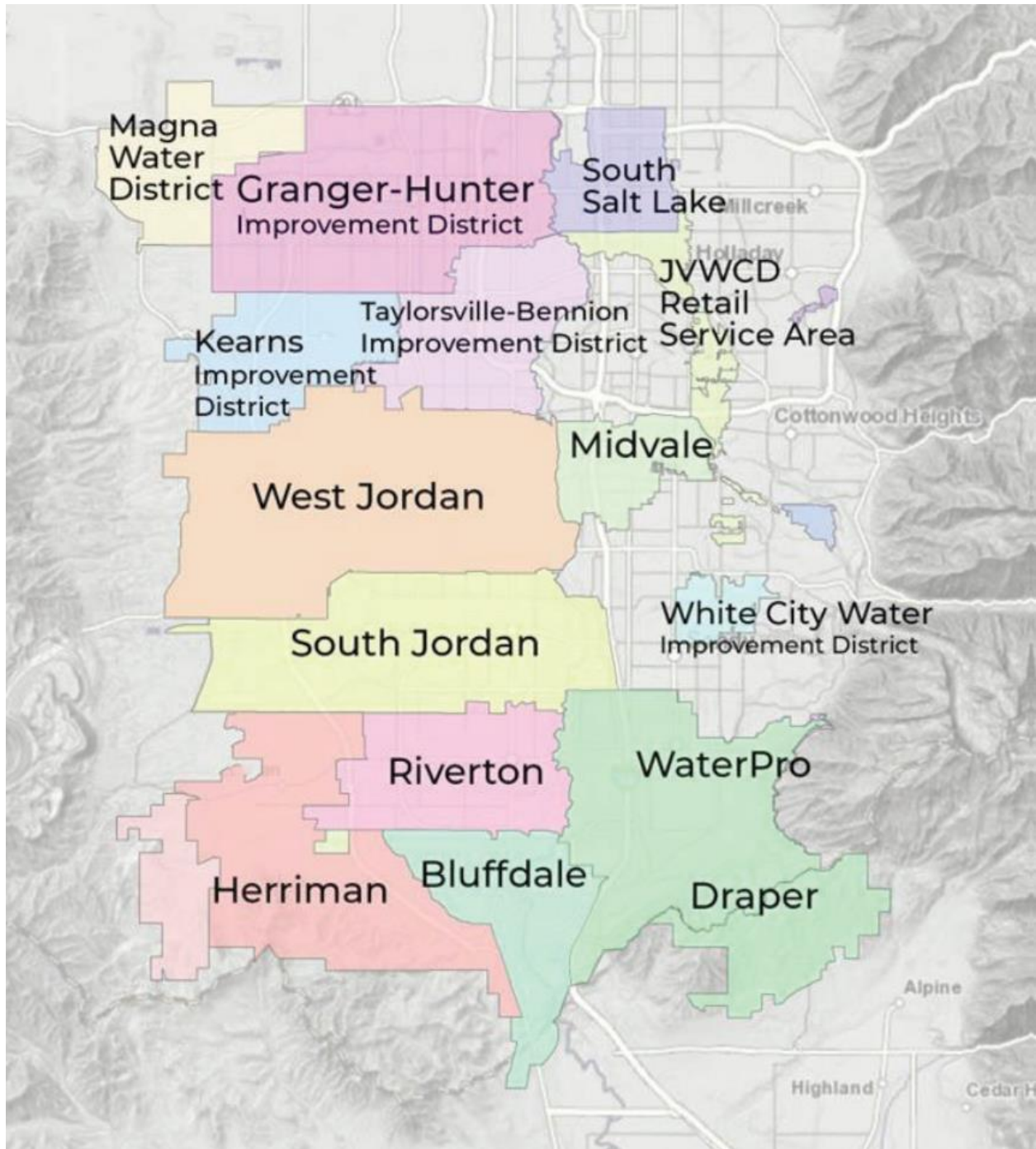


Figure I.1 JVWCD Service Area (Member Agencies & Retail Customers)



An inventory of the District’s primary types of facilities/assets types is shown in Table I.1 below, along with a summary of each one.

Table I.1 Facility/Asset Types	
Types of Facilities/Assets	Inventory
Water Treatment Plants (WTPs)	4
JVWTP	180 MGD
SERWTP	20 MGD
SWGWTP	7 MGD
High quality groundwater sources	31 wells
Brackish remediation wells	8 wells
Tanks	33 tanks at 16 sites
Booster pump Stations	14 pump stations
Major conveyance piping (>36 in)	720,000 linear feet
Transmission piping (16 in to 36 in)	540,000 linear feet
Distribution piping (<16 in)	200,000 linear feet

1. *Owned and operated by Rio Tinto Kennecott.*

Next, an overview of some of JVWCD’s facilities is presented in the following paragraphs.

There are three primary **Water Treatment Plants (WTPs)** supplying the JVWCD system:

1. Jordan Valley Water Treatment Plant (JVWTP)

Constructed in 1974, with expansions in 1979 and 1987, Jordan Valley Water Treatment Plant is the largest conventional water treatment plant in the state of Utah. Its rated treatment ability is 180 million gallons per day, and it frequently operates at capacity during the summer months. Originally owned by Central Utah Water Conservancy District, the deed was transferred to Jordan Valley Water Conservancy District and Metropolitan Water District of Salt Lake & Sandy in 2007.

2. Southeast Regional Water Treatment Plant (SERWTP)

Constructed in 1985 with a major process enhancement in 2000. It is owned and operated by Jordan Valley Water Conservancy District and uses high-rate clarification technology. The rated capacity is 20 MGD.

3. Southwest Groundwater Treatment Plant (SWGWTP)

Constructed in 2012, this plant is owned and operated by Jordan Valley Water Conservancy District and uses reverse osmosis technology to remediate a contaminated aquifer. The rated capacity is 7 MGD.

Jordan Narrows Pump Station (PS)

Constructed in 1989, this pump station draws Utah Lake water from the Jordan River and pumps it into the Provo Reservoir Canal siphon pipe for conveyance of irrigation water to the Welby and Jacob Canals Diversion Structure. The pump station delivers up to 140 cfs to meet the requirements of the Welby-Jacob Exchange Agreement.

Wells and Booster Stations

Jordan Valley Water owns and operates 39 deep wells throughout the Salt Lake Valley, as well as multiple booster stations with a combined design capacity of approximately 500 cubic feet per



second. The three wells and four booster pump stations (PSs) selected by the District to be included in their top 20 Assets are shown in Section 2.4, Table 2.3.

Reservoirs and Pipelines

Jordan Valley Water owns and operates reservoirs throughout the valley with a total storage capacity of 177.6 million gallons. More than 300 miles of water transmission pipelines allow for the transport and deliver approximately 44 billion gallons of culinary water annually. The five Reservoirs and six Pipelines selected by the District to be included in their top 20 Assets are also shown in Section 2.4, Table 2.3.

Finally, there are 2 water treatment plants were selected and included in the District's top 20 Assets. These 20 key assets are also shown on the asset location and hazard maps in Appendix A.

Past Development

JWCD has seen significant growth and development within its service area. The population served by JWCD increased 2.7 times faster the average growth rate of the United States from 2000 to 2018, and grew 19.6% from 2008 to 2018. While this population growth has not made the District nor its water system more vulnerable to natural hazards, the consequences of potential hazard vulnerabilities have increased.

Recent development within JWCD' s water system included new construction, as well as upgrades to existing facilities to increase system resiliency and meet growing demand. Supply side improvements include:

- Construction of new wells and rehabilitation of existing wells,
- Construction of the new Central Water Pipeline adding a new treated groundwater source from Central Utah Water Conservancy District (CUWCD) to further diversify the District's supply portfolio,
- High-rate sedimentation added to the SERWTP,
- Portable power generators that can be deployed to multiple wells or pump stations and permanent, on-site generators at select pump stations and SERTP. Relocation and upgrade to the JWTP generator
- Seismic upgrades completed on much of the JWTP.
- Recent improvements in the storage and conveyance side of the system include:
 - Construction of the Southwest aqueduct adding conveyance redundancy to and from JWTP,
 - Ongoing replacement of the 3300 South transmission main,
 - Construction of the parallel pipe to 10200 South transmission main,
 - Construction of the new 11800 South transmission main and pump station,
 - Ongoing Distribution main replacement,
 - Repair and upgrades of 2 MG Naniloa tank and recommission back into service,
 - Construction of the new 12.5 MG finished water storage reservoir at JWTP

Future Development

The District anticipates significant growth within its service area and is solidifying its capacity to meet those demands through a combination of focused water conservation and new supply and conveyance development. The District is also increasing the resiliency of its system through extensive rehabilitation and renewal work (R/R) and drouth contingency planning.



The JWCD service area coincides with the municipal boundaries of its member cities and improvement districts. The 2020 population served by JWCD, and its member cities and improvement districts is approximately 750,000. Population projections developed by the Wasatch Front Regional Council in coordination with the State of Utah Governor's Office of Management and Budget estimate the total 2065 population within the current JWCD boundaries will grow to approximately 1.1 million. In addition to the current JWCD service area, there are thousands of acres of developable land adjacent (west) to existing municipal boundaries which will likely annex into the JWCD service area.

The growing population served by JWCD will require further conservation to extend the beneficial use of existing supplies and will also require the development of new supplies. The majority of new development will occur on lands that historically have not been irrigated. Therefore, it will be critical for land development to be done in a way that uses water efficiently and is as drought resilient as possible. The District's 2019 Water Conservation Plan update included an expansion of conservation activities to further accelerate a reduction in the per capita usage rate in JWCD service area. Based on previous success with conservation efforts and planned future conservation activities, the District is projecting that total M&I water use in 2065 will be limited to a 35% increase, even with a population increase of 53% and increased evapotranspiration from climate change.

The projected increase in demand, along with the constant need to upgrade and rehabilitate existing infrastructure, results in total projected capital expenditure of \$3.5 billion through 2065. Beyond conservation, future projects include a phased expansion of JWTP, continued extension of the Southwest Aqueduct to provide redundant and additional water conveyance capacity from JWTP, three new high quality groundwater wells, and additional treatment capacity for Utah Lake/Jordan River water rights, new potable water storage reservoirs, pump stations, conveyance pipelines and storage reservoir renewal and replacement work, and a large regional water supply development project multiple county water supply project.

The remaining lands available for development are located in areas which are generally less susceptible to ground movement associated with seismic events than currently developed lands served by JWCD. However, JWCD will employ the same rigor to design and construction of future facilities to serve the future growth. In compliance with applicable seismic standards, JWCD will also consider all the hazards outlined in this plan as it builds new facilities.

The design of future JWCD facilities will meet current Utah Building Code and International Building Code (IBC) standards, which account for conditions associated with natural hazards (i.e., earthquake, severe winter weather, severe winds, etc.). The District will also continue in its current efforts to address and incorporate natural hazard mitigation (i.e., seismic upgrades/standards, lightning protection, backup power, etc.) into future design and construction projects whether they are for new facilities or for rehabilitation and renewal projects.

The District is currently completing a Drought Contingency Plan (DCP) to minimize the negative impacts of future droughts to its service area. The DCP identifies 15 mitigation measures that will be implemented to reduce the likelihood and consequence of adverse drought conditions. It also defines 14 response actions that will be taken during a drought to minimize both health and safety risks as well as economic impacts.



Section 1

Planning Process

A four-phase approach was used in the preparation of this new JWCD Hazard Mitigation Plan (HMP or Plan) as outlined:

- Phase A Planning Process
- Phase B Natural Hazard Risk Assessment
- Phase C Mitigation Strategy Development
- Phase D Plan Update & Adoption

Phase A was used to define the planning process and included the project Kickoff, identification of the Planning Team, and Asset Prioritization. In addition, a stakeholders list and outreach strategy were prepared for the public involvement program along with plan maintenance procedures. During this phase, other existing plans and resources were reviewed for use in the Plan's development. Included, the original 2004 Hazard Mitigation Strategy compiled by the District. The new Plan would also include new facilities/assets not previously reviewed and assessed by the District. Also, during the planning process, the District's top 20 key assets were identified and prioritized based on the District's mission specific criteria to determine their criticality. A Planning Team meeting was held with the District at the end of this phase to review all the Phase A tasks, followed by the first Stakeholder meeting to solicit input, and present the scope of work and schedule for the remaining phases of the development of the new Plan to the identified stakeholders.

Phase B, consisted primarily of hazard identification and risk/vulnerability assessment. This was accomplished through tasks of hazard identification and profiling, assessing vulnerabilities, and consequence assessment. District assets that were identified and prioritized during Phase A Planning Process were first screened at a Risk Screening Workshop and then the District JWCD's selected 40 asset-hazard pairs for assessment during this Phase B, Risk Assessment. Descriptions of the natural hazards affecting key water assets are documented in Section 2.0 of the Plan including an analysis of how hazards vary across assets, location & (severity) for each natural hazard affecting the facilities. Previous hazard occurrences were also reviewed and documented. A two-step screening process was used to limit the assets assessed to only those determined to be at High risk of hazard, in order to limit the number of asset-hazard pairs. The vulnerability assessment task included research, document reviews, and interviews of JWCD staff for critical JWCD assets. The assessment also included a review of other plans, existing hazard studies, reports and other information gathered during Phase A. A summary was compiled documenting each of the 40 selected asset-hazard pairs for the asset's vulnerability to each hazard. This included rating of the impact of each hazard. The consequence assessment task included determining the system loss of service and cost of infrastructure repair/replacement for each of the top 5 assets for the selected asset-hazard pairs. Towards the end of this phase, a Planning Team meeting was held to review the results of Phase B. A second Stakeholder meeting was then held to present the results of Phase B to Stakeholders, receive input, and provide a scope and schedule update for the new Plan.

During Phase C, the mitigation strategy was developed for the Plan. The mitigation strategy included identification of mitigation goals and actions, and development of general and specific mitigation actions based on Phase B assessment results to lower the natural hazard risk and consequence of failure of District assets. This was accomplished by conducting the following tasks: review previous



mitigation actions and determine their status, identify and develop specific mitigation actions, prioritize action items, and develop a new implementation plan. The mitigation actions for the top 5 assets were further developed with planning level rough order of magnitude cost estimates. A basic benefit-cost analysis was performed for each mitigation project using the benefits estimated during Phase B of the planning process and using the results of the consequence assessment. A mitigation implementation plan was developed for the specific hazard mitigation projects (i.e., mitigation actions of top 5 assets) and included project prioritization, potential funding source identification, and proposed implementation schedule. A Risk Assessment Workshop was held with the District’s Planning Team to review the results of Phase C. Next, a third Stakeholder meeting was held to present the results of Phase C to the Stakeholders, receive Stakeholder input, and provide a scope and schedule update for completion of this new Plan.

During Phase D, this new draft Plan was prepared with results from work performed during Phases A-C. The draft Plan was reviewed by the District, presented to Stakeholders, then revised and submitted to the State of Utah for review. After addressing State comments, the Final draft Plan was submitted to FEMA for review and approval. After receiving conditional approval of the Final Draft Plan from FEMA, the Plan was presented to the JVWCD Board for adoption. Finally, the signed adoption resolution was submitted to FEMA for final Plan approval.

1.1 Planning Team

The JVWCD Hazard Mitigation Plan (HMP) was prepared by the Elwell Consulting Group (ECG) Team under contract and the direction of the Jordan Valley Water Conservancy District. The planning team was made up of District managers, engineers, and technicians, as well as consultant civil, facilities, structural, electrical/instrumentation/controls, geotechnical engineers, geologists, and GIS specialists. Team members were chosen based on their knowledge of the JVWCD system and their engineering expertise in the area of natural hazards, water systems, and mitigation planning. The JVWCD managers and other key personnel, and the Elwell Consulting Group Team’s project manager, facilities engineer, and geotechnical engineering lead, who served as the key planners for the project, are listed in Table 1.1. The remainder of the planning team members provided technical contributions throughout the planning process and are listed in Table 1.2 below.

Table 1.1 Planning Team - Key Planners	
Team Member	Organization, Position Title
Alan Packard	Jordan Valley Water Conservancy District, Assistant General Manager - Engineering, Strategic & Long-term Planning, & New Initiatives
Brian Callister	Jordan Valley Water Conservancy District, Maintenance Dept. Manager
Bryon Elwell	Elwell Consulting Group, Project Manager/ HMP Lead
David McLean	Jordan Valley Water Conservancy District, Senior Engineer
Gordon Batt	Jordan Valley Water Conservancy District, Operations Dept. Manager
Hiram Alba	GeoStrata (ECG subconsultant), Geotechnical Engineering Lead
Jeff King	Jordan Valley Water Conservancy District, Security & Emergency Response Coordinator
Jeremy Williams	Brown & Caldwell (ECG subconsultant), Facility Specialist
Marcelo Anglade	Jordan Valley Water Conservancy District, Project Manager
Matt Hinckley	Jordan Valley Water Conservancy District, Operations Dept. Manager
Shane Swensen	Jordan Valley Water Conservancy District, Engineering Manager



Table 1.1 Planning Team - Key Planners	
Team Member	Organization, Position Title
Shazelle Terry	Jordan Valley Water Conservancy District, Assistant GM – Operations & Maintenance

Table 1.2 Planning Team - Technical Contributors	
Team Member	Organization, Position Title
Jack Grayson	Brown & Caldwell (ECG subconsultant), GIS
Jacob Young	Brown & Caldwell (ECG subconsultant), QA/QC
Jason Brown	Jordan Valley Water Conservancy District, IS Dept. Manager
Jeanette Perry	Jordan Valley Water Conservancy District, Customer Service Supervisor
Johnathan Jackson	Brown & Caldwell (ECG subconsultant), Principal EIC Engineer
Jon Harper	Brown & Caldwell (ECG subconsultant), Principal Structural Engineer
Jon Peadon	GeoStrata (ECG subconsultant), GIS Specialist
Lorrie Cowles	Jordan Valley Water Conservancy District, GIS Administrator
Matt Olsen	Jordan Valley Water Conservancy District, Assistant General Manager – Communications & Conservation
Robert Squire	Jordan Valley Water Conservancy District, Electronics & Instrumentation Manager
Shem Liechty	Brown & Caldwell (ECG subconsultant), QA/QC
Sophia Agopian	GeoStrata (ECG subconsultant), Staff Geologist
Tim Thompson	GeoStrata (ECG subconsultant), Engineering Geologist

1.2 Stakeholder Involvement

This section documents the involvement of federal, state, regional, and local stakeholders in the development of this JVWCD Hazard Mitigation Plan. The JVWCD Plan affects many jurisdictions, agencies, and organizations including wholesale member agencies/retail service & local jurisdictions, regional and county organizations, and federal and state agencies. Public involvement was attained throughout the planning process by holding periodic meetings with JVWCD stakeholders during all four phases of plan development. The meetings were provided to inform the stakeholders about the planning process, provide progress updates, brief them on evaluation results, and solicit comments and feedback. Table 1.3 identifies the stakeholder jurisdictions/agencies and organizations, and their participation in the planning process. Comments from the various public meetings were documented by the District's mitigation planning consultant and were incorporated into the JVWCD Hazard Mitigation Plan, as appropriate.

The District solicited public/stakeholder participation in the planning process by sending out Stakeholder Meeting invitation letters to all potential interested parties. A copy of the invitation list, invitation letters, and attendance records for each Stakeholder Meeting held during the planning process is provided in Appendix B along with Stakeholder comment sheets and survey forms completed during the planning process.

In addition, the District provided project briefings on the JVWCD HMP at Executive Committee/Board meetings, which were advertised with multiple notices (i.e., District website, Utah Public Notice website, etc.). The public was able to attend these District meetings in person or remotely and were



provided the opportunity to comment on the District’s project and HMP. The District also made the HMP (hard copy) available at their District office for interested public for in person review and accepted comments. Documentation of the meeting notices, meeting minutes, and any comments received are also included in Appendix B.

Table 1.3 Stakeholder Planning Participation				
Stakeholder	Stakeholder Meeting Attendance			
	Phase A Mtg #1:	Phase B Mtg #2:	Phase C Mtg #3:	Phase D Mtg #4:
Wholesale Member Agencies				
City of Bluffdale	✓	✓	✓	✓
Draper City	✓	✓	✓	✓
Granger-Hunter Improvement District	✓		✓	✓
Herriman City		✓		
Hexcel Corporation	✓	✓	✓	
Kearns Improvement District	✓	✓	✓	✓
Magna Water District	✓			
Midvale City	✓	✓	✓	
Riverton City	✓			
City of South Jordan	✓	✓	✓	✓
City of South Salt Lake	✓		✓	✓
Taylorsville-Bennion Improvement District	✓			
Utah Department of Corrections			✓	✓
WaterPro, Inc.	✓	✓		
City of West Jordan		✓		
White City Water Improvement District			✓	
Retail Service & Local Jurisdictions				
Holladay City		✓		
Murray City	✓			
Sandy City				
South Salt Lake				
County or Regional Agency				
Metropolitan Water District of SL & Sandy	✓	✓	✓	✓
Salt Lake County Emergency Management/Unified Fire Authority	✓			
Mountainland Association of Governments				
Salt Lake County	✓			
Utah Lake Water Users Association	✓	✓	✓	✓
State Agency				



Table 1.3 Stakeholder Planning Participation				
Stakeholder	Stakeholder Meeting Attendance			
	Phase A Mtg #1:	Phase B Mtg #2:	Phase C Mtg #3:	Phase D Mtg #4:
Utah Division of Emergency Management	✓	✓	✓	
Utah Division of Drinking Water	✓	✓	✓	✓
Utah Division of Water Rights	✓	✓		
Utah Geological Survey				
Utah Division of Forestry, Fire & State Lands		✓	✓	
Federal Agency				
U.S. Bureau of Reclamation			✓	
U.S. Forest Service - Intermountain Region	✓	✓		
FEMA - Region VIII	✓	✓		
Other				
Rocky Mountain Power	✓	✓	✓	
Dominion Energy				✓

1.3 Planning Timeline

The JVWCD hazard mitigation planning project began at the end of March 2021 with approximately a 9-month planned project duration. The key milestones and their corresponding completion dates are shown in Table 1.4 below. The project was divided into four phases. Phase A, Planning Process started with the Kickoff Meeting in March 2021 and ended with the Phase A Stakeholder meeting in April 2021. Phase B, Risk Assessment began in April 2021 and ended in June 2021 with the Phase B Stakeholder meeting. Phase C, Mitigation Strategy began in June 2021 and ended in July 2021 with the Phase C Stakeholder meeting. Phase D, Plan Review & Adoption started in July 2021 and was completed upon JVWCD Board adoption of the Plan in November 2021.

A review meeting to discuss the draft Plan was held on August 26, 2021, with the District's planning team, after which the District provided comments for incorporation into the final Plan. The final Stakeholder Meeting was held in September 2021. The final Plan was then prepared and submitted to the State of Utah for review. After making State-requested changes, the Plan was submitted to FEMA for review in September 2021. FEMA completed review of the Plan in October 2021 and granted conditional approval of the Plan pending JVWCD Board adoption. The District presented the JVWCD Hazard Mitigation Plan to the JVWCD Board of Trustees for adoption on November 10, 2021. The JVWCD Board adoption resolution was submitted to FEMA, and FEMA issued a letter of Plan approval on November 17, 2021.

Table 1.4 Planning Process Timeline		
Date	Action	Description
March 23, 2021	Kickoff Mtg	Kickoff meeting with District personnel lead by planning consultant to begin Hazard Mitigation Plan project
April 1, 2021	Phase A Planning Team Mtg #1 & Asset Prioritization	Planning process results reviewed with District and Phase B Asset prioritization (collaborative pairwise comparison asset criticality ranking) completed with District



Table 1.4 Planning Process Timeline		
Date	Action	Description
April 6, 2021	Phase A Stakeholder Mtg #1	Stakeholders briefed on Phase A results and feedback/comments solicited with Stakeholder Survey #1
April 28, 2021	Phase B Planning Team Mtg #2 - Risk Screening	District personnel participate in a workshop discussing consequences of identified hazard vulnerabilities of top 20 assets & selected highest 40 Asset-Hazard Pairs for Risk Assessment
May 27, 2021	Phase B - Risk Assessment Workshop	Risk Assessment results reviewed with District & Top 5 Assets ranked for Mitigation Actions during Phase C
June 8, 2021	Phase B Stakeholders Mtg #2	Stakeholders briefed on hazard evaluation & risk assessment results, and feedback/comments solicited with Stakeholder Survey #2
July 13, 2021	Phase C Planning Team Mtg #3	Hazard mitigation actions and plan for implementation reviewed with District
July 20, 2021	Phase C Stakeholders Mtg #3	Stakeholders briefed on hazard mitigation strategy & Stakeholder Survey #2 results reviewed and feedback/comments solicited
August 25, 2021 - September 2, 2021	District review of Draft Hazard Mitigation Plan	District reviewed the draft plan and provided comments
August 26, 2021	Phase D Planning Team Mtg #4 - Draft Plan Review	District personnel briefed on Plan and District review comments discussed
September 2, 2021	Phase D Final Stakeholders Briefing	Mitigation Plan briefing
September 7, 2021 - September 8, 2021	State of Utah review of Mitigation Plan	State of Utah reviewed the Plan and provided comments
September 8, 2021 - October 20, 2021	FEMA review of Mitigation Plan	FEMA reviewed the Plan and provided comments
October 22, 2021	Update JVWCD Plan to FEMA	District updated & resubmitted Plan to FEMA addressing comments received
October 22, 2021	FEMA review of Updated Plan	FEMA reviewed the updated Plan and provided conditional approval
November 10, 2021	JVWCD Board Mtg	JVWCD Board passed a resolution to adopt the JVWCD Hazard Mitigation Plan.
November 15, 2021	Signed Resolution to FEMA	Submitted signed Plan Adoption Resolution to FEMA.
November 17, 2021	FEMA approval	FEMA issued final approval of the Plan
December 13, 2021	Final Hazard Mitigation Plan	Final Plan submitted to the District with JVWCD Board adoption and FEMA approval

1.4 Plan Adoption

FEMA provided conditional approval of the JVWCD Hazard Mitigation Plan on October 22, 2021, pending adoption of the Plan by the local governing body for JVWCD (the JVWCD Board). The JVWCD Board passed a resolution adopting the Plan during a board meeting held on November 10, 2021, which was submitted to FEMA on November 15, 2021. FEMA then issued an approval letter for the JVWCD HMP on November 17, 2021. A copy of the signed JVWCD Board resolution and FEMA approval letter are provided in Addendum #1.



Section 2

Hazard Identification

In 2004, the District developed their original JWCD Hazard Mitigation Strategy (Plan), which included an assessment of what it considered at that time as its prevailing natural hazards – earthquake, landslide and flood. There was also a brief assessment of a few other potential hazards – power outages due to natural hazards, and wildfire included in the 2004 Hazard Mitigation Strategy. This new Plan now addresses all the known, applicable natural hazards that pose a potential risk to the JWCD water system.

2.1 Natural Hazards

The natural hazards that present potential risk to the JWCD system were identified from the comprehensive list included in the Federal Emergency Management Agency (FEMA) Local Mitigation Planning Handbook dated March 2013. This FEMA guidance document lists the potential natural hazards as: avalanche, dam failure, drought, earthquake, erosion, expansive soils, extreme cold, extreme heat, flood, hail, hurricane, landslide, lightning, sea level rise, severe wind, severe winter weather, storm surge, subsidence, tornado, tsunami, and wildfire. Of this all-inclusive list, the natural hazards to which the JWCD system is susceptible, based on climate and location, are:

avalanche	flood N(F)	severe wind
dam failure	landslide N(LS)	severe winter weather
debris flow	lightning N(L)	subsidence
drought N(D)	problem soils	tornado
earthquake N(E) & N(E-WF)	rockfall	wildfire N(W)

Note: The District added a few specific natural hazards that were not listed in FEMA's guidance document specifically but have been known to exist for their critical assets: Problem soils (collapsible soils, expansive soils, erosion, and undocumented fill), and debris flow. The landslide hazard also included rockfall.

The nomenclature used for each of the above natural hazards (i.e., N(D), N(E), N(F), etc.) will be used in presenting the Section 3 Risk Assessment and Section 4 Mitigation Strategy information, where the N stands for Natural Hazard and the letter in parenthesis stands for the specific hazard type. The second code used for the earthquake hazard of N(E-WF) is used to define the earthquake hazard along the Wasatch Front part of the JWCD assets (applied to all 20 key assets) which has a higher likelihood than the N(E) hazard based on a regional study performed on the Wasatch Front faults in 2016. It is also important to note that only the six hazards (drought, earthquake, flood, landslide, lightning and wildfire) are shown in the table above with the naming convention (e.g., N(D)) following them; because they were the only hazards advanced forward through the risk screening process and are part of the asset-hazard pairs that received the full risk assessment. For additional details on the Risk Assessment process, see Section 3.0. The following is a description of each of the potential natural hazards that the JWCD assets are susceptible to.

2.1.1 Avalanche

Avalanches are typically rapid down-slope movement of snow, ice, and debris. They are the result of snow accumulation on a steep slope and can be triggered by ground shaking, sound, wind, animal or a person. The two main factors affecting avalanche activity include weather and terrain – large



frequent storms combined with steep slopes result in avalanche danger. Slope angles between 30 to 45 degrees are optimum for avalanches. Additional factors contributing to slope stability are amount of snow, rate of accumulation, moisture content, snow crystal types, and the wind speed and direction. In Utah, the months of January through April have the highest avalanche risk.

2.1.2 Dam Failure

Dams are structures that store water and diverge and impound water upstream. Most dams have a spillway where the flow of water from the reservoir is controlled. Dam failures result from the breach or overtopping of a manmade water impoundment structure, which often results in catastrophic down grade flooding. Dams owned by JVWCD are all off stream structures and will never likely be overtopped. Failure of these structures would likely be associated with cracking of the embankment through either settlement or ground shaking associated with an earthquake. The severity of a dam or levee failure depends on the area protected by the dam or levee, the volume and velocity of water that breaches the structure, and the structures and population in the protected area. A dam or levee breach will result in flooding of normally protected areas, resulting in impacts similar to those seen in areas that are within the floodplain and not normally protected by a levee. Dams are classified using a National Dam Safety Program hazard classification of the following three Hazard Categories: 1) High, 2) Significant, and 3) Low (see Table below).

Table: CORPS of Engineers Hazard Potential Classification

Hazard Category (a)	Direct Loss of Life (b)	Lifeline Losses (c)	Property Losses (d)	Environmental Losses (e)
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

- a. Categories are assigned to overall projects, not individual structures at a project.
- b. Loss of life potential based on inundation mapping of area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.
- c. Indirect threats to life caused by the interruption of lifeline services due to project failure or operational disruption; for example, loss of critical medical facilities or access to them.
- d. Damage to project facilities and downstream property and indirect impact due to loss of project services, such as impact due to loss of a dam and navigation pool, or impact due to loss of water or power supply.
- e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

Source: U.S. Army Corps of Engineers, 1995

For additional details on the dam failure hazard see pages 66 - 75 of the 2019 Salt Lake County Multi-jurisdictional HMP.



2.1.3 Debris Flow

Debris flows are water-laden masses of soil and fragmented rock often called mudslides, mudflows, or debris avalanches and usually associated with flooding types of rainfall events or rapidly melting snowmelt. The debris within a debris flow is typically comprised of soil, rock fragments, and organic material such as trees and other vegetation that are picked up by scouring of rapidly moving water as the flow moves down a confining channel. Debris flow deposits are categorized based on the water to sediment ratio and viscosity of the debris flow. Debris flows may also be generated when a landslide deposit becomes rapidly saturated with water and flows into a channel.

Intense rainfall and rapid snowmelt are generally events that may trigger debris flow movement. Debris flows and floods also occur when heavy rains on recently burned slopes results in higher-than-normal runoff and in turn channel scour. Repeated debris flows and/or flood events deposit sediment at the mouth of canyons, forming an alluvial fan. Flows may travel farther down the fan from the mouth of the canyon if the channel becomes entrenched and the flow is confined.

Debris flows can be viscous and can transport extremely large boulders (greater than 6-foot diameter); debris flows may eventually become muddy flood waters as they deposit their debris. Debris flows tend to move in pulses. Early pulses or previous debris flows can form levees that channel the flow until the levees are breached. The presence of older levees indicates the recurrence and characteristics of debris flows in a particular canyon.

2.1.4 Drought

Drought is a normal recurrent but temporary feature of climate, which results from prolonged periods of below normal precipitation. The severity and frequency of droughts is expected to increase from adverse climate change impacts. Droughts affect the availability of water for M&I, agricultural, recreational, and environmental uses alike. Drought accompanied by higher temperatures also increase the occurrence of algal blooms that have the potential to produce harmful cyanotoxins that render secondary sources unusable. Droughts also heighten the risk of wildfire. The United States Drought Monitor has a map that identifies areas of drought and labels them by intensity. D1 is the least intense level and D4 the most intense. Drought is defined as a moisture deficit bad enough to have social, environmental or economic effects. D0 areas are not in a drought but are experiencing abnormally dry conditions that could turn into drought or are recovering from drought but are not yet back to normal. The five stages of drought from low to high include: D0 Abnormally Dry, D1 Moderate Drought, D2 Severe Drought, D3 Extreme Drought, and D4 Exceptional Drought.

The Palmer Drought Severity Index (PDSI), which has become the "semi-official" drought index as it is standardized across various climates. The index uses zero as normal and assigns a number between 6 and -6, with dry periods having negative numbers and wet periods expressed using positive numbers (NDMC 2006) For additional details on the drought hazard see pages 75-83 of the 2019 Salt Lake County Multi-jurisdictional HMP.

2.1.5 Earthquake

An earthquake is the abrupt shaking of the earth caused by the sudden breaking of rocks when they can no longer withstand the stresses that build up deep beneath the earth's surface. The rocks tend to rupture along weak zones referred to as faults. This sudden release of seismic energy can cause ground shaking, surface fault rupture, and liquefaction.

Ground shaking causes the most impacts during an earthquake because it affects large areas and is the origin of many secondary effects associated with earthquakes. Ground shaking, which generally lasts 10 to 30 seconds in large earthquakes, is caused by the passage of seismic waves generated



by earthquakes. Earthquake waves vary in both frequency and amplitude. High frequency low amplitude waves can cause more damage to short stiff structures, whereas low frequency high amplitude waves have a greater effect on tall (high-rise) structures. Ground shaking is measured using Peak Ground Acceleration (PGA). Local geologic conditions such as depth of sediment and sediment make up affect earthquake waves. Deep valley sediments increase the frequency of seismic waves relative to bedrock.

During a large earthquake fault movement may propagate along a fault plane to the surface, resulting in surface rupture along the fault. Anything built on top of or crossing a fault has a high potential of major damage of fault rupture displacement. Examples of damage include cracked foundations, building structures torn apart, broken up roads, and breaks or ruptures in utility lines, pipelines, or any other utilities. Surface fault rupture does not occur on a single distinct plane; instead, it occurs over a zone often several hundred feet wide known as the zone of deformation.

Soil liquefaction occurs when water-saturated cohesion-less sandy soils are subject to ground shaking. When liquefaction occurs, soils behave more like a viscous liquid (quicksand) and lose their bearing capacity and shear strength. For soils to liquefy, they must be sandy, loose, water-saturated soils typically between 0 and 30 feet below the ground surface and the ground shaking must be strong enough to cause soil to liquefy. The loss of shear strength and bearing capacity due to liquefaction causes buildings to settle or tip and light buoyant structures such as buried storage tanks and empty swimming pools to float upward. Liquefaction can also cause damage through lateral spreading, which is soil displacement of three or more feet accompanied by ground cracking and vertical displacement. Lateral spreading can cause roads, buildings, buried utilities, and other structures to be pulled apart.

2.1.6 Flood

Flooding is a temporary overflow of water onto lands not normally inundated by water. Often, mud/sediment/debris flows happen concurrently with flooding, causing damages sometimes more severe than what flooding alone may have caused. Factors that determine the severity of floods include rainfall intensity, duration of a storm, and rapid snowmelt. A large amount of rainfall over a short time span can result in flash flood conditions. Small amounts of rain can also result in flooding at locations where the soil has been previously saturated or if rain concentrates in an area having impermeable surfaces such as large parking lots, paved roadways, or post-burned areas. Topography and ground cover are also contributing factors for floods. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover. Frequency of flood inundation depends on the climate, soil, and channel slope. Conditions which may exacerbate floods include steeply sloped watersheds, constrictions, obstructions, debris contamination, soil saturation and velocity.

2.1.7 Landslide

Landslides are the downslope movement of rock, debris, or soil. Landslides occur because of either an increase in the driving forces (weight of slope and slope gradient) or a decrease in the resisting forces (friction, or the strength of the material making up a slope). Geology, topography, water content, vegetative cover, and slope aspect are key factors of slope stability.

2.1.8 Lightning

Lightning is a giant spark of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. During the development of a thunderstorm, rapidly rising air combined with movement of precipitation within a cloud causes electrical charges to build. As negative charges build up near the base of the cloud, the ground



beneath the cloud and the area surrounding the cloud become positively charged. When the potential between the positive and negative charges becomes too great, there is a discharge of electricity that we know as lightning.

2.1.9 Problem Soils

Problem soils include collapsible, expansive and undocumented fill soils. Collapsible soils are low density and typically dry soils that decrease in volume when exposed to water. This type of problem soils typically occur in alluvial fan deposits, dry loess or eolian deposits or unconsolidated colluvium deposits. Undocumented fill soils underlying facilities could have the potential for settlement which could result in differential settlement below these facilities. Expansive soils are often associated with high plasticity clays and shale bedrock.

2.1.10 Rockfall

Rockfalls are the fastest moving type of mass movement hazard and predominantly occur in mountains where a rock source exists along and above steep slopes and cliffs that slope greater than 35 degrees. Rockfalls are a result of a loss of support from beneath the rock mass that can be caused by freeze/thaw action, rainfall, weathering and erosion, and/or strong ground shaking resulting from seismic activity. Rockfalls result in the collection of rock fall material, referred to as talus, either on or at the base of the slope. The presence of talus indicates that a rockfall has occurred and the hazard is present at the site.

2.1.11 Severe Wind

Severe wind is most likely the result of a downburst, which is a severe localized wind blasting from a thunderstorm. Downbursts fall into two categories by size – micro-bursts and macro-bursts. Micro-bursts cover an area less than 2.5 miles in diameter. Macro-bursts cover an area with a diameter larger than 2.5 miles.

2.1.12 Severe Winter Weather

Severe winter weather comes in the form of snow and cold temperatures. A severe winter snowstorm deposits at least four inches of snow during a 12-hour period or six inches of snow during a 24-hour period and has winds in excess of 35 mph and temperatures at or below 20° F. A blizzard is a snowstorm with sustained winds of 40 mph or more or gusting winds of at least 50 mph with heavy falling or blowing snow persisting for one hour or more at temperatures of 10° F or colder.

2.1.13 Subsidence

Subsidence is the settling or collapse of the ground. Causes of subsidence include limestone and karst terrain, gypsiferous soil, piping, peat, and mine collapse.

- Karst terrain is characterized by closed depressions, caverns, and streams that abruptly disappear underground. Limestone is susceptible to dissolution by ground water and surface water thus forming karst terrain, which can result in a collapse of the ground surface.
- Gypsiferous deposits, when wetted, are subject to settlement, causing sinkholes similar to those found in karst terrains.
- Piping is a type of subsurface erosion caused by the movement of ground water that removes fine-grained particles creating subsurface voids or channels. These channels increase in size as more and more water is collected until the walls and roof can no longer support the weight above and collapse occurs.



- Peat consists of partially decomposed plant remains that usually accumulate in areas of shallow ground water and near standing water. When water is removed, peat can subside, compress, and settle under pressure.
- Mining removes rock and leaves underground voids that, if not supported, can collapse and cause ground subsidence and sinkholes.

2.1.14 Tornado

A tornado is a violently rotating column of air extending from a thunderstorm to the ground. Tornadoes have high wind speeds and cover large areas. Tornadoes are classified by wind damage using the Fujita Scale, which ranges from F0 at the low end (40-72 mph winds) to F5 at the high end (261-318 mph winds). The damage associated with a tornado can comparatively range from light or minor (tree limbs broken) to devastating damage that destroys structures and carries away large objects.

2.1.15 Wildfire

A wildfire is an uncontrolled fire spreading through vegetative fuel. Wildfires are placed into two classifications – wildland and urban-wildland interface fires. Wildland fires are those occurring in an area where development is essentially nonexistent, except for roads, railroads, or power lines. An urban-wildland interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels. Major ignition sources for wildfires are lightning and human causes such as arson, recreational activities, burning debris, and carelessness with fireworks. Vegetation, topography, and weather are all conditions having an effect on wildfire behavior. The Fire Effects Index (FEI) is the measure used to determine the expected effects if a fire occurs and is based on a rating of suppression difficulty and values impacted, which identifies areas that have important values at risk to wildland fire and/or are costly to suppress. The FEI has two sets of ratings 1) Values Impacted Rating (i.e., Wildland development areas, Drinking water importance areas, Infrastructure assets, Forest assets & Riparian assets) and 2) Suppression Difficulty Rating (i.e., fuel type and topography) The Fire Threat Index (FTI) is a mathematical calculation to estimate the probability of an acre igniting and the expected final fire size. Finally, the Fire Risk Index (FRI) is determined by combining the FEI with the FTI resulting in the overall risk of wildfire. For additional details on the wildfire hazard see pages 160 - 170 of the 2019 Salt Lake County Multi-jurisdictional HMP.

2.2 Previous Hazard Occurrences

Previous natural hazard events affecting the JVWCD service area are discussed below. Information about past occurrences was obtained from interviews with District personnel and also from the 2019 Salt Lake County HMP Annex for the following Cities that are also member agencies within the JVWCD service area and/or receive water from JVWCD: Bluffdale, Draper, Herriman, Midvale, Riverton, Salt Lake City, South Jordan South Salt Lake, Taylorsville, West Jordan.

The District's and its member agencies experience with natural hazards includes incidents related to drought, flood, lightning, landslide, severe wind, severe winter weather, and wildfire. The previous specific hazard occurrences identified by District personnel and those from the 2019 Salt Lake County HMP Annex are summarized in Table 2.1.

Note, while the District has experienced some past flooding occurrences at some of its assets located in or crossing waterways, there are no repetitive loss structures owned and/or operated by the District.



Table 2.1 Previous Hazard Occurrences in the JVWCD Service Area		
Hazard	Approx. Year	Occurrence Description
Debris Flow	7/21/2009	Debris Flow in Draper
	8/19/2010	Flood and Debris Flow in Draper
Drought	2012 to 2016	Utah Lake fell to levels causing the Utah State Engineer to prohibit diversions of more than 100,000-acre feet of secondary storage rights (junior water right holders) in Utah Lake. This forced early canal closures. The low water levels also intensified a wide-spread algal bloom in Utah Lake prompting public health advisories
Earthquake	2/20/1981	Earthquake magnitude of 4.7 and epicenter in South Jordan
	12/17/1981	Earthquake magnitude 2.2 and epicenter in South Jordan
	5/24/2001	Earthquake magnitude of 2.9 and epicenter in South Jordan
	2/8/2006	An earthquake with a magnitude of 2.1 and epicenter in South Jordan. Ground shaking felt over parts of the Salt Lake Valley
	5/28/2007	An earthquake with a magnitude of 2.3 and epicenter in South Jordan. Ground shaking felt over parts of the Salt Lake Valley
Flood	1983	Rapid melt of an above average snowpack in April caused flooding and super saturated the ground causing a mudflow that breached a Kennecott Copper Mines retention basin flooding contaminated water over several acres that percolated into the aquifer. The result was a contaminated groundwater plume that started migrating toward JVWCD and other community potable water supply wells. The SWGWTP and BCaWTP were constructed to remediate the groundwater plume and produce potable water
	9/6/2002	Flash Flood: A canal above Bluffdale overflowed, sending a wall of water and mud into a subdivision, flooding at least 10 homes. \$200,000 property damage
	9/6/2002	Flash Flood in Riverton: Heavy thunderstorm downpours produced localized flash flooding and caused \$200,000 in Salt Lake County
	8/3/2007	Flash Flood: Rainfall of 1.1 inches in 30 minutes inundated storm drains and resulted in numerous reports of basement flooding. \$45,000 property damage
	6/5/2010	Flash Flood in Midvale: Damage was reported in homes, apartments and businesses. \$1,500,000 property damage
	7/26/2011	Flash Flood: In Taylorsville, at least a half dozen homes had flooded basements near the intersection of 5400 South and 3200 West. Water caused a sinkhole to form in the roadway around 6200 South and 2700 West, buckling and collapsing the street. \$350,000 in property damage
	7/9/2013	Flash Flood in Midvale: Heavy rain over the Salt Lake Valley flooded six residential properties in Midvale and Sandy. \$15,000 property damage
	9/14/2013	Thunderstorms & Flooding: In Herriman, floodwaters entered an apartment complex, impacting about 18 apartment units. \$100,000 damages
	9/14/2013	In South Jordan, 11 homes in the Sunstone subdivision experienced basement flooding, with water several inches deep. \$100,000 in property damage
Lightning	1993 - 95	Offloading chemical when a near strike took out SCADA at the SERWTP
	7/26/2017	Lightning Strike & Flash Flood in Taylorsville: 2 injured, and \$8,750,000 in property damage
	7/26/2017	Lightning 2 injured
Landslide	Aug 1991	900 to 1,000 NTU Flowed into the JWTP Flocc & Sed Basins due to severe rainstorm impacting the Murdock Canal
	4/10/2013	Slope failure: A significant landslide triggered by mining activities occurred just west of South Jordan at the Kennecott Copper Mine
Severe Wind	8/21/2001	Riverton reported a gust to 70 mph (61 kts)
	3/26/2012	63 mph at Bluffdale. \$20,000 property damage
	6/12/2013	Thunderstorm/Wind in South Jordan: Multiple large trees were knocked down, including a few that fell on houses and caused damage to roofs. \$50,000 in property damage



Table 2.1 Previous Hazard Occurrences in the JVWCD Service Area		
	2/17/2016	In Salt Lake City, scaffolding collapsed on an assisted living center being built; no one was injured, but debris from the incident covered the road and forced the closure of the northbound lanes of Foothill Drive and Parleys Way during the morning. \$200,000 property damage
	3/5/2017	68 mph at Draper. 100,000 property damage
	6/12/2017	High Wind in South Salt Lake: widespread power outages. \$40,000 in damage
	10/20/2017	High winds knocked down power lines in Midvale, with over 2,000 customers losing power. 5,000 property damage
	7/30/2018	Thunderstorm Wind in South Salt Lake: Thunderstorm winds caused a 20' tree to fall on a 2 story home in South Salt Lake. \$10,000 in property damage
Severe Winter Weather	12/19/1998	Winter Storm in South Jordan: Power outages were also noted in portions of South Jordan
	11/21/1999	Heavy Snow: 10 inches at Riverton
	8/8/2008	Draper City - Corner Canyon Fire. 680 acres burned but no homes impacted
	11/28/2010	Winter Storm in West Jordan: 14 inches of snow
	3/22/2013	Lake-Effect Snow in West Jordan: 8 inches of snow
	12/19/2013	Winter Storm in Herriman: 10 inches of snow. \$40,000 in property damage
	1/10/2017	Winter Storm in South Salt Lake: 14 inches of snow. \$1,000 in property damage
	2/3/2019	Heavy Snow in Taylorsville with 18 inches
	2/3/2019	Heavy Snow in West Jordan: 22 inches of snow
	2/3/2019	Heavy Snow: 22 inches of snow in West Jordan
	3/1/2019	Heavy Snow in South Jordan: Widespread heavy snowfall due to a lake effect snow band
Wildfire	9/19/2010	Machine Gun Fire in Herriman. Wildland Urban Interface Fire
	2012	Pinyon Fire in Herriman. Wildland Urban Interface Fire
	4/15/2015	Wildfire in Salt Lake City: \$50,000 property damage
	2018	Herriman - High Country Estates Fire. Wildland Urban Interface Fire
	2018	Herriman - Rose crest Fire. Also, had the 611 acres Rosecrest Fire in June 2012, lost multiple homes in the unincorporated county but all these fires were a direct threat to Herriman residents and infrastructure

2.3 Hazard Significance

Each of these potential natural hazards were evaluated to determine the overall risk they individually pose to the JVWCD system. This evaluation used Worksheet 5.1 from FEMA 's Local Mitigation Planning Handbook (2013) as its basis and took into account the geographic extent of the hazard within the JVWCD planning area, the probable magnitude of the hazard, and the likelihood of a hazard event.

The **Geographic Area Affected** was estimated for each hazard using the following metrics:

- Negligible: affects less than 10% of planning area or isolated single-point occurrence
- Limited: affects 10-25% of planning area or limited single-point occurrences
- Significant: affects 25-75% of planning area or frequent single-point occurrences
- Extensive: affects 75-100% of planning area or consistent single-point occurrences



The **Probable Strength/Magnitude** of each hazard event was estimated based on the following metrics:

- Weak: Limited classification on the scientific scale, low speed of onset or short duration of event, resulting in little to no damage
- Moderate: Moderate classification on the scientific scale, moderate speed of onset or moderate duration of event, resulting in some damage and loss of service for days
- Severe: Severe classification on the scientific scale, fast speed of onset or long duration of event, resulting in devastating damage and loss of services for weeks or months
- Extreme: Extreme classification on the scientific scale, immediate onset or extended duration of event, resulting in catastrophic damage and uninhabitable conditions

To estimate the **Probability of a Future Event** for each hazard, the following metrics were used:

- Unlikely: less than 1% probability of occurrence in the next year or a recurrence interval of greater than 100 years
- Occasional: 1 to 10% probability of occurrence in the next year or a recurrence interval of 11 to 100 years
- Likely: 10 to 90% probability of occurrence in the next year or a recurrence interval of 1 to 10 years
- Highly Likely: 90 to 100% probability of occurrence in the next year or a recurrence interval of less than 1 year

The summary results of this overall hazard significance rating are presented in Table 2.2. **The Overall Significance Rating** of each hazard to the JWCD water system was determined by qualitatively combining the three rating criteria as follows:

Low: Two or more criteria fall in lower classifications, or the event has a minimal impact on the planning area. This rating is sometimes used for hazards with a minimal or unknown record of occurrences or for hazards with minimal mitigation potential.

Medium: The criteria fall mostly in the middle ranges of classifications and the event's impacts on the planning area are noticeable but not devastating. This rating is sometimes used for hazards with a high extent rating but very low probability rating.

High: The criteria consistently fall in the high classifications and the event is likely/highly likely to occur with severe strength over a significant to extensive portion of the planning area.



Table 2.2 Hazard Significance Summary				
Hazard	Rating Criteria			Overall Significance Rating
	Geographic Area Affected	Probable Strength/Magnitude	Probability of a Future Event	
Avalanche	Negligible	Moderate	Unlikely	Low
Dam Failure	Negligible	Severe	Unlikely	Low
Debris Flow	Negligible	Moderate	Occasional	Medium
Drought	Extensive	Moderate	Likely	Medium
Earthquake - <i>Ground Shaking (2PE50 & 10PE50)</i>	Extensive	Severe	Occasional	Medium
Earthquake - <i>Liquefaction</i>	Significant	Severe	Occasional	Medium
Earthquake - <i>Surface Fault Rupture/Fault Crossings</i>	Limited	Severe	Occasional	Medium
Flood	Limited	Moderate	Occasional	Medium
Hail	Limited	Weak	Occasional	Low
Landslide <i>including Rockfall</i>	Limited	Moderate	Occasional	Medium
Lightning	Significant	Weak	Likely	Medium
Problem Soils (<i>including collapsible soils, expansive soils, erosion, & undocumented fills</i>)	Limited	Moderate	Occasional	Medium
Severe Wind	Significant	Weak	Highly likely	Medium
Severe Winter Weather	Extensive	Moderate	Highly likely	Medium
Subsidence	Negligible	Moderate	Unlikely	Low
Tornado	Limited	Weak	Occasional	Low
Wildfire	Limited	Moderate	Likely	Medium

As can be seen in Table 2.2, all the potential hazards were determined to pose medium risk to the JVWCD system except for avalanche, dam failure, hail, subsidence, and tornado, which have low significance ratings. Therefore, these five hazards rated with low significance were not evaluated further; however, the other 12 natural hazards were evaluated for risk on an asset-by-asset basis. To facilitate the asset-based hazard evaluation assessment of the JVWCD system, the 20 key assets were prioritized based on their criticality to the function of the water system, rated based on their vulnerability to each of the 12 hazards, and classified to establish those assets which would be explicitly evaluated against each hazard (asset-hazard pairs). This Asset Prioritization process is described in Section 2.4 below. This process combined with the Section 2.5 Hazard Rating resulted in the determination of which assets and hazards would be combined into asset-hazard pairs for assessment during the Phase B Risk Assessments (see Section 3.1 and Table 3.1).

2.4 Asset Criticality Ranking

In April 2021, a workshop to determine the criticality ranking of JVWCD's 20 key assets was held using an online Zoom meeting. Attendees included key JVWCD managers and engineers, as well as key ECG Team personnel. The major objective of the workshop was to determine the criticality ranking for the top 20 JVWCD key assets shown in Table 2.3 in the order they were assessed but not by their criticality ranking which is shown in Section 2.4.2 Table 2.5.



Table 2.3 JVWCD Key Critical Assets			
Asset #	Asset Name	Asset #	Asset Name
1	South East Regional Water Treatment Plant (SERWTP)	11	Jordan Narrows Pump Station
2	Jordan Valley Water Treatment Plant (JVWTP)	12	118th South Zone C Pump Station
3	Moniter Drive Well	13	Pump Station serving Zone B North (3200 W. 6200 S.)
4	Newbury Well	14	Pump Station along 102nd South Zone D: Old Bingham PS at 6920 W
5	1443 E. 9400 S. Well	15	Jordan Aqueduct (Reaches 1 - 4)
6	JVWTP 8 MG Reservoir	16	Central Pipeline
7	JVWTP 1 MG Reservoir	17	150th South Pipeline
8	Old Bingham 3 MG Tank	18	24" Cross Valley Pipeline
9	Zone B North Reservoirs 1 MG steel, 2 MG buried concrete, 6 MG buried concrete	19	Creek Road Pipeline (24" to 33")
10	Terminal Reservoir 100 MG	20	114th South Pipeline

2.4.1 Pair Wise Comparison

A pair wise comparison method was used to perform the facility ranking. First, the JVWCD mission and values (see Introduction) were used to determine facility comparison criteria, as follow:

- Reliability: Consistently delivering water services to customers with priority for indoor demands and maintaining minimum water pressure.
- Quality: Meeting all Federal, State and internal water quality standards for drinking water.
- Safety: Employee safety, public safety, injury/illness/deaths associated with critical assets. This does not include water quality safety issues. Does not include property damage liability in Value criteria.
- Value: Financial Accountability in terms of efficient & cost-effective management of assets (i.e., costs, property, value, employees, customers, etc.).

Pair-Wise comparison of the criteria against one another resulted in criteria weighting factors shown in Table 2.4 and the complete Asset Pair-Wise matrix spreadsheets are provided in Appendix C.

Table 2.4 Criteria Weighting Factors	
Criteria	Weighting Factor
Reliability	13
Safety	11
Quality	8
Value	4

2.4.2 Asset Criticality Tier Ranking Results

Second, the 20 JVWCD assets were compared against each other using the pair-wise comparison approach based on input from the various JVWCD representatives in attendance at the Workshop. This comparison resulted in a total weighted sum (overall asset score) based on the scores for each of the four ranking criteria. The individual asset total scores were then normalized (divided) by the total maximum score possible from the pair-wise comparison. The individual assets were then



grouped into four tiers of five assets per tier based on their overall asset priority score. The assets with the highest scores were grouped into Criticality Tier 1, followed by the second highest scoring individual assets grouped into Tier 2, and so forth. The results of the asset ranking, including overall asset score, priority rank, and tier grouping for each of assets, are shown in Table 2.5. The complete set of Asset Pair-Wise matrix spreadsheets are provided in Appendix C.

Table 2.5 Asset Criticality Ranking		
Asset	Overall Asset Score	Rank
Tier 1 Assets		
JVWTP (180 MGD)	3202	1
Jordan Aqueduct Reaches (1-4)	2516	2
SERWTP (25 MGD)	2477	3
JVWTP 1 MG Reservoir	2387	4
Terminal Reservoir (100 MG)	2126	5
Tier 2 Assets		
Central Pipeline	2115	6
150 th South Pipeline	2115	7
24" Cross Valley Pipeline	2076	8
Creek Road Pipeline (24" to 33")	2076	9
114 th South Pipeline	2076	10
Tier 3 Assets		
118 th South Zone C Pump Station	1976	11
Pump Station serving Zone B North (3200 W. 6200 S.)	1976	12
Pump Station along 102nd South Zone D: Old Bingham PS at 6920 W	1820	13
Zone B North Reservoirs	1792	14
1443 E. 9400 S. Well	1781	15
Tier 4 Assets		
Moniter Drive Well	1768	16
Newbury Well	1768	17
Old Bingham 3 MG Tank	1747	18
JVWTP 8 MG Reservoir	1704	19
Jordan Narrows Pump Station	1542	20

2.5 Hazard Rating

In order to prioritize the natural hazard risks, each JVWCD key asset was rated based on its potential risk for each type of natural hazard.

A hazard evaluation for each of the medium-risk and high-risk hazards identified in Section 2.3 was performed on the 20 key assets. The Assets were scored by the project team based on the following scoring definitions:

- High (H): asset completely disabled; utility's mission fully or nearly defeated; deaths, injuries, or other high costs.



- Medium (M): asset partially disabled; utility's mission moderately impacted; moderate amount of other costs.
- Low (L): asset not or only slightly disabled; utility's mission only slightly impacted; low amount of other costs.
- Not Applicable (N/A): given threat cannot be carried out, or otherwise does not apply.

Each applicable hazard was assessed based on that hazard’s impact to the Asset. There were 20 Assets that were assessed for 12 natural Hazards resulting in a total of 240 asset-hazard pairs. The results of the ECG Team’s preliminary hazard assessment scoring found the following number of asset-hazard pairs for the 20 Assets for each of the four scoring criteria of H, M, L, and not applicable (N/A); results are summarized in Table 2-6.

Table 2.6 Preliminary Hazard Assessment - Scoring					
Natural Hazard	High(H)	Medium (M)	Low(L)	N/A	Total # of Assets by Hazard
Debris Flow	1	1	3	15	20
Drought	3	4	0	13	20
Earthquake - Ground Shaking (2PE50 & 10PE50)	19	1	0	0	20
Earthquake - Liquefaction	8	0	0	12	20
Earthquake - Surface Fault Rupture/Fault Crossings	2	0	0	18	20
Flood	1	1	18	0	20
Landslide including Rockfall	2	0	1	17	20
Lightning	6	4	4	6	20
Problem Soils (including collapsible soils, expansive soils, erosion, & undocumented fills)	0	0	20	0	20
Severe Wind	0	4	10	6	20
Severe Winter Weather	0	0	20	0	20
Wildfire	3	0	12	5	20
Total # of Assets by Scoring Criteria	45	15	88	92	240

This preliminary hazard assessment which found 45 High (H) consequence asset-hazard pairs as shown in the second column of Table 2.6 was reviewed with the District’s Planning Team at the Phase B Planning Risk Screening Workshop to screen and select up to 40 asset-hazard pairs for risk assessment. This is covered in greater detail in Section 3.1 Risk Screening under the next Section 3.0, Risk Assessment.



Section 3

Risk Assessment

This section covers risk screening, risk analysis, and risk assessment results for the Hazards and Assets defined in Sections 2.1 and 2.4, respectively.

A hazard evaluation of each of the JWCD selected 40 asset-hazard pairs from the Risk screening conducted during the Phase B Planning Team Meeting #2 for the 20 critical assets was performed. The results of the assessments of the 40 asset-hazard pairs are discussed below by hazard type.

3.1 Risk Screening

The Phase B Risk Assessment began with a risk screening workshop conducted during the Phase B Planning Team Meeting #2 to review with the District's Planning Team the preliminary hazards assessment performed by the ECG Team discussed in Section 2.5 by reviewing the asset-hazard pair screening worksheet (see Appendix D). The purpose of the Workshop was to verify consequence ratings in the asset-hazard pair screening worksheet and thereby screen all of the applicable hazards against the 20 assets. This screening of the asset-hazard pairs was done by scoring each of the 20 assets against each of the 12 hazards using the same scoring criteria presented in Section 2.5, with the addition of the "Not Selected" criterion:

High (H): asset completely disabled; utility's mission fully or nearly defeated; deaths, injuries, or other high costs.

- Not Selected (N/S): asset initial scoring of H, but not selected by Utility for further assessment due to limited resources.
- Medium (M): asset partially disabled; utility's mission moderately impacted; moderate costs.
- Low (L): asset not or only slightly disabled; utility's mission only slightly impacted; low costs.
- Not Applicable (N/A): given threat cannot be carried out, or otherwise does not apply.

Scores were assigned based on the District's qualitative assessment of the level of consequence that would occur assuming the hazard does occur. The hazard likelihood and vulnerability of the asset are not considered during this screening exercise. Those other two risk variables will be applied later after the asset-hazard pairs have been selected by the District during the next step in the risk assessment process covered in Section 3.2 below. The District reviewed and adjusted several of the asset-hazard scores as discussed below with the complete details provided in the Planning Team Meeting #2 – Risk Screening minutes found in Appendix D. In addition, see Appendix G Geohazards Tech Memo for risk screening which specifically addresses the geohazards of earthquake, landslide and debris flow.

For comparison purposes, Table 3-1 shows the Asset-Hazard Screening and Selection Summary from the Risk Screening Workshop, which when compared to Table 2-6 Preliminary Hazard Assessment Scoring shows that the number of H consequence Asset-Hazard pairs was reduced from 45 to 40 pairs, which is the number of pairs that the risk assessment was performed on for the JWCD assets in the next section. There were actually 41 pairs determined to have H consequence scoring for the risk screening, but the District's Planning Team was able to determine 1 H consequence Asset-Hazard pair to not select (N/S) for the Debris Flow hazard shown in Table 3.1.



Table 3.1 Asset-Hazard Screening & Selection Summary						
Natural Hazard	High (H)	N/S	Medium (M)	Low (L)	N/A	Total # of Assets by Hazard
Debris Flow	0	1	2	3	14	20
Drought	2	0	1	3	14	20
Earthquake - Ground Shaking (2PE50 & 10PE50)	18	0	2	0	0	20
Earthquake - Liquefaction	8	0	0	0	12	20
Earthquake - Surface Fault Rupture/Fault Crossings	2	0	0	0	18	20
Flood	1	0	6	2	11	20
Landslide including Rockfall	2	0	1	0	17	20
Lightning	5	0	4	11	0	20
Problem Soils (including collapsible soils, expansive soils, erosion, & undocumented fills)	0	0	0	20	0	20
Severe Wind	0	0	0	14	6	20
Severe Winter Weather	0	0	0	20	0	20
Wildfire	2	0	2	2	14	20
Total # of Assets by Scoring Criteria	40	1	18	75	106	240

The 40 High ranking asset-hazard pairs include 19 of the 20 critical assets and 8 of the hazards that advanced from the hazard significance evaluation.

3.2 Risk Analysis

The risk analysis was performed on the 40 selected asset-hazard pairs from the Risk Screening Workshop at Planning Team Meeting #2.

The ECG Team used a Generic Risk Assessment Tool (GRAT) for the risk analysis that assesses the Risk (R) by considering the likelihood of the hazard (T) also referred to as threat likelihood, vulnerability (V) of each segment to the hazard and the consequence (C) of the hazard to each segment if the hazard were to occur. This can be expressed in the following equation:

$$R = T \cdot V \cdot C$$

where: R=Risk, T=Likelihood of Hazard (Threat), V=Vulnerability, C= Consequence

The variables in the risk equation were determined as described as follows for each of the 40 asset – hazard pairs: The Likelihood of Hazard or Threat was determined for natural hazards using historical records from NOAA, FEMA flood maps, Seismic report for the Wasatch Front faults, power outage records, etc. The vulnerability against natural hazards was assessed by analyzing each asset’s age, material type, condition, etc. against the current IBC codes (i.e., seismic, wind, snow load, etc.). The consequence that would be incurred for each segment if the hazard were to occur was assessed by applying consequence metrics established with the District during the risk assessment planning workshop. A summary of the results for the 19 assets analyzed for the various hazards is presented in Table 3-2 with Asset name, Hazard type, and the relative Risk Rating. There



were five possible relative Risk Ratings of L = Low, ML = Medium Low, M = Medium, MH = Medium High, and H = High.

Table 3.2 Risk Analysis Summary of Results		
Asset	Hazard Type	Relative Risk Rating
1 - SERWTP	N(D), N(E-WF)*, N(L), N(W)	ML, MH, M, ML
2 - JWTP	N(D), N(E-WF)*, N(W)	M, MH, M
3 - Moniter Drive Well	N(E-WF)*	ML
4 - Newbury Well	N(E-WF)*	ML
5 - 1443 E. 9400 S. Well	N(E-WF)*	ML
6 - JWTP 8 MG Reservoir	N(E-WF)*	M
7 - JWTP 1 MG Reservoir	N(E-WF)*	M
8 - Old Bingham 3 MG Tank	N(E-WF)*	M
9 - Zone B North Reservoirs 1 MG steel, 2 MG buried concrete, 6 MG buried concrete	N(E-WF)**	M, ML
11 - Jordan Narrows Pump Station	N(E-WF)**, N(F), N(L)	M, M, L, M
12 - 118th South Zone C Pump Station	N(E-WF)*, N(L)	L, M
13 - Pump Station serving Zone B North (3200 W. 6200 S.)	N(E-WF)*, N(L)	M, M
14 - Pump Station along 102nd South Zone D: Old Bingham PS at 6920 W	N(L)	ML
15 - Jordan Aqueduct (Reaches 1 - 4)	N(E-WF)***, N(LS)	MH, MH, MH, MH
16 - Central Pipeline	N(E-WF)**, N(LS)	ML, ML, M
17 - 150th South Pipeline	N(E-WF)**	ML, M
18 - 24" Cross Valley Pipeline	N(E-WF)***	M, ML, M
19 - Creek Road Pipeline (24" to 33")	N(E-WF)**	ML, M
20 - 114th South Pipeline	N(E-WF)**	ML, M

* Earthquake - N(E-WF) - ground shaking.

**Earthquake - N(E-WF) - ground shaking and liquefaction.

*** Earthquake - N(E-WF) - ground shaking, liquefaction, and fault rupture.

A preliminary review of the relative Risk Ratings received by each asset reveals that the highest relative Risk Rating received by any asset was a MH or Medium High risk. This is below the highest possible rating of H or High but is still a concern for the District that should be addressed to lower the risks of the various hazards with M or in some cases even those with ML ratings. The complete Risk Analysis Table with all risk equation variables and their scores in addition to the overall relative risk shown in Table 3-2 is provided in Appendix E Risk Analysis & GRAT Top 5. In the next Section 3.3, the Risk Assessment results are further analyzed including performing a sensitivity analysis to determine those assets with highest relative risk.



3.3 Risk Assessment Results

Next, a consequence workshop was held with the District Planning Team to review the Risk Assessment results from Section 3.2 Risk Analysis and confirm asset rankings using a sensitivity analysis. This was used to establish the risk tolerance of the District for selecting the cutoff point for addressing the highest risk assets based on scoring of their asset-hazard pairs. The sensitivity analysis was performed by assigning scores of 1 to 5 for each of the five relative risk ratings of L, ML, M, MH, and H for each of the assets that were assessed during the Risk Analysis described in Section 3.2 above. The scores for each asset were normalized on a relative risk scoring scale with a maximum of 5.0 points. No projects with ‘H’-risk were identified that needed to proceed immediately to “In Progress”. The 19 assets assessed scored between 2.0 and 4.0; a score between 4.0 and 5.0 would require immediate attention, so scores between 3.0 and 4.0 are still quite high and should be addressed as soon as practicable depending on District resources.

Scoring for the 19 assets is shown in Table 3-3 where the Top 5 cluster of highest risk assets from the final risk analysis have been identified with yellow highlight as Assets 2, 6, 7, 8, and 15 with scores of 3.3, 3.0, 3.0, 3.0, 3.0, and 4.0, respectively. Figure 3.1 is also presented below to show the relative risk of the 19 Assets analyzed. For additional details on the consequence workshop and risk assessment results see the workshop minutes in Appendix E. In addition, see Appendix G Geohazards Tech Memo for risk results specifically addressing the geohazards of earthquake, landslide and debris flow.

Note that the initial risk assessment effort from the consequence workshop scored the 118th South Zone C Pump Station in the top 3, with a cluster of assets tied with a score of 3.0 for a top 8 rather than a top 5. Further investigation into the 118th S Pump Station’s vulnerabilities to seismic and lighting hazards reduced the relative risk score, dropping it out of the top 5. The planning team ranked the tied assets using a qualitative analysis with feedback from District O&M staff on the difficulty to recover from the loss of a particular asset. The top 5 now reflects the assets with the highest risk scores, and those assets that O&M would have the most difficulty replacing.

Asset	Relative Risk Score
1 - SERWTP	2.8
2 - JWTP	3.3
3 - Monitor Drive Well	2.0
4 - Newbury Well	2.0
5 - 1443 E. 9400 S. Well	2.0
6 - JWTP 8 MG Reservoir	3.0
7 - JWTP 1 MG Reservoir	3.0
8 - Old Bingham 3 MG Tank	3.0
9 - Zone B North Reservoirs 1 MG steel, 2 MG buried concrete, 6 MG buried concrete	2.5
11 - Jordan Narrows Pump Station	2.5
12 - 118th South Zone C Pump Station	2.0
13 - Pump Station serving Zone B North (3200 W. 6200 S.)	3.0
14 - Pump Station along 102nd South Zone D: Old Bingham PS at 6920 W	2.0



Table 3.3 Asset Risk Analysis Summary	
Asset	Relative Risk Score
15 - Jordan Aqueduct (Reaches 1 - 4)	4.0
16 - Central Pipeline	2.3
17 - 150th South Pipeline	2.5
18 - 24" Cross Valley Pipeline	2.7
19 - Creek Road Pipeline (24" to 33")	2.5
20 - 114th South Pipeline	2.5

The complete details of GRAT Top 5 sensitivity analysis discussed above are included in Appendix E. The mitigation strategies and recommendations for addressing the Top 5 highest risk Assets will be presented next in Section 4 Mitigation Strategies.

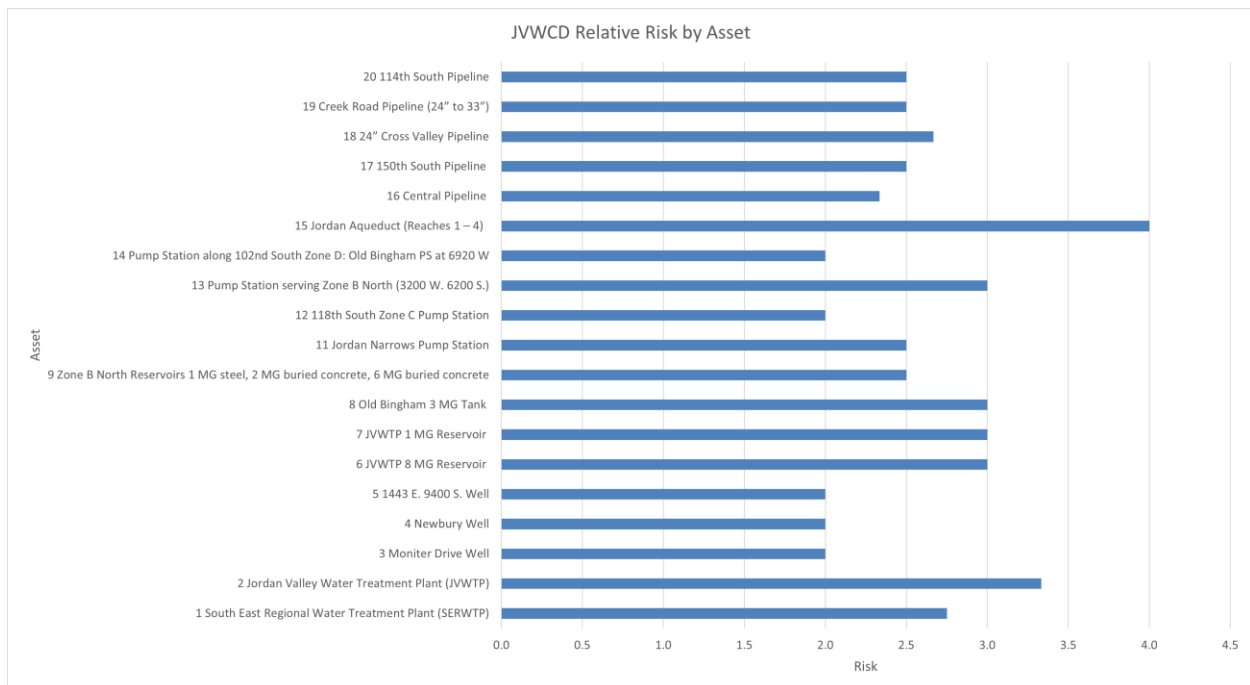


Figure 3.1 Relative Risk by Asset



Section 4

Mitigation Strategy

4.1 District Authorities

JVWCD is the only jurisdiction covered by this Hazard Mitigation Plan. JVWCD's authority falls under the Utah Code Title 17B Limited Purpose Local Government Entities - Local Districts. Title 17B contains Chapter 2a Provisions Applicable to Different Types of Local Districts, which lists the 11 different types of Districts covered by this State Code. JVWCD is recognized as a Water Conservancy District under Part 10 Water Conservancy District Act within Title 17B Chapter 2a.

The above State and District Codes provide JVWCD with the existing authorities and policies to be able to implement the mitigation strategy presented in Section 4 of this Hazard Mitigation Plan. The following are some of the important authorities and policies under Title 17B-1-103 (2) Local district status and powers that JVWCD has for implementing their Mitigation Strategy:

- (d) acquire or construct works, facilities, and improvements necessary or convenient to the full exercise of the district's powers, and operate, control, maintain, and use those works, facilities, and improvements;
- (e) borrow money and incur indebtedness for any lawful district purpose;
- (f) issue bonds, including refunding bonds;
- (g) levy and collect property taxes;
- (h) as provided in Title 78B, Chapter 6, Part 5, Eminent Domain, acquire by eminent domain property necessary to the exercise of the district's powers;
- (i) impose fees or other charges for commodities, services, or facilities provided by the district, to pay some or all of the district's costs of providing the commodities, services, and facilities, including the costs of:
 - (A) maintaining and operating the district;
 - (B) acquiring, purchasing, constructing, improving, or enlarging district facilities;
 - (C) issuing bonds and paying debt service on district bonds; and
 - (D) providing a reserve established by the board of trustees
- (p) construct and maintain works and establish and maintain facilities, including works or facilities:
 - (i) across or along any public street or highway, subject to Subsection (3) and if the district:
 - (A) promptly restores the street or highway, as much as practicable, to its former state of usefulness; and
 - (B) does not use the street or highway in a manner that completely or unnecessarily impairs the usefulness of it;



- (ii) in, upon, or over any vacant public lands that are or become the property of the state, including school and institutional trust lands, as defined in Section 53C-1-103, if the director of the School and Institutional Trust Lands Administration, acting under Sections 53C-1-102 and 53C-1-303, consents; or
- (iii) across any stream of water or watercourse, subject to Section 73-3-29;

The District has been using the above district powers and authorities in implementing some of the mitigation actions from the original JVWCD Hazard Mitigation Strategy, as discussed in the Introduction under the Future Development section. Table 4.1 in Section 4.2, which summarizes the completion status of previous mitigation actions, demonstrates the District's policies, programs, and resources at work to implement mitigation actions. In addition, the District's Mitigation Strategy discussed in Section 4.5, including the mitigation implementation plan provided in Appendix F with its prioritization, funding, and scheduling of mitigation projects, further supports JVWCD's ability and intention to use its authorities, programs, and resources to continue to implement mitigation measures.

4.2 Status of Previous Mitigation Actions

The District's 2004 Hazard Mitigation Strategy identified 19 Mitigation Actions for reducing critical water facilities' risks associated primarily with earthquake, landslide, and flood hazards. The District has implemented (completed or partially completed) several of these mitigation measures and either addressed, eliminated (cancelled), or is in the process of implementing various others. Table 4.1 summarizes the status of each of these previous mitigation actions. Those mitigation actions that are shown as "To Be Scheduled" have been carried forward into this new HMP through the planning process of hazard identification, risk assessment, and mitigation strategies.



Table 4.1 Status of Previous Mitigation Actions (Original 2004 JVWCD Plan)

Orig. Line Number	Mitigation Measure Description	Overall Perceived Risk	Orig. Priority	Orig. Implement. Time Frame	Orig. Estimated Cost (2004 dollars)	Project Status					Comments
						Completed	Addressed	In Progress	To Be Scheduled	Canceled	
1	Seismic upgrades for the Jordan Valley Water Treatment Plant: High-rise, Filter Gallery (Bldg. Structures), Upper Raw Water Pond, Screening Bldg., Flocculation Basins, Sedimentation Basins, Filter Basins, Chemical & Control Bldg., 8 MG Reservoir, Washwater Recycle PS #1	H	H1	2005-2008	\$6,470,000	X			X		Completed the following two seismic upgrade mitigation projects at JVWTP: Seismic Retrofit JVWTP 6 Story Bldg. & Renovation – (2006-2008). \$2.4M of \$8.5M Total Project Cost and \$1.79M FEMA Grant. Seismic Retrofit JVWTP Filter & Chemical Bldgs. – (2009-2010). \$2.2M Project Cost and \$1.64M FEMA Grant. The new 2021 HMP is also assessing the JVWTP for additional seismic upgrade mitigation actions.
2	Seismic upgrades for the Administration Bldgs. A principal concern is life-safety of District employees and use of facilities after an earthquake.	H	H2	2005-2007	\$2,000,000	X					Completed: Seismic Retrofit JVWCD Headquarters – (2009-2010). \$2.7M Project Cost and \$2.04M FEMA Grant
3	Seismic upgrades for the Southeast Regional Water Treatment Plant: Filter Operations Bldg. and Filter Basins	H	H3	TBD	\$550,000	X			X		Partially completed: Phase 1 Construction of \$55,500 was underway in 2004 and completed in FY2004. Other work to be determined (TBD) in next five year HMP update of the new 2021 HMP.
4	Seismic upgrades that includes the installation of flexible couplings or relocation of pipe connections at the following reservoirs: 6200 South 3200 West - 2 MG #1 and 2 MG #2; and 4500 South 4800 West - 1 MG and 2 MG	H	H	TBD	\$76,000				X		Partial alternate mitigation: No seismic mitigation was performed on these reservoirs, with the exception of the installation of automatic shut-off natural gas valves. This type mitigation action is being assessed in 2021 HMP for critical Reservoir assets for the earthquake hazard.
5	Acquire backup sources of power – portable diesel generator sets for pump stations in the following output capacities: 800 kW 4160 Volt (3600 West, 10200 South Pump Station) 600 kW 480 Volt (3145 West, 11400 South and 5700 West, 10200 South Pump Stations) 600 kW 2400 Volt (Terminal Reservoir Pump Station) 500 kW 480 Volt (Draper No. 1 and 1300 East, 10700 South Pump Station)	H	M	TBD	TBD	X			X		Partially completed with the following: Power outage mitigation – Combination of emergency backup power added for new facilities (PSs & WTPs) and 3 Emergency Gen Sets (portable diesel) designed/purchased for use at 4 PSs (included 3600 West, 10200 South Pump Station) & 3 Wells equipped for alternate use, 2 ten-wheeler trucks to transport Gen Sets during emergency, & purchased 3 new truck bed mounted 150-gallon tanks for refueling Gen Sets. The new 2021 HMP will also have a general recommendation for backup power at critical assets under the lightning hazard.
6	Perform structural seismic upgrades for the following reservoirs. There is a concern for localized flooding and damage to property in the vicinity if reservoir contents were released. 2300 East 9800 South- 6 MG 6000 West 4700 South- 6 MG 3600 West 10200 South- 3 MG 5700 West 10200 South- 3 MG	M	M	TBD	800,000		X		X		Addressed for 3 Reservoirs as follows: 6000 West 4700 South 6-MG Reservoir cannot be retrofit, and no mitigation actions have been taken for the 3-MG at 3600 West 10200 South and 3-MG at 5700 West 10200 South. This type mitigation action is being assessed in new 2021 HMP for critical Reservoir assets for the earthquake hazard.
7	A raw water or treated water aqueduct may catastrophically fail. Acquire repair segments to reduce the delay in repairing.	M	H	TBD	Small			X	X		In progress as follows: There are 4 pipe segments at the JVWTP location which can be used along the aqueduct, but the quantity is very limited and the District is planning on acquiring additional pipeline segments and constructing storage location(s) strategically located across the service area. The new 2021 HMP will also have a general recommendation for stockpiling of pipeline materials for critical assets.
8	Install a parallel pipeline (potentially a 33" line) to either the 4500 South or 6600 South crossing of the Jordan River / liquefaction zone with a seismic-resistant pipeline design.	M	M	TBD	Project-dependent				X		This type of mitigation action is being assessed in 2021 HMP for critical assets and also general recommendations for the earthquake hazard.
9	Perform seismic upgrades for well house structures.	M	M	TBD	\$330,000				X		No action taken. This type mitigation action is being assessed in the new 2021 HMP for critical Well assets for earthquake hazard.
10	Booster pump station seismic upgrades – There are no pump stations that would be expected to be non-functional in a 475-yr earthquake (10% in 50 years) for which no redundant flow path exists, with the potential exception of the finished water pumps at Jordan Valley Water Treatment Plant that pumps water from the 8 MG reservoir to Bluffdale City's 6 MG reservoir (mainly rural/agricultural area with limited number of industrial customers).	L-M	M	TBD	\$200,000				X		No action taken. This type mitigation action is being assessed in the new 2021 HMP for critical Pump Station assets for earthquake hazard.



Table 4.1 Status of Previous Mitigation Actions (Original 2004 JVWCD Plan)

Orig. Line Number	Mitigation Measure Description	Overall Perceived Risk	Orig. Priority	Orig. Implement. Time Frame	Orig. Estimated Cost (2004 dollars)	Project Status					Comments
						Completed	Addressed	In Progress	To Be Scheduled	Canceled	
11	Develop the capability to provide temporary disinfection of groundwater from the wells. Some wells already have this capability and thus more research is necessary to more concretely define this mitigation action. 9 of 27 equipped, 2 portable stations.	L	M	TBD	Small					X	<i>No additional action taken. This mitigation action was cancelled and not carried forward into the new 2021 HMP.</i>
12	Ensure adequate procedures and training are in place for minimizing the risks for fire and flooding	H	H	TBD	Small	X			X		<i>Annual training on fire hazard is performed by use of risk and tailgate talks. This type of general mitigation measure is being carried forward into the new 2021 HMP under the wildfire hazard.</i>
13	There is concern that a landslide could damage the Salt Lake Aqueduct or the Olmsted Aqueduct. Such damage results in the loss of the District's raw water supply but would be the responsibility of others.	H	N/A	NA	NA		X				<i>No recommended mitigation actions were identified, so addressed and remove from mitigation actions.</i>
14	Such damage could result in loss of the District's raw water supply but would be the responsibility of others to repair.	H	N/A	N/A	N/A					X	<i>Duplicate of #13 mitigation action for other hazards but same end result, so remove from mitigation actions list.</i>
15	Consider obtaining emergency electrical generators as noted above.	H	M	TBD	TBD					X	<i>Duplicate of #5 mitigation action for other hazards, so remove from mitigation actions list.</i>
16	The operations and maintenance complex may be flooded during a 100-year or 500-year event, resulting in potential loss of SCADA, as well as access to maintenance shops, repair equipment and the emergency operations center. Consider making provisions to have a temporary SCADA system for use at an alternate location. Practice yearly SCADA-free operation for a day. Make provisions to move equipment and vehicles temporarily if flooding threatens. Make provisions for a temporary location for the emergency operations center.	H	H	TBD	Small		X				<i>No additional mitigation measures have been taken on this item to protect against flood damage. As part of the Utah Shakeout Exercise held every year in April, the District runs the system without the SCADA. There were 2 Flood hazard project actions have been addressed in 2021 HMP and found to be Low relative risk, so no further specific mitigation action or general mitigation measures recommended for the flood hazard.</i>
17	Loss of more than one river-crossing pipeline is unlikely in any flood event. Recommended actions noted above for installing a parallel pipeline to either the 4500 South or 6400 South crossing would further enhance redundancy.	M	M	TBD	Project-dependent					X	<i>Duplicate of #8 mitigation action for other hazards, so remove from mitigation actions list.</i>
18	Reduce flooding vulnerability of bridge/road to allow access to complex and passage of District vehicles.	M	L	TBD	Project-dependent		X				<i>The installation of an enlarged culvert is schedule for January at the unnamed stream crossing Beckstead Ln.. No mitigation measures have been planned for the bridge over the North Jordan Canal</i>
19	Flooding of the Jordan Narrows Pump Station may require replacement of the electrical control equipment on the floor of the station.	L	N/A	N/A	N/A		X				<i>N/A since no mitigation project was identified, but assessed again in 2021 HMP where found to be Low relative risk so no further action recommended</i>



4.3 Mitigation Goals

Mitigation Goals:

The mitigation goals established in this plan are based upon the mission of the District to “Deliver quality water and services every day.” From this mission statement and the District’s vision and values, the four mission criteria of Reliability, Safety, Quality, and Value were developed to prioritize water system assets and thereby mitigation goals (see Section 2.3.1 and Appendix C for Pair-Wise Comparison discussion and results). The District also considered the mitigation goals in the 2019 Salt Lake County HMP for developing the following general mitigation goals for this mitigation plan:

- Protect the lives, health, and safety of District employees and the public before, during, and after a disaster.
- Protect and eliminate and/or reduce damages and disruptions to the District’s critical facilities, structures, and infrastructure during disasters
- Enhance and protect the communication and warning/notification systems of the District, its member agencies, and emergency responders within Salt Lake County.
- Promote education and awareness programs, campaigns, and efforts designed to encourage District employees, member agencies, retail customers, and the public to mitigate and become more resilient to disasters.
- Advocate, support, and promote the continued coordination and integration of disaster planning efforts between the District, its member agencies, partner agencies, and other stakeholders.
- Advocate, support, and promote the use of laws and local regulations and ordinances (i.e., building codes and standards) aimed to mitigate hazards and to enhance resiliency.

Some additional more specific District mitigation goals to reduce and/or avoid natural hazard vulnerabilities include:

- Retrofitting and/or constructing building structures for life safety and damage reduction
- Retrofitting and/or constructing nonstructural items for continued operation of the water system
- Performing geotechnical/geological soil strengthening to prevent structural damage and water system loss of operation
- Preventing loss of electrical power to critical water system facilities

Development of mitigation measures (general and specific) was based on avoiding the anticipated post-hazard event damage states or deficiencies identified in Section 4.4 Mitigation Actions/Measures which are expected to enable the District to meet its performance objectives listed below.

Performance Objectives:

The District’s performance objectives for their water system assets subsequent to the occurrence of a natural hazard are as follows:

- Provide potable water service (fully treated water normally delivered) to all wholesale and retail customers:
 - At 100% of indoor demand (winter demand rates) within 7 days following a natural hazard event



- At 100% of peak daily demand rates within 30 days following a natural hazard event
- Maintain adequate emergency finished water storage to serve 2/3rds of average daily demand
- Provide raw water delivery to Welby-Jacob canal for secondary water use within 30 days following a natural hazard event for summer demands
- Maintain life safety at all manned/occupied District buildings/facilities (i.e., offices) during a natural hazard event

4.4 Mitigation Actions/Measures

Mitigation measures are discussed in two categories. The general mitigation measures include actions for JWCD to integrate to its standard practices and the specific asset mitigation measures are projects that should be completed to mitigate hazards to specific critical assets.

4.4.1 General Mitigation Measures

General measures are presented below for the 6 hazards with the highest potential to impact JWCD facilities.

4.4.1.1 Drought Mitigation

The Diversity of the Districts water supply portfolio provides significant drought resiliency. No single source provides more than 50% of the total water supply. Central Utah Project, Provo River Project, and Salt Lake Valley high quality groundwater supply make up approximately 73% of the source water with the remaining 27% coming from a combination of 6 other sources. The most significant vulnerabilities identified in the Drought Contingency Plan (DCP) include; climate change impacts reducing snowpack and creating earlier spring runoff which ultimately reduces stream flows during the peak usage season, water quality events in Utah Lake that shut down secondary supplies and subsequently increase demand on potable systems, and significant dependence on the Provo River watershed.

The following are general mitigation measures applicable to JWCD facilities with risk to the drought hazard:

- Plan for drought and implement drought mitigation measures
 - Complete Drought Contingency Plan that is currently under development and will include a list of priority action items that are both proactive and reactive to drought conditions. The proactive mitigation measures include 15 mitigation projects to be implemented prior to a drought and the reactive mitigation measures include 14 response actions that are used to adapt to the available water supply level during a drought.
 - Implement Drought Contingency Plan mitigation measures and response actions, which include continued conservation activities and treatment plant improvements to handle impaired raw water quality, in accordance with their priorities after the DCP is completed. Maintain the DCP and the action items including drought management mitigation measures and guidelines.
 - Actively manage water sources during drought conditions by utilizing JWCD's Supply, Demand, and Major Conveyance Study that includes a system-wide model. This Study provides provisions on backing up almost every JWCD source identifies alternate sources that will be useful for JWCD, and evaluates the effect of variable water supply scenarios, including drought, on its ability to meet the contractual water demands of its customers.



- Monitor drought conditions at least monthly and make an official declaration prior to peak season each year
 - JWCD coordinates with CUWCD to monitor water supply conditions for its Provo River Project and Central Utah Project rights through regular updates from the National Weather Service's Salt Lake Office, NOAA's Colorado River Forecast Center, and NRCS's Utah Snow Survey Office. Drought conditions and stream flow are also closely monitored from NOAA and USGS websites.
 - Each March a drought committee, consisting of JWCD staff and a representative from each member agency, convenes to review water supply forecast information and develop a preliminary recommended the water supply availability level for the remainder of the year.
 - The preliminary recommendation is then verified at the annual Member Agency Meeting held every April and taken to the JWCD board for consideration and approval in May.

4.4.1.2 Earthquake Mitigation

The following are general mitigation measures applicable to all pipelines identified as having seismic ground shaking, faulting, and/or liquefaction hazard vulnerabilities associated:

- Material Stockpiling
 - Stockpile representative sizes of steel repair sleeves, steel plate patch material, pipe replacement segments, valves, and other spare parts/materials for immediate access after a seismic event. Wherever possible, storage of stockpiled material should be provided near the location where the material will be used. Note that for larger pipe diameters, this is a less effective method.
 - Stockpile repair segments and clamps of each size of existing pipe within high liquefaction zones for immediate access to perform repairs following a damaging seismic event.
 - Pipe Supply Contract - JWCD should develop priority supply contract(s) with pipe suppliers such that replacement segments can be procured expeditiously after a damaging seismic event.
 - Training- JWCD should incorporate response to seismic events, including pipeline repair and restoration, as part of its emergency training for employees.
 - Post-earthquake event inspections (i.e., CCTV inside pipe or in-person inspections where large enough) should be conducted for critical pipelines.
- Seismic upgrades of pipelines (hardening)
 - Large diameter pipe and joint replacement
 - Redundant pipelines
 - Flex couplings at building connections near faulting areas
 - Supporting pipelines with deep foundations (e.g., piles, driven piles, stone columns) through liquefaction zones
- Nonstructural bracing and/or anchoring of pipe, equipment, etc. for critical assets
- Geological investigation/evaluation for further study and identification of mitigation actions
- Structures at risk of earthquake-related damages include the 8MG and 1MG tanks at JWTP, Old Bingham Tank, and the original sedimentation basins at the JWTP, which would severely cripple JWCD's ability to meet summer demands. Details on how these risks should be addressed are provided in Section 4.4.2 and until those specific measures can be implemented the District



should include special provisions in their continuity of operations plan to operate the system if any of these structures were to fail.

4.4.1.3 Flood Mitigation

There was only a single asset (Jordan Narrows Pump Station) assessed for the flood hazard, which was determined to have a relative risk level of Low. Therefore, there were no JWCD assets identified with significant flood vulnerabilities, and there are no recommended mitigation measures for this hazard.

4.4.1.4 Landslide Mitigation

General recommendations for mitigating the identified landslide concerns associated with the evaluated JWCD pipelines are listed below:

- Material Stockpiling - It is recommended that JWCD stockpile representative sizes and types of repair sleeves, steel plate patches, and/or pipe replacement segments for immediate access after a seismic event. Wherein it is possible, storage of stockpiled material should be provided near the location where the material will be used. Note that for larger pipe diameters, this is a less effective method.
- Upgrades of pipelines (hardening)
 - Large-diameter pipe and joint replacement
 - Redundant pipelines
 - Flex couplings at building connections near landslide areas
 - Pipe Supply Contract - JWCD should develop priority supply contract(s) with pipe suppliers such that replacement segments can be procured expeditiously after a damaging landslide event.
- Training - JWCD should incorporate pipeline repair and restoration response to landslide events into its emergency training for employees.
- Geological investigation/evaluation for further study and identification of mitigation actions

The Jordan Aqueduct system crosses several landslide areas, and requires further investigation to determine the preferred approach to harden this important lifeline, which is covered in greater detail in Section 4.4.2.1.

4.4.1.5 Lightning Mitigation

General recommendations for mitigating the identified lightning hazard vulnerabilities for the evaluated JWCD facilities are outlined below.

- Perform lightning protection system assessments for critical assets to determine protection needs.
- Add lightning protection systems to buildings and structures starting with highest priority structures that do not include them
- Add surge protection at each service entrance (i.e., power, communications, and antenna systems) and critical equipment
- Add uninterrupted power supply (UPS) to electrical/controls
- Provide backup power supply with lightning protection to critical assets [i.e., emergency transfer power equipment, onsite generator/purchase portable generator(s), line up rental generator(s)]



4.4.1.6 Wildfire Mitigation

General recommendations for mitigating potential wildfire hazard concerns associated with JVWCD and its customer's facilities are listed below.

- Pipelines:
 - Monitor burned areas for erosion, debris flows, and landslides after a burn event.
- Structure and Infrastructure Projects:
 - Protect propane tanks and external fuels
 - Create defensible space around structures and infrastructure (i.e., fire barrier, fire break road)
 - Conduct maintenance to reduce risk (i.e., remove vegetation & other fuel sources)
- Natural Systems Protection:
 - Implement a Fuels Management Program
- Education and Awareness Programs:
 - Increase wildfire risk awareness
 - Educate about wildfire mitigation techniques
- Secondary impact mitigation measures for wildfire:
 - Work with watershed agencies and other stakeholders (Forest Service, NRCS, Soil Conservation Service, State Forestry & Lands, counties, cities, etc.) to perform erosion control after a wildfire
 - Monitoring at raw water entry points into JVWCD raw water collection system

There were no assets identified with significant direct wildfire vulnerabilities; however, the watersheds that supply the JWTP and SERWTP are constantly at risk of a wildfire, which would adversely affect water quality at both plants. The specific mitigation measure described in Section 4.4.2.2 addresses this issue for the JWTP.

4.4.2 Specific Asset Mitigation Actions

Projects to mitigate risks for the five assets with the top relative risk scores (see Section 3.3) are described below.

4.4.2.1 Jordan Aqueduct (JA) Reaches 1, 3 & 4 Project Scoping

Asset Description

The JA system consists of four distinct reaches:

- JA-1 is 17,716 linear feet (LF) of 78-inch steel pipe with gasketed (not welded) joints and reinforced concrete pipe (RCP) with bell-and-spigot joints. Reach 1 conveys raw water from the Provo River Aqueduct to the JWTP. It was constructed in the early 1970s.
- JA-2 is 62,981 LF of 78-inch steel pipe with gasketed (not welded) joints and RCP with bell-and-spigot joints. Reach 2 conveys finished water from the JWTP to the Terminal Reservoir, and does not have major geological hazards. It was constructed in the early 1970s.
- JA-3 is 29,540 LF of steel pipe ranging in size from 66-inches to 48-inches. Reach 3 conveys finished water north from the Terminal Reservoir to the end of JVWCD's service area near 2100 S. It was constructed in the early 1970s.



- JA-4 is 89,840 LF of steel pipe with gasketed (not welded) joints and RCP with bell-and-spigot joints. It ranges in size from 72-inches to 66-inches. Reach 4 conveys raw water from CUWCD's Alpine Aqueduct north to the JVWTP. It was constructed in the late 1970s.

Deficiency

Three of the four reaches encounter geologic hazards along their alignment, and need to be addressed through further study to better identify and quantify the hazards. The affected segments will then be prioritized by developing an implementation plan.

Liquefaction and associated lateral spread can cause significant damage to a portion of Reach 1 located near the Jordan River.

Reach 3 and Reach 4 intercept surface fault special study zones related to the Granger segment of the West Valley fault zone and the Provo segment of the Wasatch Fault zone, respectively. Surface fault rupture special study zones are designated in areas where surface faulting could occur.

Landslide deposits and areas that are identified as having a potential for landslides are identified as intercepting Reach 4 in several areas which can cause significant damage to portions of Reach 4.

Damage Scenario Description

During a seismic event, if liquefaction under Reach 1 occurs, it will lead to settlement of up to 3 to 4 inches or more. Factoring in lateral spread, lateral movements of several feet could occur in the same area, which would pull the unrestrained joints apart.

If fault splays are identified as trending through portions of Reach 3 and Reach 4, a surface fault rupture event along those splays would cause offset of Reach 3 and Reach 4. The amount of offset could be on the order of several feet.

If instability of a hillside or slope occurs, a landslide, through portions of Reach 4, displacement on the order of several feet could occur in the same area.

Any of the above events will lead to separation of the unrestrained joints, causing leaks that lead to flooding and significant property damage with the potential for loss of life in addition to significant loss of service.

Mitigation Measure

Site specific liquefaction studies will need to be completed to assess the likelihood of liquefaction occurring at a given location, and to define the magnitude of settlement/lateral movement that could occur. In accordance with the typical standard of care for assessing surface fault rupture hazards, trenches should be excavated to pass through the pipeline and 50 feet beyond either side in areas where the pipeline is located in a surface fault rupture special study zone. In areas where trenching is not feasible, geophysical surveying should be completed. Landslide assessments can be staged with an initial site reconnaissance to define the limits of the landslide deposit. If required, further study would include trenching and boring into the landslide mass along with laboratory testing and slope stability modeling to define the potential for movement of the landslide mass.

Data from this study will be used to design specific mitigation measures for the aqueduct, which may include realignment to avoid the hazard(s) where possible, harden the aqueduct to survive the event, and/or prepare mitigation measures like emergency shutoff valves and provisions for bypass piping to quickly restore service.



4.4.2.2 JWTP Sed Basins 1&2 Seismic, Drought, and Wildfire Resilience Upgrade

Asset Description

The JWTP is the District's key water treatment facility, accounting for 80% of the District's water treatment capabilities and the majority of the District's potable water supply. It was designed in 1971 and constructed from 1971-1974. It was expanded in 1987. The original construction included two flocculation/sedimentation basins (basins 1&2) with circular clarifier mechanisms for solids removal. Basin 1&2 have three circular mechanisms over sloped concrete floors. There is an unreinforced expansion joint in each section of sloped floor between each circular mechanism. The expansion included four flocculation/sedimentation basins, basins 3&4 on the north side of basin 1&2, and basins 5&6 on the south side of basins 1&2. Figure 4.1 is a site plan for the JWTP.

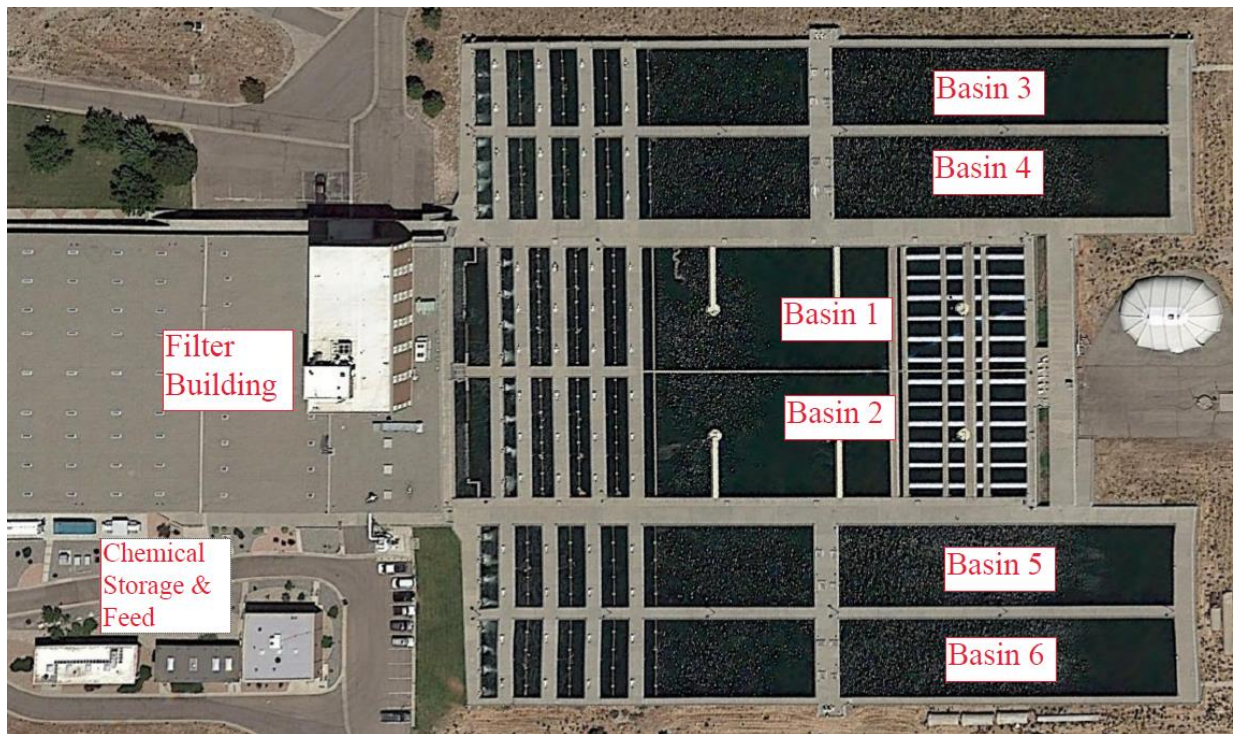


Figure 4.1. JWTP Site Plan

Deficiency

Feedwater for the JWTP originates from the Provo River. Diversions occur at either the Olmsted Diversion or the Murdock Diversion, but both are run-of-the-river diversions that are directly affected by river water quality. Seismic activity, wildfire, and drought present water quality hazards within the geologically active canyon. The landslides would result in high amounts of sediment in the river which would be difficult to treat with the existing sedimentation basins. Similar risks exist for winter season avalanches that are common after deep snow storms within the canyon, and as rainstorms occur after a wildfire. The steep side walls of the Provo River Watershed will result in significant debris/sediment flows to the diversion point. This hazard has occurred in the past after wildfire events. A significant amount of fire debris and ash will be transported via the diversions to the JWTP, increasing chemical dosing and sediment loads.

The circular mechanisms must be plumb at the center column for the rake arm to travel efficiently through a full revolution. The unreinforced expansion joints create, in effect, floating slabs that are susceptible to differential settlement from ground shaking. See Figures 4.2 and 4.3.



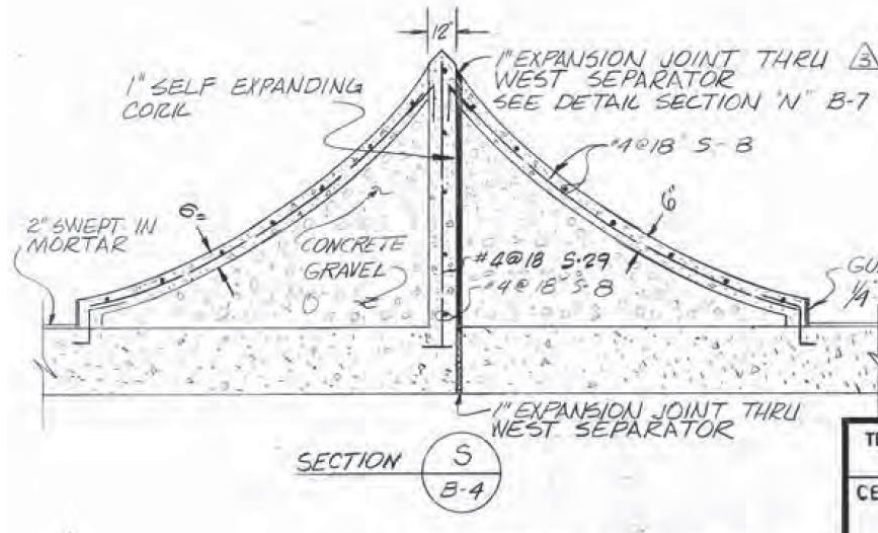


Figure 4.2. Unreinforced Expansion Joint, Drawing 10-B-5 from 1971 Drawings

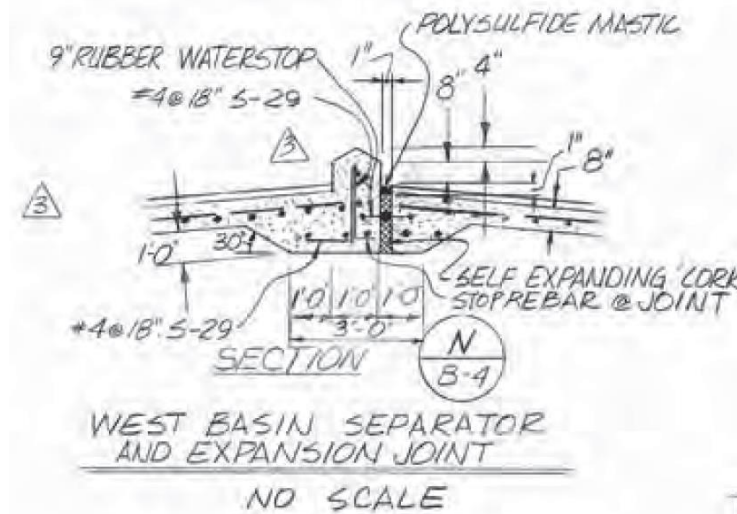


Figure 4.3. Unreinforced Expansion Joint, Drawing 10-B-7 from 1971 Drawings

Damage Scenario Description

A seismic event with ground shaking that leads to differential settlement will create leaks in basins 1 & 2, and knock the mechanisms out of level. This would prevent the basins from removing solids, knocking them offline for several years while they are rebuilt. The initial damage state would take JVWTP offline for 7 days while the shared settled water channels are repaired and isolated so the outer basins (3, 4, 5, and 6) can be brought back online. This will impact a population of approximately 624,000 before basins 3-6 are returned to service with the plant back online at a reduced capacity. The District would have to perform workarounds for the two summers it would take to reconstruct basins 1 & 2, which would impact a population of approximately 54,337 for 39 days during peak demand each year for 2 years, or 78 days total. The combination of the Initial Damages & Workarounds was combined to determine the B/C ratio.

Mitigation Measure



As shown in the figures above, the original design does not allow for simple retrofit options like a carbon-fiber overlay to tie the adjacent slabs together. A topping slab could be placed over the existing floors if the conical bottoms were filled in, but the basins only have a 10-ft water depth. The topping slab would reduce water depth and significantly impair settling.

The sloped floors under each circular mechanism need to be removed, and a new double-mat foundation placed at a lower elevation to improve settling characteristics for future wildfire and drought conditions that bring more turbidity and TOC to the plant, requiring higher coagulant doses to treat and remove accumulating solids.

This project will seismically upgrade sedimentation basins 1 and 2 by replacing under-slab unrestrained cast-iron soil pipe with seismically resilient piping, replacing the basins' shallow conically-sloped bottoms with deeper flat bottoms, constructing sister walls around the perimeter and divider walls, and installing a dowelled connection between flocculation & sedimentation. The project team will design and administer the construction contract to upgrade the two original sedimentation basins to mitigate ground shaking hazard and improve process resilience against water quality degradation from drought and fires.

4.4.2.3 JWTP 1 MG Reservoir Seismic Upgrade

Asset Description

The 1 MG Reservoir is a conventionally reinforced circular concrete tank. It sits on a hill immediately south of the JWTP, on the south side of the Mountain View Corridor. Its primary purpose is to provide pressure and storage for the plant's utility and process water systems. For example, the process water is used to generate chlorine dioxide onsite for pre-oxidation and some disinfection credit; it also supplies water to several other chemical systems as well as seal water for pumps.

Deficiency

This tank was part of the original design and construction in the early 1970s. The seismic accelerations for this area qualify as a region of High Seismicity per the ASCE 41-17 Seismic Evaluation Standard. The tank floor design, with several unreinforced expansion joints, was found to be deficient because the joints compromise the lateral load carrying capability of the diaphragm, see Figure 4.4.

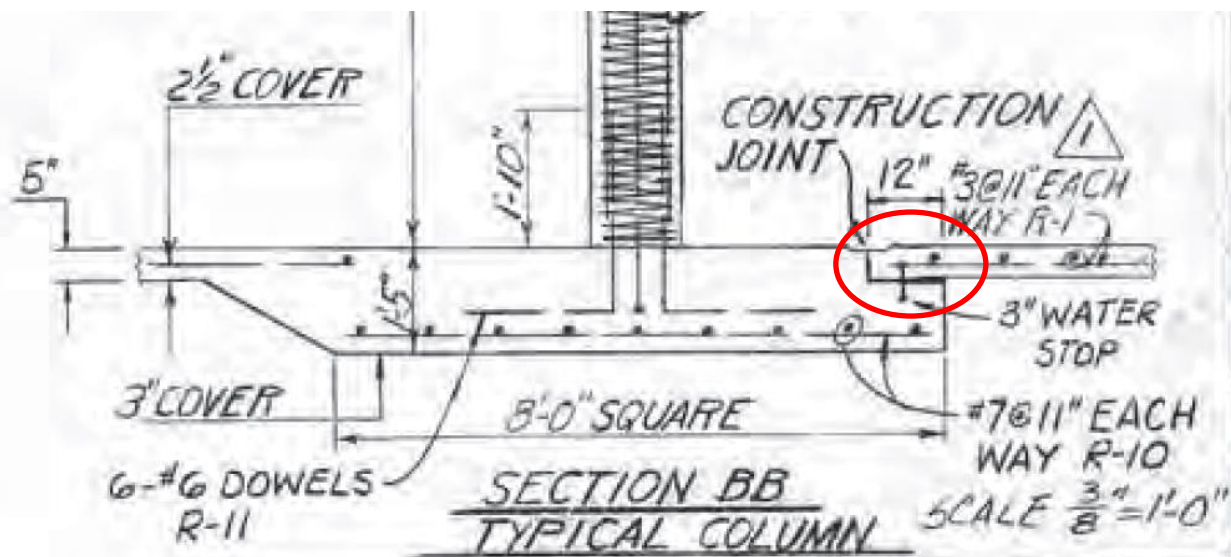


Figure 4.4. Unreinforced Expansion Joint, Drawing 10-S-10 from 1971 Drawings



This tank was also examined with respect to other current building codes and standards for tanks, such as the ACI 350 Building Code and the ACI 350.3 Seismic Design Standard. This tank was found to have insufficient freeboard for sloshing waves during a seismic event (4- $\frac{3}{4}$ ""). For reference, tanks in this area typically require freeboard of around 12" for sloshing to prevent uplift of the roof slab in a seismic event.

This tank no longer meets many other criteria included in the ACI 350 Building Code, such as the concrete cover requirements to the reinforcing steel for durability. Upgrading this tank to current standards is not practical and replacement of the structure should be considered.

Piping connections to the tank are rigid and subject to failure with ground shaking, and should be replaced with seismically-resilient piping when the tank is replaced.

Damage Scenario Description

A seismic event with ground shaking that leads to differential settlement will create leaks in all floor joints and piping connections. The saturated hillside below the tank may cause the tank to fail catastrophically if the downhill side gives way causing debris flow over Mountain View Corridor. The JVWTP would then have no process water for its chemical systems, leading to the entire JVWTP shutting down for at least 7-days while a workaround is implemented. The temporary workaround is expected to fail intermittently (assume 1-day per month) until a more permanent workaround is designed/installed approximately 9 months later.

Mitigation Measure

Construct a new two-celled process-water tank to eliminate the single point of failure in the existing deficient tank. Install flexible connections for all piping. Remove the existing tank from service after the new tank is online and demolish the existing tank.

4.4.2.4 Old Bingham 3 MG Reservoir Seismic Upgrade

Asset Description

The 3 MG Reservoir at Old Bingham Highway is a distribution system reservoir that provides operational and emergency storage to its service area. It was constructed in 1976 as a prestressed tank reinforced with post-tensioning tendons in the floor, wall, and roof. This tank was constructed before the first publication of the AWWA D115 tank Standard, but it can be loosely characterized as an AWWA D115 style tank.

Deficiency

The original drawings could not be located, so the project team evaluated drawings from other comparable tanks of similar age and design. The cracking this tank exhibits, circumferentially in the wall and around the perimeter of the roof slab, is indicative of the construction detailing used by Atlas Prestressing in the late 70's and early 80's, as is the sloping closure strip connecting the base of the wall to the floor slab.

The seismic accelerations for this area qualify as a region of High Seismicity per the ASCE 41-17 Seismic Evaluation Standard. The tank does not meet many of the modern requirements of ACI 350 Building Code for tanks, the ACI 350.3 Seismic Design Standard, or the AWWA D115 Standard for Tendon Prestressed Tanks. Examples include minimum concrete cover requirements for reinforcing steel and corrosion protection requirements for post-tensioned tendons. Previous inspections and observations by JVWCD staff indicate that one or more post-tensioned tendons in the roof have failed.

Damage Scenario Description



Failure of post-tensioned tendons could cause the roof to collapse, damaging columns, walls, and the foundation, leading to a complete failure of the tank. The service area would experience a loss of supply for a short time (assume 3-days) while distribution system modifications are made to isolate the tank and provide backup supply with the correct pressure for the zone. The temporary workaround is expected to require increased maintenance with brief intermittent shutdowns (assume 1-day per quarter) until a new tank is designed/installed approximately 18 months later.

Cast iron piping without flexible connections will also likely break, contributing to tank failure.

Mitigation Measure

If further study determines that tendons in the roof have failed, the roof could be selectively demolished to preserve the walls and columns. The roof could then be replaced, while placing a coating on the tank interior to mitigate corrosion on the columns, walls, and floor.

Yard piping, including all tank connections, should be replaced with seismically-resilient piping with flexible connections.

4.4.2.5 JWTP 8 MG Reservoir Seismic, Wildfire, and Water Quality Improvements Project

Asset Description

The 8 MG Reservoir is a conventionally reinforced rectangular concrete tank. It sits on a slight bench immediately north of the JWTP, just uphill from the Welby-Jacobs Canal and a residential subdivision. Its primary purpose is to provide volume to meet regulatory disinfection requirements using free chlorine, volume for plant operations such as backwashes, volume to meet distribution system peak-hour demands without affecting plant operations, and volume for emergency shutdowns. The tank also provides pressure for system demands downstream of the JWTP.

Deficiency

This tank was part of the original design and construction in the early 1970s. The seismic accelerations for this area qualify as a region of High Seismicity per the ASCE 41-17 Seismic Evaluation Standard. The tank design, with several unreinforced expansion joints that pass through the floor, walls, and roof, was found to be deficient because the joints compromise the lateral load carrying capability of the diaphragm, see Figure 4.5. There are five of these joints that effectively divide the tank into 6 sections with no reinforcement tying them together.



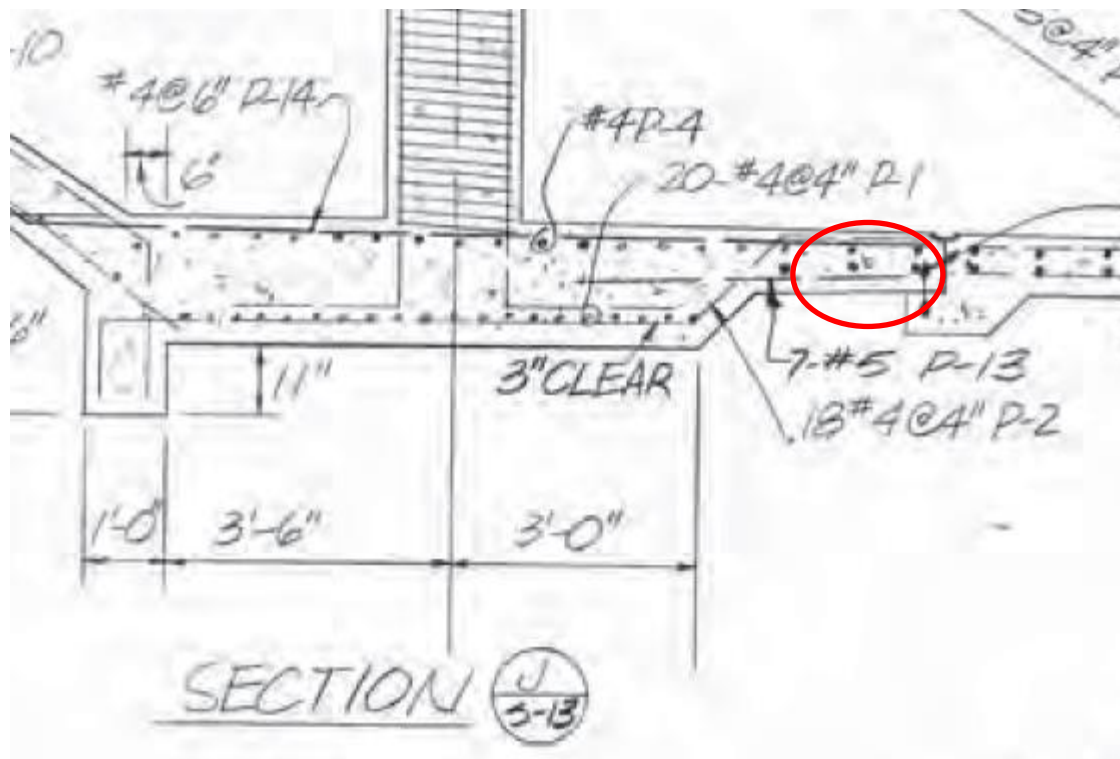


Figure 4.5. Unreinforced Expansion Joint, Drawing 10-S-14 from 1971 Drawings

This tank no longer meets many other criteria included in the ACI 350 Building Code, such as the concrete cover requirements to the reinforcing steel for durability. Upgrading this tank to current standards is not practical and replacement of the structure should be considered.

Piping connections to the tank are unrestrained and subject to failure with ground shaking.

Damage Scenario Description

A seismic event with ground shaking that leads to differential settlement will create leaks in all of the unreinforced expansion joints and piping connections. The tank will develop slow leaks in the separated floor and wall joints with the downhill side eventually giving way, causing a debris flow and flood surge into the nearby Welby-Jacob Canal. The finished water line will fill with contaminated water before it can be isolated, causing a boil order and estimated minimum of a 5-day shutdown to drain, flush, and refill the lines. The JWTP capacity will be reduced for lack of disinfection volume, and/or the plant will need to feed higher chlorine dose than is otherwise needed until the replacement tank is designed and installed approximately 18 months later.

Mitigation Measure

Replace the existing deficient tank with a new larger 12.5 MG tank to maximize storage in the footprint currently occupied by the 8 MG Reservoir. The new tank will be designed to modern standards, reducing, or eliminating a post-event outage entirely, and it will provide additional finished water storage for wildfire-related plant disruptions that may require temporarily shutting down the JWTP's raw water intake. The new tank should be highly baffled to improve water quality by reducing chlorine use to meet required disinfection credits.

4.4.2.6 JA Reaches 1, 3, & 4 Mitigation Project(s)

Asset Description

See Section 4.4.2.1

Deficiency

See Section 4.4.2.1 for the base deficiencies that will be further examined and determined in more specific and greater detail with the completion of the JA 1, 3, 4 Scoping Project.

Damage Scenario Description

See Section 4.4.2.1 for the base damage scenario description that will be further examined and determined in more specific and greater detail with the completion of the JA 1, 3, 4 Scoping Project (Mitigation Action 1).

Mitigation Measure

Design and construct recommended mitigation measures for hardening JA Reaches 1, 3, and 4 based on the results of Mitigation Action 1, once completed.

4.5 Mitigation Implementation

In order to facilitate development of an implementation plan for the specific mitigation measures/actions delineated in Section 4.4.2 above, the measures were combined into projects (mitigation actions), cost estimates were prepared for the Top 5 Assets' high priority projects, and the projects were prioritized and scheduled. This implementation development process is described in corresponding subsections below.

4.5.1 Packaging of Mitigation Measures

The first step in developing the mitigation implementation plan was to define mitigation projects that combine individual measures into larger, standalone projects that are more practical for execution. The mitigation projects were created based on the top 5 assets determined through Section 3 Risk Assessment and identified in Section 3.3 Risk Assessment Results as shown in Table 3.3 and Figure 3.1. The specific asset mitigation actions that were developed into mitigation projects are described in Section 4.4.2 above. The funding sources (i.e., Operation & Maintenance (O&M), FEMA grants, and Capital Improvement Plan (CIP)) were also considered in determining the packaging of mitigation measures. The various mitigation projects are listed in Table 4.2 below along with their total estimated mitigation costs.

4.5.2 Mitigation Project Cost Estimate

Planning level estimated costs are provided in Table 4.2 for those mitigation projects that were determined by the District to be high priority. Detailed breakdowns of the estimates can be found in Appendix H. Costs are rough order of magnitude estimates which reflect approximate construction costs in Second Quarter 2021 dollars. An Order of Magnitude estimate is defined as a Conceptual Level or Project Viability Estimate. Typically, engineering is from 0 to 2 percent complete. Order of Magnitude estimates are used to prepare planning level cost scopes or evaluation of alternative schemes, long range capital outlay planning. Expected accuracy for Order of Magnitude estimates typically ranges from -50 to +100 percent, depending on the technological complexity of the project, appropriate reference information and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.



The estimates include the fees directly related to labor and materials for physical implementation of mitigation measures, consultant design and/or analysis fees, construction management and administration fees, as well as estimated allowances for contractor overhead and profit. Additional design and in-depth analysis work are required to fully quantify the cost associated with implementing the mitigation measures. The intent of this estimate is to provide a basis from which the future work may begin.

Table 4.2 Mitigation Project Estimated Costs	
Mitigation Project	Total Estimated Mitigation Cost**
1 Jordan Aqueduct (JA) Reaches 1, 3 & 4 Project Scoping	\$302,300
2 JVWTP Sedimentation Basins 1&2 Seismic, Drought, and Wildfire Resilience Upgrade	\$30,400,00
3 JVWTP 1 MG Reservoir Seismic Upgrade	\$1,610,000
4 Old Bingham 3 MG Reservoir Seismic Upgrade	\$2,000,000
5 JVWTP 8 MG Reservoir Seismic, Wildfire, and Water Quality Improvements Project	\$16,310,000
6 Jordan Aqueduct (JA) Reaches 1, 3 & 4 Mitigation	TBD*

* To Be Determined (TBD) upon completion of Mitigation Action 1

**This cost opinion of probable costs of construction is made on the basis of the experience, qualifications and judgement of the cost estimators. Brown and Caldwell cannot and does not guarantee that proposals, bid or actual construction costs will not vary from this, or subsequent estimates prepared by Brown and Caldwell

Items that are not in these planning level cost estimates include, but are not limited to:

1. Relocation of owner's equipment to permit construction access
2. Hazard abatement or remediation

Items that may change the estimated costs include, but are not limited to:

1. Modifications to conceptual scope of work in estimate
2. Special phasing requirements not known at this time
3. Unforeseen conditions
4. Force Majeure conditions (e.g., COVID-19 pandemic)

Since the cost of labor, materials, and equipment, the contractor's method of determining prices, or over competitive bidding cannot be controlled or accurately anticipated, the opinion of construction cost provided for herein is made on the basis of professional experience. There is no guarantee that actual project proposals, bids, or construction costs will not vary from the estimated costs. Because the mitigation measures described within this Plan are conceptual and the costs herein are rough order of magnitude estimates, there is no guarantee that the actual project costs will not exceed the estimates and/or the established project budgets.

Factors that should be considered in developing an accurate project cost at the time the mitigation project is implemented include: escalation, construction phasing, and non-business work hours. Prices included herein should be escalated at a minimum of 3% to 4% annually (based on the CPI), with a base date of June 2021, to account for implementation schedule. If any of the projects are implemented as phased construction, phasing costs will need to be included in the cost estimate and should be added to the total project budget to cover the cost of temporary shutdowns and work-arounds, multiple mobilizations, and additional labor for work done outside of normal working hours. Any cost for excessive overtime to meet stringent milestone dates will also need to be added to the planning level cost estimates.



4.5.3 Mitigation Project Prioritization, Funding, and Scheduling

The final step in preparing an implementation plan for the mitigation measures was to identify the priority, potential funding, and proposed implementation schedule for the mitigation projects found in Section 4.5.1. The mitigation projects were prioritized based on the criticality ranking (see Table 2.6) of the assets within each mitigation project and the results of the benefit cost analysis (see Section 4.6). The potential funding was determined based on discussions with District management concerning O&M funds and CIP funds and on eligibility requirements for FEMA grant funds. The results of the mitigation project prioritization, funding, and scheduling is shown in tabular form in Appendix F.

A summary of each of the 6 mitigation projects found in Appendix F, Table F. I is presented below. The Mitigation Action number corresponds to the mitigation package's priority. All of these Mitigation Actions are considered High priority since they pertain to the District's top 5 highest ranked assets by risk for the combined natural hazard risk and consequence of failure.

The summary of each Mitigation Action includes the hazard to be mitigated, mitigation objective, priority of the action, estimated cost, estimated implementation time frame, and potential funding source(s). Also shown is the responsible jurisdiction, which in all cases is solely JVWCD.

Mitigation Action 1 - Jordan Aqueduct (JA) Reaches 1, 3 & 4 Project Scoping

<i>Hazards:</i>	Earthquake, Landslide
<i>Objective:</i>	Study earthquake (fault rupture & liquefaction), liquefaction, and landslide impacts on JA Reaches 1, 3, and 4 for preparation of detailed plan to harden the JA system.
<i>Priority:</i>	HIGH
<i>Time Frame:</i>	Based on funding, estimated in Years 2-3
<i>Funding:</i>	Local and Federal
<i>Estimated Cost:</i>	\$302,300
<i>Jurisdiction:</i>	JVWCD

Mitigation Action 2 – JWTP Sed Basins 1&2 Seismic, Drought, and Wildfire Resilience Upgrade

<i>Hazard:</i>	Earthquake, Drought, and Wildfire
<i>Objective:</i>	Design and administer the construction contract for a seismic upgrade of the two, original deficient sedimentation basins to mitigate ground shaking hazard and improve process resilience against water quality degradation from drought and wildfires.
<i>Priority:</i>	HIGH
<i>Time Frame:</i>	Based on funding, estimated in Years 1-4
<i>Funding:</i>	Local and Federal
<i>Estimated Cost:</i>	\$30,400,000
<i>Jurisdiction:</i>	JVWCD



Mitigation Action 3 – JWTP 1 MG Reservoir Seismic Upgrade

Hazard: Earthquake
Objective: Construct a new two-celled process-water tank to eliminate the single point of failure in the existing seismic deficient tank. Remove the existing tank from service after the new tank is online, and demolish the existing tank.
Priority: HIGH
Time Frame: Based on funding, estimated in Years 3-4
Funding: Local and Federal
Estimated Cost: \$1,610,000
Jurisdiction: JVWCD

Mitigation Action 4– Old Bingham 3 MG Reservoir Seismic Upgrade

Hazard: Earthquake (Ground Shaking and Liquefaction)
Objective: Remove the roof with failing post-tensioned tendons; place a coating on the tank interior to mitigate corrosion; construct a new roof; install flexible connections on all yard-piping connections to the tank.
Priority: HIGH
Time Frame: Based on funding, estimated in Year 5
Funding: Local and Federal
Estimated Cost: \$2,000,000
Jurisdiction: JVWCD

Mitigation Action 5 – JWTP 8 MG Reservoir Seismic, Wildfire, and Water Quality Improvement Project

Hazards: Earthquake, Wildfire
Objective: Replace the existing seismic deficient tank with a new larger tank to provide additional storage for wildfire-related plant disruptions; improve tank baffling to improve water quality by reducing chlorine use.
Priority: HIGH
Time Frame: Based on funding, estimated in Years 3-4
Funding: Local
Estimated Cost: \$16,310,000
Jurisdiction: JVWCD



Mitigation Action 6 – Jordan Aqueduct (JA) Reaches 1, 3 & 4 Mitigation

<i>Hazards:</i>	Earthquake and Landslide
<i>Objective:</i>	Design and construct recommended mitigation measures for hardening JA Reaches 1, 3, and 4 (see Mitigation Action 1)
<i>Priority:</i>	HIGH
<i>Time Frame:</i>	Based on funding, estimated in Years 4-5
<i>Funding:</i>	Local and Federal
<i>Estimated Cost:</i>	To Be Determined upon completion of Mitigation Action 1
<i>Jurisdiction:</i>	JVWCD

NOTE: The District does not participate in the NFIP and has no repetitive loss structures. However, the District will review all mitigation projects to evaluate their impact to any NFIP identified regulatory floodplain prior to implementing the mitigation action. Should the project impact an identified regulatory floodplain, the District will coordinate and obtain required floodplain development permits from local floodplain administrators or discuss the potential development with the State NFIP Coordinator, in accordance with Part 60.3 of the National Flood Insurance Act of 1968 and the Disaster Mitigation Act of 2000.

4.6 Benefit Cost Evaluation

A benefit cost analysis was performed for the mitigation projects identified above which consist of physical retrofit measures. FEMA's BCA Reference Guide (2009) and What is A Benefit? (2001) documents were used as the basis of the benefit cost evaluation. The benefit cost evaluation performed is in accordance with the basics of the FEMA Benefit Cost Analysis (BCA) methodology used in the Building Resilient Infrastructure and Communities (BRIC) program for federal disaster grant funding applications to determine the cost-effectiveness of utility improvement measures. It should be noted, however, that the FEMA BCA modules were not run for any of the mitigation projects, and therefore benefit-cost ratios shown herein may not be equivalent to those obtained from the modules. A benefit cost analysis using the appropriate BCA modules will need to be completed when submitting a FEMA grant application.

Two categories of "Avoided Damage" were used to determine the benefits portion of the benefit cost analysis: 1) avoided physical damages, and 2) avoided loss-of-function impacts (i.e., economic impact of loss of water services). Benefits for avoided casualties and injuries were not accounted for because they are considered to be relatively minor for typical utility systems compared to physical damage and loss-of-function impacts and in some cases are not applicable. The benefits were calculated using the difference between baseline conditions and upgraded conditions.

Avoided physical damage was determined based on the expected performance of the assets and the estimated structure, pipeline segment, nonstructural item, or equipment replacement value. Based on the assessment results for each hazard event, an estimate of the damage state (e.g., severe, moderate, light, etc.) was defined for each deficient asset's baseline and upgraded condition. The physical loss estimate was then expressed as a percentage of the replacement value, which was linked to each estimated damage level. The avoided physical damage benefit was calculated in dollars as the difference in the expected baseline damage and the anticipated damage after upgrades have been implemented.

Avoided loss-of-function impacts (i.e., economic impacts of loss of water service) were determined in accordance with the FEMA BCA standard utility loss of service values and Sections 6.3 and 6.4.2 of FEMA's What is a Benefit? document. The economic impacts of loss of water service are estimated based on complete loss of potable water service, which is currently valued by FEMA in their BCA tool at \$114 per person per day. Based on the hazard assessment results, scenario damage descriptions



were defined for individual assets. Using these damage descriptions, the District estimated the functional downtime of the JWCD water system facilities/assets (in days of complete loss of service) both for the baseline condition and the upgraded condition assuming only the individual asset under consideration is damaged. The District also determined the number of customers served by each asset in terms of population. The total economic impact of the loss of service was determined for the baseline and upgraded conditions using FEMA’s current 2021 standard economic impact value of \$114 per person per day of loss of potable water service. The FEMA standard value accounts for the effects of reduced regional economic activity, direct impacts on customers, and disruption of customer’s normal activities. The avoided loss-of-function benefit was calculated as the difference in the expected baseline impacts and the upgraded impacts.

The total hazard scenario benefits for each asset are the sum of the avoided damage benefit and the avoided loss-of-function benefit. To account for the useful project lifetime of the mitigation work and the time value of money, the "expected annual benefits" are converted to a "present value of annual benefits" using the FEMA-mandated discount rate of 7% and a standard project useful lifetime value of 50 years for utility projects. The benefit-cost ratio is determined by dividing this " present value of annual benefits" by the estimated project mitigation cost.

The benefit cost ratios for each mitigation project were determined using a sum of the avoided physical damage benefits for each asset included in the project and a system-wide determination of the avoided loss-of-function benefits considering the combined contribution of each individual asset within that project. Table 4.3 shows a summary of the benefit cost results for each mitigation project.

	Mitigation Project	Total Annualized Present Value Benefits	Total Mitigation Costs	Benefit Cost Ratio
1	Jordan Aqueduct (JA) Reaches 1, 3 & 4 Project Scoping	NA	\$302,300	NA
2	JVWTP – Sed Basins 1&2 (Earthquake, Drought, Wildfire)	\$104,940,000	\$30,400,000	3.5
3	JVWTP – 1 MG Reservoir (Earthquake)	\$125,211,000	\$1,610,000	80.2
4	Old Bingham 3 MG Tank (Earthquake)	\$2,868,000	\$2,000,000	1.6
5	JVWTP – 8 MG Reservoir (Earthquake, Wildfire)	\$54,446,000	\$16,310,000	3.4
6	Jordan Aqueduct (JA) Reaches 1, 3 & 4 Mitigation Project	N/A	TBD	N/A



Section 5

Plan Maintenance

The District plans on monitoring and evaluating the JWCD Hazard Mitigation Plan yearly as it correlates to the District's annual Capital Improvement Plan updates. In addition, the District plans on monitoring and evaluating the Plan in conjunction with updates to the State Plan that include the District's water system. The regional plans covering the District's facilities include Salt Lake County and Mountainland Association of Governments (MAG). The District is considering submitting portions of their Plan to Salt Lake County and MAG, for inclusion in their regional plans for future updates. The District intends on updating their natural hazard mitigation plan at least once every five years, either through State and/or Regional Plan updates or through an actual update to their own Plan. The District will continue to provide its stakeholders with updates to the JWCD Plan and encompassing State/Regional Plans in order to solicit public involvement and comments.

Appendix A: Asset Location and Hazard Maps

All Hazard Maps_2021 0713

- Asset Location Map
- Debris Flow Hazard
- Ground Shaking Hazard
- Liquefaction Potential
- Surface Fault Rupture Hazard
- Collapsible Soil and Rock
- Expansive Soil and Rock
- Landslide Hazard

Flood Maps_2021 0428

1_SERWTP	15e_JA-1
2_JVWTP	15f_JA-2
3_Monitor Dr Well	15g_JA-2
4_Newbury Well	15h_JA-2
5_1443E 9400S Well	15i_JA-2
6_8MG Tank	15j_JA-2
7_1MG JVWTP Culinary Tank	15k_JA-2
8_Old Bingham Tank	16_Central
9_Zone B North Tanks	17a_150th South Pipeline
10_Terminal Reservoir	17b_150th South Pipeline
11_Jordan Narrows PS	18a_Cross Valley Pipeline
12_11800 S Zone C Pump Station	18b_Cross Valley Pipeline
13_3200 W 6200 S Pump Station	18c_Cross Valley Pipeline
14_Old Bingham Pump Station	19a_Creek Road Pipeline
15a_JA-4	19b_Creek Road Pipeline
15b_JA-4	20a_114th South Pipeline
15c_JA-4	20b_114th South Pipeline
15d_JA-4	



Appendix B: Stakeholder Participation Documentation

- 1_Stakeholder Mailing List
- 2_Stakeholder Meeting Invitation Letters
 - Meeting 1 Email and Letter examples
 - Meeting 2 Email and Letter examples
 - Meeting 3 Email and Letter examples
 - Meeting 4 Email and Letter examples
- 3_Stakeholder Meeting Agendas
 - Stakeholder Meeting 1 Agenda_2021 0406
 - Stakeholder Meeting 2 Agenda_2021 0608
 - Stakeholder Meeting 3 Agenda_2021 0720
 - Stakeholder Meeting 4 Agenda_2021 0902
- 4_Stakeholder Meeting Sign-in Sheets
 - Stakeholder Meeting 1_Sign-in Sheet_2021 0406
 - Stakeholder Meeting 2_Sign-in Sheet_2021 0608
 - Stakeholder Meeting 3_Sign-in Sheet_2021_0720
- 5_Stakeholder Meeting #1 Questionnaire/Comment Sheets
 - Stakeholder Questionnaire-Comment Sheet_Blank
 - Stakeholder Questionnaire_Dan McDougal_TBID
 - Stakeholder Questionnaire_Emily Alvarez_FEMA
 - Stakeholder Questionnaire_Greg Anderson_KID
 - Stakeholder Questionnaire_Quincy Bahr_Forest Service
 - Stakeholder Questionnaire_Raymond Garrison_South Jordan City
 - Stakeholder Questionnaire_T.JonesW.Skinner_RMP
 - Stakeholder Comment_Steve Bowman_Utah Geological Survey
- 6_Stakeholder Meeting #2 Surveys
 - Stakeholder Survey_Aaron Sainsbury_City of South Jordan
 - Stakeholder Survey_Keith Ludwig_Midvale City
 - Stakeholder Survey_Wade Tuft_ULWVA



Appendix C: Asset Pair Wise Comparison Matrices

Asset Prioritization _Mission Criteria

Criteria 1 – Reliability

Criteria 2 – Quality

Criteria 3 – Safety

Criteria 4 – Value

Summary



Appendix D: Risk Screening & Selection

Preliminary Risk Screening Table_2021 0427

Final Risk Screening and Selection Table_2021 0607

JVWCD HMP - Project Planning #2 Meeting Minutes_2021 0428



Appendix E: Risk Analysis & GRAT Top 5

Risk Analysis

Risk Chart

Risk Analysis Metrics

JVWCD HMP - Risk Assessment Workshop Meeting Minutes_2021 0527



Appendix F: Mitigation Implementation Plan

Table F-1: JWCD HMP Mitigation Actions Implementation Plan



Appendix G: JWCD Geohazards Technical Memorandum

JWCD Geohazards Technical Memorandum



Appendix H: Mitigation Cost Estimates

Mitigation Project #1 – Jordan Aqueduct Reaches 1, 3 & 4 Project Scoping

Mitigation Project #2 – JWTP Sed Basins 1&2 Seismic, Drought, and Wildfire Resilience Upgrade

Mitigation Project #3 – JWTP 1 MG Tank Seismic Mitigation

Mitigation Project #4 – Old Bingham 3 MG FWR Seismic Mitigation Project

Mitigation Project #5 – JWTP 8 MG FWR Seismic, Wildfire, and Water Quality Improvement Project



Appendix I: Mitigation Benefits

Mitigation Benefits Table

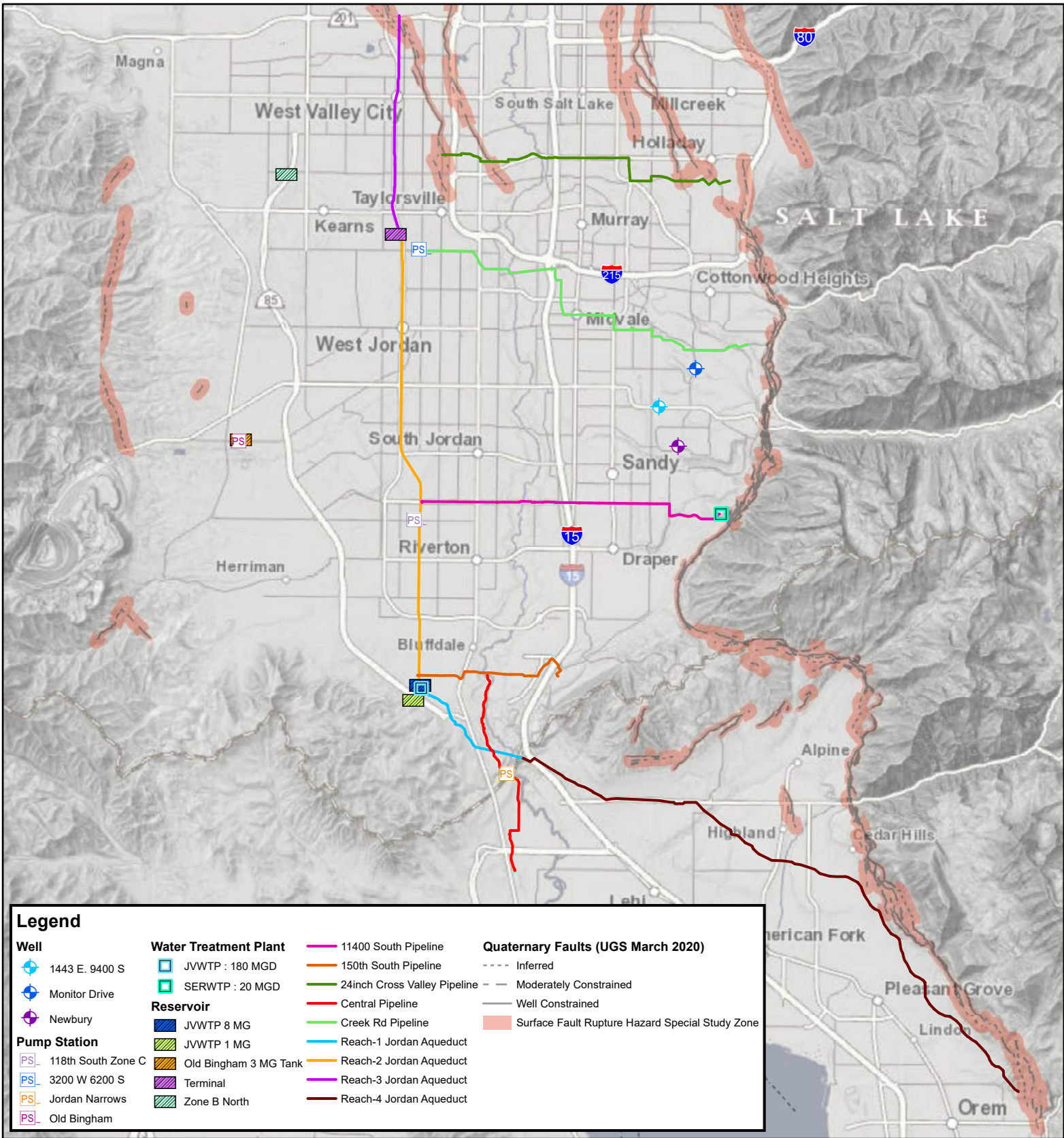


Addendum #1 – JVWCD Plan Adoption and FEMA Approval

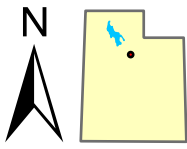
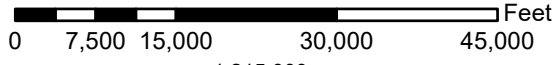
Resolution 21-18_JVWCD HMP Adopted-signed
Final Approval Packet_JVWCD_UT_11-17-2021

ATTACHMENT D

JORDAN AQUEDUCT SYSTEM HAZARD MAPPING



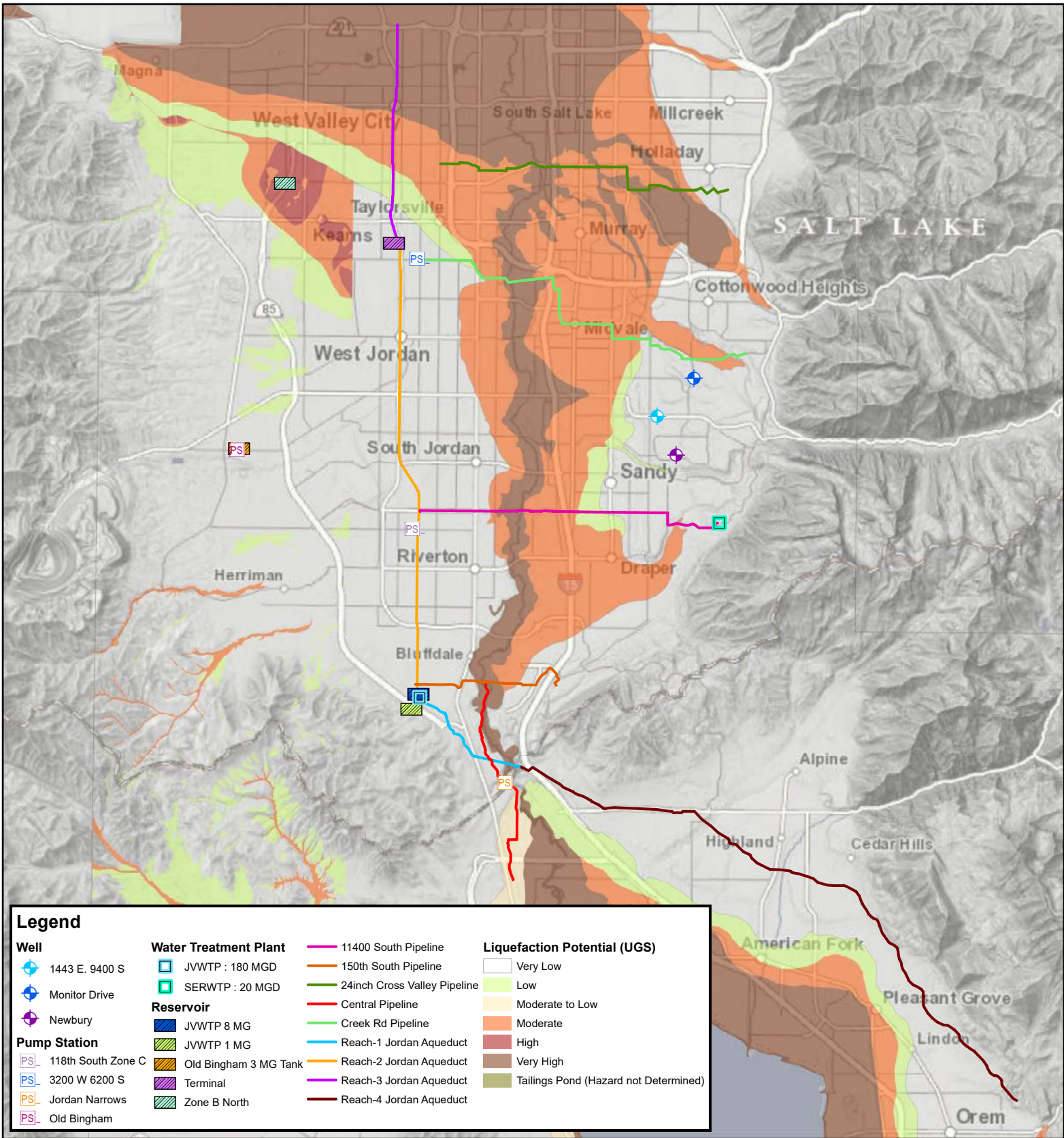
Legend			
Well	Water Treatment Plant	Pipeline	Quaternary Faults (UGS March 2020)
1443 E. 9400 S	JWTP : 180 MGD	11400 South Pipeline	Inferred
Monitor Drive	SERWTP : 20 MGD	150th South Pipeline	Moderately Constrained
Newbury	Reservoir	24inch Cross Valley Pipeline	Well Constrained
Pump Station	JWTP 8 MG	Central Pipeline	Surface Fault Rupture Hazard Special Study Zone
118th South Zone C	JWTP 1 MG	Creek Rd Pipeline	
3200 W 6200 S	Old Bingham 3 MG Tank	Reach-1 Jordan Aqueduct	
Jordan Narrows	Terminal	Reach-2 Jordan Aqueduct	
Old Bingham	Zone B North	Reach-3 Jordan Aqueduct	
		Reach-4 Jordan Aqueduct	



Basemap and Geologic Hazard Data provided by the State of Utah AGRC. Assets provided by the Client.

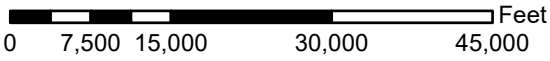
Geologic Hazards Assessment
Jordan Valley Water Conservatory District
Surface Fault Rupture Hazard

Plate
G-2



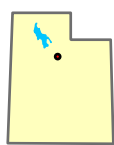
Legend

Well	Water Treatment Plant	Pipeline	Liquefaction Potential (UGS)
1443 E. 9400 S	JVWTP : 180 MGD	11400 South Pipeline	Very Low
Monitor Drive	SERWTP : 20 MGD	150th South Pipeline	Low
Newbury	Reservoir	24inch Cross Valley Pipeline	Moderate to Low
Pump Station	JVWTP 8 MG	Central Pipeline	Moderate
118th South Zone C	JVWTP 1 MG	Creek Rd Pipeline	High
3200 W 6200 S	Old Bingham 3 MG Tank	Reach-1 Jordan Aqueduct	Very High
Jordan Narrows	Terminal	Reach-2 Jordan Aqueduct	Tailings Pond (Hazard not Determined)
Old Bingham	Zone B North	Reach-3 Jordan Aqueduct	
		Reach-4 Jordan Aqueduct	



1:215,000
Basemap:

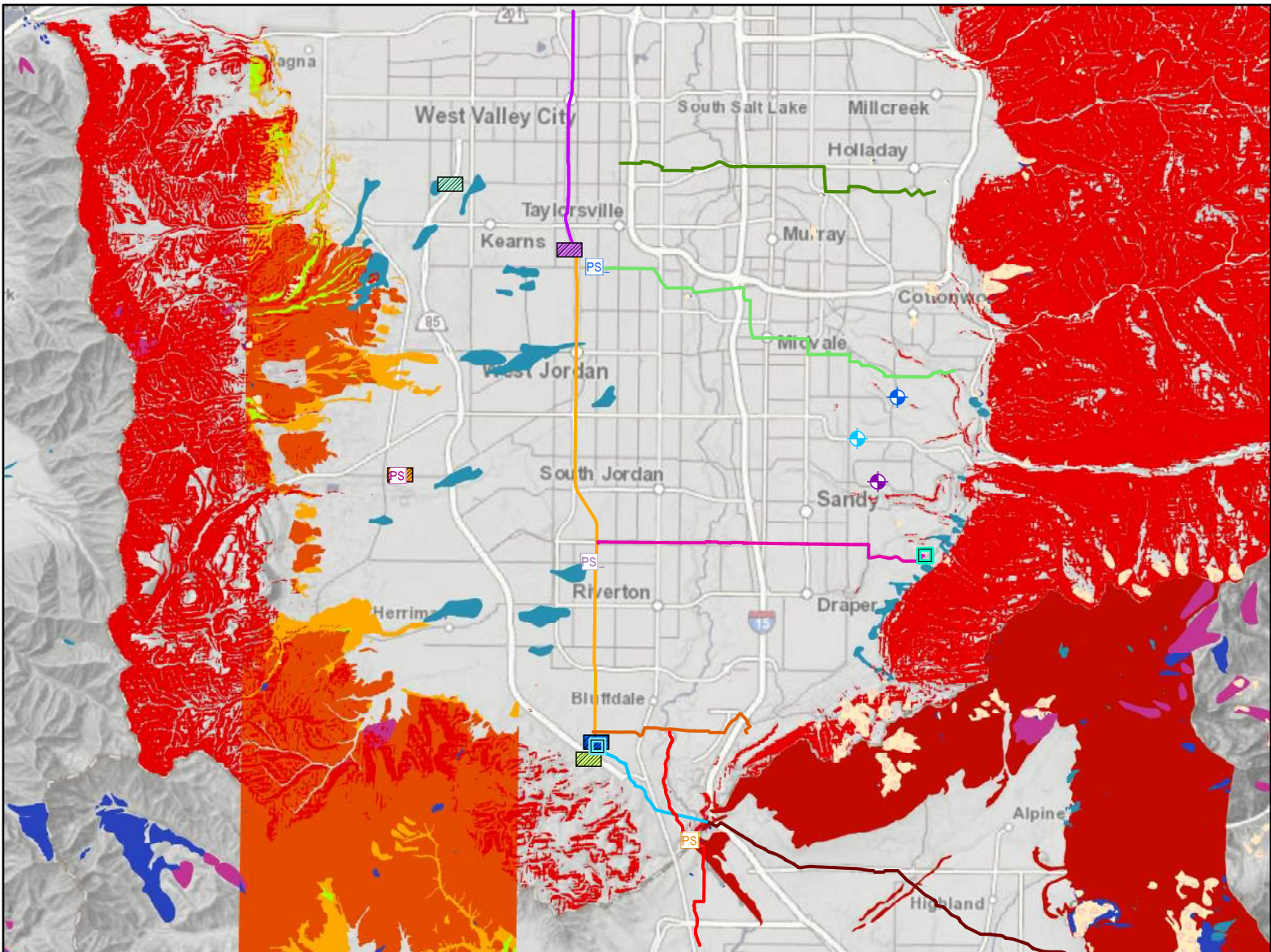
Basemap and Geologic Hazard Data provided by the State of Utah AGRC. Assets provided by the Client.



GeoStrata
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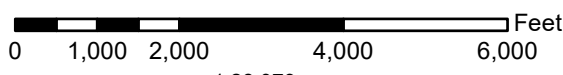
Geologic Hazards Assessment
Jordan Valley Water Conservatory District
Liquefaction Potential

Plate
G-3



Legend

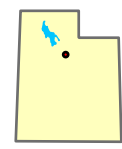
<p>Well</p> <ul style="list-style-type: none"> 1443 E. 9400 S Monitor Drive Newbury <p>Pump Station</p> <ul style="list-style-type: none"> 118th South Zone C 3200 W 6200 S Jordan Narrows Old Bingham 150th South Pipeline 11400 South Pipeline 24inch Cross Valley Pipeline Central Pipeline Creek Rd Pipeline 	<p>Water Treatment Plant</p> <ul style="list-style-type: none"> JWVWP : 180 MGD SERWTP : 20 MGD <p>Reservoir</p> <ul style="list-style-type: none"> JWVWP 8 MG JWVWP 1 MG Old Bingham 3 MG Tank Terminal Zone B North Reach-1 Jordan Aqueduct Reach-2 Jordan Aqueduct Reach-3 Jordan Aqueduct Reach-4 Jordan Aqueduct 	<p>Mapped Landslide & Landslide Hazards (UGS)</p> <ul style="list-style-type: none"> Mapped Landslides Greater than 30% Slope Mapped Landslide & Greater than 30% Slope High Moderate Low <p>Landslide Map of Utah (Elliot and Harty 2010)</p> <ul style="list-style-type: none"> deep or unclassified landslide landslide and/or landslide undifferentiated from talus, colluvial, rock-fall, glacial, and soil-creep deposits landslide undifferentiated from talus and/or colluvial deposits lateral spread and/or flow failure shallow landslide
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1:28,079

Basemap:

Basemap and Geologic Hazard Data provided by the State of Utah AGRC. Assets provided by the Client.

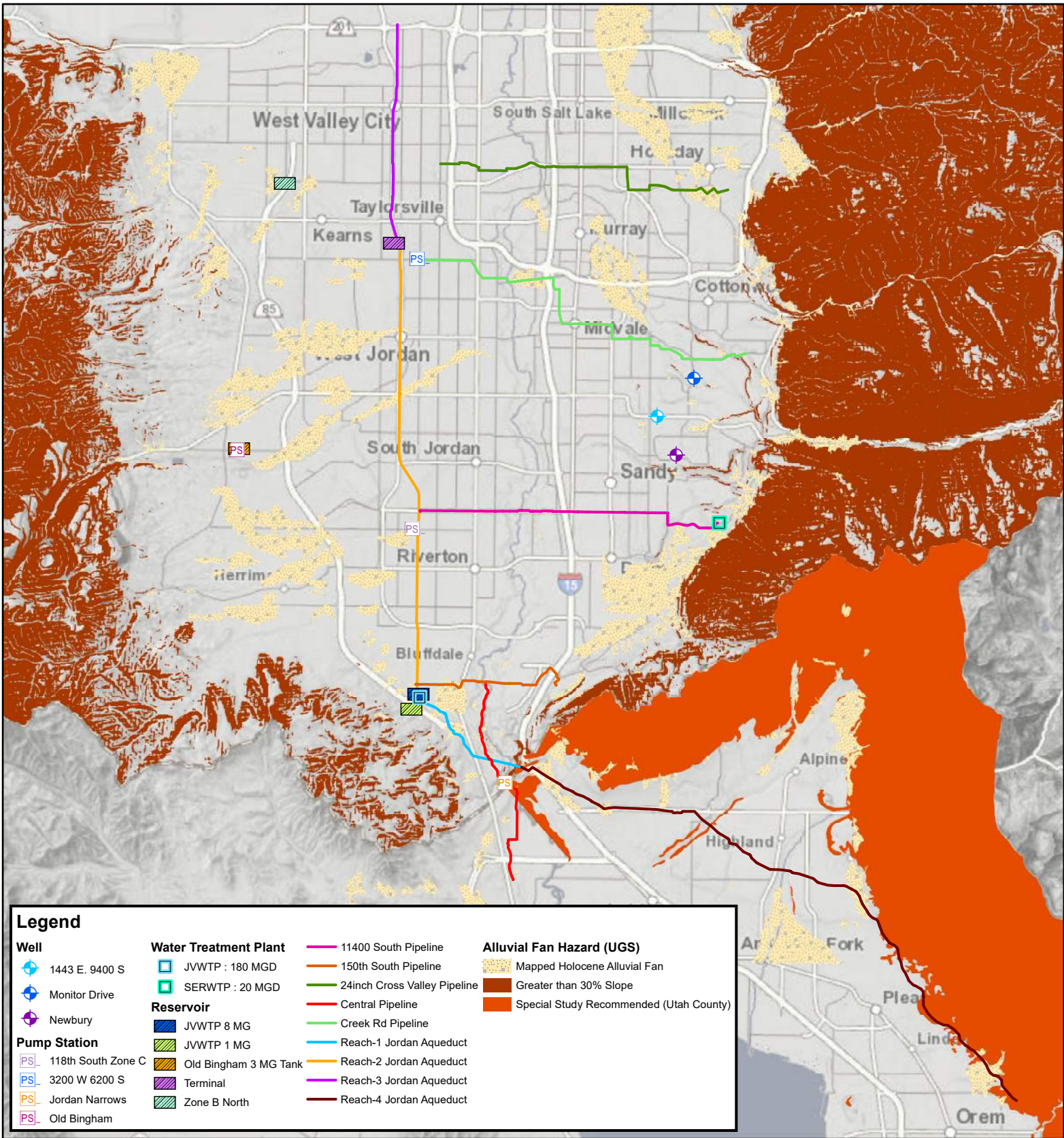


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Geologic Hazards Assessment
Jordan Valley Water Conservatory District

Landslide Hazard

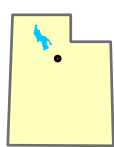
**Plate
G-4**



Legend

- | | | | |
|---------------------|------------------------------|------------------------------|---|
| Well | Water Treatment Plant | 11400 South Pipeline | Alluvial Fan Hazard (UGS) |
| 1443 E. 9400 S | JWTP : 180 MGD | 150th South Pipeline | Mapped Holocene Alluvial Fan |
| Monitor Drive | SERWTP : 20 MGD | 24inch Cross Valley Pipeline | Greater than 30% Slope |
| Newbury | Reservoir | Central Pipeline | Special Study Recommended (Utah County) |
| Pump Station | JWTP 8 MG | Creek Rd Pipeline | |
| 118th South Zone C | JWTP 1 MG | Reach-1 Jordan Aqueduct | |
| 3200 W 6200 S | Old Bingham 3 MG Tank | Reach-2 Jordan Aqueduct | |
| Jordan Narrows | Terminal | Reach-3 Jordan Aqueduct | |
| Old Bingham | Zone B North | Reach-4 Jordan Aqueduct | |

0 5,500 11,000 22,000 33,000 44,000 Feet
 1:215,000



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2018 1m NAIP aerial imagery and Geologic Hazard Data provided by the State of Utah AGRC. Assets provided by the Client.

Geologic Hazards Assessment
 Jordan Valley Water Conservatory District
Debris Flow Hazard

Plate
 G-5