CHAPTER 13 WATER STORAGE RESERVOIRS

13.01 General

A. This chapter delineates the standards and guidelines for design of steel and pre-stressed concrete reservoirs, where a reservoir is defined as a facility that provides operational, emergency, and fire protection storage, as well as regulation and control of potable or finished water.

B. The design criteria for steel and concrete reservoirs are governed by the guidelines of this chapter as well as the standards and codes presented in Chapter 1.

C. The civil design criteria described in Chapter 2 must be considered.

D. It is the responsibility of the Engineer to ensure that the design complies with ADEQ Engineering Design Guidelines for the Construction of Water Systems.

E. It is the Engineer’s responsibility to make reference to and/or utilize industry standards not otherwise directly referenced within this document.

13.02 Site Considerations

A. General: Site selection requires direct coordination with COS to ensure the design meets the requirements of the water system master plan for the project as well as the COS Water Master Plan.

B. Final selection of the site will be reviewed and approved by the COS Public Works Director. The list below describes site selection criteria specific to reservoir design:

1. Site location with easements, site ownership, neighboring property ownership, APN information, and legal description.

2. Preliminary reservoir size(s) and quantity, and master planned for not less than two 1.2-MG reservoirs.

3. Proximity to existing and future water pump stations.

4. Distribution system hydraulic capacity requirements including overflow elevations.

5. Access to facility including staging plan and construction access.

6. Site drainage. The tank site should be located in an area that will not be impacted by washes and/or floodplains.
7. Future expansion with site suitable for buildout of at least two reservoirs of equal capacity.

8. Appearance complies with COS Unified Development code.

13.03 Concept Design Review (CDR) Phase

A. General: A CDR is the basis for the subsequent design process and must clearly present the basis of design. Final design cannot proceed without an approved CDR, which must include the following at a minimum:

1. Executive Summary.

2. Table of Contents.

3. Project Background.

4. Description of property ownership, right-of-way, and easement information (per Chapter 1).


6. Draft Drainage Study.


10. Topographic mapping information summary.

11. Description of Reservoir Sizing and Site Selection to include at a minimum:
   a) Project-specific cost comparison of steel versus pre-stressed concrete, which includes capital costs and operating and maintenance costs
   b) Summary of constructability issues
   c) Summary of maintenance issues
   d) Table that summarizes the reservoir sizing.

12. Description of security features in accordance with the current COS Security Master Plan.

13. Preliminary drawings that include the following at a minimum:
   a) Proposed service area
   b) Site access
c) Contractor staging area(s)

d) Proposed site plan and improvements

e) Preliminary grading plan

f) Slope stabilization options, as required by the geotechnical report

g) Any offsite improvements

h) Preliminary plans, sections, and details

i) Existing topography

j) Property ownership information

k) Rights-of-way/easements.

14. Description of connection(s) for future facilities.

15. Identify any permanent and temporary right-of-way or easement constraints and acquisitions.

16. Matrix summary of permits to be obtained and fees.

17. List of applicable agencies and utilities to review and sign the drawings.

18. Preliminary quantity and associated cost estimates.

19. Preliminary construction schedule.

20. Figures, tables, and other displays to support recommendations.

21. List of applicable reports, master plans, and maps reviewed and other relevant project information.

22. Preliminary work sequence for connecting to existing facilities (phasing, shutdowns, etc.).

23. Preliminary description of operations and controls to include communication with SCADA.

24. Draft design calculations.

13.04 Agency and Utility Coordination

  A. The Engineer shall initiate contact and coordinate efforts with outside utilities and agencies in accordance with Chapter 1.
13.05 Final Design Phase

A. General: The Engineer shall provide a Final Design with progress submittals to the COS at 60 percent and 90 percent level of completion in accordance with Chapter 1, which builds upon work completed during the CDR. The Final Design shall include:

1. Final design drawings.
2. Final specifications.
3. Details of security features in accordance with the current COS Security Master Plan.
4. Final cost estimate.
5. Final drawings and specifications shall meet the general requirements presented in Chapter 1.
6. Final versions of all studies and reports submitted with the CDR.

B. Requirements of the final design include the following:

1. A minimum design service life of 50 years.
2. Provisions for future facilities required for anticipated growth in the service area.
3. The reservoir shall be architecturally compatible with the surrounding area.
4. Sufficient space for vehicle access for operation and maintenance.
5. Inlet, outlet, drain, and overflow piping with all necessary control and measurement features that may include but are not limited to the following:
   a) Altitude valves
   b) Isolation valves
   c) Flapper valves
   d) Roof vent
   e) Man way access
   f) Pipe couplings.
6. Disinfection provisions in accordance with Section 13.10, if required.
7. Electrical facilities in accordance with Chapter 7 for power to equipment, lighting, and receptacles.
8. Instrumentation and control facilities in accordance with Chapter 8, which includes communications, PLC, instruments, and SCADA system in accordance with COS standards and guidelines.

13.06 Volume Criteria

A. General: The reservoir volume shall be determined by the Engineer, if not provided by the approved Water Master Plan.

B. Minimum Reservoir Size: A minimum reservoir size of not less than 1.0 MG (useable volume) is required unless approved in writing by the COS Public Works Director or his designee.

C. Maximum Sidewall Height: Volume shall be determined based on a maximum sidewall height of 16 feet.

D. Volume Requirements: Per the most recent version of the City of Surprise Integrated Water Master Plan.

   1. Operational Storage: Is the volume of the reservoir devoted to supplying the water to the system under normal operating conditions.

   2. Emergency Storage: Shall be considered during the design process. The amount of emergency storage shall be based upon an assessment of risk and the desired degree of system dependability.

   3. Fire Suppression Storage: Is the volume required to deliver the largest fire flow in accordance with the fire flow requirements set forth by the currently adopted edition of the International Fire Code and any COS amendments.

13.07 General Design Requirements

A. Yard Piping:

   1. Pipe material shall be as delineated in Chapter 10 and approved by COS.

   2. All mainline valves shall be the same diameter as the pipeline.

   3. Yard piping shall include aboveground tank isolation valves.

   4. Multiple tanks shall be piped such that each tank can operate independently, in parallel, or in series.
B. Inlet and Outlet Piping:

1. Inlet and outlet piping shall be configured to fill from the top and drain from the bottom to promote mixing as illustrated by Figure 13.1.

2. In-line valves shall be the same diameter as inlet/outlet piping.

3. Inlet and outlet piping shall be offset 180 degrees to maximize water circulation.

C. Roof Access:

1. General: The Engineer shall provide roof access for reservoirs per the requirements herein and designed to meet currently adopted codes and standards.

2. External Ladders: Constructed of hot-dipped galvanized steel or epoxy-coated steel. Ladders shall be routed from ground level with a ladder cover extending from 4 inches below the bottom rung to a height of 8 feet to prevent unauthorized access and be equipped with the following in accordance with OSHA requirements:
   a) Safety ladder cage with the bottom fully blocked whenever the ladder cover is in the closed position, similar to Figure 13.2.
   b) Rest platforms.
   c) Non-slip rungs.

3. Internal Ladders: Shall be constructed of stainless steel and be located at each access hatch.

4. All conduit shall be located behind the ladder for security.

D. Roof Hatches:

1. General: Provide access hatches on roof and coordinate with roof access facilities as required for inspection and maintenance.

2. Each hatch shall have a hold open device, hasp lock, intrusion alarm, and security bar in accordance with COS Security Master Plan.

3. Minimum roof hatch dimensions required are 31-inch by 31-inch opening per Figure 13.3.

4. Locate one roof hatch for personnel access near the tank inlet pipe.

5. Locate one roof hatch above the tank overflow pipe as well as one at the interior ladder with ladder post safety device, which is generally opposite from the overflow hatch.
6. Hatches shall have a minimum 4-inch curb and the cover shall have a downward overlap of at least 3 inches on concrete tanks.

7. For buried, concrete tanks where vehicle loads are anticipated, roof hatch shall be designed for H20 loading.

8. Design roof with positive drainage away from hatches.

E. Security and Safety:

1. At a minimum, an eight-foot tall masonry perimeter wall with lockable entrance that is compatible with the surrounding development and landscaping.

2. At a minimum, the exterior of the masonry perimeter wall shall be coated with anti-graffiti protection coating system.

3. Provide security features at the discretion of the COS in accordance with the current COS Security Master Plan.

4. All access, safety, and structural components shall be designed per current OSHA requirements for the safety of COS personnel. At a minimum, the following safety equipment is required:
   a) Ladder cages with locks to restrict access
   b) Rest platforms
   c) Handrails
   d) Guardrails
   e) Fall protection
   f) Any other appropriate devices to conform to applicable state and federal requirements for occupational safety.

F. Paving and Drainage:

1. An asphalt concrete (AC) or decomposed granite (DG) roadway with a thickness of at least 4 inches and a width of 10 feet shall be provided around the entire perimeter of each reservoir.

2. Roadway slopes shall not exceed 10 percent.

3. Adequate drainage away from all structures shall be provided.

G. Disinfection:

1. Reservoirs must be disinfected before being put into service for the first time and after being entered for cleaning, repair, maintenance, rehabilitation, or painting.
2. Disinfection shall be in accordance with AWWA C652.

13.08 Concrete Reservoir Design

A. General: The COS concrete tank standard is prestressed concrete tank with cast-in-place core wall, vertical post-tensioned tendons, and circumferential prestressed strands.

B. Prestressed concrete tank shall be in accordance with AWWA D110 and equipped with:
   1. Reinforced concrete foundation.
   2. Walls with internal and external ladders.
   3. Roof with hatches and vents.
   4. Seismic cables.
   5. Safety cages and fall protection as required by OSHA.
   7. Overflow drains.
   8. Circumferential prestressed strands shall be tensioned by elongation methods with continuous electronic monitoring and recording. Pre-stressing by die drawing is not acceptable.

C. Design Criteria:
   1. Tanks with precast concrete wall panels with internal post-tensioned tendons, and tanks with precast concrete wall panels with circumferential wrapped pre-stressing are not acceptable for use.
   2. The following currently adopted version of standards and codes shall govern and shall be used for the design of concrete tanks:
      c) Wire and Strand-Wound Circular, Prestressed Concrete Water Tanks, ANSI/AWWA D110.
      d) Building Code Requirements for Reinforced Concrete ACI 318.
      e) National Sanitation Foundation Standard 61 - Drinking Water System Components.
D. Seismic Loads:

1. Seismic Loads shall be in accordance with the requirements of AWWA D110 as amended by the currently adopted IBC and latest edition of ASCE 7.

2. The COS Building Department shall be consulted for verification of the seismic zone designation.

3. Site-specific seismic design recommendations, as provided in the geotechnical report, shall be considered.

E. Foundation and Tank Floor:

1. Design in accordance with the Geotechnical Report.

2. A structural floor or slab-on-grade foundation is allowable.

3. The concrete floor shall be cast continuously, without construction joints, when possible. Curing of the floor shall be done with water only.

4. A slab-on-grade type floor shall be designed to transmit loads to the sub-base through the floor. Anchored flexible base is preferred.

5. At a minimum, a membrane liner on the sub-base and covered with an aggregate sub-base; a liner sloped away from the center of the tank; and perimeter drains shall be provided.

6. The Design Engineer shall be responsible for the design of the foundation and tank floor according to codes for live and dead loads and for operating requirements and loading conditions during construction. The allowable loads shall be listed on the contract documents.

F. Tank Roof:

1. The roof pitch shall not preclude operators from walking on the roof. Fall protection anchors shall be located where operators can attach to anchors before stepping on the above-grade roof. Roof drains shall be provided on the entire perimeter of the tank.

2. A concrete tank shall have a precast/cast-in-place roof, or a flat precast/cast-in-place, two-way reinforced concrete flat slab roof. The joint between the roof and wall, separated by an elastomeric bearing pad, is preferred on a concrete tank. Aluminum roofs will not be allowed.
3. For buried reservoirs, the roof shall be designed for H2O traffic load unless guard posts are provided to prevent vehicle access.

G. Inlet and Outlet Piping:

1. Reinforced concrete piers shall be designed to support the pipe and to protect against uplift of the pipe due to buoyancy.

2. The inlet should be controlled by a valve outside the tank that can be closed for maintenance or inspection.

3. The outlet pipe requires a manual isolation valve located outside the tank that can be closed for maintenance or inspection.

H. Drain:

1. A tank drain shall be provided on the tank. It shall have an isolation valve located outside of the tank and be piped to a discharge manhole or storm drain vault.

2. All reservoir drains must have an air gap.

I. Overflow:

1. The overflow shall be provided on the exterior of the tank. Overflow pipe shall be sized for the maximum possible fill rate with a minimum diameter not less than the inlet pipe diameter.

2. Piping shall enter through the floor of concrete tanks near the tank wall. The overflow system must be designed to discharge not less than 12 inches but at least twice the pipe diameter.

3. Overflow discharge shall be sloped for complete drainage and discharge over a drainage inlet, plunge pool, or splash plate without causing erosion.

4. Provide duckbill check valve with air gap at the discharge point of the overflow drain per Figure 13.4. It shall be piped to a manhole or drainage facility for manual flow monitoring.

5. Verification in writing shall be provided to confirm that overflows will not impact adjacent properties.
6. An energy dissipater may be required to control erosion at point of discharge of the overflow system.
   a) The overflow pipe shall be designed to discharge to an energy dissipater at a maximum flow rate to be determined by the Engineer
   b) The Engineer shall design the energy dissipater to ensure that water within the reservoir is protected from cross-contamination with surface water

J. Reservoir Access:
   1. Tanks shall have a minimum of two hinged, leak-proof, spring-loaded, alarmed, aluminum, lockable hatches.
   2. Each hatch shall have a hold open device, hasp lock, intrusion alarm, and security bar in accordance with the current COS Security Mater Plan.
   3. Both hatches shall be a minimum 31 inches square (Figure 13.3). One hatch shall be a personnel access hatch and located near the tank inlet pipe.
   4. One of the roof hatches shall be located above the overflow system and the other is to be located at the interior ladder with ladder post safety device (generally opposite from the overflow hatch).
   5. Hatches shall have a minimum 4-inch curb and the cover shall have a downward overlap of at least 3 inches on concrete tanks.
   6. If the concrete tank is buried, the hatch shall be designed for H2O loading and drainage away from the hatch shall be provided.

K. Roof Vent:
   1. Roof vents shall be sized to prevent excess pressure or vacuum buildup during the maximum inflow or outflow of water.
   2. A minimum of one vent near the center of the tank shall be supplied. Roof venting shall be provided with two stainless steel mesh screens to prohibit entry of insects, birds, or undesirable objects.
   3. For security, a metal cage shall be installed over the roof vent.

L. Underdrain System:
   1. The underdrain system shall protect against uplift that occurs when the tank is drained and to detect excessive leakage from the tank.
underdrain system shall be provided for partially-buried and buried pre-stressed concrete tanks. At a minimum, the underdrain system shall consist of a perimeter ring drain system. Water collected from beneath the tank and around the perimeter is discharged to a drainage facility or overflow/drain manhole.

2. The size and configuration of drain rock, polyethylene or PVC sheeting, filter fabric, and PVC perforated piping shall be determined by the Geotechnical Engineer.

M. Sampling Station:

1. A minimum of two sampling stations shall be provided. The taps shall be a stainless steel locking ball valve and shall be placed in a weatherproof secured locking box.

13.09 Steel Tank Design

A. General: The COS steel tank standard is ground level, fixed roof, epoxy-coated welded steel tank.

1. Standpipes and bolted steel tanks are not acceptable to the COS.

B. Design Criteria:

1. The currently adopted version of standards and codes shall govern and shall be used for the design of steel tanks.
   a) Currently adopted International Building Code of the International Conference of Building Officials
   b) Building Code Requirements for Minimum Design Loads in Building and Other Structures, ASCE 7
   c) Standards for Welded Steel Tanks for Water Storage, ANSI/AWWA D100
   d) Building Code Requirements for Reinforced Concrete ACI 318
   e) AWWA Standard for Painting Steel Water Storage Tanks, ANSI/AWWA D102
   f) National Sanitation Foundation Standard 61 - Drinking Water System Components.

C. Seismic Loads:

1. Seismic Loads shall be in accordance with the requirements of AWWA D110 as amended by the currently adopted IBC and latest edition of ASCE 7.
2. The COS Building Department shall be consulted for verification of the latest seismic zone designation.

D. Wind Loads:

1. Load (pressure) asserted on the tank shall be as recommended by ANSI/AWWA D100 on the basis of a basic wind speed of 100 mph or the requirements of the local code, whichever is more stringent.

E. Roof Design:

1. The tank roof shall be a structural-steel-supported, steel roof having a 3/4-inch vertical to a 12-inch horizontal slope. A knuckle with a 2-foot to 4-foot radius shall be provided at the roof and wall junction.

2. The roof plate that is not in contact with water shall be at least 3/16-inch thick; the roof plate submerged in water during normal operations shall be 1/4-inch minimum.

3. Corrosion allowance is not required for the roof plate.

4. The roof plate construction shall be in accordance with the standard practice of ANSI/AWWA D100, by continuous fillet weld at the topside only.

5. Full penetration welds shall be used to join the roof knuckle together.

6. The roof plate shall not be seal welded at the support members.

7. The roof supports shall be hot-rolled structural shapes with a minimum thickness of 3/16 inch.

8. Shape, bar, and plate submerged in water shall be 1/4-inch minimum.

9. Lateral bracing of the roof rafter compression flanges shall be required. Friction between rafters and roof plates may be considered unless otherwise restricted by ANSI/AWWA D100.

10. A typical roof guardrail is presented in Figures 13.2B and 13.2C.

11. Bolts inside the reservoir shall be Type ASTM A 325.

12. Columns shall be fabricated from steel pipe that is seal welded at both ends. Column base shall be fabricated from steel plate and designed for a maximum allowable soil bearing as recommended by a Geotechnical Engineer. The column base shall not be welded to
the bottom plate to allow for rotation during seismic events, but must be restrained from any lateral movement. The base assembly shall be fully coated prior to erection per ANSI/AWWA D100.

F. Wall Design:

1. The tank wall design shall be in accordance with ANSI/AWWA D100 standard.

2. The design fabrication and inspection requirements specified in ANSI/AWWA D100 will be allowed.

3. The lowest 1-day mean ambient temperature at the tank site shall be generally at 20 degrees Fahrenheit unless a lower ambient temperature is required by the COS.

4. Corrosion allowance is not required. Minimum tank wall thickness shall be in accordance with the requirements of ANSI/AWWA D100.

5. The tank wall shall be designed for stability without the requirements of intermediate girders on the inside or outside surface of the wall.

G. Tank Bottom:

1. The bottom shall be lap welded continuously from the top of the plate with a minimum thickness of 5/16 inch.

2. The bottom plate shall be extended a minimum of 1-1/2 inches beyond the exterior of the tank.

3. The joint between the tank wall and the bottom plate shall be continuously welded from inside and outside of the tank wall.

4. Corrosion allowance is not required.

5. The width and thickness of the bottom annular ring shall conform to the requirements of ANSI/AWWA D100.

6. The requirements of the butt-welded bottom annular ring shall be in accordance with the requirements of ANSI/AWWA D100.

H. Footings and Foundations:

1. Design in accordance with the Geotechnical Report.

2. Reinforced concrete ring footings shall be provided.
3. The top on the ring footing shall be approximately 6 inches above the finished surface.

4. The minimum embedment of the ring footing shall be as recommended by the geotechnical Engineer, but shall not be less than 2 feet, 6 inches.

5. Ring footings shall be reinforced to resist the lateral soil pressure on the confined earth.

6. The width and height of the ring footing shall be sized for the loads presented in Chapter 3 and the allowable soil bearing pressure recommended in the geotechnical report.

7. The minimum width shall not be less than 1 foot, 6 inches.

8. A compressive strength of at least 4,000 psi as determined by the Engineer shall be used for the concrete; 60,000 psi yield strength shall be required for reinforcing steel.

9. Concrete cover for rebar shall be in accordance with the requirements of ACI 318.

10. The Alternate Design method is recommended for the design reinforcement. Corrosion protection for concrete shall be as recommended by the Geotechnical Engineer.

I. Allowable Stress:

1. Allowable stress for steel plate and structural steel shall be in accordance with the requirements of ANSI/AWWA D100.

2. Allowable stresses for tank concrete footing shall be in accordance with the requirements of ACI 318.

J. Inlet and Outlet Piping:

1. The outlet pipe shall penetrate the bottom plate or lower wall plate (minimum of 12 inches from floor) and shall be separated as much as is practical for circulation. In-line valves shall be the same diameter as inlet/outlet piping.

2. Pipe penetration openings through the bottom plate shall be reinforced in accordance with the requirements of ANSI/AWWA D100.
K. Overflow:

1. The overflow shall be provided on the exterior of the tank. Overflow pipe shall be sized for the maximum possible fill rate with a minimum diameter not less than the inlet pipe diameter.

2. To ensure a proper air gap, the overflow system must be designed to dispense not less than twice the pipe diameter above the surface of the ground, be sloped for complete drainage, and discharges over a drainage inlet, plunge pool, or splash plate without causing erosion.

3. Provide duckbill check valve with air gap at the discharge point of the overflow discharge (Figure 13.4). It shall be piped to a manhole or drainage facility for manual flow monitoring The Engineer shall design the overflow system to ensure that water within the reservoir is protected from cross contamination with surface water, insects, and animal intrusion, etc.

4. Verification in writing shall be provided to confirm that overflows will not adversely impact adjacent properties.

L. Drain:

1. An appropriately sized drain pipe shall be installed at the bottom of the tank with a size of not less than 8 inches.

2. If the tank is unanchored, the location of the penetration in the bottom plate shall conform to the requirements of Chapter 13 of the ANSI/AWWA D100.

3. The drain line may be discharged to a drainage structure or facility common with the overflow pipe.

4. All reservoir drains must have an air gap.

M. Roof Vent:

1. Roof vents shall be sized to prevent excess pressure or vacuum buildup during the maximum inflow or outflow of water.

2. A minimum of one vent near the center of the tank shall be supplied. Roof venting shall be provided with two stainless steel mesh screens to prohibit entry of insects, birds, or undesirable objects.

3. Four eye bolts shall also be supplied for tie-offs.
N. Reservoir Manways:

1. Tanks shall have a minimum 33-inch diameter, hinged, inward opening manways at the bottom of the shell, per Figure 13.5.

2. Design of manways and reinforcement shall confirm to the requirements of ANSI/AWWA D100.

O. Corrosion Control:

1. Corrosion control measures shall be provided in accordance with Chapter 5.

2. Provide protective coatings for welded steel reservoirs and all interior surfaces including, but not limited to shell, roof framing, roof plates, columns, floor, piping, manways, and ladders; and painting of all exterior surfaces including, but not limited to shell, roof, manways, ladders (including cage and door), hatches, vents, and exposed piping is required.

3. All interior coatings shall meet requirements of NSF 61 for drinking water service.

4. All parts of steel shall be painted in accordance with the requirements of ANSI/AWWA D102.

5. Corrosion Control: Corrosion control measures such as cathodic protection shall meet the requirements of Chapter 5.

6. The warranty from defects in material and workmanship shall extend for a period of one year from the date of acceptance of the work. This first anniversary inspection requirement shall conform to ANSI/AWWA D102.

7. Application procedures, safety precautions, and testing of coatings shall be in accordance with the requirements of ANSI/AWWA D102.

8. A NACE certified coating inspector will be required to monitor the entire coating process from surface preparation to finished coating and perform integrity tests on the coatings to confirm proper application.

9. Interior Coating Systems:
   a) Epoxy or polyurethane coating system is required for all interior surfaces including the tank wall, roof plate, bottom plate, and roof support member.
b) The epoxy shall be a self-priming epoxy coating intended for potable water contact. The epoxy formulation shall use 100 percent solids and zero VOC.

c) The polyurethane coating shall be self-priming; plural-component lining that uses 100 percent solids and zero VOC.

d) All welds, rafter edges, top of truss beams, etc. shall be stripe-coated by hand.

e) Surface preparation shall be near white blast cleaning that conforms to SSPC-SP10. The surface profile shall be 2.5 – 3.5 mils.

10. Exterior Coating Systems:
   a) For exposed exterior metal surfaces of the tank, a coating system composed of epoxy, intermediate epoxy, and polyurethane will be applied
   b) The epoxy is a polyamide or polyamine, anti-corrosive converted epoxy primer containing rust inhibitive pigments
   c) The intermediate epoxy is a two-component epoxy capable of 4 to 6 MDFT per coat
   d) The aliphatic polyurethane shall be a two-component acrylic-based polyurethane, semi-gloss finish. This paint shall only be used in areas where reflection is not a problem

P. Sampling Station:
   1. A minimum of two sampling stations shall be provided. The taps shall include a stainless steel locking ball valve.

13.10 Water Quality Provisions

A. The Engineer shall provide chlorination provisions for reservoirs in accordance with Chapter 6, which may include the following:

   1. Onsite sodium hypochlorite generation or bulk sodium hypochlorite system.
   2. Sodium hypochlorite storage tanks with secondary containment with drain sump.
   3. Sodium hypochlorite metering pumps.
   4. Sampling ports.
   5. Piping, analyzers, and accessories.
B. Provide chlorine injection locations at inlet and outlet of reservoir to allow for feed forward and trim back chemical dosage control.

C. Mixing: The Engineer shall evaluate volume turnover and potential for stratification, which may dictate the need for reservoir mixing.

13.11 Electrical Systems

A. Electrical power and lighting systems shall be designed in accordance with the requirements of Chapter 7.

B. Site Lighting: Three levels of site lighting shall be provided as follows to maintain security in accordance with the current COS Security Mater Plan:
   1. Dusk to dawn lighting.
   2. Motion detection for security.

C. The electrical system providing power to components of the reservoir shall be designed by a qualified electrical engineer registered in the State of Arizona.

D. Raceways shall be installed using rigid steel conduit, flexible liquid tight conduit, plastic-coated rigid steel conduit, and/or plastic conduit.

E. Exposed raceways shall be rigid steel conduit, flexible liquid tight conduit in non-corrosive areas; exposed raceways shall be plastic-coated rigid steel conduit, flexible liquid tight conduit in corrosive areas; underground conduits shall be plastic conduit with plastic-coated steel conduits for all bend greater than 45 degrees and all risers and shall be encased in a concrete reinforced duct bank.
   1. Boxes available for use are pull boxes, junction boxes, outlet boxes, and terminal boxes and shall be of the same type material as that of the conduit system.
   2. The wire and cable used shall be 600-volt and single conductor, type XHHW 2. Nameplates shall be provided on each electrical panel, motor starter, and control device.
   3. Underground, non-metallic, utility marking tape shall also be provided.
   4. All conduit on aboveground tank exterior wall shall be located behind the tank roof access ladder or stairway for security.
5. Pull boxes shall be identified with COS marking.

13.12 Instrumentation and Control

A. All instrumentation and control shall be provided per the requirements of Chapter 8.

B. Level Indication and Monitoring:

1. External Level Gauge: Provide an external level gauge that utilizes a float and counterweight with switches associated with HIGH LEVEL alarm and LOW LEVEL alarm.

2. The reservoir level shall be measured, locally indicated, and transmitted to a Level Monitoring Cabinet and Programmable Logic Controller (PLC).

3. Level measurement shall utilize a 3-inch, flange-mounted differential pressure transducer equipped with FAILED ALARM.

4. Provide backup level switches not associated with level gauge float for HIGH-HIGH alarm and LOW-LOW alarm.

5. Pump suction from reservoir: The low-level switch activated from the level transmitter signal will be used to protect the pumps from cavitation.

6. Pump discharge to reservoir: The high-level and low-level switch alarms activated from the level transmitter signal shall be transmitted to the pumping station or well site and used to in the starting, stopping, and control of pumps as well as to protect the reservoir from overflow.

7. The Engineer shall also include elevations needed for all alarm conditions that will be programmed into the system during startup.

8. In the event some of the alarm conditions are to be provided by suppliers of the equipment, those shall be clearly defined in the contract documents and defined as the responsibility of the Contractor.

9. Locate level transmitters and junction boxes in an accessible location for maintenance.

C. Reservoir Alarms:

1. HIGH LEVEL alarm indication associated with level gauge float
2. LOW LEVEL alarm indication associated with level gauge float
3. HIGH-HIGH alarm indication
4. Level measurement device FAILED alarm indication
5. LOW-LOW alarm indication.

D. Reliability:
   1. In order to enhance reliability of the instrumentation and control system, the use of redundant instruments and power supplies is encouraged.
   2. PLCs and critical instruments must be powered with uninterruptible power supplies, preferably by DC battery supply sized to enable 12 hours of use.

E. Intrusion Alarm Switches:
   1. Provide intrusion switches for doors and hatches with alarms and in accordance with the current COS Security Master Plan.
   2. Alarm switches shall be annunciated to SCADA.

F. Provide a single integrator or subconsultant to be responsible for all PLC programming, and SCADA per Chapter 8 requirements.

13.13 Landscaping

A. Landscaping shall be site specific and conform to local landscaping schemes. The landscape must be perceived as an extension of the directions established for the tank aesthetics. As such, the Engineer shall be responsible for guiding and coordinating the landscape design for the Project, either by retaining the services of a subconsultant, or engaging a landscape professional on his own staff.

B. Block walls shall conform to Surprise Unified Development Code.
3/4" x 10 GA FLATTENED EXPANDED METAL MESH TACK WELD TO L'S & HOOPS

3" x 3/8" FLAT BAR HOOPS AT 4' OC TYP

9 L’S 1" x 1" x 1/8"

2 STEEL HINGES

3/4" Ø ROUND BAR (SEE DETAIL 3)

PADLOCK HASP

3/8" ROD WITH TURNBUCKLE DIAGONAL BRACE

9 L’S 1" x 1" x 1/8"

3/4" x 10 GA FLATTENED EXPANDED METAL MESH TACK WELD TO L’S & HOOPS

1' - 3" RAD

3" x 3/8" FLAT BAR HOOPS

NOTES:
1. PAINTED TO MATCH TANK

SECURE MESH TO LADDER NOT TANK

PER WATER STORAGE TANK EXTERIOR LADDER (FIGURE 13.2B)
1 1/4" STANDARD PIPE HANDRAIL

3/8" PLATE STIFFENER

2" 1/4" GUSSET PLATE FROM 12" x 6"

5" x 3/8" BRACKETS AT 11'-6" OC MAX

PROVIDE "SAF-T-CLIMB" DEVICE PER MANUFACTURERS SPECS

2 1/2" x 3/8" RUNNERS AT 12" OC

HEIGHT OF CAGE (FIGURE 13.2A)

14 - 3/4" DIA RUNS AT 12" OC = 13'-0"

NOTES:
1. PAINTED TO MATCH TANK

CITY OF SURPRISE
Maricopa County, Arizona
Water and Wastewater Guidelines
WATER STORAGE TANK EXTERIOR LADDER DETAIL

FINAL

DATE APRIL 2011
NOTES:
1. PAINTED TO MATCH TANK

CITY OF SURPRISE
Maricopa County, Arizona
Water and Wastewater Guidelines

WATER STORAGE TANK
TOP PLATFORM DETAIL

SCALE NO SCALE
FIGURE REV.
13.2C 0

FINAL
NOTES:

1. PAINTED TO MATCH TANK

A DETAIL

B DETAIL

12" FREEBOARD (MIN)

16" SCH 40 STEEL PIPE

16" SCH 40 STEEL LR WELD ELBOW

SCH 40 STEEL LR WELD 45°

PIPE SUPPORT SEE DETAIL "A"

PER WATER STORAGE TANK OVERFLOW PIPE CHECK VALVE

MIN 32° AIR GAP

TOP OF BOX Flush W. GRADE ELEV.

GRAVITY DRAIN

WATER STORAGE TANK OVERFLOW DRAIN BOX

CITY OF SURPRISE
Maricopa County, Arizona
Water and Wastewater Guidelines

DESIGNED 

DRAWN 

CHECKED 

APPROVED 

APPROVED 

DATE APRIL 2011

SCALE NO SCALE

WATER STORAGE TANK OVERFLOW PIPE DETAIL

FIGURE REV.

13.4 0