ENGINEERING DESIGN STANDARDS

VOLUME 1

GENERAL DESIGN GUIDE

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LAS VEGAS VALLEY WATER DISTRICT

SOUTHERN NEVADA WATER AUTHORITY

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TABLE OF CONTENTS

		Page
	Disclaimer Notice	**v**
	Foreword	**vii**
Chapter 1	**Introduction**	**1-1**
1.1	Scope and Coverage	1-1
1.2	Order of Precedence	1-2
1.3	Inconsistencies Between Guidelines	1-3
Chapter 2	**General Administrative Guidelines**	**2-1**
2.1	Purpose	2-1
2.2	Project Administration	2-1
2.3	Design Process and Deliverables	2-1
2.3.1	Project Startup	2-2
2.3.2	60% Design Deliverables	2-3
2.3.3	100% Design Deliverables	2-3
2.3.4	Bid Set Deliverables	2-4
2.3.5	Conformed Set Deliverables	2-4
2.4	Interface between Work of Design Engineers	2-4
2.5	Deviations from Contract and EDS	2-5
2.6	Change Management	2-5
2.7	Public Outreach	2-5
2.8	Records Management	2-5
2.9	Sustainability	2-6
2.9.1	Climate Sensitivity	2-6
Chapter 3	**Project Schedule Guidelines**	**3-1**
3.1	Introduction	3-1
3.2	Project Cost/Schedule Control	3-1
3.2.1	Schedule Standards	3-1
3.2.2	Schedule Updates	3-1
3.3	Preliminary Construction Schedule	3-2
Chapter 4	**Cost Estimating Guidelines**	**4-1**
4.1	Introduction	4-1
4.2	Definition and Types of Cost Estimates	4-1
4.3	Types of Cost Estimates at Various Levels of Design	4-2
4.4	Cost Estimate Methodology and Reporting	4-3
4.5	Format Requirements of Cost Estimate	4-4
Chapter 5	**Quality Management Guidelines**	**5-1**
5.1	Introduction	5-1
5.2	General	5-1
5.3	Definitions	5-1
5.4	Quality Requirements	5-2

5.4.1 Requirements 5-2

Chapter 6 Land Acquisition Guidelines 6-1
6.1 Objective 6-1
6.2 ROW Definitions 6-1
6.2.1 Fee Simple Title 6-1
6.2.2 Public ROW 6-1
6.2.3 Easements - Private Landowners 6-2
6.2.4 Encroachment Permits (EP) – Utility Agencies 6-3
6.2.5 Bureau of Land Management (BLM) ROW Grants 6-3
6.2.6 Bureau of Reclamation (BOR) Right-of-Use 6-3
6.2.7 Patent Reservations 6-3
6.2.8 Condemnation/Eminent Domain 6-4
6.3 The Acquisition Process 6-4
6.3.1 Definition of Need 6-4
6.3.2 Authorization to Acquire and Coordinate with Design Engineer 6-5
6.3.3 Contact and Negotiation 6-5
6.3.4 Condemnation / Eminent Domain 6-5
6.3.5 Changes in ROW 6-5
6.4 Design Engineer's Role 6-5
6.4.1 ROW Plan Review 6-5
6.4.2 Acquisition Support 6-6
6.5 Construction Phase 6-6
6.5.1 Close Out 6-6

Chapter 7 Permitting and Utility/Agency Coordination 7-1
7.1 General 7-1
7.2 Environmental Compliance 7-1
7.3 Permitting Coordination 7-1
7.3.1 Responsibility 7-2
7.4 Agency Consultations 7-2
7.5 Utility Coordination and Consultations 7-3

Chapter 8 Drafting Standards and Local Standards 8-1
8.1 Drafting Standards 8-1
8.2 Guidance on Use of Local Standards 8-2
8.2.1 Use of Local Uniform Standards 8-2

Chapter 9 Bid Phase Guidelines 9-1
9.1 Bid Process 9-1
9.2 Bid Documents 9-1
9.3 Bid Phase Questions 9-2
9.4 Pre-Bid Conference and Site Tour 9-2
9.5 Addenda 9-2
9.5.1 Issuing Addenda 9-2
9.6 Bid Evaluation and Award of Contract 9-3

Chapter 10 Construction Phase Assistance 10-1
10.1 Attend Construction Progress Meetings 10-1
10.2 Respond to Requests for Information 10-1
10.3 Assist with Change Order Processing 10-1
10.4 Review Contractor Submittals 10-2
10.5 Provide Field Evaluation of Construction 10-2
10.6 Assist Claims Management 10-3
10.7 Provide Facility Integration and Testing Support 10-3
10.8 Provide Construction Record Drawings 10-3
10.9 Provide Project Closeout Support 10-3

Chapter 11 Surveying and Right-of-Way 11-1
11.1 General 11-1
11.2 Survey Provisions 11-2
11.3 Drawings 11-5
11.4 Legal Description Requirements 11-6

Chapter 12 Operation and Maintenance Manual Guidelines 12-1
12.1 O&M Manuals Submitted by Contractor 12-1

Chapter 13 Geotechnical Investigation 13-1
13.1 General 13-1
13.2 Investigative Methods 13-2
13.2.1 Soil Borings 13-2
13.2.2 Rock Evaluation 13-3
13.2.3 Test Pits 13-3
13.2.4 Survey of Explorations 13-4
13.2.5 Laboratory Testing 13-4
13.3 Investigations 13-4
13.3.1 Initial Investigation 13-4
13.4 Final Design Investigations 13-5
13.4.1 Pipeline Final Investigations 13-5
13.4.2 Site-based Facilities Final Investigations 13-6
13.5 Reports 13-8

Chapter 14 Hazardous Material Investigation 14-1
14.1 Potential Hazardous Materials 14-1
14.2 Preliminary Investigations 14-1
14.3 Follow-up Investigations 14-2
14.4 Remediation or Mitigation 14-2
14.4.1 Remove from Site 14-2
14.4.2 Treat Onsite 14-2
14.5 Permitting 14-3
14.6 Contract Documents 14-3
14.6.1 Dewatering 14-3

14.6.2 Trenching 14-3

Appendices

Appendix A Acronyms and Abbreviations A-1
Appendix B Definitions B-1
Appendix C Utility Coordinating Procedures C-1
Appendix D List of Standards D-1
Appendix E SNWA Adaptive Management Strategies for New & Existing Facilities E-1

List of Figures

Figure No. **Page**

11-1 Example Horizontal Control Sheet 11-8
11-2 Example Right-of-Way Sheet 11-9

DISCLAIMER NOTICE

The Owner has prepared and issued these Engineering Design Standards (EDS) to promote consistency and compatibility between Owner projects and inform Design Engineer of Owner preferences on certain issues. These EDS are not intended to supersede or abrogate the primary responsibility of each individual Design Engineer to produce a design product that complies with the terms of the applicable design agreement and appropriate standards of professional care and performance. In the event a Design Engineer disagrees with any provision of these EDS, the Design Engineer should advise the Owner's Design Manager and reach consensus on an appropriate resolution of the disagreement.

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FOREWORD

This document provides uniform design guidelines for facilities for the Las Vegas Valley Water District (LVVWD), Southern Nevada Water Authority (SNWA) and Springs Preserve, hereafter referred to as “Owner”.

The LVVWD is a not-for-profit utility that began providing water to the Las Vegas Valley in 1954. Today, the LVVWD water system connects more than 375,000 homes and businesses to the community's water supply through a vast network of service laterals, pipelines, pumping stations, and reservoirs. The LVVWD service area is approximately 300 square miles in size and includes metropolitan Las Vegas, areas of unincorporated Clark County, Blue Diamond, Coyote Springs, Jean, Kyle Canyon, Laughlin (Big Bend Water District), and Searchlight. The LVVWD aims to be a global leader in service, innovation, and stewardship. Its mission is to provide world class water service in a sustainable, adaptive and responsible manner to customers through reliable, cost-effective systems.

The SNWA was formed in 1991 to address southern Nevada's unique water needs on a regional basis. The SNWA is charged with acquiring and managing current and future resources for southern Nevada, constructing, and managing regional water facilities, and promoting water conservation. The SNWA is governed by a Board comprised of one director from each of its seven member agencies. These member agencies are:

- Boulder City
- Henderson
- Las Vegas
- North Las Vegas
- Big Bend Water District
- Clark County Water Reclamation District
- LVVWD

The LVVWD serves under contract as the operating agent for the SNWA.

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CHAPTER 1
INTRODUCTION

These Engineering Design Standards (EDS) create the framework for designing projects under the Design-Bid-Build process for Las Vegas Valley Water District (LVVWD), Southern Nevada Water Authority (SNWA) and Springs Preserve, hereafter collectively referred to as the Owner. Projects using alternative delivery methods (Construction Management At-risk, Design-Build, Integrated Project Delivery, Public-Private Partnership, etc.) may use the EDS for guidance but the Owner's appointed representative will provide direction on which sections of the EDS will not apply.

For Engineering Projects, design is administered by the Owner's Engineering Department and construction is performed by an outside contractor.

For Maintenance Engineering Projects, design is administered by the Owner's Infrastructure Management Department. Construction may be performed by outside contractor or in-house personnel, and equipment is pre-purchased by Owner more often than for Engineering Projects.

The EDS generally describe Engineering Projects, with any exceptions for Maintenance Engineering Projects.

The Owner will appoint a representative to oversee the design, referred to as the Design Manager. The Owner will also select an Engineer of Record to design the project and provide support through the bid and construction phase, referred to as the Design Engineer. The Design Engineer may be a member of the Owner's staff or an external consultant.

The purpose of the EDS is to establish uniformity in design concepts, formats, methodologies, procedures, and quality of work products that are produced by Design Engineers. The Owner has a significant investment in its treatment, transmission and distribution facilities and where possible desires to use the same equipment, appurtenances, materials, etc., to simplify operating logistics, minimize spare parts inventory, and make administration, management, and review of the design packages more efficient. Notwithstanding, the EDS are not intended to stifle creativity, design innovation, and ingenuity of Design Engineers. Design Engineers are required to review these EDS and adapt them for design of the facilities for which they are responsible with the above stated objective(s) in mind. It is important to note that Design Engineers are ultimately responsible for their design efforts, and this responsibility is in no way transferred, diluted, or absolved by these EDS.

1.1 SCOPE AND COVERAGE

The EDS are divided into volumes. They are:

- Volume 1 – General Design Guide
- Volume 2 – Drawing Standards Guide
- Volume 3 – Construction Document Guide (not published; will include both front-end and technical specifications)
- Volume 4 - Pipeline Design Guide (24 inches and smaller diameter) (is UDACS)
- Volume 5 – Pipeline Design Guide (greater than 24 inches diameter)
- Volume 6 – Pumping Station Design Guide
- Volume 7 – Reservoir Design Guide
- Volume 8 – ROFC Design Guide
- Volume 9 – Well Design Guide
- Volume 10 – Electrical Design Guide
- Volume 11 – Instrumentation and Control Design Guide
- Volume 12 – Disinfection Design Guide
- Volume 13 – Pressure Reducing Valve Design Guide

The intent is that Volumes 1-3 will be applicable to all projects. Additionally, any of Volumes 4-13, along with the Scope of Work (SOW) document, will provide Design Engineers with sufficient basis to complete design in accordance with Owner requirements and preferences.

1.2 ORDER OF PRECEDENCE

The Owner will provide the latest revision of the EDS to Design Engineers, along with the SOW for their respective projects and facilities. Although inconsistencies and conflicts between these documents should be minimal, their existence cannot be ruled out completely. When such inconsistencies and conflicts are discovered by Design Engineers, they are to be brought to the immediate attention of the Design Manager. The SOW takes precedence over the EDS.

The Design Engineer should be aware of design requirements meeting Nevada Revised Statutes (NRS), especially NRS 445A – Water Controls, Nevada Administrative Code (NAC) and other regulations. EDS and SOW are generally more stringent than NRS and NAC. In situations where EDS is less stringent than the NRS regulations, the Design Engineer shall consult the Owner for guidance.

A list of standards is shown in Appendix D – List of Standards.

1.3 INCONSISTENCIES BETWEEN GUIDELINES

If the Design Engineer identifies inconsistencies in the EDS or if inconsistencies should develop during design (necessitated by site-specific and/or project-specific considerations and constraints), they are expected to immediately notify the Design Manager with their findings and propose recommendation(s) to resolve the inconsistency. As stated above, Design Engineers are ultimately responsible for their designs and shall resolve all conflicts, inconsistencies, errors, and omissions in the EDS to ensure that their designs meet the required professional standard of care.

CHAPTER 2
GENERAL ADMINISTRATIVE GUIDELINES

2.1 PURPOSE

The EDS provide general administrative and technical guidelines to be followed by Design Engineers preparing detailed designs and Contract Documents. The EDS also describe the relationships between the Design Engineer and the Design Manager and provide a degree of standardization for the design process of each type of facility the Owner constructs and operates. The Agreement for design will include a detailed SOW, which includes specific administrative requirements. The EDS supplement the SOW. The designs of these facilities shall be based on the SOW and EDS. Additional documents and criteria developed during the conceptual and/or preliminary design phases also serve as a basis for design. This chapter also describes the expected deliverables and guidelines.

2.2 PROJECT ADMINISTRATION

The Owner will designate a Design Manager to administer and act as the main point of contact on the project. In addition to the provisions of the Agreement between the Owner and the Design Engineer, the Design Manager will use the EDS, of which this chapter is a part, for guidance in administering the project. These EDS provide a basis for uniformity of format, methodology, procedures, and quality of work products. The Design Engineer, their staffs, and subconsultants are expected to familiarize themselves, in detail, with these guidelines. Review of work products by the Owner does not relieve the Design Engineer of full responsibility for its work in accordance with its contract agreement with the Owner.

2.3 DESIGN PROCESS AND DELIVERABLES

The Design Engineer shall provide deliverables at the 60% and 100% level of design, and at Bidding phase. The minimum requirements for each deliverable are listed below. Additional submittals, if any, will be listed in SOW. Should deliverables not listed be required to complete the design, the Design Engineer shall include said deliverables with each submittal. Digital copies (PDF, AutoCAD, Word) are required for all deliverables. Hard copies may also be required.

Design deliverables shall be submitted as a complete package even if a document is not revised from the previous submittal: for example, should the Design Report have no changes between the 60% and 100% deliverable, the 60% Design Report shall be submitted with the 100% deliverable. The SOW will include the expected schedule of deliverables required to meet the project delivery date; the Design Engineer will make updates to the schedule in accordance with Chapter 3 - Project Schedule Guidelines.

Contract Documents include Specifications and Drawings. The standard specifications will be part of future Volume 3 - Construction Document Guide. The Design Engineer shall

be responsible for reviewing and modifying the standard specifications as necessary to meet the specific requirements of the project. Standards for Drawings are outlined in Chapter 8 - Drafting Standards of this Volume 1 and Volume 2 – Drawing Standards Guide.

All stamps, seals, and signatures shall be per regulations NRS 625.610 and 625.611. The Design Engineer's PE stamp may be digitally placed as a project specific attribute. Owner signature blocks shall be set up as signature fields when digital signatures are used on the Bid Set submittal. Signatures for all relevant agencies should be located on the appropriate general sheet and each sheet within the drawing set should be signed and sealed by the design engineer in responsible charge of that discipline.

The Owner will review each submittal, perform constructability review if the project's construction cost exceeds $10 Million and provide comments. Unless otherwise stated, the Design Engineer shall schedule an Owner's review period of 4 weeks. During the review period, the Design Engineer may only work on specific scope with the consent of the Design Manager. The Design Engineer will respond to each comment and note if the comment will be incorporated, provide reason(s) for not implementing, or reason(s) for implementing an alternative solution. Responses to comments should be completed within 2 weeks. Review of work products by the Owner does not relieve the Design Engineer of full responsibility for its work in accordance with its Contract.

The frequency of design progress meetings should be appropriate to the complexity of the project. Unless otherwise noted, design progress meetings will be held monthly. The Design Engineer will take notes and document action items and major decisions from each meeting. The Design Engineer's SOW also includes special meetings with the Owner to resolve potential conflicts, disagreements on comments, and other matters that can significantly delay and/or increase the cost of the project.

2.3.1 Project Startup

Upon Notice to Proceed (NTP) but prior to kickoff, Project Management Plan (PMP) may be required as dictated in SOW. For Maintenance Engineering Projects a less detailed PMP may be required. After the PMP has been submitted, a project kickoff meeting shall be held at the Owner's office. The meeting is to introduce team members, establish lines of communication, and ensure that project correspondence and invoices will be properly routed. The meeting shall cover topics most likely to delay or otherwise negatively impact the project. All key Design Engineer personnel shall attend. The Design Manager and Owner's project engineer, Permits Coordinator, public information officer, and accounting representative shall attend.

2.3.2 60% Design Deliverables

The 60% submittal provides detail on all major features such that constructability review can be performed. Refer to the SOW for all required information. Deliverables may include:

- Digital copy (PDF, AutoCAD, Word) of all documents. Specifications shall include Word documents with revisions completed using “Track Changes”
- Draft Design Report with key design calculations, list of Major Equipment including preferred supplier(s)
- Draft Complete set of Contract Documents (Drawings and Specifications)
- Draft Construction Cost Estimate per Chapter 4 - Cost Estimating Guidelines
- Draft Schedule per Chapter 3 - Project Schedule Guidelines

For Maintenance Engineering Projects, the 60% Submittal shall include applicable specifications and standard drawings; other drawings are not required unless right-of-way must be obtained.

Note that the lead time to obtain Owner-furnished items may necessitate an accelerated schedule to procure by the start of construction. For such cases the associated documents are to be delivered when ready and not held for subsequent deliverables to be completed.

2.3.3 100% Design Deliverables

The 100% deliverable is to be a complete set of Contract Documents. While it is understood that revisions will be required, the design engineer should not have to perform major revisions or make significant additions in preparing the Bid Set submittal. Proposed easements and land acquisitions need to be in final form with the 100% submittal. Refer to the SOW for all required information. Deliverables may include:

- Digital copy (PDF, AutoCAD, Word) of all documents. Specifications shall include Word documents with revisions completed using “Track Changes”
- Final Design Report, including all final calculations, documentation of equipment selection, etc., if requested
- Final Contract Documents (Drawings and Specifications), including Bidding Documents
- Procurement documents for any Owner-furnished items
- Final Construction Cost Estimate
- Final Schedule
- Liquidated Damages Memorandum. This shall estimate the Owner’s additional daily costs to administer the construction contract, operate the system, interest to bond the project, plus any other incidental costs. The amount of liquidated damages in the Contract Documents shall equal the estimate in the memorandum, or as agreed to by the Owner.

For Maintenance Engineering Projects, final specifications and updates to all previous submittals are required. Drawings are required as part of the Contract Documents if the project is to be bid.

2.3.4 Bid Set Deliverables

The Bid Set incorporates minor updates from the 100% submittal and includes the complete set of Contract Documents. Refer to the SOW for the complete list of items required with the Bid Set. Deliverables may include:

- Digital copy (PDF, ACAD, Word) of all Contract Documents (Drawings, Specifications)
- Hard copy (signed and sealed) of Contract Documents (Drawings, Specifications)
- Updated Final Construction Cost Estimate
- Updated Final Schedule

2.3.5 Conformed Set Deliverables

The Conformed Set incorporates updates from addenda, request for clarifications, bid questions during the bid process and includes a complete set of Contract Documents. Refer to the SOW for the complete list of items required with the Conformed Set. Deliverables may include:

- Digital copy (PDF, ACAD, Word) of Contract Documents (Drawings, Specifications)
- Hard copy (seals removed and "conformed stamp" added) of Contract Documents (Drawings, Specifications).

2.4 INTERFACE BETWEEN WORK OF DESIGN ENGINEERS

Since the Owner may select multiple Design Engineers for the design of various facilities, it is important that those selected for the design of adjacent facilities work closely with each other so that the completed facilities are functional and ready for operation immediately upon completion of construction. Such occasions will be called out in the SOW. For example, the Design Engineer for a particular pumping station must coordinate its design effort with the Design Engineer for the pipeline connecting the pumping station to assure that facility interfaces are not a cause for schedule delays or unexpected costs. Design Engineers must work closely with the Design Managers to ensure these interfaces are carefully thought out and planned.

In some circumstances, it may not be possible to predict which construction contract will be completed first. In such cases, the Design Engineers are expected to provide flexibility in their design(s) to be able to add or delete the construction work associated with the above-described connection between the two projects, depending upon the timing of construction. One way to accomplish this objective is to provide a separate item in the bid schedule of each related design package covering this item of work. Depending upon the timing of construction, the decision could be made to include or delete this item from one or the other construction contract at a price bid by the respective contractor in its bid schedule. It is important, however, that the scope of this item of work be clearly defined

in the Contract Documents so that the cost of the item does not have to be negotiated after award of the construction Contract.

The Design Engineer may choose to refer to preliminary work done by Owner as part of a planning effort for identifying interface requirements.

2.5 DEVIATIONS FROM CONTRACT AND EDS

The EDS, SOW, and any Predesign Reports are considered baseline configuration documents. When the Design Engineer believes an alternative solution not in accordance with the EDS and SOW is preferable, the finding shall be promptly communicated to the Design Manager. Minor changes that will not impact facility operations, increase cost by less than 2% of preliminary construction cost, or add less than 30 calendar days to project completion should not be considered deviations and may be decided solely by the Design Manager.

For significant deviations, the Design Engineer and Design Manager will agree on a meeting time with appropriate personnel present to expeditiously determine the path forward that best satisfies the Owner's needs. The Design Engineer will prepare descriptions of feasible alternatives with the advantages and disadvantages of each, including probable schedule and life-cycle cost impacts, so stakeholders can make an informed decision.

2.6 CHANGE MANAGEMENT

The Design Engineer is responsible for detecting impending deviations from the scope, schedule, or budget. When a potential need for change is identified, the Design Engineer shall promptly notify the Design Manager so appropriate action can be taken. Written approval for changes to contractual requirements must be obtained from the Design Manager before the changes are implemented.

2.7 PUBLIC OUTREACH

The Design Engineer will support the Design Manager in preparing exhibits for public meetings and materials to be distributed to the public as described in the SOW. The Owner's Public Information staff will attend meetings with public entities, and homeowner's associations, as necessary to acquire necessary approvals of the project. The Design Engineer or designee shall be invited to attend any meetings.

2.8 RECORDS MANAGEMENT

The Design Engineer will develop a document control system that ensures that documents and deliverables generated by the design team can be easily and cost effectively retrieved. When required, project documents shall use the appropriate Work Breakdown Structure (WBS) activity number, as defined in the Project SOW, as the reference number.

2.9 SUSTAINABILITY

The Owner has developed adaptive management strategies for new and existing facilities for sustainability (see **Appendix E**). Design Engineer shall consider sustainability throughout the project phases, planning, design, construction, and operation of facilities by following Institute for Sustainable Infrastructure's (ISI) Envision. Envision v3 is a tool that guides the project for resilient and sustainable infrastructure. It includes 64 sustainability criteria (or credits) which fall under five categories:

- Quality of Life (well-being, mobility, community)
- Leadership (collaboration, planning, economy)
- Resource Allocation (materials, energy, water)
- Natural World (siting, conservation, ecology)
- Climate and Resilience (emissions, resilience)

2.9.1 CLIMATE SENSITIVITY

The Design Engineer shall consider climate sensitivity during Project Initiation, SOW Development, and Design, understanding that climate change is projected to increase the frequency and intensity of extreme heat and precipitation in the future. For the facilities to withstand extreme heat and intense rainfall, the Design Engineer shall consider design criteria, that are best suited for the future climate conditions expected over the life of the facility. Examples of applicable design criteria are:

- Using light colored materials and coatings on all exterior surfaces
- Using light colored and reflective surfaces for roofs
- Using light colored pavements
- Orientating and designing buildings to minimize heat gain
- Planting trees and vegetation to keep facilities cool
- Installing solar panels for shading and generating energy
- Providing backup power supply
- Providing resilient or redundant SCADA communications with critical facilities
- Providing redundant HVAC systems designed to anticipated future climate parameters
- Selecting equipment that can operate under high temperature conditions within their lifespan
- Including instrumentation to monitor climate conditions and equipment performance; and
- Providing open spaces and permeable surfaces for stormwater management.

Criticality of the project and the project cost shall determine further evaluation of climate risk and cost/benefit analysis of alternative design. Critical components shall always be protected.

CHAPTER 3
PROJECT SCHEDULE GUIDELINES

3.1 INTRODUCTION

Chapters 3 and 4 of the EDS establish general project control guidelines for schedule and construction cost estimating to be followed by the Design Engineer. These sections also describe the necessary controls to be applied toward bid and construction activities during the design phase.

Each Design Engineer must schedule, monitor, and control the work under contract in conformance with these guidelines and the SOW. While each Design Engineer is expected to use their own system of control, there are basic elements, which the Owner expects each Design Engineer to manage and to report upon each month. All participants in this program shall report in accordance with the project WBS or Activity Code as defined in the SOW.

3.2 PROJECT COST/SCHEDULE CONTROL

The Design Engineer will prepare a detailed project schedule including design activities and sub-activities using the WBS and milestones, including project deliverables and QA/QC Reviews. Sufficient detail is required to determine whether project design is on schedule and budget. The following guidelines and the SOW specify the detailed requirements to be met.

3.2.1 Schedule Standards

For Engineering Projects, the design schedule will be in the form of a Gantt (bar) chart and reports, which may be divided into a number of separate pages with suitable notations relating the interface points among the pages.

Notation on each design sub-activity will include a brief work description, start, and finish dates, a duration estimate, and a budgeted cost. Each activity and sub-activity shall be plotted so that the beginning and completion dates of said activity can be determined graphically by comparison with the calendar scale. The duration estimate for each activity and sub-activity shall be computed in working days and will represent the single best estimate considering the SOW and resources planned for the activity. Owner review periods for design submittals will be a minimum of 4 weeks.

For Maintenance Engineering Projects, a milestone schedule containing durations for design/specification, procurement, and construction is sufficient.

3.2.2 Schedule Updates

For Engineering and Maintenance Engineering Projects, the Design Engineer will update the schedule monthly and submit with the monthly invoice.

3.3 PRELIMINARY CONSTRUCTION SCHEDULE

For Engineering and Maintenance Engineering projects, the Design Engineer's submitted schedule will include preliminary timeframes for bid, award, and construction activities. The initial submittal may include the Owner's anticipated schedule but subsequent updates shall reflect the better understanding of the timeframes needed from bid through completion of construction. The preliminary construction schedule shall be the basis for determining milestones in the Contract Documents.

CHAPTER 4
COST ESTIMATING GUIDELINES

4.1 INTRODUCTION

This chapter establishes general cost estimating guidelines to be followed by the Design Engineer in preparing project cost estimates during the design phase of capital projects. The intent is to set standards in the development of the cost estimates to achieve consistency and the expected level of accuracy, and to facilitate review by various participants. Design Engineers are expected to prepare estimates consistent with practices set forth by the American Association of Cost Engineers International (AACE). Design Engineers need to be aware that cost estimates are prepared primarily for internal use and are to be treated with reasonable confidentiality; distribution is typically only to the Owner and Design Engineer staff.

Owner developed cost estimates and past projects cost data is available for reference.

4.2 DEFINITION AND TYPES OF COST ESTIMATES

The Owner uses the AACE Cost Estimates Classes to define the level of detailed required with each submittal. The definitions from AACE are included below.

- CLASS 5 ESTIMATE
  (Typical level of project definition required: 0% to 2% of full project definition.)
  Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. As such, some companies and organizations have elected to determine that due to the inherent inaccuracies, such estimates cannot be classified in a conventional and systemic manner. Class 5 estimates, due to the requirements of end use, may be prepared within a very limited amount of time and with little effort expended. Class 5 estimates are prepared for any number of strategic business planning purposes, such as but not limited to market studies, assessment of initial viability, evaluation of alternate schemes, project screening, project location studies, evaluation of resource needs and budgeting, long-range capital planning, etc.

- CLASS 4 ESTIMATE
  (Typical level of project definition required: 1% to 15% of full project definition.)
  Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Class 4 estimates are prepared for a number of purposes, such as but not limited to, detailed strategic planning, business development, project screening at more developed stages, alternative scheme analysis, confirmation of economic and/or technical feasibility, and preliminary budget approval or approval to proceed to next stage.

- CLASS 3 ESTIMATE
  (Typical level of project definition required: 10% to 40% of full project definition.)
  Class 3 estimates are generally prepared to form the basis for budget authorization, appropriation, and/or funding. Class 3 estimates are typically prepared to support full project funding requests and become the first of the project phase "control estimate" against which all actual costs and resources will be monitored for variations to the budget. They are used as the project budget until replaced by more detailed estimates. In many owner organizations, a Class 3 estimate may be the last estimate required and could well form the only basis for cost/schedule control.

- CLASS 2 ESTIMATE
  (Typical level of project definition required: 30% to 75% of full project definition.)
  Class 2 estimates are generally prepared to form a detailed control baseline against which all project work is monitored in terms of cost and progress control. For contractors, this class of estimate is often used as the "bid" estimate to establish contract value. Class 2 estimates are typically prepared as the detailed control baseline against which all actual costs and resources will now be monitored for variations to the budget and form a part of the change/variation control program.

- CLASS 1 ESTIMATE
  (Typical level of project definition required: 65% to 100% of full project definition.)
  Class 1 estimates are generally prepared for discrete parts or sections of the total project rather than generating this level of detail for the entire project. The parts of the project estimated at this level of detail will typically be used by subcontractors for bids, or by owners for check estimates. The updated estimate is often referred to as the current control estimate and becomes the new baseline for cost/schedule control of the project. Class 1 estimates may be prepared for parts of the project to comprise a fair price estimate or bid check estimate to compare against a contractor's bid estimate, or to evaluate/dispute claims. Class 1 estimates are typically prepared to form a current control estimate to be used as the final control baseline against which all actual costs and resources will now be monitored for variations to the budget and form a part of the change/variation control program. They may be used to evaluate bid checking, to support vendor/contractor negotiations, or for claim evaluations and dispute resolution.

4.3 Types of Cost Estimates at Various Levels of Design

For capital improvements, the following types of cost estimates shall be provided to the Owner at the indicated design completion points:

- 60% submittal: Class 3
- 100% submittal: Class 2
- Bid Set submittal: Class 2

Updates after 100% submittals are not required unless a significant change in contractor scope has been made. The most recent cost estimate will be submitted with the Pre-final and Bid Set submittals. Construction cost estimates should be packaged along with each respective design submittal.

For Maintenance Engineering Projects, a Class 2 estimate focusing on major equipment piece(s) is required. A spreadsheet with design, procurement, administrative, equipment, and labor unit and net costs is sufficient; narrative reports are not required.

4.4 COST ESTIMATE METHODOLOGY AND REPORTING

The Design Engineer shall document the basis of the construction cost estimate. This should include, for each estimate prepared, lists of drawings and specifications, quantities/takeoffs, equipment lists, qualifications, assumptions, inclusions, exclusions, and a narrative to properly define the respective cost estimate with respect to the current design completion and construction approach used in developing the cost estimate. For example, it is expected that the 60% design cost estimate may base the cost of electrical and instrumentation and controls as a percent of construction cost for the individual processes or areas. However, 100% and (if required) subsequent Plans and Specifications cost estimates will be based on detailed quantity takeoff and pricing for electrical and instrumentation and controls.

When recent local unit cost data is limited, unit costs should use the following cost components as a basis for estimating costs:

- Labor
- Material
- Equipment
- Subcontracts
- Other Contractor costs

The following are reasonable examples of cost basis:

- In-house historical unit cost rates from similar completed projects.
- R.S. Means cost database index for concrete, site work and mechanical, etc., for unit labor costs
- Quotation from noted fabricator/supplier with date
- Quotation from turnkey contractor or supplier with date and estimated installation (labor) and operator training requirements
- AACE Guide to Cost Estimating
- Attached details, sections, and sketches utilized to perform typical quantity takeoffs
- Construction equipment costs obtained from the “Contractor’s Equipment Cost Guide”, published by Dataquest.

The Design Engineer is expected to provide a quantity takeoff with each applicable cost estimate and define the unit cost (pricing) data used to calculate/extend the respective

line items. It is expected that the quantity takeoff will be adjusted between the initial and final cost estimates. For pricing, the Design Engineer may use industry cost databases or may use estimates of unit costs developed specifically for the project, although when available, recent local data is preferred. It is critical that the Design Engineer clearly define their cost sources on which the pricing was based. This includes indirect costs, and direct costs for labor, material, equipment, subcontractors, suppliers, escalation, and sales tax.

When directed by the Owner, the Design Engineer is expected to identify all major material and equipment costs with supporting written price quotations from suppliers included as backup to each estimate. These quotations are to be supplied in written form by manufacturers and/or suppliers. Minor equipment costs may be documented by written telephone quotations. All backup information shall be sorted in the order used in the estimate. An index shall be provided identifying the support material.

The Design Engineer will summarize the differences in methodologies and cost between previous estimates and provide an explanation for any line item deviating greater than 10% from the previous cost estimate, and the net estimate. The format of the cost estimate will allow for detailed as well as summary presentation of the project costs. It is expected that the breakdown of cost will facilitate review and comments of the Plans and Specifications. The Design Engineer may be required to participate in Cost Estimate Review Meetings with the Owner if the estimate varies significantly from the estimate in the Scope of Work.

The cost estimate shall include an assessment of the difficulties inherent in the specific construction work. This will include but is not limited to such factors as: labor conditions, construction equipment, construction supervision, material costs and equipment installation costs. All reasonable costs, which a contractor is expected to incur, shall be included.

4.5 FORMAT REQUIREMENTS OF COST ESTIMATE

The format of cost estimate will allow for detailed as well as summary presentation of the project costs. For Bid purposes the cost estimate shall be in accordance with Specification Section 00 41 05 Bid Form and Section 01 20 00 Measurement and Payment Procedures.

CHAPTER 5
QUALITY MANAGEMENT GUIDELINES

5.1 INTRODUCTION

The purpose of these Quality Guidelines is to communicate the goals, responsibilities, and the minimum acceptable procedures to each Design Engineer so that the appropriate emphasis on quality can be planned and budgeted into the project. The Design Engineer must understand its requirements before budget negotiations are undertaken. The EDS, including the Quality Guidelines, are incorporated by reference into the Design Engineer's contract as part of SOW (Exhibit A of the PSA).

5.2 GENERAL

Quality is generally defined as performing to the contract, and means meeting the project objectives (scope), schedule, and budget for the project. The principal aspects of quality management for a project are:

- Prepare project management and quality control plans that detail how the project will be undertaken and completed, and implement the plans
- Ensure that the design is completed on time and within budget by effectively monitoring progress and implementing corrective action when necessary
- Ensure that the project supports the Owner's goals by providing technical review of the design
- Ensure the accuracy of design through a rigorous checking of design calculations, drawings, and specification language.

Quality is expected to be a continuous part of the design to ensure project goals are met; a reliance on quality checks is insufficient.

5.3 DEFINITIONS

Quality Control: a series of activities performed by a party to ensure its product meets established standards.

Quality Assurance: a series of activities, performed by an external party, as a check on the quality of the external party's product.

By the above definitions, the Design Engineer performs quality control (QC) on its design and the Owner perform quality assurance (QA). While checking of the product prior to submission is part of the QC process, proactive measures to ensure the product meets agreed upon goals are expected. QA is by nature more reactive.

5.4 QUALITY REQUIREMENTS

Each party in the design process must understand its responsibility for quality.

The Design Engineer is solely responsible for the quality of services it provides, and the construction Contract Documents it prepares. These services include performing QC reviews prior to submitting each deliverable.

The Design Manager performs timely QA, monitoring the Design Engineer's efforts and reviewing deliverables including constructability review as required.

Constructability review – this shall include comment on potential problems that may make construction risky, more expensive, or create operational concerns.

5.4.1 Requirements

The Design Engineer shall have either a written quality management procedure describing the roles for its personnel or a project-specific quality management plan. When the procedure is used to satisfy quality requirements, the Design Engineer shall submit in writing the names of personnel performing each role. The principal elements that must be included in the quality plan or procedure include:

- Quality must be planned, budgeted, and scheduled into the project. The procedure/plan will specify how each member of the design team, including any subconsultants, is responsible for quality of work and how the project manager will monitor the work to ensure required quality. A task with budget dedicated to quality reviews conducted prior to each design submittal shall be included in the Design Engineer's SOW. The budget shall only be used for QC reviews. The project schedule shall contain sufficient time for all quality reviews.

- The Design Consultant must ensure quality procedures are implemented during the design process. This includes use of project controls such as schedule and cost estimating to monitor progress and project progress. Additionally, individuals must document all work thoroughly so it can be checked. Assumptions must be written down, with appropriate references if applicable, calculations must be shown, and the input parameters to computerized programs must be listed. All documentation must be arranged in a logical fashion for easy review. Preprinted calculation sheets normally used by the Design Engineer shall be used. The individual performing the work shall sign each sheet and date it. All technical work must be checked, and the initials of the checker and date of checking must also be added to each page. Note that all documentation for sizing of facilities or selecting equipment should be included in the Final Design Report with each deliverable as described in Chapter 2 of this Volume.

- Reviews prescribed in Chapter 2 of this volume and the written quality procedure/plan shall be performed and documented.

- The quality plan will prescribe how to take corrective action should it be necessary.

QC reviews shall be consistent with the design process described in Chapter 2 and include the following:

- An independent (not actively involved with the design team) Subject Matter Expert (SME) shall review deliverables to ensure the design satisfies the project needs. The SME shall review deliverables early in the project to eliminate the need for rework resulting from inaccurate conceptual work.

- Review of design calculations, specification language, and drawings for accuracy.

The Design Engineer shall ensure that review comments are considered by, and responded to, by appropriate design staff who define in writing the actions to be taken. The Design Engineer shall also check that the stated responses to comments are implemented.

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CHAPTER 6
LAND ACQUISITION GUIDELINES

6.1 OBJECTIVE

The following summarizes, in general, the land acquisition process for Owner projects and describes the role and responsibility of the Design Engineer. The Owner's Right-of-Way (ROW) Team will appoint a ROW Agent at design kickoff to acquire any required ROW for the project.

Owner facilities must be located on property for which Owner has appropriate land rights. Those rights may include acquiring parcels owned in fee, PEs, federal ROW grants, right-of-use, patent easements, encroachment permits, or other similar rights. To aid in construction, temporary easements and/or staging areas may be required to be obtained.

All projects that may require the acquisition of land rights, permanent and/or temporary, are acquired by Owner's ROW Agent. The Design Engineer will work closely with the ROW Agent to determine the placement of the facilities and ROWs required and provide the ROW Agent with technical support, engineering drawings, maps, and exhibits, and when necessary, attend meetings held with the landowner.

6.2 ROW DEFINITIONS

The following describe the typical types of property rights acquired.

6.2.1 Fee Simple Title

Purchasing property in Fee Simple Title is the highest possible ownership interest that can be held in real property, entitling the landowner to use the property in any manner consistent with federal, state, and local laws and ordinances. Should a site-based facility (reservoir, pumping station, well, rate of flow control station, etc.) be located on privately owned property, the property will be acquired in fee simple title.

6.2.2 Public ROW

Public ROW is property that is dedicated to public use, such as streets. The use of existing or future public ROW is preferred for pipelines but it is rarely available for pipeline appurtenances or site-based facilities. Where existing public ROW is not available, another type of ROW is required for project facilities.

6.2.3 Easements - Private Landowners

6.2.3.1 Permanent Easement (PE)

A PE is a right, privilege, or interest in real property that one has in the land of another. The easement document identifies the purpose of the easement and any stipulations

relating thereto. The easement holder is entitled to do specific things, like construct, operate, and maintain such facilities; however, ownership of the property and responsibility to maintain the surface remains with the landowner.

There are two types of PEs: Exclusive and Non-Exclusive Easement. Each type will run in perpetuity.

- Exclusive Easements are exclusive to the acquiring party, restrict future uses within the easements, and prevent the current and any future landowner from granting other easements without acquiring party's written permission. Exclusive easements are acquired for transmission pipelines when located outside of future streets. All commercial, multi-family, and condo properties require exclusive easements for PRV's, AV/AR's, backflows, meter vaults, and other above ground facilities.

- Non-Exclusive Easements are not exclusive to the acquiring party; therefore, the underlying landowner may use the easement area as long as it does not interfere with the acquiring party's right of use or for the purpose of which the easement was granted. The Non-Exclusive easement may be used within the common elements of residential subdivisions for domestic and landscape meters, and for distribution pipelines that will be located in private streets or where a future street dedication is planned.

For planning purposes, PEs for pipelines greater than 24 inches in diameter shall have a minimum of 50 feet wide in developed areas and 75 feet wide in undeveloped areas. However, the width should be adjusted based on the total width needed for pipe diameter, depth of pipe, appurtenances, construction activities, maintenance access roads, topographic features, and operation and maintenance requirements. On Federal Lands, PE widths are also balanced against environmental mitigation requirements of the agency, so a wider PE may be necessary for operation and maintenance and any future improvements must be considered.

When identifying the PE requirements for above-ground appurtenances, a minimum of 3 feet around the appurtenance is required.

6.2.3.2 Temporary Construction Easement (TCE)

A TCE is granted for a specific purpose and applicable for a specific time period, and typically only involves the surface. A TCE is terminated after the construction of the improvement and the unencumbered fee interest in the land reverts to the landowner.

TCEs for staging area(s) may be acquired to aid in the construction of a project. These area(s) shall be utilized to store materials, equipment, and access to the project. TCE's sizes vary and should be based on the construction activities, land available, environmental impacts, and topographic features. Staging areas in developed communities shall be limited to minimize impact on the neighborhood.

6.2.4 Encroachment Permits (EP) – Utility Agencies

An EP authorizes specific work to make improvements within another party's easements or land owned by another utility. For instance, Basic Water Company and NV Energy have acquired property rights, including easements and ROW grants from federal agencies, for their facilities. In order to encroach into their ROWs, an EP must be obtained from the utility, in addition to acquiring rights from the underlying fee-owner, if different.

6.2.5 Bureau of Land Management (BLM) ROW Grants

The BLM is a federal agency within the United States Department of the Interior that administers public land in the Unites States. When a project crosses BLM-managed land, BLM will require the acquiring party to apply for a permanent ROW grant for project alignments and facilities. Once the project scope has been determined a completed BLM Standard Form (SF) 299 will be submitted to BLM requesting issuance of a ROW grant for project development. On federal lands, PE and TCE widths should be minimized to the extent practicable to reduce the potential for environmental impacts. TCEs (BLM refers to these as Short-Term Use [STU]) will be submitted on a separate SF 299. Once the NEPA compliance and other permits/authorizations required for the proposed project are met, BLM will issue a ROW grant to the acquiring party.

6.2.6 Bureau of Reclamation (BOR) Right-of-Use

The BOR is a federal agency within the United States Department of the Interior, which oversees water resource management. The BOR administers public land that was withdrawn for water purposes. When a project crosses BOR management land, BOR will require the acquiring party to apply for a permanent ROW grant for project alignments and facilities that cross BOR-managed lands. Similar to the BLM process, the ROW Agent will prepare and submit a Right-of-Use Application, SF 299 to the appropriate BOR office. On federal lands, PE and TCE widths should be minimized to the extent practicable to reduce the potential for environmental impacts. Once NEPA compliance and other permits/authorizations required for the proposed project are met, the Bureau of Reclamation will notify the acquiring party with approval and authorization to use the land.

6.2.7 Patent Reservations

A Land Patent is an exclusive land grant made by a sovereign entity with respect to a particular tract of land. To make such a grant "patent", a sovereign (proprietary landowner) must document the land grant, securely sign and seal the document (patent), and openly publish the documents for the public to see. An official land patent is the highest evidence of right, title, and interest to a defined area. It is granted by a federal or state government to an individual or to a private company. The United States reservations in a patent is a clause added at the end of the patent excepting and retaining some rights, title, or interest in the lands conveyed, and are required or authorized by law to be retained

in Federal ownership, such as a ROW for ditches or canals constructed, or subsurface reservation in a patent that retains all valuable mineral rights, such as oil and gas, coal and phosphate, etc. The patent is typically subject to a ROW of 33 feet (in some cases 50 feet) in width for roadway and public utilities purposes to be located along the boundaries of said land. This verbiage allows for the installation of the Owner's pipelines and some appurtenances that may be installed in future street ROW. Before Owner utilizes the patent to install pipeline and/or appurtenances, proof that the ROW reservation has not been previously vacated and remains in force must be verified through either a title report or from the Clark County Recorder's office.

6.2.8 Condemnation/Eminent Domain

Eminent domain is the power of a state, provincial, or national government to take private property for public use and the landowner must be paid fair market value of the part taken and when appropriate severance damages. When negotiation efforts fail to acquire the necessary land rights for a project, Owner may acquire the rights by Eminent Domain. In such cases, Owner must show the parcel to be acquired is necessary for the project and that the project is being constructed for the public benefit with the least private damages. Eminent domain actions are handled by the Owners Legal Department in cooperation with the Design Engineer and the ROW Agent.

6.3. THE ACQUISITION PROCESS

6.3.1 Definition of Need

Normally, information describing privately-owned land requirements for fee title, permanent and temporary easements, other easements, property ownership's, ROWs and other special conditions will be identified by Owner. The ROW Agent will require legal descriptions based on recorded plat or survey for any rights acquired. The surveyor will require preliminary title reports to identify deeds, which bear on the property boundaries, survey, and the writing of the legal descriptions. The legal description(s) shall adhere to the requirements as identified in Chapter 11, Survey and Right-of-Way, Section 11.4, Legal Description Requirements. If warranted, legal descriptions will be utilized to order appraisal reports from an independent appraiser who will determine the just compensation for the area of take.

6.3.2 Authorization to Acquire and Coordination with Design Engineer

The land acquisition effort is managed by the ROW Team. To avoid confusing landowners or giving conflicting information, the Design Engineer should not have any direct contact with property owners, unless requested or approved by the ROW Agent. Once the real property requirements of a project element are finalized, the ROW Agent will seek authorization from the Owner's appropriate Director to proceed with the acquisition(s). The authorization will specify the landowner of record, assessor's parcel number, and provide an exhibit showing the proposed facility in relation to the property boundary. Acquisition activity is likely to be underway during the design phase.

6.3.3 Contact and Negotiation

Landowners will be contacted by the ROW Agent. The ROW Agent will present the offer package to the landowner. The offer package will include an offer letter, term sheet, easement document(s) with legal description(s) and exhibit(s). If design information is required, the agent will contact the Design Engineer to request the required technical information, drawings or other material. If necessary, the ROW Agent may request that Design Engineer attend meetings with the landowner to discuss design issues.

6.3.4 Condemnation / Eminent Domain

If an agreement between Owner and the landowner cannot be reached, a determination of impasse in consultation with the Design Manager will be made. Once impasse is determined, the acquisition will be transferred to the Owner-appointed legal counsel for condemnation. The ROW Agent will prepare a "condemnation package" to forward to legal counsel. The package will consist of the preliminary title report, appraisal report, offer letter, easement documents with legal description(s) and exhibit(s), and all correspondence including any e-mail correspondence. The ROW Team will work closely with legal counsel through the condemnation process to ensure the property rights are received in a timely manner. During condemnation proceedings, the Design Engineer may be required to provide project design-related materials and drawings. The Owner has determined it will not use Eminent Domain against local, state or federal agencies.

6.3.5 Changes in ROW

If the Design Engineer proposes changes in the ROW or SOW plan, the Design Engineer will notify Owner and prepare a proposal that includes the rationale for the change. Any changes to the ROW plan requiring acquisition on additional parcel(s) must be approved by the ROW Team and appropriate Director.

6.4 DESIGN ENGINEER'S ROLE

6.4.1 ROW Plan Review

The Design Engineer and the ROW Agent will meet to review project engineering plans and the ROW plans. This meeting may take place at the regularly scheduled design meetings held with Owner staff. As the design work progresses, the Design Engineer and the ROW Agent will refine, if necessary, the alignment and determine changes to be made. The meetings will ensure that any changes in the ROW plan are current and are acted upon in a timely manner.

Design changes after 60% design review submittal may cause a delay in the property acquisition activities. Should the design change on an already authorized parcel, the legal description and exhibit will be revised. If the change affects a parcel not already authorized by the Owner's appropriate Director, the ROW Agent will seek authorization.

Refer to Section 6.3 for the acquisition process, which must be repeated to reflect change(s).

6.4.2 Acquisition Support

The ROW Agent will attempt to acquire the easements for a donation or the appraised value. It is likely that landowners will want specific information about the proposed project and potential impacts to their property. The Design Engineer may be asked to provide project information, drawings, exhibits, or other materials necessary to provide to the landowner. The ROW Agent may request the Design Engineer to attend meetings with the landowner to discuss technical engineering issues.

During the acquisition process, the ROW Agent shall attend the design review meetings with the Design Engineer to review the status of land acquisition activities and discuss any potential delays to the schedule. The ROW Agent will notify the Design Engineer and the Design Manager when the property rights have been acquired. Once all property rights have been acquired, the ROW Team will certify that the project can proceed with advertising for construction bids.

6.5 CONSTRUCTION PHASE

During the construction phase, the ROW Agent will remain the landowner's point of contact. If situations arise where additional contact is needed (for example, additional easements, removal of improvements, loss of access, etc.), the Design Engineer may be requested to provide design modifications and/or surveys to support this effort.

During the construction period, the ROW Agent may make occasional contacts with the landowner to keep the landowner comprised of project activities.

6.5.1 Close Out

When construction is complete, the ROW Agent will coordinate with the Construction Manager and landowner to ensure the property has been left in a clean and orderly manner. The ROW Agent will release temporary easements and vacate any remaining property interests no longer needed for project purposes.

CHAPTER 7
PERMITTING AND UTILITY/AGENCY COORDINATION

7.1 GENERAL

This chapter provides guidance on how the Design Engineer supports the Owner in complying with environmental requirements. This chapter provides guidance to the Design Engineer on supporting permit acquisition from agencies or utilities and performing due diligence to avoid utility construction conflicts. For purposes of this chapter, obtaining right to construct from agencies or utilities is referred to as permitting, while completion of environmental documents and implementing mitigation measures is referred to as environmental compliance.

The Owner will assign a Permits Coordinator at the start of design who will complete environmental documents and obtain permits necessary for construction, unless responsibility to obtain the latter is assigned to the Design Engineer.

7.2 ENVIRONMENTAL COMPLIANCE

The Owner takes its commitment to protecting the environment and complying with environmental regulations seriously and insists its Design Consultants bring the same commitment to each project. The Owner employs environmentally responsible and sustainable practices, and complies with a variety of federal, state, and local environmental laws and regulations. By diligently following applicable environmental laws and regulations, and by using the latest best management practices, the environmental footprint is minimized, and the Owner works to conserve and preserve the environment's natural resources. The Design Engineer shall follow all applicable environmental laws during its design. The facility designed shall comply with the latest regulations for public water systems by the Nevada Division of Environmental Protection, Bureau of Safe Drinking Water.

Unless otherwise noted, the Owner will have prepared the environmental documents and the conditions necessary to comply before the Design Engineer begins design. The documents will be provided to the Design Engineer to incorporate into the agreement. In cases where the environmental documents and mitigation measures are not yet complete, the Design Engineer will support completion of the environmental documents as required. In all cases, the Design Engineer shall incorporate all mitigation measures into the Contract Documents and work with the Permits Coordinator to ensure compliance during construction can be enforced.

7.3 PERMITTING COORDINATION

For the purposes of this chapter, agencies are generally government entities with property interests giving the authority to grant or deny permission to access the area under its purview. Utilities are generally privately owned and providers of a service to the region, and usually do not have property interests with the authority to grant or deny permission

to access to areas where the Owner wishes to construct but may have facilities which could conflict with construction.

7.3.1 Responsibility

Permits required for performing design work shall be acquired solely by the Design Engineer. Such work could include performing surveying and geotechnical operations within the rights-of-way of the jurisdictional agency.

The Design Engineer will coordinate receiving the utilities' final approvals upon completion of design. For work located within City of Las Vegas jurisdiction, the Permit Coordinator will obtain the City Engineer's signature indicating final approval.

The Owner will acquire all entitlements. Owner will also acquire all Federal permits. The Design Engineer will provide the Permits Coordinator all required drawings and documents needed for the application submittal(s).

The Contract Documents must state that the Contractor shall acquire all construction permits.

Associated fees for new utility services for the Owner's facility will be coordinated by and paid by the Owner. This must be stated in the Contract Documents.

In situations where significant lead times are needed for acquiring permits that are required prior to advertising and construction, the Design Engineer shall coordinate with the Permits Coordinator to avoid delays. Refer to Specification Section 01 41 26 Permit Requirements, for a list of typical state and local permits. The Design Engineer shall work closely with the Design Manager and Permits Coordinator to ensure timely, or where required early, submittal of permit applications.

7.4 AGENCY CONSULTATIONS

The Design Engineer shall coordinate all formal and informal meetings and consultations with the governing agencies, with the Design Manager to identify any project-specific requirements that must be addressed during the initial stages of design.

The Design Engineer will research any potential conflicts with other construction projects by using the Regional Transportation Committee Conflict Avoidance Website, the Owner's Approved Facilities Layer (provided by the Design Manager upon request), and the Road Construction Management Program.

Items such as pavement replacement requirements, work time restrictions, possible encroachments, or conflicts with other entities' easements or proposed projects shall be identified and included in the Contract Documents.

7.5 UTILITY COORDINATION AND CONSULTATIONS

The Design Engineer shall perform a search to identify all known existing and proposed facilities that may be impacted by the Owner's project. The Design Engineer shall follow the process outlined in Appendix C in forwarding plans to all utilities with facilities in the area. Where potential conflicts are identified, the Design Engineer shall either avoid or mitigate. The Design Engineer will meet with any utility as necessary to ensure both parties' needs are satisfied. The Design Engineer will also obtain the signature of the utility representative on the Bid Set Plans granting approval to construct around the facilities. Where no crossings or facilities exist along the alignment, the utility's signature is not required.

A list of utilities most frequently requiring coordination is found at the end of Appendix C.

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CHAPTER 8
DRAFTING STANDARDS AND LOCAL STANDARDS

The Design Engineer is responsible for developing contract drawings to meet the specific needs of the project. Reference information will be provided to the Design Engineer and used initially as the basis of design, and shall be amended consistent with the EDS.

Guidelines regarding drawing production are found in Volume 2 – Drawing Standards Guide. Volume 2 presents Owner's standard drawings and references local prevailing standard drawings that impact design and construction of the Owner's capital projects.

Several standard plates are also located in the Uniform Design and Construction Standards (UDACS), which is Volume 4 - Pipeline Design Guide (24 inches and smaller diameter), of these EDS.

8.1 DRAFTING STANDARDS

Drafting standards and guidelines have been established for use in preparation of construction contract documents, construction record drawings, and site (living) drawings. The Design Engineer shall use these drafting standards appropriately in the development of project documents.

- Contract (Project) Documents (Drawings) - The drawings which show the scope, extent, and character of the Work to be furnished and performed by the Contractor.

- Conformed Set – Contract Documents modified to include addenda, request for clarifications, and bid questions during the bid process, prepared by the Design Engineer.

- Shop Drawings - All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for the Contractor and submitted by the Contractor to illustrate some portion of the Work.

- As-Built Drawings (Red-Line Drawings) - Drawings marked up in the field to reflect changes to the design documents compiled by the Inspector / Contractor (modifications, field changes, shop drawing changes, design changes, extra works and every change that was approved and made during construction).

- Record Drawings – Drawings compiled from the as-built drawings submitted by the contractor, as a record of the work.

- Site (Living) Drawings – Drawings compiled from one or more contracts, or generated from field verification for maintenance purposes, which reflect the most current information about the facilities at a project site.

8.2 GUIDANCE ON USE OF LOCAL STANDARDS

The Design Engineer shall use the local standards as much as possible. No effort shall be made to deviate from the local standards without the written permission of the Owner. The Owner will consider approval of a change in instances where such a change in a standard drawing can result in an efficient design without adversely compromising consistency.

8.2.1 Use of Local Uniform Standards

The list below includes several local standards that may be referenced or used during design. Design Engineers and Contractors are required to be familiar with these uniform standards.

- Uniform Design and Construction Standards for Potable Water Distribution Systems (UDACS)
- Uniform Design & Construction Standards for Wastewater Collection Systems (DCSWCS)
- Uniform Standard Drawings for Public Works Construction, Offsite Improvements, Clark County Area (USD)
- Hydrologic Criteria & Drainage Design Manual, Clark County Regional Flood Control District
- State of Nevada, Department of Transportation, Standard Plans for Road and Bridge Construction
- State of Nevada, Occupational Safety and Health Administration Standards for General Industry
- State of Nevada, Occupational Safety and Health Administration Standards for Construction
- NV Energy Construction Standards.

CHAPTER 9
BID PHASE GUIDELINES

This section includes information on the bid process to help the Design Manager and Design Engineer prepare for the bid phase.

For Engineering Projects - a representative of the Owner's Construction Management Division, referred to as the Construction Manager in subsequent chapters, will take over management responsibilities from the Design Manager for the remainder of the project.

For Maintenance Engineering Projects - a representative of the Owner's Purchasing Division will take over management responsibilities from the Design Manager for the bid phase only.

For simplicity, the Construction Manager or Purchasing Division representative is referred to as the Owner's Representative in this chapter.

9.1 BID PROCESS

The Owner advertises the Project and uses the Nevada Government e-marketplace (NGEM) website for bidding. The Owner uploads all Contract Documents for bidders to download and subsequently input bids. The Owner produces any hard copies associated with bidding. Refer to Section 00 21 13 "Instruction to Bidders" of the Contract Documents for specific details about the bid process.

The Design Engineer's role during the bid process includes:

1. Participating in the pre-bid conference and site tour.
2. Preparing any artifacts related to the Project for the pre-bid conference, when requested.
3. Preparing responses to technical inquiries and technical revisions (addenda) to contract documents.
4. Participate in the bid evaluation process, if requested.

The Owner's Representative will be the Design Engineer's point of contact during the bid phase. The Design Engineer shall provide technical assistance and clarification only through the Owner's Representative. The Owner's Representative will route all addenda for approval and distribution and communicate with potential bidders.

9.2 BID DOCUMENTS

The Design Engineer shall prepare the necessary Bidding Documents during the design phase. Refer to Chapter 2 "General Administrative Guidelines and Design Process" for the requirements for the Bid Set deliverables. The Design Engineer shall develop Line Items for bidding in the NGEM system in accordance with specification Section 00 41 05 Bid Form and Section 01 20 00 Measurement and Payment Procedures.

9.3 BID PHASE QUESTIONS

The Owner's Representative will receive questions about the Contract Documents through NGEM or email and will refer to the Design Engineer. Section 00 21 13 "Instructions to Bidders", allows submission of questions up to 5 calendar days prior to bid opening. All questions received during the Bid Phase, whether in writing or verbal, shall be answered by the Owner in consultation with the Design Engineer through addenda.

9.4 PRE-BID CONFERENCE AND SITE TOUR

The date of the pre-bid conference and (if included) site tour shall be stated in the Notice Inviting Bids. The Design Engineer is required to attend both the pre-bid conference and site tour to better understand the basis of potential bidders' questions. In response to questions arising at the conference, Owner will issue Addenda as Owner considers necessary.

9.5 ADDENDA

Addenda are the only method of changing the Contract Documents between advertisement and bid opening. Addenda may change bidding requirements, correct errors or omissions, change specifications or drawings for clarity or for technical reasons, or add to or reduce from the scope of the work.

Changes to the "Line Items" shall be made through the NGEM website and if required Section 01 20 00 "Measurement and Payment Procedures" shall be updated and issued through addenda.

Addenda must always follow these rules:

- Addenda are numbered sequentially
- Items addressed by an addendum are presented in the order of appearance in the Contract Documents.
- Each change must be referenced precisely and clearly explained. For changes to text, the document, the paragraph, paragraph title, and subparagraph must be listed, as a minimum.
- For changes to drawings, alphanumeric information can be changed by addendum wording. Changes to graphical information must be accomplished by reissuing the drawing with a new revision date on it.

9.5.1 Issuing Addenda

The Design Engineer, Design Manager, and Owner's Representative need to maintain regular communication during the bid period to determine the appropriate times to issue addenda and if necessary, adjust bid opening dates. It is desired that bid opening be no earlier than one working week after the final addendum is issued. Exceptions may be

made for minor addenda that do not materially change the efforts required to assemble a bid.

The Design Engineer shall forward a copy of changes to the drawings and/or specifications directly to the Owner's Representative. The Owner's Representative will forward the addendum cover page along with the changes for signature to:

For Engineering Projects - Director of Engineering
For Maintenance Engineering Projects - Director of Infrastructure Management

The Owner will then post the complete addendum to the NGEM website. The Design Engineer shall not issue addenda directly to any plan holder. Addenda that only direct potential bidders to portions of the Contract Documents to answer questions and do not alter the Contract Documents may not require Owner to contact the Design Engineer for a response.

The Design Engineer shall submit a "conformed" set, which are Contract Documents modified to include addenda issued during the bidding process.

9.6 BID EVALUATION AND AWARD OF CONTRACT

Bid evaluation and award of contract will be handled by the Owner, with assistance from the Design Engineer, where needed.

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CHAPTER 10
CONSTRUCTION PHASE ASSISTANCE

The Design Engineer shall provide Engineering Services during Construction (ESDC) to the Construction Manager. This assistance includes attending regular construction progress meetings; responding to requests for information; reviewing proposed change orders; assisting with change order processing; reviewing contractor submittals including "or equal" and "substitute" items; providing field evaluation of construction; assisting with claims management; supporting project closeout; and supporting system integration and testing. If included in the SOW, the Design Engineer shall assist in value engineering.

During construction, all written correspondence, except those with oversize drawings, samples, or requiring signatures such as executed Change Orders, are routed using Owner's in-house construction management software, currently Procore.

Typically, communication between Design Engineer and Contractor shall be through or in the presence of the Construction Manager. Should conversations with the Contractor occur without the Construction Manager, the Design Engineer shall promptly provide the Construction Manager a record of the items discussed and any proposed decisions.

10.1 ATTEND CONSTRUCTION PROGRESS MEETINGS

Regular progress meetings are held throughout the construction phase of a project. Typically, the meetings are held every other week at the project site. The purpose of the meetings is to provide early discussions of construction needs and issues as well as Requests for Information (RFI), submittal reviews, change orders, and construction progress. At times, special meetings need to be held in addition to and separate from the regular progress meetings to address specific issues in detail. A designated representative of the Design Engineer shall attend the construction progress meetings. Additional Design Engineer personnel shall attend if requested by the Construction Manager.

10.2 RESPOND TO REQUESTS FOR INFORMATION

The Design Engineer shall assist the Construction Manager during construction in answering questions from the Contractor pertaining to the contract documents. Questions from the Contractor can be grouped into two categories: (1) questions, which only require a verbal interpretation or clarification of the drawings and specifications; and (2) more complex questions, which are transmitted by means of a formal RFI. The procedure for processing RFIs is described in the Standard Specifications.

10.3 ASSIST WITH CHANGE ORDER PROCESSING

The Design Engineer shall assist the Construction Manager with Change Order processing. This includes but is not limited to:

- Evaluating Potential Change Orders (PCO) from the Contractor
- Evaluating value engineering proposals from the Contractor
- Notifying the Construction Manager when an RFI or submittal response necessitates a change order.

Unless a PCO does not warrant further evaluation, the Design Engineer shall independently estimate the change in cost and recommend whether to accept or reject the PCO. While the Construction Manager will process and sign any Change Orders, the Design Engineer shall author the technical portions. The Design Engineer shall only proceed to author changes upon confirmation from the Construction Manager.

10.4 REVIEW CONTRACTOR SUBMITTALS

The Design Engineer shall review Submittals received from the Contractor. All such submittals (e.g., shop drawings, samples, certificates, or other items) are submitted to the Construction Manager by the Contractor. The Construction Manager then forwards the submittal to the Design Engineer for review. The Design Engineer subsequently returns the submittal with the appropriate action to the Construction Manager. Unless noted otherwise, the Design Engineer must return the submittal with the disposition and comments to the Construction Manager within 7 calendar days of receipt. The submittal turnaround time will depend on the complexity of the project, with the following suggested durations to return to the Contractor:

- For In-house projects: 14 days
- For Consultant design projects: 21 days

The turnaround time may be adjusted as deemed necessary by the Owner.

The contract documents provide the various dispositions of submittals. For any dispositions requiring a resubmittal or revision, the Design Engineer shall mark the submittals so that the Contractor can determine the reason for the mark ups and the need for resubmittal or rejection.

10.5 PROVIDE FIELD EVALUATION OF CONSTRUCTION

Inspection and quality assurance testing are the overall responsibility of the Owner and are performed continually throughout the construction phase to ensure that the work and materials furnished are in conformance with the Contract Documents. The Design Engineer shall be available to assist the Construction Manager at any time in performing field evaluation of the construction. This also includes availability to visit any of the manufacturing facilities to verify compliance of the manufactured product or material when requested by the Owner.

The Design Engineer shall be available to remotely consult with the Owner during visits to witness testing of pumps, piping, or other equipment, and if requested shall include a

recommendation whether to accept the equipment. This consultation may be required outside of normal business hours.

10.6 ASSIST CLAIMS MANAGEMENT

The Design Engineer shall assist the Construction Manager in claims review and resolution, if claims should arise during construction.

10.7 PROVIDE FACILITY INTEGRATION AND TESTING SUPPORT

The Design Engineer shall provide a preliminary plan for the tie-in and integration of the new facility to new and existing facilities in the Contract Documents. The Design Engineer shall coordinate with other Design Engineers for separate projects that may connect or conflict with the new facility.

While the Contractor is responsible for the facility tie-in and integration, the Design Engineer shall assist the Construction Manager to verify the Contractor's tie-in and integration plan meets the design intent.

10.8 PROVIDE CONSTRUCTION RECORD DRAWINGS

Unless noted otherwise, record drawings are not in the Design Engineer's scope. The Owner will incorporate all changes made during construction onto the original design drawings and produce a set of record drawings. If included in the SOW, the Design Engineer shall produce record drawings in accordance with Owner standards.

10.9 PROVIDE PROJECT CLOSEOUT SUPPORT

The Design Engineer shall assist the Construction Manager in performing the tasks involved with the project closeout process. These tasks include technical manual preparation; spare parts list preparation and checkoff; warranty documentation; operator training and startup/check out certifications; and Punch List preparation.

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CHAPTER 11
SURVEYING AND RIGHT-OF-WAY

This chapter describes the guidelines for design-level surveying and mapping to be performed.

11.1 GENERAL

The following requirements apply to all work:

1. Certifications
    a) All survey work shall be performed by or under the direct supervision of a Professional Land Surveyor (PLS) with a valid certificate of registration as a PLS issued by the State of Nevada.
    b) All photogrammetric mapping work shall be done under the direction of a Certified Photogrammetrist, holding a current certification with the American Society of Photogrammetry and Remote Sensing (ASPRS).
2. All survey work shall be conducted at a minimum level of accuracy to conform to NAC 625.666 (Positional certainty: Horizontal and vertical components of certain land surveys), except in instances where greater accuracy is required.
3. Topographic survey information shall be provided for an area extending a minimum of 100 feet beyond the property lines of the project site and/or a minimum of 100 feet beyond each side of the centerline of pipelines at the discretion of the Owner.
4. Topographic data shall include contour lines at 1-foot intervals; topographical features including but not limited to any above ground or exposed feature or marker within the project area and extending to 100 feet outside the project area if deemed necessary by the Owner.
    a) Accuracy of Survey control shall meet or exceed the accuracy requirements for Horizontal and Vertical surveys as defined in NAC 625.666
    b) A comprehensive survey shall be performed to identify all monuments located within the project area and a Record of Survey filed to memorialize the identification and position of the monuments prior to the beginning of the project.
5. Survey methods for control surveys include static Global Positioning System (GPS) or total station terrestrial surveys. Automatic level is required for vertical control work and RTK GPS, total station or photogrammetry for topographic surveys. Prior to commencing survey, the Owner Surveyor must approve any alternative methods.
6. GPS data, if used, shall include statements regarding Datum and Geoid modeling sources, estimated accuracy, and methods used.
7. A Survey report is required and shall include the following items:

a) Copies of all record data used for survey analysis including but not limited to Plats, Records of Survey and Legal Descriptions.

b) Tabular and Graphical Documentation of reference material including but not limited to TCEs, PEs, Dedicated ROW, and Patent Reservations showing the extent of the Owners property rights.

c) Continuously Operating Reference Stations (CORS) position and Datum information used for GPS collected for the project.

d) Project Benchmark (Published Agency Benchmark) information including Agency, Published Elevation and Identification Number.

e) A report detailing Survey control, including Public Land Survey System (PLSS), Cadastral, Property corner, Project Benchmark and On-Site control monuments set for construction to meet requirements set forth in 11.2.1.a including Monument descriptions including but not limited to type, size, character and markings

f) Survey control shall be reported in Geographic, Project and State Plane coordinates and shall include Ellipsoid Height and Orthometric Height for each point.

    i. Project coordinates shall be of a character greatly distinguishable from State Plane.

    ii. Orthometric Heights reported shall be referenced to the Project Benchmark

        1) If a Geoid model is used to determine Orthometric Elevations, the Geoid model used shall be reported and the adjustment required to tie into the Project Benchmark shall be reported.

g) Conversion parameters and step by step procedures shall be provided for conversion of project coordinates to State Plane coordinates and State Plane coordinates to Project coordinates.

h) Information related to the Basis of Bearings

i) A ROW report including Recording information and graphical representation of documentation used to determine the Owners property rights.

j) Any additional information necessary to assess the accuracy and completeness of the survey work.

k) A Record of Survey shall be included in the Survey report.

11.2 SURVEY PROVISIONS

1. Horizontal Control

a) Survey control shall be tied to a minimum of two NGS CORS (Continuously Operating Reference Stations) or control monuments having NAD83 or later published values, reference datum and epoch information.

b) On-Site control monuments shall be established in a manner to facilitate construction of the project.

   i. For pipeline projects, there shall be a control monument every 0.3 miles along the project alignment. All control points shall be inter-visible with at least two additional control monuments.

   ii. For all other projects, all points of construction shall be within 300 feet of a minimum of two control monuments.

   iii. All control monuments shall be reported in Geographic, State Plane and Project coordinates and Ellipsoid and Orthometric Heights.

c) Basis of Bearings:

   i. For in-valley projects the basis of bearings shall be determined from the Nevada State Plane Coordinate System of 1983, East Zone between two found, reliable and inter-visible monuments with reliable record information.

   ii. Monuments used for the basis of bearings should be in close proximity of the project, preferably Survey control monuments reported for the project, and shown on the Horizontal Control Plan (See Figure 11-1)

   iii. For projects, which extend outside the Las Vegas Valley, the project Basis of Bearings shall be determined from the Nevada State Plane Coordinate System of 1983, East Zone between two found, reliable and inter-visible monuments with reliable record information.

d) State Plane coordinates shall utilize the Nevada State Plane Coordinate System of 1983, East Zone as designated by NRS 327.0502a. State Plane coordinates shall be reported in U.S. Survey feet.

e) Project coordinates shall be provided for all points of construction including but not limited to angle points, pipeline beginning and points of terminus, building corners, reservoir corners, antenna locations and any other important design features.

   i. Project coordinates shall be greatly distinguishable from State Plane coordinates in both the Northing and Easting. The use of State Plane coordinates as Project coordinates is prohibited.

Project coordinates and State Plane coordinates shall be reported in U.S. Survey feet.

f) Conversion parameters and step-by-step procedures shall be provided for conversion of project coordinates to State Plane coordinates and State Plane coordinates to project coordinates.

g) The Horizontal Control plan shall include a legend identifying line types, monument symbols, abbreviations, and any other undefined graphical feature.

h) A north arrow shall be visible and directed to the top or right side of the sheet.

i) The drawing scale shall be shown either on the border of the drawing or in the viewport of the drawing.

j) Bearings and distances shall be shown on lines connecting Survey control monuments shown on the Horizontal Control plan.

k) The Horizontal Control plan shall be drawn at a scale to ensure line work, features and annotation remain visible and un-obstructed.

2. Vertical Control

a) Elevations shall utilize NAVD88 Datum and shall be shown in U.S. Survey feet.

b) The Project Benchmark shall be the nearest published local agency benchmark and shall be in an undisturbed condition with a reliable reputation. Elevations shown on the Horizontal Control plan shall be reported in U.S. Survey feet.

c) For Local Projects, other than pipelines, the survey shall be tied to at least one control monument related to the Water Facility Control Network (WFCN). The project surveyor shall contact the Owner Surveyor to determine a suitable control monument and shall report the measured coordinates and elevation to the Owner Surveyor as a blind check prior to submitting the Horizontal Control plan for review.

For pipelines, locate one temporary construction benchmark every 0.3 miles along the pipeline alignment to coincide with the Horizontal Control Monuments listed in Paragraph 11.2.a) of this document (may be the same monument if usable and durable). For all site developments, provide temporary construction benchmarks such that the entire construction site may be covered using a construction level with a single setup and providing accessible check-ins to at least one additional benchmark. The intent is that a level loop should not be required to provide vertical control during construction. Temporary construction benchmarks shall be established in a manner that will allow them to remain undisturbed throughout construction.

3. Accuracy Requirements

Surveys for the Owner's reservoir sites, in addition to the requirements stated in other portions of this document, shall include the following:

a) A property survey shall be performed, and all property corners shall be established as "final monuments" in accordance with NRS 278.371, paragraphs 3 through 8, inclusive.

b) A control survey with a positional certainty of 0.05 feet in the horizontal dimension and 0.1 feet in the vertical dimension. The survey shall

   i. Include a second order, Class I, level survey traversing the property corners and the controlling monuments

   ii. On Local Projects, be tied to two permanent WFCN monuments as designated by the Owner Surveyor, and

   iii. Include a minimum of 3 control monuments from any of the following:

      1) National Geodetic Survey (NGS) monuments

      2) NGS CORS sites.

Surveys for the Owner's pumping stations and pipelines, in addition to the requirements stated in other portions of this document, shall include the following:

a) For Local projects, a horizontal and vertical survey tying control monuments to a local benchmark and one WFCN monument as designated by the Owner Surveyor. The positional certainty shall be 0.1 feet in the horizontal dimension and 0.2 feet in the vertical dimension.

b) Documentation demonstrating that all surveys were performed to the required accuracy shall be submitted as a part of the Survey Report specified in this document.

4. Record of Survey

a) A Record of Survey shall be required for all well, reservoir, and pumping station sites and pipeline projects or if required by NRS 625.340. At the discretion of the Owner Surveyor, a recently recorded Record of Survey may be used in lieu of this requirement. A Record of Survey shall be recorded whenever a public land survey corner is reconstructed or rehabilitated in accordance with NRS 329.140.

b) In the event that a public land survey corner monument cannot be found within one mile of the project site or at a maximum of one-mile intervals along a pipeline alignment, the lost or obliterated corner monuments shall be reconstructed or rehabilitated in accordance with NRS 329.180.

c) A diligent effort shall be made to research and locate all reference monuments within the project limits. Reference monuments shall be established for all found or set monuments within the project limits. The reference monuments shall be noted on a Record of Survey in accordance with NRS 329.140. A copy of the reference monument tie data shall be included in the survey report.

d) The survey shall determine the ownership of all parcels adjacent to the construction zone and shall show the County APN identifier.

11.3 DRAWINGS

The following applies to all survey drawings:

1. All drawings shall be completed in conformance with the most current version of Owner CAD Standards.
    a) Horizontal Control Plan sheet(s):
        i. Shall start withdrawing number SV01 and be numbered consecutively.
        ii. Shall be signed and sealed by a PLS with a valid license in the State of Nevada.
        iii. Shall include a diagram of all Survey control, monument descriptions, bearings and distances between monuments, Project benchmark location and description, On-Site control monuments, basis of bearings, references, Survey control table, Project control table, transformation parameters, parcel and Right of Way line work, and shall include all elements described in 11.2.1 of this document.
        iv. See Figure 11-1 for an example Horizontal Control Plan sheet.

    b) Right of Way sheet(s):
        i. Shall be designated SV## and continue numbering from the Horizontal Control Plan Sheet(s).
        ii. Shall be signed and sealed by a PLS with a valid license in the State of Nevada.
        iii. Shall include a key map identifying the size and location of all rights-of-way, easements, patent reservations, dedications, encumbrances, APN identifiers for project area and all adjoining parcels, current record deed information and any other right that may impact the project.

iv. Shall include a legend identifying line types, abbreviations and any other undefined graphical feature.

v. A north arrow shall be visible and directed to the top or right side of the sheet.

vi. The drawing scale shall be shown either on the border of the drawing or in the viewport of the drawing.

vii. The Right of Way plan shall be drawn at a scale to ensure line work, features and annotation remain visible and un-obstructed.

viii. See Figure 11-2 for an example Right-of-Way sheet.

c) Record of Survey sheet:

i. Shall be designated SV## and continue numbering from the Right-of-way Sheet(s).

ii. When a recent Record of Survey has been completed and will be substituted as described in Section 11.2.4a, the Record shall be shown on the Record of Survey sheet for the project being designed.

11.4 LEGAL DESCRIPTION REQUIREMENTS

The following apply to all right-of-way document legal descriptions:

1. The easement shall be on an Owner form with all attachments on 8.5 x 11-inch paper.
2. All font sizes shall be minimum 10-point.
3. Clark County Assessor Parcel Number shall appear in the upper left corner of each page.
4. A 1-inch margin is required around all pages with no writing, signatures, stamps, etc., within said margin.
5. Every portion of the legal description must be an original.
6. Legal descriptions shall be stamped and signed by a PLS and shall contain his or her mailing address within the document.
7. If the legal description references a previously recorded document as part of the easement description, all information to locate the referenced document (recording information) must be included as part of the legal description. A legible copy of the referenced document shall be provided with the legal description package.
8. **All writing on the document MUST be in BLACK INK ONLY (no color).** The only exception is the signatures, Notary Public or PLS initials, and the notary block, which may be in blue ink.

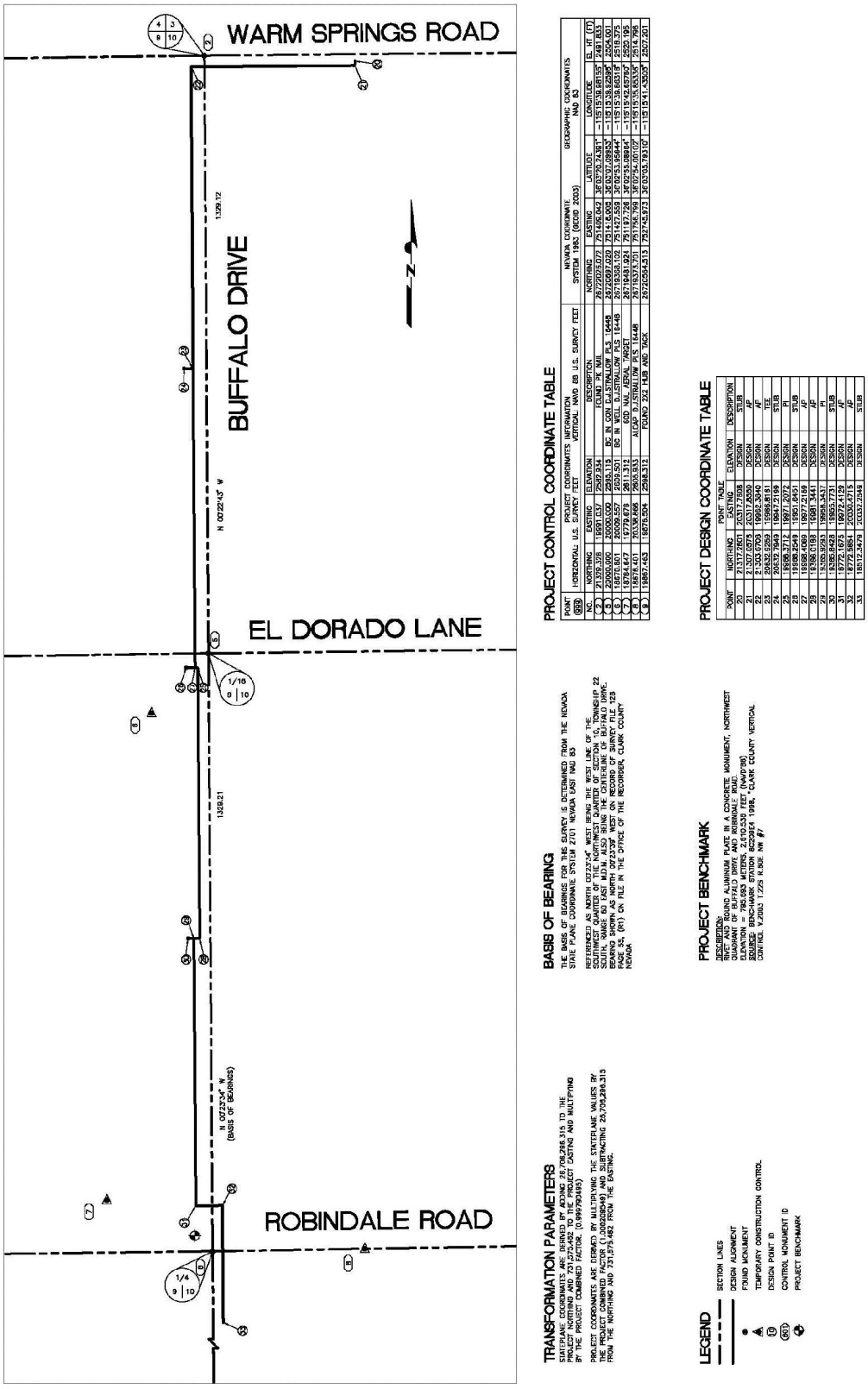

Figure 11-1 Example Horizontal Control Sheet

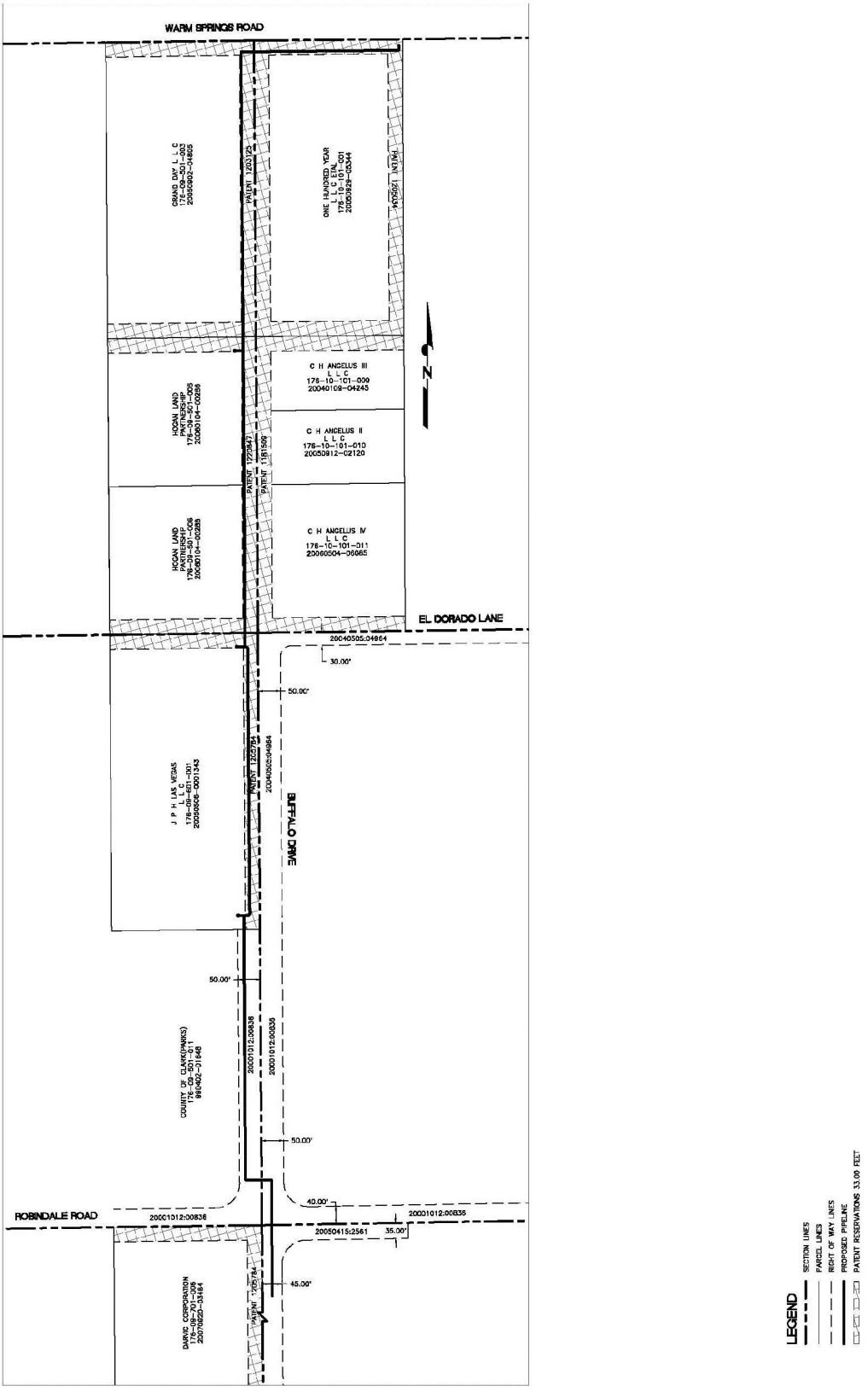

Figure 11-2 Example Right-of-Way Sheet

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CHAPTER 12
OPERATION AND MAINTENANCE MANUAL GUIDELINES

These guidelines have been prepared so that all Operations and Maintenance (O&M) manuals prepared for the Owner follow a consistent format and style and contain the same level of detail and types of information.

12.1 O&M MANUALS SUBMITTED BY CONTRACTOR

The Design Engineer will review the O&M manuals submitted by the Contractor and subcontractors, which include parts lists, O&M instructions, and a completed Owner Equipment Record Form for each piece of equipment. The project specifications require that manufacturers identify which building codes their product was designed to meet. These codes will be identified in the O&M manual submittals.

The Design Engineer shall specify manuals and other data to be received from the contractor in accordance with specification Section 01 78 23 - Operation and Maintenance Data. All material shall be marked with project identification, and inapplicable information shall be marked out or deleted. The O&M manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or that may be required by Contractor.

Shipment of equipment will not be considered complete until all required manuals and data have been received.

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CHAPTER 13
GEOTECHNICAL INVESTIGATION

13.1 GENERAL

This Chapter describes the geotechnical investigation and reports required for Engineering Projects. Maintenance Engineering Projects will typically have much more limited geotechnical investigation requirements that should be adjusted to the project needs.

The Design Engineer working with the Geotechnical Consultant shall be responsible for determining the specific design criteria and site conditions. Geotechnical evaluations and recommendations shall be conducted by a qualified geotechnical professional who is an Engineer or Geologist with current professional registration in Nevada. The Geotechnical Consultant shall be qualified by the following:

- Experience on previous projects for the same type of facility to be designed
- Previous local experience
- Knowledge of local soil and geological conditions and construction practices

The Geotechnical Consultant shall be able to present examples of previous reports and shall provide references for previous local work.

Geotechnical reports prepared for design purposes shall be prepared in accordance with the following general guidelines:

- The geotechnical investigations shall comply with ASTM standards for conducting the Standard Penetration Test (SPT), providing soil descriptions, and conducting laboratory tests on soils. Geologic formations shall be described following USGS and the Geological Society of Nevada recommendations.

- Keep data separate from summaries and recommendations. Generally, except for small projects, the data report and the summary report should be in separate volumes.

- On some projects, the Design Engineer, the Geotechnical Consultant, and Owner may jointly conclude that potential geotechnical uncertainties are sufficiently great to merit adoption of a baseline approach to resolving differing site condition claims. This decision should be reached before the geotechnical report is written so that the Geotechnical Consultant can craft the report to support development of a baseline geotechnical definition. If a baseline approach to differing site conditions is to be used, the baseline definition should be presented in the Supplemental Conditions of the Contract Documents, not in the geotechnical report. Contractual agreements between the Owner and the Contractor are appropriately established only within the Contract Documents, not in the geotechnical reports.

- For projects within Clark County which are identified by the Owner as requiring permits for grading or building of structures, the Geotechnical Consultant should submit data in the format specified by the Clark County Building Department for the Electronic Submittal of Geotechnical Information (ESGI) program. More information on the ESGI program can be obtained from the Clark County Building Department.

Soil corrosivity concerns are addressed in the “Cathodic Protection” chapter of Volume 5, Large Pipeline Design Guide. Normally, much of the data related to the soil corrosivity study are collected during or as part of the geotechnical investigation. It will be important to coordinate the geotechnical investigation and the soil corrosivity investigation.

When part of the SOW, the Design Engineer shall coordinate with the Geotechnical Consultant to address hazardous materials as described in Chapter 14, Hazardous Material Investigations.

13.2 INVESTIGATIVE METHODS

This section describes the different methods and follow-up laboratory testing that may be used to evaluate project geotechnical conditions.

13.2.1 Soil Borings

Soil borings shall be drilled at intervals along the pipeline alignment or at the project site as agreed between the Owner, Design Engineer, and its Geotechnical Consultant. The Geotechnical Consultant shall store soil boring samples until construction is completed.

The minimum information to be provided on the soil boring logs is:

- Boring number, location, elevation
- Drilling contractor (company name, office location), drilling method, and equipment used
- Water level, date and time measured
- Sampling data from SPT (top and bottom of sample interval, length of sample recovered in split-spoon, SPT results and N-value)
- Soil description (see below)
- Comments (observations of drilling difficulty, driller's observations of material changes or boulders, addition or loss of drilling fluid, etc.)

The soil descriptions shall be in accordance with ASTM D 2488, which provides soil information for engineering purposes. Geologic formations that are weathered to soil shall be described in accordance with their engineering properties; the geologic description may be presented following the engineering description. Geologic formation names should not be provided on the boring logs but may be described in the

Interpretation of Data portion of the Geotechnical Data Report. The format and order for soil descriptions shall be presented in the boring logs as follows:

1. Soil name (ASTM D 2488 Group Name)
2. Group symbol
3. Color
4. Moisture content
5. Relative density or consistency
6. Other descriptors as appropriate (soil structure, mineralogy, particle size, shape, angularity, maximum particle size, plasticity of fines, dilatancy, cementation, etc.)

13.2.2 Rock Evaluation

A surface evaluation of any encountered bedrock shall be performed. The evaluation shall describe discontinuities (type, orientation, roughness, planarity, infilling material and thickness, surface staining, and tightness) and lithology (rock type, color, mineralogy, hardness, and rock mass characteristics).

Lithology descriptions must rely on professional judgment and experience, and local practice and terminology shall be used. For engineering purposes, general rock names are preferred over petrologically specific names (for example, sandstone and basalt are preferable rock names to arkose and tholeiite). Specific formation names may be provided in the Interpretation of Data section of the data report.

13.2.3 Test Pits

Test pits may be excavated to supplement or substitute for the soil borings where permitted by the site features and where appropriate. Test pits are helpful to identify relative degree of excavation difficulty, excavation side-slope stability, depth to groundwater and its infiltration rate, presence of cobbles and boulders, and depth to sound bedrock and its characteristics (rip ability, weathering, surface features). OSHA regulations for work in excavations shall be followed during all test pit operations.

Detailed test pit logs shall be prepared for inclusion in the data report. The minimum information to be presented on the test pit log is:

- Test pit number, location, elevation
- Excavation contractor (company and operator name, office location)
- Equipment used (kind of equipment, approximate horsepower rating, bucket width, use of rippers)
- Water level, date and time measured
- Soil description
- Comments (observations of excavation difficulty, stability of pit walls including the duration of observation, debris encountered, water seepage and infiltration rate, results of in situ tests, operator comments, etc.)

If cobbles (dimensions between 3 and 12 inches) and boulders (greater than 12 inches) are encountered in a test pit, the number and size of cobbles and boulders excavated from the test pit shall be noted; the relative amount of cobbles/boulders per volume excavation can then be calculated and presented in the Interpretation of Data section of the Data Report. If cemented materials are encountered along the pipeline alignment, their thickness and lateral extent should be estimated, and their difficulty of excavation evaluated and presented in the Data Report.

13.2.4 Survey of Explorations

All exploration locations shall be located vertically and horizontally to a level of accuracy approved by the Owner and be shown on a site map which includes contour elevations.

13.2.5 Laboratory Testing

Laboratory tests shall be relevant to the engineering analyses and recommendations for the project and shall be conducted on representative soil samples. The engineering characteristics that will affect design and construction of the project shall be considered prior to selecting laboratory tests.

The laboratory testing program should be prescribed by the Geotechnical Consultant and reviewed and approved by the Design Engineer. Conducting vast numbers of classification or other tests is generally not useful to project design. All tests should be designed to either provide useful information to the potential bidders or provide data relevant to design.

Close coordination between the project Corrosion Engineer and the Geotechnical Consultant must be established so that when required soil samples can be obtained and soil chemical analysis testing can be conducted simultaneously.

13.3 INVESTIGATIONS

This section describes the investigations that are typically performed for design of facilities.

13.3.1 Initial Investigation

The initial investigation consists of a reconnaissance investigation followed by limited subsurface exploration to identify conditions at areas of concern or other critical locations. The purpose of the initial investigation is to identify site geology and surficial and subsurface features at the project site or along the project alignment that may affect construction. The investigation begins with a data review and site surficial examination. Where subsurface conditions of concern are identified during the site walk and data review, the Geotechnical Consultant shall coordinate with the Design Consultant and a

limited subsurface investigation shall be conducted. Results of the initial investigations shall be summarized in a Geotechnical Data Report, as described in Section 13.5.

13.3.1.1 Data Review

The data review shall consist of evaluating published geologic information (maps, studies, articles, etc.) and other available subsurface information in the project vicinity.

13.3.1.2 Site Surficial Examination

The site surficial examination shall consist of visual observation along the pipe alignment. The purpose of the examination is to identify features that can help to characterize the subsurface materials and to identify any features that may cause construction problems. Engineering observation of the following items shall be included as part of the examination:

- Site relief
- Vegetation
- Existing improvements
- Adjacent structures and facilities
- Surface features (including drainage ways)
- Unusual conditions (landslides, subsidence, rock outcroppings)
- Nearby construction (observe slopes, excavations, exposed soils)

13.3.1.3 Limited Subsurface Explorations

Some limited explorations may be required at critical locations such as

- For pipelines: bore-and-jack sites, bends in the pipe, manholes or valves, structures, or other locations identified during the site surficial examination or data review
- For site-based facilities: major structure(s) and at least one location along the major pipe alignment

These preliminary explorations shall consist of test pits or soil borings, as described in Section 13.2.

13.4 FINAL DESIGN INVESTIGATIONS

The final design investigation is performed to provide reasonably comprehensive knowledge of the site or alignment for design and construction. The methods described in Section 13.3 are anticipated to be used.

13.4.1 Pipeline Final Investigations

General practice is one boring every 500 to 1,000 feet, with additional borings drilled at every structure and bore-and-jack location; in areas of bedrock, borings as close as 100 feet is common practice. Boreholes should generally extend 5 to 10 feet below the pipe invert to identify potential trench subgrade problems, including heaving soils or groundwater problems, and to reduce the possibility of having to drill additional borings if the pipe elevation is later changed during design.

Trench excavation, pipe bedding, backfill, and compaction recommendations shall comply with the requirements of the agency having jurisdiction.

The Geotechnical Consultant shall provide recommendations for the following:

- Excavation slope
- Trench shoring
- Bedding material and trench backfill
- Chemical test and corrosivity
- Tests for pH, chlorides, total salts, sulfate, and sulfides
- Oxidation reduction
- Corrosion potential for buried pipelines
- Cement type

A corrosion investigation is also required. Corrosivity testing is required at maximum 1,000-foot intervals and as necessary for yard piping on site-based facilities. Refer to the "Cathodic Protection" chapter in Volume 5, Large Pipeline Design Guide, for information on corrosion investigation and mitigation.

13.4.2 Site-based Facilities Final Investigations

Investigations for site-based facilities (pump stations, reservoirs, wells, rate of flow control stations) covered by the EDS require a different layout and testing program to provide data relevant to design and construction. The layout shall be determined by the Design Engineer in consultation with the Geotechnical Consultant. Testing shall include items listed in 13.4.1 and other tests as determined necessary to the type of facilities being installed.

13.4.2.1 Design Parameters

The following are minimum design parameters to be addressed:

- Active and passive soil pressure
- At rest soil pressure
- Total and differential settlement
- Design bearing capacity
- Minimum footing embedment
- Recommended foundation system

- Groundwater
- Corrosive soils
- Expansive soils

Coefficient of friction between soil and concrete shall also be provided for reservoir and pump station sites.

13.4.2.2 Seismicity

The following are minimum seismicity parameters to be evaluated by the Geotechnical Consultant:

- Maximum credible earthquake for known major faults including distances to project site
- Site classification as defined in Chapter 20 of ASCE 7, Minimum Design Loads for Buildings and Other Structures (2010 Edition), as specified by IBC Section 1613.3.2 (2012 Edition)
- The mapped spectral accelerations for short periods S_s, and for mapped spectral accelerations for a 1-second period, S_1, in accordance with the requirements of Section 1613.3.3 of IBC
- Maximum Considered Earthquake Spectral Response Accelerated Adjusted for Site Class Effects, S_{MS} and S_{M1} as determined in Section 1613.3.3 of IBC
- Design Spectral Response Acceleration, S_{DS} and S_{D1} as determined in Section 1613.3.4 of IBC
- Site coefficient F_a and F_v as defined in Table 1613.3.3 (1) and 1613.3.3 (2) of IBC
- All other seismic parameters needed for design
- Potential for liquefaction and recommendations
- Seismically induced lateral earth pressures.

13.4.2.3 Groundwater

The Geotechnical Consultant shall evaluate and provide recommendations for the following groundwater conditions:

- During construction
- Dewatering
- Design groundwater elevation
- Detail mineral and water quality analysis to assess need of treatment prior to disposal.

13.4.2.4 Site Preparation

The Geotechnical Consultant shall provide recommendations for the following:

- Temporary excavation slope

- Permanent fill and cut slope
- Fill and backfill materials and compaction
- Pavement design for both flexible and rigid pavement for traffic index of TI = 4,5,6, and 7.

13.4.2.5 On-site Pipelines

At least two points on the site, located where key buried pipes are to be installed, shall be evaluated for the parameters required in Section 13.2.1. For buried pipelines, corrosion potential is a significant concern.

13.5 REPORTS

The Geotechnical Recommendations Report will generally follow the Geotechnical Data Report as a companion volume; information already presented in the Data Report should generally not be repeated in the Recommendations Report. The Recommendations Report is intended for use by the Design Engineer; however this information may also be made available to prospective bidders.

A combined data and recommendations report (one that contains all the elements of both reports) may be developed for small projects as agreed upon by the Geotechnical Consultant, Design Engineer, and Owner. Small projects are generally considered to be pipelines 36 inches in diameter or smaller and less than 10,000 feet in length. Separation of the factual data (background, technical data, and data interpretation) from design recommendations provides a separation of factual and subjective information for the construction bidders and allows the design criteria to be modified as the project changes during the various design phases.

CHAPTER 14
HAZARDOUS MATERIAL INVESTIGATION

If included in the SOW, the Design Engineer shall provide a reconnaissance-level investigation to identify possible contaminants that may be encountered during construction. Data from potholing and geotechnical borings may also indicate possible soil or groundwater contamination. In such instances, Contract Documents must include provisions for the identification, handling, and disposal or treatment of contaminated soils or groundwater by the Contractor.

14.1 POTENTIAL HAZARDOUS MATERIALS

Soils or groundwater are designated as contaminated if they contain hazardous or designated waste materials including asbestos, petroleum hydrocarbons, pesticides, heavy metals, and any material that is classified as hazardous or toxic according to applicable regulations.

14.2 PRELIMINARY INVESTIGATIONS

When indicated, the Design Engineer shall conduct a reconnaissance-level evaluation of all known hazardous waste sites and will include the following activities:

- **Site Reconnaissance**--Site visit of project site(s) and/or pipeline routes to observe field conditions, take photographs, and record field notes.

- **Literature Review**--Acquisition of readily available records and documents (e.g., Environmental Protection Agency's Resource Conservation, Recovery Act list of hazardous waste generators, Superfund Amendments and Reauthorization Act Title III inventory, Comprehensive Environmental Response Compensation and Liability Act Information System list of contaminated sites, and the National Priority List of Superfund sites; U.S. Department of Labor, Occupational Safety and Health Administration's Process Safety Management (PSM) rule applicable to all facilities handling listed chemicals above threshold limits; State of Nevada Chemical Accident and Prevention Program (similar to PSM) for the project area to identify areas of known contamination).

- **Regulatory Agency Contacts**--All applicable federal, state, and local regulatory agencies shall be contacted to obtain updated information about the location of contaminated sites, the types of contaminants, and the current regulatory status of the sites.

A summary of the activities listed above will be provided to the Design Manager and will include the following information:

- Hydrogeology
- Surface-water characterization

- Summary of site reconnaissance
- Project area history
- Regulatory Agency contacts and summary
- Summary of contaminated soil sites (including map)

14.3 FOLLOW-UP INVESTIGATIONS

Information acquired during potholing or geotechnical explorations will supplement the data compiled during the preliminary investigations. Additional laboratory analysis of soil samples may be included in areas of known contamination. If possible, additional soil borings should be included to characterize the extent of soil and groundwater contamination. Any supplemental information obtained during field investigations regarding contaminated soils or groundwater shall be included in the geotechnical reports.

The subconsultant responsible for potholing and geotechnical investigations shall prepare a safety plan that is appropriate for the level of contamination identified during the preliminary investigations.

14.4 REMEDIATION OR MITIGATION

If contaminated soils, materials, or groundwater are expected to be encountered during construction, the Design Engineer shall identify all contaminants discovered in the preliminary and follow-up investigations and shall recommend a course of action to the Design Manager. The recommended course of action may involve either removing the contaminated materials from the site or treating onsite; rerouting or relocation of facilities should also be considered. The recommended course of action should minimize risk to the Owner from the exposure of workers to contaminants or from contaminants being introduced into nearby receiving waters or drainage channels and should recognize the schedule constraints of the project.

14.4.1 Remove from Site

The Design Engineer shall specify that removal or treatment of contaminated materials must be performed by a properly licensed and qualified contractor. The Design Engineer should consider a screening plan in the Contract Documents to determine where materials, soils, and/or groundwater is contaminated. Estimates of the quantities of materials to be removed from the project should be provided in the Bid Schedule as separate items to obtain a reasonable construction cost estimate.

14.4.2 Treat Onsite

Oftentimes, it is economically feasible to provide onsite portable treatment systems during construction. An estimate of the volume of soil and quantity of water to be removed from the project should be provided in the Bid Schedule as separate items to obtain a reasonable construction cost estimate.

14.5 PERMITTING

If permits are required for the collection and disposal of groundwater, then provisions shall be included in the permit application for the removal or treatment of contaminated groundwater if any is expected to be encountered. The disposal of contaminated materials may require specific classification for disposal at an appropriate facility. State health agencies may require the classification of expected contaminants so that appropriate safety plans may be developed to protect workers during any field investigations or construction. It is the responsibility of the Design Engineer to coordinate with the appropriate agencies and customize the Contract Documents to require mitigation contractors meet all permit requirements.

14.6 CONTRACT DOCUMENTS

The Standard Specifications does not contain any provisions for the handling and disposal or treatment of contaminated soils, lead paint, or groundwater. Provisions do exist for asbestos pipe. The Design Engineer shall provide appropriate language as to the level of training that the contractor may need to minimize any health risk to workers in identifying, handling, treatment, and disposal of contaminated materials or groundwater.

14.6.1 Dewatering

Dewatering requirements are addressed in Standard Specifications. In areas where contaminated groundwater is expected to be encountered during construction, specific provisions shall be included in the contract documents for the removal or treatment of the contaminated groundwater. The location and extent of contaminated groundwater shall be indicated on the contract drawings. The design of dewatering systems should consider the collection and disposal of contaminated groundwater or the onsite treatment of contaminated groundwater prior to discharge.

14.6.2 Trenching

Trenching and backfill requirements are addressed in Specification Section 31 20 00 Earthwork. In areas where contaminated materials are expected to be encountered during construction, specific provisions shall be provided in the contract documents for the removal or treatment of the contaminated materials. The location and extend of the contamination shall be indicated on the Contract Drawings.

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APPENDIX A
ACRONYMS AND ABBREVIATIONS

Note: Where acronym or abbreviation definitions differ, use the term which applies to the respective section.

AACEi – American Association of Cost Engineers International

ACI – American Concrete Institute

ANSI – American national Standards Institute

APN – Assessors Parcel Number

AR – Air Release Valve

ASPRS - American Society of Photogrammetry and Remote Sensing

ASTM – American Society of Testing Materials

AV – Air Vacuum Valve

AV/AR Combination Air Vacuum/Air Release Valve

AWWA – American Water Works Association

BFV – Butterfly Valve

BLM – Bureau of Land Management

BOR - Bureau of Reclamation

CADD – Computer-Aided Design and Drafting

CCDDS - Clark County Department of Development Services

CCI – Construction Cost Index

CCWRD – Clark County Water Reclamation District

CORS - Continuously Operating Reference Stations

CSI – Construction Standards Institute

DCS - Distributed Control System

DCSWCS – Design and Construction Standards for Wastewater Collections Systems

DR – dimension ratio

EDS – Engineering Design Standards

ENR – Engineering News Record

ESDC - Engineering Services During Construction

ESGI - Electronic Submittal of Geotechnical Information

FEG – Facility Engineering Guides

GPS - Global Positioning System

IBC – International Building Code

ID – inside diameter or identification

LAM - Land Acquisition Manager

LVVWD – Las Vegas Valley Water District

M – million

mg/L – milligrams per liter

NAC – Nevada Administrative Code

NAD83 – North American Datum of 1983

NAVD88 - North American Vertical Datum of 1988

NEPA – National Environmental Policy Act

NGEM – Nevada Government e-marketplace

NGS - National Geodetic Survey

NRS – Nevada Revised Statutes

NTP – Notice to Proceed

O&M – Operations and Maintenance

OSHA – Occupational Safety & Health Administration

PCO – Potential Change Order

PE – Permanent Easement

PLS– Professional Land Surveyor

PLSS – Public Land Survey System

PMP – Project Management Plan

ppm – Parts per million

PRV – Pressure Reducing Valve

psi – pounds per square inch

PSA – Professional Services Agreement

PSM – Process Safety Management

PVC – Polyvinyl chloride

QA - Quality Assurance

QC - Quality Control

RFI – Request for Information

ROW - Right-of-Way

RTU - Remote Terminal Unit

SCADA - Supervisory Control and Data Acquisition

SF - Standard Form

SME – Subject Matter Expert

SNWA – Southern Nevada Water Authority

SOW – Scope of Work

SPT - Standard Penetration Test

STU – Short Term Use

TCE – Temporary Construction Easement

TI – Traffic Index

UDACS – Uniform Design and Construction Standards for Potable Water Distribution Systems

USA – Underground Service Alert

USD – Uniform Standard Drawings for Public Works Construction Offsite Improvements, Clark County Area, Nevada

USGS – United States Geological Survey

USS – Uniform Standard Specifications for Public Works Construction Offsite Improvements, Clark County Area, Nevada

WBS – Work Breakdown Structure

WFCN – Water Facility Control Network

APPENDIX B
DEFINITIONS

Note: Where definitions differ, use the term which applies to the respective section.

Agency's Representative – The individual duly authorized by the Agency to act as the agent for an Agency or a jurisdiction.

Appurtenances – Any machinery, appliances, structures and other parts of the main structure that will enable the main structure to function but is not considered part of the main structure.

As-Built Drawings (Red-Line Drawings) - Drawings marked up in the field to reflect changes to the design documents compiled by the Inspector / Contractor (modifications, field changes, shop drawing changes, design changes, extra works and every change that was approved and made during construction).

Assessor's Parcel Number – A number found in real property records. This number is assigned by Clark County to identify and track a particular parcel of land.

Backfill – The material used to refill an excavation.

Backflow – A hydraulic condition, caused by a difference in pressures, that causes non-potable water or other fluid to flow into a potable water system.

Bid Documents – The portion of the Contract Documents that a Contractor must submit as part of a valid bid.

Concrete – A mixture of Portland cement, sand and water.

Condemnation – the process of acquiring a property using eminent domain.

Conformed Set – Contract documents modified to include addenda, request for clarifications and bid questions during the bid process, prepared by the Design Engineer.

Construction Manager – the Owner's designated representative to administer the construction contract.

Contamination – A potable water quality impairment by sewage, industrial fluids, or waste liquids, compounds, or other materials to a degree that creates an actual or potential hazard to the public health.

Contract Documents – The complete set of specifications, drawings, and any other documents that comprise a contract for construction of facilities.

Contract (Project) Documents (Drawings) - The drawings which show the scope, extent and character of the Work to be furnished and performed by the Contractor.

Contractor – The construction firm properly licensed in the State of Nevada retained to install water facilities in accordance with these Standards.

Design and Construction Standards for Wastewater Collection Systems – Minimum design and construction criteria for sanitary sewer systems within the jurisdiction of the participating agencies.

Dedicated Public ROW's – A plot of ground which, by owner definition, has been reserved for the public's use or betterment. The uses are, but not limited to, utilities, roadways, and flood control.

Design Engineer – The Engineer of Record for projects designed for the Owner (LVVWD, SNWA or Springs Preserve).

Design Manager – the Owner's (LVVWD, SNWA or Springs Preserve) representative responsible to oversee design of a project.

Developer – The individual, corporation or partnership that requires water service, either by a service lateral installation or by constructing a water main extension for proposed or existing structure(s).

Developer's Engineer – (See "Engineer".)

Distribution Main – Any pipe in a distribution system that allows a service line connection.

Domestic Service – A metered service connection through which water is obtained for all purposes, including residential, commercial, and industrial uses, exclusive of fire protection.

Easement – An acquired legal right to the use of land owned by others, or a plot of land reserved under County recording that allows the Agency ingress and egress to Agency facilities on private property (outside the public ROW).

Emergency – A situation in which an unusual calamity, including a flood, fire, storm, earthquake, drought, civil disturbance, accidental spill of a hazardous material, or similar occurrence, disrupts the provision of water by a public water system or endangers the quality of water provided by a public water system.

Eminent Domain – the power of a state, provincial, or national government to take private property for public use, when fair market compensation is provided to the landowner.

Engineer – Civil Engineer or Architect, licensed in the State of Nevada, who is responsible for the design submitted for a Developer, Owner, or Agency.

Existing public water system – A system for providing to the public, water for human consumption through pipes or other constructed conveyance and is operational.

Finished Water or Potable Water – Water that is safe and satisfactory for drinking and cooking.

Geotechnical Consultant – the geotechnical expert

Inspector – The Agency representative authorized to make detailed inspections for compliance with these standards.

Landowner – refers to the party from whom a property interest is acquired. Also includes the landowner's designated representative.

Meter Box – An enclosure constructed of approved materials protecting one or more water meters installed in the ground outside and allows access for a person to read the meters.

Owner – The individual, corporation, or partnership who owns the parcel of land to be developed. Owner in this Volume refers to LVVWD, SNWA or Springs Preserve.

pH – A measure of the acidity or alkalinity of a solution such that a value of 7 is neutral on a scale ranging from zero (0) to fourteen (14). Lower numbers represent acidic solutions, and higher numbers represent alkaline solutions.

Point of Contact – person through whom all contact with a defined third party (landowner, Contractor, etc.) must be facilitated, whether for a predetermined phase or entirety of a project.

Potable Water – Water that is safe and satisfactory for drinking and cooking, meeting all applicable standards.

Public Water Facilities – The water facilities owned, operated, and maintained by the Agency after completion and acceptance.

Public Right-of-way – property that is dedicated to public use.

Public Water System (As Defined By NRS 445A.235) – Any system, regardless of ownership, that provides the public with water for human consumption through pipes or other constructed conveyances, if the system has fifteen (15) or more service connections, as defined in NRS 445A.843, or regularly serves twenty-five (25) or more persons. The term includes:

A. A facility for the collection, pumping, treatment, storage, or distribution of water which is controlled by the operator of the system and used primarily in connection with the system; and
B. A facility for the collection or storage before treatment of water which is not controlled by the operator of the system but is used primarily in connection with the system.

Quality Assurance – The actions or tests performed as a check on the quality of another party's product.

Quality Control – The actions or tests performed by a party on the quality of its product.

Record Drawings – Drawings compiled from the as-built drawings submitted by the contractor, as a record of the work.

Service Connection – The point of connection between a public water system and the water system used by a customer of the public water system, at which the public water system loses its authority and control over the water; If a meter is installed at a connection between a public water system and the water system used by a customer of the public water system, the downstream end of the meter shall be considered the point of service connection.

Service Line or Lateral for Water – The pipe and all appurtenances located between a water main of a distribution system and service connection.

Shop Drawings - All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for the Contractor and submitted by the Contractor to illustrate some portion of the Work.

Site-based facility – a facility that is constructed on a plot of land, as opposed to pipelines which are linear project. Site-based facilities include treatment plants (not part of EDS), pumping stations, reservoirs, wells, and rate of flow control stations.

Site (Living) Drawings – Drawings compiled from one or more contracts, or generated from field verification for maintenance purposes, which reflect the most current information about the facilities at a project site.

Standards – The Uniform Design and Construction Standards for Potable Water Distribution Systems (UDACS), latest edition as amended by each Agency.

Standard Plates – The illustrations in Section 5 of the Uniform Design and Construction Standards for Potable Water Distribution Systems, latest revision as amended by each Agency, also referred to as UDACS Plates.

Subdivision – Subdivision has the meaning ascribed to it in NRS 278.320.

Supplier of Water – A person or other entity, including a governmental entity, which owns or operates a public water system.

Temporary Construction Easement – A Temporary Construction Easement (TCE) is granted for a specific purpose and applicable for a specific time period, and typically only involves the surface.

Transmission Main – Large diameter pipelines used exclusively for moving water from one point to another. Valved outlets, if allowed, are typically at uniform distances and there are no service laterals allowed from the pipe. A water main that transports water from the main supply or source to a distant area where the water is distributed through distribution lines.

Treatment Facility – A facility that contains various processes for the treatment of water for a public water system.

Valve Box – A housing that encloses the operating nut of a valve and extends to the ground surface, allowing an access opening for an operating or valve key to be inserted and connected to the operating nut so that the valve may be opened and closed.

Wastewater – Water which, as a result of domestic, commercial, or industrial use, contains physical, chemical, or biological impurities.

Water Service Lateral – A pipe that conveys water from a water main to the point of use of the water.

APPENDIX C
UTILITY COORDINATING PROCEDURES

Design Engineers shall follow the procedures herein to coordinate with utility companies during the design and preconstruction.

Design Engineers should note that each privately owned utility is obligated to relocate its facilities when necessary to make way for the proper governmental use of the project land area, except in areas where the utility owns title to the land or a pre-existing easement. The Owner does not prefer to force a utility to move its facilities and prefers where possible to work around them during construction. Requiring utilities to move facilities is most often associated with large pipelines where it is impractical to go over or under the existing utility. Design shall only proceed with the utilities being moved with approval of the Owner. The utility owner shall be contacted and presented with the alternatives including the logistics of moving the existing utility and maintaining services to the line.

NOTE: All correspondence between the Design Engineer and the utilities shall reference the phase that the attached drawings or comments refer to.

C.1 INFORMATION TO INCLUDE

The drawings shall show the Owner's facilities in plan view with an accompanying profile for pipelines. The drawings shall show the following:

- Existing and proposed utilities including gas, water, sewer, irrigation, petroleum, communication, power, and traffic signalization
- Any other public or private utilities
- Utilities provided by developers, as information becomes available

Utility maps and as-built drawings typically include the following information:

- Location and type of utility
- Offset from edge of pavement, edge of road, or centerline of street
- Size of utility
- Material
- Depth of utility
- Location, size, and depth of underground access structures or appurtenances
- Datum reference

When provided, the datum that the maps or drawings are based on shall be compared with the Owner's datum (provided by the Owner's Surveyor) and adjustments shall be made to the data taken from the maps or drawings, if necessary, prior to transfer to the plan and profile sheets. Overlooking this datum adjustment can result in errors and construction change orders.

C.1.1 Existing Utilities of Special Concern

Especially for pipelines, the following utilities need additional effort to accurately locate and minimize likelihood of conflict:

- Large diameter (greater than 15-inch) water lines
- Storm drainage pipelines and facilities
- Sanitary sewer service connections and sanitary sewer pipelines
- Sanitary sewer force mains
- Underground communication lines and powerlines
- High pressure gas lines
- Utilities to be installed by developers during design/construction

C.1.2 Tracking

A detailed listing of maps and as-built drawings received from utility companies shall be logged into a document control system showing the date received, utility company name, utility map or drawing number, date of preparation of the utility map or drawing, revision number of the utility map or drawing, major streets referenced on each map or drawing, type of utility, and size of utility. This log also will be helpful to the utility company, which may not track all records sent previously.

Data provided by utility companies in the form of utility maps and as-built drawings shall be compared against field-located utilities to verify that all existing utilities records are requested.

C.2 FIELD VERIFICATION OF UTILITIES

During the initial phase of design, a field reconnaissance of the proposed alignment shall be made and the location of all existing utilities shall be verified on the preliminary drawings. Before any potholing, geotechnical borings, or construction work can start, contact USA North 811 at least 48-hours prior to digging.

The following agencies need to be contacted as needed.

- Call Before You DIG: 811
- Call Before You UNDERGROUND: 702-227-2929
- Call Before You OVERHEAD: 702-593-6111
- CC Traffic Operators: 702-455-7511
- LV Area Computerized Traffic System: 702-229-6611

Utility offsets from edge of pavement, edge of road, or some visible landmark shall be noted in the field notes. These field notes will provide a valuable tool during design to verify existing utility information provided by the utility companies. Any discrepancy

between as-built data and field notes shall be resolved as quickly as possible with the utility company.

C.2.1 Potholing

Potholing is the process whereby the soil above a utility is probed to determine the location and depth to the top of a specific utility. Potholing is primarily used for pipelines but can also be used for site-based facilities. "Soft dig" technologies are available that minimize the amount of soil disruption and will not damage the utility being verified. Many utility companies use the "soft-dig" contractors for potholing their own utilities and may require that the Design Engineer do the same. Any damage to pavement, roads, or soil during potholing work shall be fully restored in accordance with local prevailing standards before leaving the site.

C.2.1.1 Determination of Utilities to Pothole

Utilities that may be in conflict or in proximity to the facility vertical and horizontal alignment shall be potholed to verify that the location of the utility is accurate. The number of potholes required shall be sufficient to determine alignment and grade of the utility. Invert elevations of sewers and storm drains with access manholes can be verified during surveying. Small-diameter, shallow utilities may not need to be potholed if only in horizontal conflict.

C.2.1.2 Recording Utility Locations

Preliminary drawings shall be provided to the potholing subcontractor with the locations of potholes clearly marked and numbered. The potholing subcontractor should provide a log of utility locations verified during potholing. This log should contain the pothole number (from preliminary alignment drawings), type and size of utility, depth to top of pipe, and horizontal distance to the nearest visible object at the surface (fence, road, curb, etc.) that can be identified on the mapping. Two or three distance measurements should be made to each pothole location.

C.3 UTILITY LOCATION PROCEDURE FOR DESIGNS

C.3.1 60% Design

60% drawings shall be sent to each utility, for the marking of all facilities within the project boundaries. When available, the Utility point of contact for the project will be provided to the Design Engineer.

- Each Utility shall respond in writing within 21 calendar days of receiving 60% drawings acknowledging receipt and transmitting requested information. Each utility shall provide the information available on utility records. If no reply is received within that time frame, the Design Engineer shall contact the utility representative for immediate response and coordination and notify the Owner.

- During the design phase the Design Engineer shall contact the utility representative to resolve conflicts as soon as they become apparent. NOTE: It is the responsibility of the Design Engineer to obtain all pertinent existing utility information and to include that information on the 60% drawings.
- On large projects (i.e., reservoirs, pumping stations, etc.), coordination meetings shall be arranged by the Design Engineer, between the 60% and 100% drawings with utility representatives that have major conflicts.

C.3.2 100% Design

100% drawings shall be sent to each utility. During this phase the Design Engineer shall inform the utilities in their correspondence, of project status, possible delays, advertising date, construction schedule and any other information necessary to establish tentative work schedules.

- Each utility representative shall respond in writing within 30 calendar days of receipt of 100% drawings, giving a brief description of the utility conflict(s) and construction schedule.
- Each utility shall have 60 calendar days after receipt of 100% drawings for the planning and engineering of relocations required. Certain projects May be of a magnitude that may require additional time to design and construct, therefore, each Utility shall be responsible for informing the Design Engineer of scheduling changes or difficulties associated with any project.

NOTE: Projects requiring utilities to obtain railroad permits, right-of-way, materials, etc. could take 6 to 8 months. Projects requiring the transfer or removal of "joint" aerial facilities with Nevada Power, telephone company and/or cable television may require additional time to coordinate their work.

The Design Engineer shall negotiate scheduling requirements for special situations with the utilities. The Design Engineer and the utility representative shall communicate closely during the engineering phase to resolve any potential conflicts. Not doing so could result in delays in construction.

C.3.3 Bid Set Drawings

The Design Engineer shall forward Bid Set drawings and outline in writing any changes made since releasing 100% drawings (i.e., engineering design, bid date, construction schedule or any foreseeable delays in the project due to public hearings, etc.). These changes are critical to each utility's construction schedule and budgeting of capital dollars for public improvement projects.

- Utilities shall have a minimum of 60 calendar days to schedule and construct relocations, unless previously negotiated, prior to the Owner contractor starting construction. Each utility shall respond in writing within 10 calendar days of receipt of 100% drawings, confirming schedule of relocation construction in writing.

NOTE: If there are any significant changes between the 100% and Bid Set drawings which require re-engineering, a new project schedule will be made and the timetable for any construction required by the utility updated.

C.4 UTILITY RELOCATION

Where a conflict exists with an existing utility, relocation of the existing utility may be required. An evaluation of the feasibility of and alternatives for relocation shall be conducted. The utility owner shall be contacted and presented with the alternatives including the logistics of moving the existing utility and maintaining services to the line, and the cost of relocation.

C.4.1 Feasibility and Alternatives

An evaluation of the feasibility of moving an existing utility shall be conducted and relocation alternatives shall be developed with the utility owner. If the line to be relocated is a gravity pipeline, the impacts of relocation will extend to service connections, structures, and upstream pipes. Relocating storm drains will involve assessment of the drainage area contributing flow to the pipe to be relocated and could involve a significant analysis. Small-diameter, low-pressure systems such as some gas and electric lines are more easily relocated than other types of pipelines.

C.4.2 Coordination with Utility Owner

The utility owner shall be presented with the alternatives developed for utility relocation. If all issues are addressed and the utility owner is agreeable to relocating the utility, the utility owner needs to determine if they will design the relocation, or the Design Engineer will proceed with the relocation design. These drawings shall be included in the contract documents for bidding, unless the utility owner chooses to relocate its own utility.

C.4.3 Logistics and Maintenance of Service

Once a decision is made to relocate an existing utility and the preferred alternative alignment is set, provisions shall be included in the contract documents for the continuation of service during construction, unless otherwise allowed by the utility owner. Construction sequencing shall be determined to ensure that the relocation is completed with a minimum amount of disruption.

C.4.4 Cost of Relocation

If the utility owner designs the relocation, the cost to relocate the existing utility is usually determined by the utility owner. If the Design Engineer designs the relocation, then the utility owner may have some review and inspection fees associated with the relocation.

The Design Engineer shall coordinate with the utility owner to determine `actual construction costs to include in the engineer's cost estimate. The cost estimate shall be prepared in accordance with the requirements of the EDS, Volume 1, General Design Guidelines, Chapter 4, Cost Estimating Guidelines.

C.5 COMMONLY CONTACTED UTILITIES AND AGENCIES

AT&T
BHP Nevada Railroad Corporation
Cal-Nevada Pipeline
Century Link (Formerly Embarq, Sprint)
City of Henderson
City of Las Vegas
City of Las Vegas, Sewer Services Division
City of Los Angeles, Department of Water and Power
City of North Las Vegas
Cox Communications
Clark County Building Department
Clark County Public Works
Clark County Regional Flood Control District
Clark County Water Reclamation District
Kern River Gas Transmission Pipeline
Kinder Morgan Energy Partners (CALNEV)
Lincoln County Power District
Lincoln County Roads Department
Mcgill-Ruth Consolidated Water and Sewer District
Moapa Valley Telephone Company
Moapa Valley Water District
Mt. Wheeler Power
Muddy Valley Irrigation Company
Nevada Department of Transportation
NV Energy
Nevada Public Service Commission
New Wave Communications (Laughlin/Searchlight)
Overton Power District #5
Regional Transportation Commission
Southwest Gas Corporation
Union Pacific Railroad
Western Area Power Administration
White Pine County Public Works

APPENDIX D
LIST OF STANDARDS

Note: This is not a complete list, but as a minimum, the Design Engineer shall be aware of these standards, codes and regulations.

AABC - Associated Air Balancing Council

AACEi – American Association of Cost Engineers International

ACI – American Concrete Institute

ADC - Air Diffuser Council

AFBMA - Anti-Friction Bearing Manufacturers Association

AGMA – American Gear Manufacturers Association

AISC - American Institute of Steel Construction

ANSI – American National Standards Institute

API – American Petroleum Institute

ARI - American Refrigeration Institute

ASCE – American Society of Civil Engineers

ASHRAE - American Society of Heating, Refrigeration, and Air Conditioning Engineers

ASME - The American Society of Mechanical Engineers

ASTM – American Society of Testing Materials

AWS - American Welding Society

AWWA – American Water Works Association

Chlorine Institute

Clark County - Clark County Regional Flood Control District, Hydrologic Criteria & Drainage Design Manual

Clark County - Uniform Design and Construction Standards for Potable Water Distribution Systems (UDACS)

Clark County - Uniform Standard Drawings for Public Works Construction Offsite Improvements, Clark County Area, Nevada (USD)

Clark County - Uniform Standard Specifications for Public Works Construction Offsite Improvements, Clark County Area, Nevada (USS)

Clark County - Design and Construction Standards for Wastewater Collections Systems (DCSWCS)

Clean Air Act of 1990 Guidelines

CRSI – Concrete Reinforcing Steel Institute

NDOT – Nevada Department of Transportation

EPA – Environmental Protection Agency

HI – Hydraulic Institute

UPC - Uniform Plumbing Code

IBC – International Building Code

IEEE - Institute of Electrical and Electronics Engineers

IFC - International Fire Code

IMC - International Mechanical Code

IPC - International Plumbing Code

IPCEA - Insulated Power Cable Engineers Association

ISA - International Society of Automation

MSS - Manufacturer's Standardization Society

NAC - Nevada Administrative Code

NACE – National Association of Corrosion Engineers

NAPF – National Association of Pipe Fabricators

NDEP – Nevada Department of Environmental Protection

NDWR – Nevada Division of Water Resources

NEBB - National Environmental Balancing Bureau

NEC - National Electric Code

NEMA - National Electrical Manufacturer Association

NFPA – National Fire Protection Association

NGWA - National Ground Water Association

NSF International - National Sanitation Foundation

NRS - Nevada Revised Statutes

NV Energy – Electric Service Standards for Southern Nevada

OSHA - Occupational Safety and Health Administration

PCA - Portland Cement Association

RCRA - Resource Conservation and Recovery Act

SMACNA - Sheet Metal and Air Conditioning Contractors National Association Standards

SSPC - Society for Protective Coatings

UL - Underwriters Laboratories

USBLM – United States Bureau of Land Management

USBR – United States Bureau of Reclamation

USFWS – United States Fish and Wildlife Service

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APPENDIX E
SNWA ADAPTIVE MANAGEMENT STRATEGIES FOR NEW & EXISTING FACILITIES

PLANNING FOR
CHANGE

SNWA ADAPTIVE MANAGEMENT STRATEGIES FOR NEW & EXISTING FACILITIES

Studies warn that infrastructure currently designed for historical climate conditions are more vulnerable to future weather extremes and climate change, and that forward-looking infrastructure design, planning and operational measures and standards can reduce exposure and vulnerability to the impact of climate change.

FOURTH NATIONAL CLIMATE ASSESSMENT, Volume II, 2018

Southern Nevada is no stranger to weather and climate extremes. Located within one of North America's hottest and driest desert regions, the community regularly experiences searing temperatures and extended dry spells. These conditions have intensified due to changing climate conditions, particularly in recent years. Warmer local temperatures are beginning sooner in the spring, lingering longer into fall and reaching record-breaking highs more often. This paper outlines climate change considerations for Southern Nevada and details how the Southern Nevada Water Authority (SNWA) is addressing climate change impacts to critical water treatment and delivery infrastructure through proactive planning and adaptive management.

Southern Nevada's Changing Climate

The top ten warmest years for Las Vegas occurred between 2003 and 2020. Of these, 2017 and 2018 went down in history as the warmest year and warmest summer on record, respectively.[1] 2020 broke records too. The weather station at McCarran International Airport recorded 2.35 inches of precipitation in Las Vegas last year, well below the city's 4.19-inch rainfall average. Monsoons—typical between June and September—never came. Instead, residents and visitors sweltered through a record 97 days of temperatures at or above 100°F and endured the longest number of consecutive days without measurable rainfall. The 2020 dry spell eventually ended at 240 days, crushing the prior record of 150 dry days in 1959. The precipitation event that ended the 2020 dry spell offered little reprieve, recording just 4/100th of an inch of rain. Local projections indicate these trends will continue with temperatures warming between 5-10°F by the end of the century.[2]

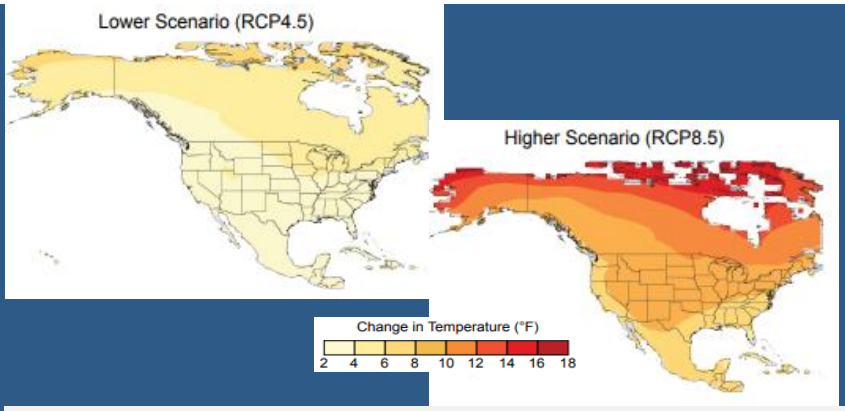
Climate Change Impacts to Regional Water Facilities and Operations

The SNWA manages a complex network of facilities used to deliver Nevada's Colorado River allocation to its member agencies, which collectively serve more than 2.3 million residents and more than 40 million annual visitors in the SNWA service area. These facilities include water intake, pumping and treatment facilities at Lake Mead; more than 100 miles of large diameter pipeline; and water pumping and rate-of-flow-control stations throughout the greater Las Vegas Valley. In addition to existing facilities, the SNWA manages a $3.5 billion Major Capital and Construction Plan that includes new facilities to support future regional water deliveries and ongoing reliability needs.

Climate Change Considerations

The global mean annual air temperature in has warmed 1.8°F since the early 20th century. [3] Consistent with global trends, warming has also occurred in the southwestern United States.

While climate change models project that warming trends will continue, the magnitude of change at a given location will depend in part on global mitigation efforts to reduce greenhouse gas emissions. Locally, projections indicate that Clark County, Nevada will warm between 5-10°F by the end of the century.[2]



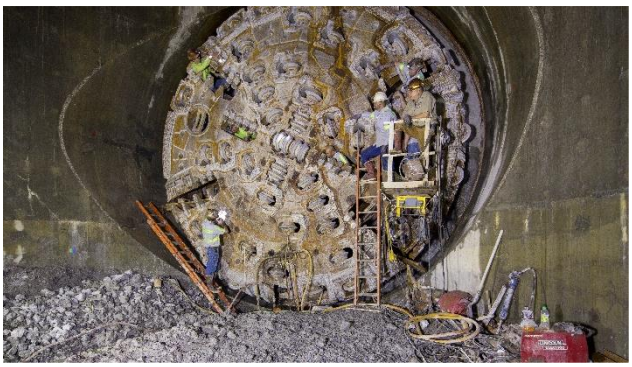
4th National Climate Assessment, 2018: Summary of projected temperature changes in annual average temperatures based on low and high greenhouse gas concentration scenarios.

MANAGING CHANGE THROUGH ADAPTIVE MANAGEMENT IN ACTION

ADAPTIVE MANAGEMENT

The SNWA has experienced direct impacts associated with climate change. Most noticeably, the drastic decline in Lake Mead water levels – the result of severe and sustained drought conditions in the Colorado River Basin. The lake's surface elevation has dropped 135 feet since the drought began in 2000. This prompted the SNWA to take swift action to develop new facilities to protect the community's access to its primary drinking water supply and address water quality impacts.

The SNWA also has experienced climate-related increases to water and energy demands associated with pumping and distribution facilities and building maintenance. Other impacts include reduced efficiency and increased maintenance of heating, ventilation and air conditioning (HVAC) systems that support critical facilities; increased electrical loads associated with water treatment processes; and reduced efficiency of pumping equipment and distribution pipeline materials. Facility-related climate change impacts, primarily due to warmer conditions and higher overnight low temperatures, are expected to expand and intensify as local temperatures continue to warm.



Adaptive Management in Action

The SNWA took swift action to preserve and protect the community's primary water supply as drought and climate change conditions in the Colorado River Basin began to impact Lake Mead water levels. Nevada accesses its Colorado River allocation from Lake Mead, which has declined by more than 135 feet since the drought began in 2000.

With access to water supplies at risk and to address water quality challenges associated with declining lake levels, the SNWA began work in 2005 to develop new major facilities, including a new raw water intake at Lake Mead. Construction began in 2008 and work on a new low lake level pumping station (L3PS) followed shortly thereafter. Completed in 2015 and 2020, respectively, Intake No. 3 and L3PS preserve the SNWA's treatment and transmission capacity to a Lake Mead elevation of 875 feet and help ensure reliable water delivery for Southern Nevada's residents and businesses. These new facilities address current and future drought conditions, as well as effects of climate change.

A 24-foot diameter tunnel boring machine (pictured top left) was used to excavate the intake's three-mile tunnel shaft located 600 feet below Lake Mead. The intake works in conjunction with IPS3 (pictured bottom left and right), which consists of 34 submersible pumps placed 500 feet below ground in a forebay at the intake tunnel.

ADAPTIVE MANAGEMENT STRATEGIES FOR

NEW & EXISTING FACILITIES

As our community prepares for a hotter and drier future, the SNWA has taken several steps to integrate climate change considerations into new facility planning, as well as the retrofit of existing buildings. The SNWA recently updated its Engineering Design Standards to require a climate sensitivity assessment for new engineering projects and will complete a similar assessment as retrofit plans for older facilities are developed.

As part of this process, design, construction and maintenance teams are conducting detailed risk assessments to consider climate change impacts on new and existing structures, and to evaluate if or how the adaptive management strategies detailed below could address climate change factors. Specific actions will vary from project to project based on facility size, location, purpose and need.

BUILDING DESIGN & ORIENTATION

The orientation of a structure relative to the sun can significantly impact interior heat loads and associated cooling demands. Other design elements such as roof overhangs, daylighting and thermal massing can reduce heat accumulation, improve energy efficiency and extend the useful life of heating and cooling equipment.

The SNWA will implement passive and active solar design strategies in the development of new facilities to the extent practical. Active solar design strategies include development and utilization of rooftop or site-based solar facilities to capture and repurpose the sun's energy for equipment operation and building cooling. Passive solar design strategies include orienting buildings for optimal solar positioning and other tactics to reduce heat accumulation and sun exposure. The SNWA will implement passive solar design strategies including designing, orienting and constructing new facilities for reduced southern sun exposure; utilizing design elements such as daylighting and/or rooftop overhangs to minimize heat gains associated with electrical lighting and window heat exposure; venting facilities to allow for the release of accumulated heat; and integrating thermal massing into building designs for improved heating and cooling efficiency. These strategies can reduce interior heat loads, extend the life of heating and air conditioning (HVAC) systems, and maximize cooling water and energy efficiency.

BUILDING & CONSTRUCTION MATERIALS

The strategic selection of more efficient building envelope and insulation materials can significantly reduce heat accumulation and associated cooling demands and extend the life of HVAC systems.

The vast majority of SNWA facilities feature a concrete or concrete block exterior shell. This provides thermal massing, cooling interior temperatures during the hottest parts of the day and providing radiant heat during cooler winter months. While concrete building materials provide for increased efficiency, extreme heat during summer months—including higher overnight temperatures—contributes to warmer indoor temperatures that can stress HVAC systems. Reducing solar gains through materials selection can help to reduce heat transfer/heat accumulations, improve energy efficiency, reduce associated cooling water/energy demands in new construction and reduce maintenance needs/extend the useful life of HVAC systems. To the extent practical, the SNWA will implement building design features that improve energy efficiency such as the utilization of high-efficiency wall, slab and roof insulation; radiant/reflective roofing barriers; high-efficiency windows; LED, solar or high-efficiency lighting fixtures; automatic or adjustable lighting controls; and light colored and/or reflective envelope coatings.

LANDSCAPES, HARDSCAPES & EXTERIOR DESIGN

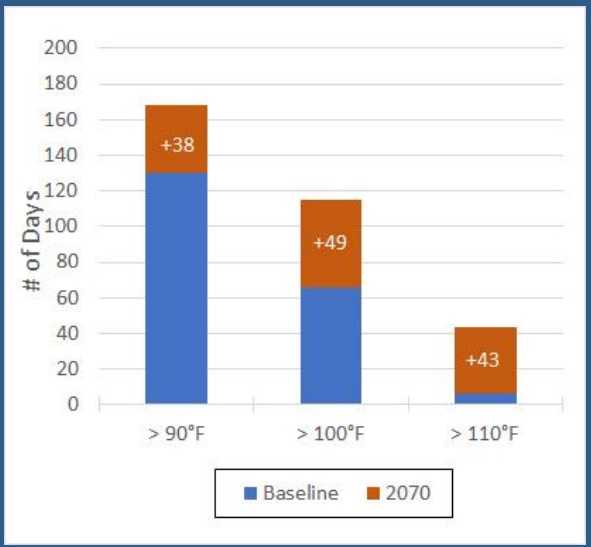
The use of light-colored hardscapes, shade structures and strategic landscaping design can reduce heat island effect and building heat loads, and improve cooling efficiency.

Trees are useful in reducing surface temperatures. They also provide a natural cooling mechanism through the process of evapotranspiration. Strategically placed trees and vines can reduce temperatures by 20-45°F over unshaded materials.[4] Constructed shade structures—particularly those with reflective surfaces—offer an alternative when natural canopy coverage is not possible or is less practical. Like trees, shade structures are effective at blocking the sun's intense rays, which can extend the life of hardscapes, reduce heat island effect and provide a place of respite for workers. Using light colored pavement or alternative pavement products can also reduce heat island impacts and extend the lifespan of parking lots, paved maintenance areas and other hardscapes. Asphalt binders are susceptible to heat and are known to break down in intense heat, which can cause cracking, rutting and more frequent replacement. Where practical, the SNWA will consider implementation of these strategies in new development and retrofit projects.

EQUIPMENT SIZING & REDUNDANCY

The facilities we build today must keep up with tomorrow's climate conditions. Right-sizing HVAC equipment with warmer future temperatures in mind will expand equipment longevity and reduce factors that contribute to climate change.

The SNWA experienced more unplanned HVAC repairs during abnormally warm years (2015-2020), suggesting a link between warm temperatures (including increased overnight low temperatures) and increased mechanical issues. Studies indicate that the lifespan of critical equipment decreases as the ambient temperature it operates within increases. This results in shorter equipment lifespan and increased replacement costs. Equipment lifespan reductions associated with climate change has been quantified using the industry standard "10-degree rule." Simply put, for every 10°C (18°F) rise in operating temperature, the motor insulation lifespan is reduced by a factor of half.[5] To the extent practical, the SNWA will consider purchasing higher rated units to prepare for increasing heat loads anticipated in the future, and to potentially extend the life of the assets. The SNWA also will consider placement of redundant compressors and motors for key cooling facilities to avoid the potential for cooling system outages.



Planning for an Uncertain Future

Based a 2020 heat impacts study, the number of days between 90°F and 120°F in the SNWA's service area will grow substantially in the future—increasing from a 1990-2010 baseline of 130 days to 168 days or more by 2070.[6]

Dramatic shifts in temperature will impact the operational efficiency of SNWA's cooling systems that support water treatment and delivery infrastructure. Located in laboratory spaces, pump stations and rate-of-flow control buildings, cooling systems are already working harder, longer and require more frequent maintenance to meet cooling demands due to warmer temperatures and higher overnight lows. Changes in building cooling requirements, reduced motor and motor control center lifespans, and degradation of roofs and parking lots are key areas for adaptive management and proactive action.

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