APPENDIX II

AIRPARK DRIVE GROUND STORAGE RESERVOIR INSPECTION REPORT

COATING EVALUATION REPORT

AIRPARK GROUND STORAGE RESERVOIR
(300,000-Gallons Capacity)

CULPEPER COUNTY
ENVIRONMENTAL SERVICES

Culpeper County, Virginia
Suite 101
118 West Davis Street
Culpeper, Virginia 22701

QCS PROJECT NO. CC 007-QCS-009-001

By

Quinn Consulting Services, Inc.
10500 Wakeman Dr. Suite 100
Fredericksburg, VA 22407
(540) 907-9673
(540) 898-8248 {fax}

TABLE OF CONTENTS

TABLE OF CONTENTS

1.0 GENERAL INFORMATION

1.1 On June 8, 2017 Quinn Consulting Services' representatives, Jason Varner and Christopher Triana, visited the Airpark GSR (300,000-Gallons Capacity) located in Culpeper County Virginia.

1.2 QCS performed a field inspection/evaluation of the tanks in conformance with the applicable sections of AWWA M42, "Steel Water-Storage Tanks".

1.3 Exterior: A visual review of the accessible surfaces was performed from ground level, the exterior shell ladder, and the respective tank roof.

- On July 6, 2017 Quinn Consulting Services' representative, Christopher Triana, revisited the Airpark GSR and performed an aerial review using a DJI Phantom 4 UAV (unmanned aerial vehicle) to perform visual inspections and subsequent video recordings of the existing conditions.

1.4 Interior Wet: A visual review of the accessible surfaces was performed by inserting a VideoRay "Scout" remote operated vehicle (ROV) to video recorded the interior wet inspection observations both above and below the water level for review by the Tank Owner.

- Still photos were taken from the interior wet ladder of the roof and access tube.
- All Equipment (VideoRay, tether cables, rubber gloves, etc.) used during this "ROV" Inspection method was disinfected in accordance with AWWA C652 (Method #2) Standard for Disinfection of Water Storage Facilities prior to tank entry, using a 200-ppm chlorinated water solution.
- The tank bottom plates were covered with the typical water treatment fines/residue.

2.0 SUMMARY

2.1 **Coating Systems**

2.1.1 Heavy Metals Content Analysis: Interior Wet

Based on the construction history of the structure being built in 1987/1988, the total lead content of the interior wet coating system was not analyzed.

The coating systems supplied for the initial 1987/1988 coating project should have been lead-free based on the respective Local, State, and Federal requirements.

- Removal of the existing coating must be performed in accordance with the applicable local, state and Federal regulations.
- Any reconditioning specifications must include provisions for containment to prevent generation of fugitive dust/waste emissions.

2.1.2 Heavy Metal Content Analysis: Exterior

Based on the construction history of the structure being built in 1987/1988, the total lead content of the exterior dry coating system was not analyzed.

The coating systems supplied for the initial 1987/1988 coating project should have been lead-free based on the respective Local, State, and Federal requirements.

- Removal of the existing coating must be performed in accordance with the applicable local, state and Federal regulations.
- Any reconditioning specifications must include provisions for containment to prevent generation of fugitive dust/waste emissions.

2.1.3 Interior Wet - Coating System

While the majority of the coating film on the roof, roof rafters, and shell is still in fair shape, there are sporadic corrosion spot areas in the roof, roof rafters, roof/shell rim angle, shell, and shell/inlet pipe & support brackets. See photos in Appendix B

Overall, the interior wet coating is in fair condition with a less than 3.0 percent failure observable below the High Water Level (HWL) and at least 3.0 percent failure above the HWL.

Visual inspection of the tank bottom plates was not possible due to the presence of sediment/water treatment residue layer obscuring the surfaces.

The coating film is approximately 30 years old and should be replaced with a NSF Standard 61 approved epoxy coating system within the next two (2) to four (4) years. See Section 3.1 for more details.

2.1.4 Exterior - Coating System

The exterior coating system's film on the roof and shell has been degraded and exhibits moderate to severe chalking which is allowing widespread pinpoint rust areas to be exposed through the coat system's film.

There are also corrosion areas on the underside of the center roof vent's mushroom cover and neck.

The exterior lower (6") shell and chime exhibit moderate to severe coating film failure as well a moderate rust areas. See photos in Appendix B.

The tank exterior coating system should be removed and replaced the next two (2) years. See Section 3.2 for more details'

2.2 Structural

2.2.1 Based on the inspection data, it appears that some structural modifications/replacements are required for AWWA D-100-14 compliance. See Sections 3.3, 3.4, and the photos in Appendix B.

2.2.2 While the tank structure's accessible areas appear to be in fair condition, the following areas were not accessible for visual inspection.

1) Interior wet's tank bottom plates due the presence of heavy sediment/water treatment residue.

2) Percentage of metal thickness removal from the roof rafters' bottom flanges due to corrosion.

3) Percentage of metal thickness removal from the roof rafters' bottom flanges and webs at the center support column due to corrosion.

2.2.3 Items noted above in 2.2.2 are addressed in Section 3.3 for possible engineering review and repairs when the tank is made available for rehabilitation.

2.3 Cathodic Protection System

2.3.1 This water storage tank does have a hanging style Cathodic Protection system with seven roof plate access hand-hole openings.

2.3.2 At least two (2) of the cover plates are positioned correctly and allow access for rainwater into the interior wet's water supply.

2.3.3 The replacement cost of a new submerged style Cathodic Protection system is not included in the tank repair cost estimate.

2.4 Remaining Coating Service Life

If the recommended coating system replacements (Interior and Exterior) are performed within the next two (2) years, as recommended in Section 4.0, and inspected regularly every three (3) to five (5) years thereafter, the tank's new coating systems should be expected to perform satisfactorily for the next fifteen (15) to twenty (20) years.

2.5 Repair and Reconditioning Cost Estimates

This "ballpark" budget estimate is based on current pricing for similar structure projects.

The cost of structural repairs, modifications, & new installations as well as replacing the interior wet coating system and the exterior dry coating system is estimated at $XXXXX.

Please see Section 4.0 for a more detailed summary of this cost breakdown.

3.0 RECOMMENDATIONS

3.1 Interior Wet - Coating

3.1.1 The overall age of the coating system is approximately thirty (30) years old with deficient coating film areas on the roof plate lap joints, shell, overflow pipe & support brackets, along the lower shell course and tank bottom plates.

- The coating system should be replaced with a NSF Standard 61 approved coating system for a potable water storage tank within the next two (2) to four (4) years.

3.1.2 The Project specifications must be designed to comply with current environmental regulations for fugitive dust containment during surface preparation and coating applications.

3.1.3 The Project specifications shall include provisions to reduce the generation of waste and address proper disposal of waste generated.

3.2 Exterior Dry - Coating

3.2.1 The age of the coating system is thirty (30) years old with deficient coating film areas on the roof plates, roof vent, shell courses, and shell/overflow pipe & support brackets.

The exterior coating film should be replaced within the next two (2) years;

3.2.2 The Project Specifications must be designed to comply with current environmental regulations for containment of any fugitive dust emissions during surface preparation and coating applications.

3.2.3 The Project Specifications shall also include provisions to reduce the generation of waste and address proper disposal of waste generated.

3.3 Interior Wet – Structural Repairs/Modifications

3.3.1 Epoxy caulk the circumferential gap at the roof/shell plates' rim angle joints with an NSF Standard 61 approved epoxy caulking for potable water service.

3.3.2 Epoxy caulk the roof plate lap joints with an NSF Standard 61 approved epoxy caulking for potable water service.

3.3.3 Install backer rod into gap areas (>1/4") between radial rafters and roof plates and seal both sides with NSF Standard 61 approved epoxy caulking for potable water service.

3.3.4 Seal weld, using ¼" weld, the inside joints between the roof plate and the roof access manway's curb.

3.3.5 Repair by welding and grinding operations any pitting spots with depths greater than 1/16" in the lower shell and tank bottom plates.

3.3.6 Install a solid rail safety climb device on the interior wet ladder for compliance with OSHA climbing regulations.

3.3.7 Severely corroded bottom flanges along the roof rafters shall be abrasive blast cleaned and evaluated for structural integrity by a registered Professional Engineer. Deficient structural items should be modified or replaced as directed by the engineering findings.

3.4 Exterior Dry – Structural Repairs/Modifications

3.4.1 Remove the existing fixed roof vent. Install a new vent with a removable mushroom style vent cover with a vacuum freeze component and a new flange base with a 24" interior diameter. Use a corrosion resistant, heavy-gauge, No.24 SS mesh screen.

3.4.2 Modify the roof step-through opening for the existing shell ladder by installing vertical posts for attachment to the new roof wing handrail assembly.

3.4.3 Install wing handrail sections compliant with OSHA Regulations on either side of the new step-through opening for the modified shell ladder.

3.4.4 Install a swing gate, such as a FabEnco Gate, at the new step through opening to comply with OSHA Regulations.

3.4.5 Install one, 24-inch diameter, hinged roof manway, approximately 180 degrees from the existing roof access manway.

3.4.6 Remove the lower eight (8) feet of the existing shell ladder as well as the wire framed cover gate and cable safety climb device.

3.4.7 Install a new cable safety climb device and support brackets on the modified shell ladder.

3.4.8 Install a new hinged solid cover gate over the lower eight (8') feet of the modified shell ladder.

3.4.9 Install a davit on each of the two (2) shell manways.

3.4.10 Remove the existing screen assembly over the overflow pipe outlet and install a flanged plate to the outlet opening to allow bolted connections.

3.4.11 Install a properly sized TideFlex Flapper valve at the modified overflow pipe outlet.

3.4.12 Remove the existing asphalt sealant covering the chime/concrete ring-wall joint area.

3.4.13 Remove the loose, cracked, and spalled grout and concrete under the tank's chime. Repair using non-shrink 3000 PSI grout.

3.4.14 Reposition the cover plates for Cathodic Protection Systems' roof hand-hole openings to prevent exterior water and contaminates access to the potable water supply.

3.5 **Site**

3.5.1 Lower and contour the surrounding landscape so that the grade is 4 to 6" below the top of the tank chime/ring-wall foundation.

3.5.2 Landscape contour operations should route ground water and overflow pipe outlet discharges to an adjacent ditch or storm drain.

4.0 COST ESTIMATES

4.1	Interior Wet Coating Complete Replacement Type of Coating – NSF Standard 61 Epoxy System	$ XXXXX
4.2	Exterior Coating * Complete Replacement Type of Coating - Epoxy/Urethane System	$ XXXXX
4.3	Interior Structural Repairs	$ XXXXX
4.4	Exterior Structural Repairs	$ XXXXX
4.5	Site Landscaping	$ XXXXX
4.6	Estimated Total Cost	$ XXXXX

*Note #01: The pricing provided above represents budget estimates of the various phases of recommended work and should not be construed as binding or committal upon QCS's behalf.

Report written by:

William E. Pybus

William E. Pybus
Senior Inspector, Coatings
NACE Certified Coating Inspector No. 402

Date: July 14, 2017

1.0 TANK DATA

1.1 General

QCS Project No.: CC-007-QCS-009-001 **QCS Proposal No.:** 6223-388

Customer: Culpeper County Environmental Services **Phone:** 540-727-3409

Street/City/State/Zip: Suite 101, 118 West Davis Street, Culpeper, Virginia 22701

Customer Contact: Mr. Paul Howard, Director

Structure Owner: Culpeper County Environmental Services **Phone:** 540-727-3409

Structure Owner Contact: Mr. Paul Howard, Director

Owner's Structure Designation: Airpark GSR

Structure Description: Steel Ground Storage Potable Water Tank

Structure Location (Street/City/State/Zip): 13175 Airpark Drive
Culpeper, Virginia 22718

Type of Inspection: QCS Standard Existing Steel Water Storage Tank Inspection

a) Exterior Dry - Aerial Drone Inspection

b) Interior Wet – Underwater Remote Operated Vehicle

Date of Inspection: June 8, 2017 & July 6, 2017

Inspected By: 1) Jason Varner, NACE Certified Coating Inspector
2) Chris Triana, NACE Certified Coating Inspector

Structure Contractor: Industrial Alloy Fabricators. **Construction Date:** 1987

Design Code: AWWA D-100 (1984) **Capacity:** 300,000 Gallons

Type of Construction: Steel Welded Yes Riveted N/A

Diameter: 40'-6" **Height:** 32'-0"

Type of Access to Tank Interior: 1) Exterior Shell Access Ladder to Roof
2) Roof Access Manway to Interior Wet Shell Ladder
3) Two (2) Manways in the Shell at Grade Level

Tank Construction Drawings: Yes (B & B Consulting)

Previous Inspection Records: None Available

1.2 Interior Wet Coating History

Coating History: 1987

Coating Contractor: Industrial Alloy Fabricators

Surface Preparation:

Unknown

Coating System:

(1) Primer – Epoxy

(2) Finish Coat – Epoxy

Coating Manufacturer:

Unknown

Coating Samples/ Heavy Metals Content Evaluation (% by WT.)

Lead:	☐ Yes	☐ No	No Samples Taken & Tested.
Chromium:	☐ Yes	☐ No	No Samples Taken & Tested.
Cadmium:	☐ Yes	☐ No	No Samples Taken & Tested.

1.3 Exterior Dry Coating History

Coating History: 1987

Coating Contractor: Industrial Alloy Fabricators

Surface Preparation:

Unknown

Coating System:

(1) Primer – Epoxy

(2) Finish Coat – Polyurethane

Coating Manufacturer:

Unknown

Coating Samples/ Heavy Metals Content Evaluation (% by WT.)

Lead:	☐ Yes	☐ No	No Samples Taken & Tested.
Chromium:	☐ Yes	☐ No	No Samples Taken & Tested.
Cadmium:	☐ Yes	☐ No	No Samples Taken & Tested.

Photo #: 1
Description: Overall View of Airpark Industrial Ground Storage Reservoir (32'-0" Height x 40'-6" diameter).

Photo #: 2
Description: Exterior Shell (4 Courses): Coating film degrading and exhibiting sporadic rust areas, Lower Shell course and circumferential chime shows the most severe corrosion areas.

Photo #: 3
Description: Exterior Shell: View of the Exterior Access Ladder. Ladder has a framed diamond style wire, hinged, locking cover gate over the lower five (5) feet of the ladder.

Photo #: 4
Description: Exterior Shell: Side view of the lower five (5) feet of the Exterior Access Ladder. Note cable style safety climb framework extends below attachments to ladder rungs.

Photo #: 5
Description: Exterior Shell: Wire rope grab on safety climb cable.

Photo #: 6
Description: Exterior Shell: Downward view of ladder rungs and shell.

Photo #: 7
Description: Exterior Shell: Downward view of ladder rungs and shell. Upper attachment bracket for cable safety climb device is shown.

Photo #: 8
Description: Exterior Shell/Roof Rim Angle: Spot corrosion areas along stitch welded shell/rim angle joint and general pinpoint rusting on the underside of rim angle.

Photo #: 9
Description: Exterior Shell/Roof Rim Angle: Spot corrosion areas along stitch welded shell/rim angle joint and general pinpoint rusting on the underside of rim angle.

Photo #: 10
Description: Exterior Shell/Roof Rim Angle: Spot corrosion areas along stitch welded shell/rim angle joint and general pinpoint rusting on the underside of rim angle.

Photo #: 11
Description: Exterior Shell: Support Brackets for the interior water level indicator exhibit general corrosion with very little coating film left.

Photo #: 12
Description: Exterior Roof: Support Brackets for the interior water level indicator exhibit general corrosion with very little coating film left.

Photo #: 13
Description: Aerial drone photo of the exterior roof and shell.

Photo #: 14
Description: Exterior Roof: Ladder Step Thru Opening positioned at the Roof Access Manway.

Photo #: 15
Description: Exterior Roof: Side View of Shell Ladder Step Thru Opening , the Roof Access Manway, and the Water Level Indicator.

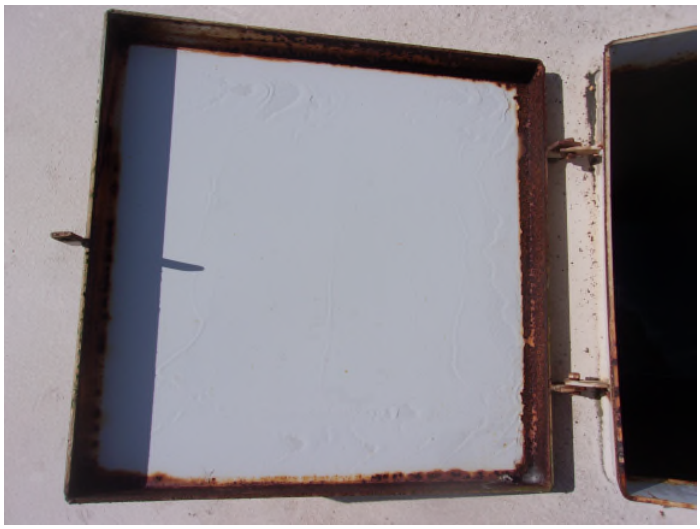

Photo #: 16
Description: Exterior Roof: Corrosion areas on the interior cover lid for the Roof Access Manway.

Photo #: 17
Description: Exterior Roof: Corrosion areas on the interior cover lid and adjoining curb for the Roof Access Manway.

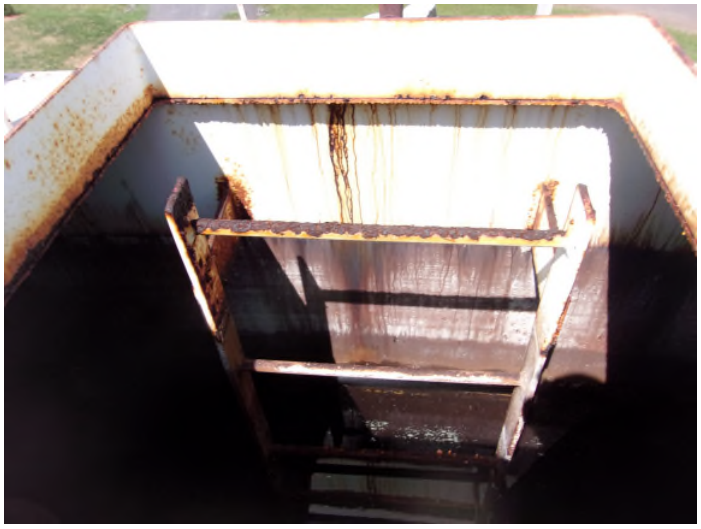

Photo #: 18
Description: Interior Wet: Corrosion areas on the interior curb for the Roof Access Manway. Curb/roof plate interior joint is not welded. Moderate corrosion and coating film failure on the interior wet ladder (rungs, siderails, standoffs, & shell plate.

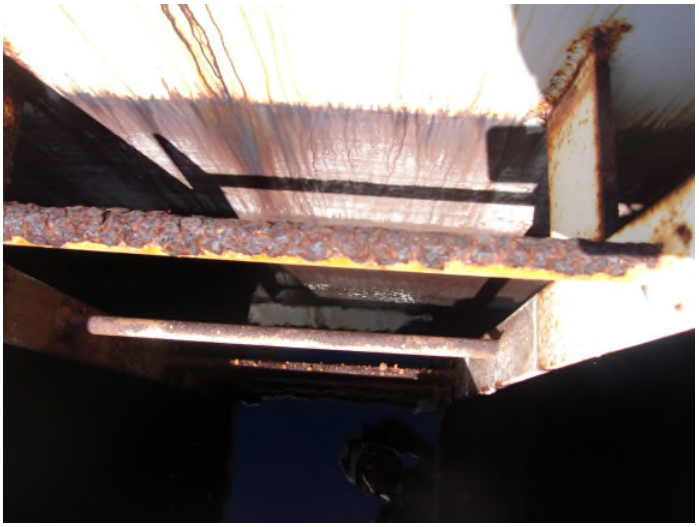

Photo #: 19
Description: Close-up of corrosion areas on the ladder rungs.

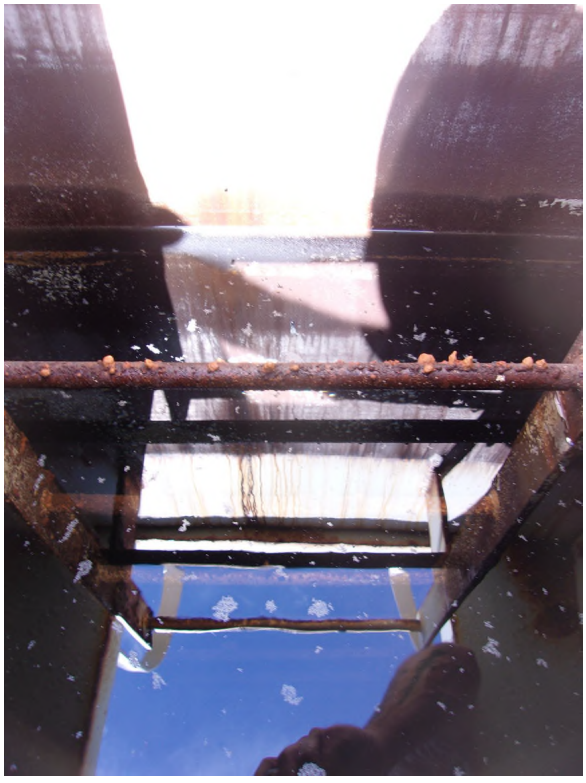

Photo #: 20
Description: Interior Wet: Close-up view of moderate to severe corrosion on the ladder rungs.

Photo #: 21
Description: Interior Wet: Moderate corrosion observed along the circumfenrential gap of the roof/shell rim angle joint. Spot rust areas observed on roof plates, roof rafters, and upper shell course.

Photo #: 22
Description: Interior Wet: Close-Up view of corrosion observed along the circumfenrential gap of the roof/shell rim angle joint.

Photo #: 23
Description: Interior Wet: Close-Up View of roof rafter and upper shell support bracket. Support bracket appears to be fully seal welded to the shell plate.

Photo #: 24
Description: Interior Wet: General view of the interior wet's roof, roof rafters, and center support column. General rust conditions observed on roof rafters. Roof plates' lap joints appear to be exterior welded.

Photo #: 25
Description: Interior Wet: General view of the interior wet's roof, roof rafters, and center support column. General rust conditions observed on roof rafters. Roof rafters do not appear to be stitch welded to the roof plates.

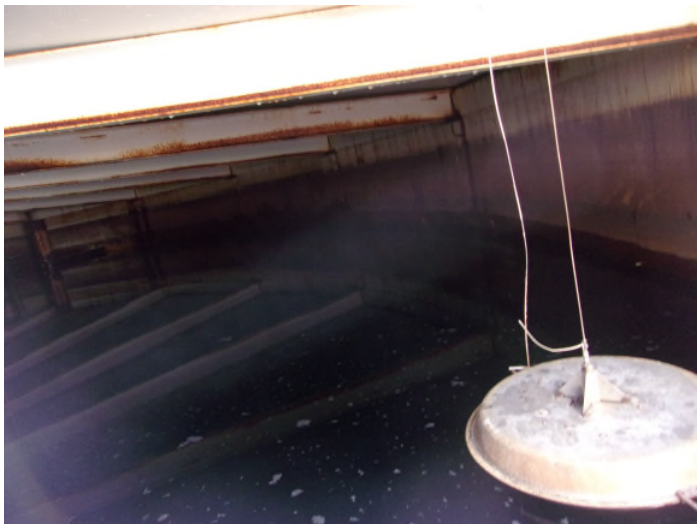

Photo #: 26
Description: Interior Wet: General view of the interior wet's roof, roof rafters, upper shell course, and flotation device for exterior water level indicator. General rust conditions observed on roof rafters.

Photo #: 27
Description: Exterior Roof (Aerial Drone Photograph): Roof coating film exhibits general degradation due to ultraviolet light.

Photo #: 28
Description: Exterior Roof: Roof coating film exhibits general degradation due to ultraviolet light. Sporadic pinpoint rust areas are evident.

Photo #: 29
Description: Exterior Roof: Center Roof Vent. Unknown device appears to have formed a circular corrosion area on the roof plate around the neck of the roof vent.

Photo #: 30
Description: Exterior Roof: Center Roof Vent. Number 4 SS mesh screen and held in-place by tension strap. Underside of the roof cover plate exhibits general corrosion.

Photo #: 31
Description: Exterior Roof: Roof coating film exhibits general degradation due to ultraviolet light. Rust areas are showing up all over the roof.

Photo #: 32
Description: Exterior Roof: Roof coating film exhibits general degradation due to ultraviolet light. Rust areas are showing up all over the roof.

Photo #: 33
Description: Exterior Roof (180 Degrees): Roof coating film exhibits general degradation due to ultraviolet light. Rust areas are showing up all over the roof. Ponding area observed close to the edge of the exterior roof.

Photo #: 34
Description: Exterior Roof: Corrosion areas along the roof's circumference.

Photo #: 35
Description: Exterior Roof: Corrosion areas along the roof's circumference.

Photo #: 36
Description: Exterior Roof: General View of cathodic protection access hole with intact cover plate. Conduit pipe/roof plate penetration does not have an installed cover plate and is allowing unauthorized water access to the interior wet water supply.

Photo #: 37
Description: Exterior Roof: General View of cathodic protection wiring conduit. Conduit pipe/roof plate penetration does not have an installed cover plate and is allowing unauthorized water access to the interior wet water supply.

Photo #: 38
Description: Exterior Roof: General View of cathodic protection wiring conduit, well pump equipment/wiring cable, and antenna with support stand.

Photo #: 39
Description: Exterior Shell: General corrosion areas visible on all 4 shell courses.

Photo #: 40
Description: Exterior Shell: 1st Shell Manway (24" inside diameter) with tank ID plate. Fabricator - Industrial Alloy Fabricators. No davit in-place. Chime area shows moderate corrosion and coating film failure.

Photo #: 41
Description: Solar Power Equipment Unit.

Photo #: 42
Description: Exterior Shell: Wiring conduit and uni-strut support bracket. Chime/shell area exhibits coating failure.

Photo #: 43
Description: Exterior Shell: General corrosion areas visible on all four (4) shell courses.

Photo #: 44
Description: Exterior Shell: General corrosion areas visible on all four (4) shell courses.

Photo #: 45
Description: Exterior Shell: 2d Shell Manway (24" inside diameter) with no davit in-place. Chime and lower shell areas show moderate corrosion and coating film failure. Circumfenrential chime/concrete ring wall joint coated with tar.

Photo #: 46
Description: Exterior Shell: General corrosion areas visible on all four (4) shell courses. Exterior overflow pipe (8" diameter) and splash pad shown.

Photo #: 47
Description: Exterior Shell: Close-Up View of overflow pipe outlet and concrete splash pad. Cover screen over end of overflow pipe outlet held in-place with tension strap. Unknown pipe penetration and lower shell course just above the chime.

Photo #: 48
Description: Close-up view of overflow pipe outlet's screen assembly.

Photo #: 49
Description: Exterior: General corrosion area along the backside of the overflow pipe.

Photo #: 50
Description: Exterior: Support bracket weld to the Overflow Pipe.

Photo #: 51
Description: Exterior Shell: General corrosion areas visible on all four (4) shell courses.

Photo #: 52
Description: Exterior: Water Level Indicator Assembly.

Photo #: 53
Description: Exterior Shell/Chime: Surrounding grade almost even with top of chime area.

Photo #: 54
Description: Exterior: Tar sealant application cover chime/fiberboard joint has failed.

Photo #: 55
Description: Exterior: Tar sealant application cover chime/fiberboard joint has failed.

Photo #: 56
Description: Exterior: Tar sealant application cover chime/fiberboard joint has failed. Spalling concrete observed.

Photo #: 57
Description: Exterior Shell: Chime and lower shell areas show moderate corrosion and coating film failure. Circumfenrential chime/concrete ring wall joint coated with tar.

Photo #: 58
Description: Exterior: Landscape damage to coating film probable cause for some of the lower shell course rust areas.

Photo #: 59
Description: Exterior Shell: Close-Up view of general corrosion areas.

Photo #: 60
Description: Exterior: General View of the lower shell course, chime, and ringwall foundation.

Photo #: 61
Description: Exterior Shell: Close-Up view of general corrosion areas.

Photo #: 62
Description: Pump House Building.

QCS INSPECTION AND EVALUATION METHODS

1.1 Scope

1.1.1 The interior tank coating was evaluated in conformance with the following:

a. QCS Proposal No. 6223-388.

b. General guidelines of SSPC Painting Manual Volume 1.

c. AWWA M42, “Steel Water Storage Tanks”

1.1.2 The inspection of the base metal and of the coating on all interior wet and exterior surfaces was limited to areas accessible without scaffolding or special rigging.

- Where possible, the base metal and the coating on the interior wet surfaces (roof and upper shell courses) were examined from the roof access manway hatch and by means of a VideoRay “Scout” Underwater Remote Operated Vehicle (ROV).

- Where possible, the base metal and the coating on the exterior wet surfaces (roof and shell courses) were visually examined (photographs & video) from grade level, the exterior shell ladder, the roof, by means of a DJI Phantom 4 Plus Drone.

1.1.3 No structural analysis was performed to determine if the tank design complies with the AWWA D100-11 Standard for "Welded Steel Tanks for Water Storage." However, any observed non-conformance to the AWWA D100-11 standard is noted in this report.

1.1.4 Although compliance with OSHA regulations was not a part of this inspection, any unsafe conditions or violations of current OSHA regulations, which were observed, are noted in this report.

1.2 Evaluation Techniques

1.2.1 Site

The tank site was visually examined for proper drainage away from the tank and for conditions affecting access and exterior reconditioning.

In addition, the following tank site information was obtained, *as applicable*. Site dimensions: distance to fence(s), power lines, owner buildings, public property, private property/buildings, school/playgrounds, public parks and other property.

1.2.2 Foundations

The concrete tank foundation was visually examined for cracks, spalling, condition of grout, indications of distress/settlement, and elevation above grade.

1.2.3 Coating Thickness

Interior and exterior coatings, where accessible were tested in accordance with Steel Structures Painting Council SSPC-PA2 "Measurement of Dry Film Thickness with Magnetic Gages," using PosiTector-6000 Type 2, fixed probe, magnet flux gages.

1.2.4 Coating Serviceability

The estimated remaining coating life or serviceability evaluation was performed using a wide variety of inspection instruments such as dry film thickness gauge, pen knife, Tooke gauge, adhesion tester(s), and 30x microscope.

The instrument inspection was combined with a thorough, total, close visual inspection of all accessible areas of the interior coating for holidays (misses), skips, runs, sags, surface contaminants, overspray, dry spray, poor coating cohesion, inter-coat delamination, loss of adhesion to the substrate, condition of the steel underneath the coating, and any other objectionable defects for the service required.

1.2.5 Coating Lead Content Analysis

No samples were taken of the various types of coatings present on the interior and exterior surfaces.