

January 23, 2015

City of Lynchburg  
Department of Water Resources  
525 Taylor St.  
Lynchburg, VA 24501

Attn: Scott Parkins, P.E.

Re: 2,000,000 Gallon Candler Mountain Reservoir  
Maintenance Inspection

Dear Mr. Parkins:

Please find enclosed the above referenced report for the 2,000,000 reservoir. The inspection was completed on November 5, 2014. The report consists of: 1) cover page; 2) conclusions and recommendations; 3) detailed report; 4) Field Inspection Report (FIR); 5) photographs and descriptions; and 6) flash drive.

Brief explanation: 1) The cover page is self-explanatory. 2) Conclusions and recommendations explain in short form what was found on the tank and what DIXON recommends for repair and maintenance of the tank. 3) This section is the long report that goes into detail to explain what exactly was found and why DIXON makes the recommendations. 4) Field Inspection Report (FIR) is the form that was completed when the inspection team was on-site and includes the dimensions and conditions of the tank. 5) Photographs and descriptions give the Owner a visual record of the condition of the tank and appurtenances. 6) Flash drive is an Adobe PDF format of the complete report and photos for your convenience.

If you have any questions or concerns, please call me at 616-374-3221 ext. 310.

Thank you for choosing DIXON for your inspection needs.

FOR DIXON ENGINEERING, INC.,

Thomas Rounds  
Project Manager

Enclosures

# **Dixon Engineering, Inc.**

Maintenance Inspection

2,000,000 Gallon Reservoir  
Candlers Mountain #1 (East Tank)

Lynchburg, Virginia

Inspection Performed: November 5, 2014  
Report Prepared: January 20, 2015  
Reviewed by Ira M. Gabin, P.E.: January 23, 2015

Phone (616) 374-3221  
Fax (616) 374-7116  
<http://www.dixonengineering.net>

**Dixon Engineering Inc.**  
1104 Third Ave. Lake Odessa, MI 48849

## **INSPECTION:**

On November 5, 2014, Dixon Engineering, Inc. (DIXON) performed a maintenance inspection on the 2,000,000-gallon Candler's Mountain (Tank #1) reservoir owned by the City of Lynchburg, Virginia. Purposes of the inspection were to evaluate the interior and exterior coating's performance and life expectancy; assess the condition of metal surfaces and appurtenances; review safety and health aspects; and make budgetary recommendations for continued maintenance of the tank. All recommendations, with budgeting estimates for repairs are incorporated in this report. The inspection was performed by Trevor Felton, Staff Engineer. The inspector was assisted by Eric Binkowski, Inspection Department Supervisor, and Tom Rounds, Project Manager. A source of water for cleaning was provided by the City. Following the inspection, chlorine was added to disinfect the tank per AWWA Standard C652-11 method No. 3.

## **TANK INFORMATION:**

The tank has an estimated height to high water line of 36 feet, the tank is welded construction with an aluminum geodesic dome. The tank was last painted in 1999.

## **CONDITIONS AND RECOMMENDATIONS:**

### **EXTERIOR COATING CONDITIONS:**

The exterior coating system is a multiple coat epoxy urethane system.

The exterior coating is in good condition overall and is beginning to chalk and fade and there is loss of gloss. Surfaces have faded due to exposure to ultraviolet rays, which is a normal occurrence for an exterior coating system. There are only a few isolated coating failures on the exterior.

Good adhesion was noted on the ASTM x-cut test area, with trace loss of topcoat to the prime coat in the area tested. The tank is a candidate for over-coating.

### **EXTERIOR COATING RECOMMENDATIONS:**

Budget to overcoat in 1 – 2 years.

The recommended procedure is to high-pressure water clean (5,000-10,000 psi) the exterior to remove any delamination or flaking coating and any contaminants, followed by spot power tool cleaning to bare metal (SSPC-SP 11) any rusted or failed areas.

The coating system would consist of a spot prime coat on the bare metal, a full coat of epoxy, followed by a two full coats of polyurethane. The polyurethane system offers excellent abrasion resistance with high gloss and sheen retention. The expected life of this system is fifteen years. The system can be recoated again in fifteen years, extending the life of the coating to forty-five years before total removal would be necessary again. The tank would be removed from service during the painting project. This is necessary to reduce moisture condensation on the tank's surface. Polyurethane coatings have a minimum temperature requirement for application and are sensitive to moisture during the curing process. If moisture is present during the curing process, the appearance will become cloudy with little or no gloss.

#### **WET INTERIOR COATING CONDITIONS:**

The wet interior coating is an epoxy system applied in 1999.

The sidewall coating is in good condition overall. There is not any significant damage at the high water line, which would be the area most affected by ice pressures and ice movement. Cause of deterioration is spot coating breaks with most of the failures at welded plates at the top of the sidewall.

The coating on the tank bottom is in poor condition. Deterioration consists of spot coating breaks with well over 100 failures.

Overall adhesion of the coating is good. Adhesion was tested by use of low-pressure washing. With poor adhesion, it would be possible to notice the coating fluctuate and layers of coating would be removed. With very poor adhesion, the existing coating may be removed.

This is a crude form of testing, yet the least destructive. The destructive tests cut the coating to the substrate. The test area is then susceptible to corrosion because it has been scratched to bare metal.

#### **WET INTERIOR COATING RECOMMENDATIONS:**

The existing coating system has not deteriorated to the point where replacement is warranted assuming cathodic protection is installed. Installation of a cathodic protection system would adequately protect all areas below the high water line where the coating has deteriorated.

**Note:** The floor plate is likely ¼ inch thick or less and the spot failure will develop into leaks if cathodic protection is not installed.

**CATHODIC PROTECTION CONDITIONS:**

The tank does not contain a cathodic protection system.

The tank has clips and a pressure fitting installed for a future cathodic protection installation. The clips are located on the floor.

**CATHODIC PROTECTION RECOMMENDATIONS:**

Install an impressed current cathodic protection system. The system is designed with a horizontal ring configuration. The anode is suspended into the lower one-third of the tank by floats. As water fills the tank, the anode takes the desired ring configuration. This design is considered ice-free. Formation of ice normally occurs at the high water level and some along the sidewalls. As long as the tank is operated in the upper one-half of its capacity, the probability of ice damage is very low. The anode used is a platinized niobium or titanium wire with a design life of ten years. The system also incorporates copper/copper sulfate reference anodes.

The system is automatically controlled by monitoring the water-to-tank potential. It provides protection to steel surfaces where holidays (coating pinholes) or coating breaks exist. Cathodic protection operates by inhibiting galvanic cell corrosion where steel is exposed. The system creates an equipotential across the tank and drives the tank potential down to a point (-850 millivolts) where corrosion is essentially non-existent. Only surfaces that are in contact with water are protected because water acts as the electrolyte for the circuit. Therefore, areas of the roof and upper sidewalls are not protected by the system.

**PIT AND PIT PIPING CONDITIONS:**

The tank is operated by valves located in the pit next to the tank.

The piping is in good condition. Coating on the pipes is in good condition. The pipes and valves have some minor surface rust.

**FOUNDATION CONDITIONS:**

The top 4-6 inches of the foundation is exposed. Soil is covering the rest of the foundation.

The exposed foundation is in good condition and showed minor deterioration with some cracking.

The piping in the pit is supported by concrete saddles. Two of the saddles have deteriorated.

**FOUNDATION RECOMMENDATIONS:**

Rebuild the damaged pipe supports.

Pressure wash the concrete foundation and coat the exposed concrete to help prevent deterioration with an epoxy coating system. The cost would be incidental to exterior painting.

**CAULK CONDITIONS:**

The caulk is in poor condition. Caulk is missing or damaged around most of the circumference between the bottom plate and the foundation.

**CAULK RECOMMENDATIONS:**

Replace the caulk by removing all caulk and replace with new caulking.

**ROOF HANDRAIL AND PAINTER'S RAIL:**

A handrail is located on the roof up to the center of the dome. Some sections are loose.

**ROOF HANDRAIL AND PAINTER'S RAIL RECOMMENDATIONS:**

Tighten the railing post bolts. The cost would be incidental to the recoating.

**VENT CONDITIONS:**

The roof vent is a 24-inch square pressure-vacuum design. The vent is in good condition.

The screen is fully intact.

The sidewall to roof gap is screened. Complete inspection was not performed due to limited access, however evidence of containment entering into the tank was found.

**VENT RECOMMENDATIONS:**

Install replaceable screened frames at the sidewall stiffener and roof connection. These are more sturdy and would be similar to those retrofitted on the 4.5 million College Hill reservoir.

Annually inspect the vent to make sure the screen is open and not damaged.

**LADDER CONDITIONS:**

Exterior:

The tank has an exterior sidewall ladder that starts approximately 13-feet above ground level, and extends up to a small platform at the top of the sidewall. The ladder is in good condition and contains a rail-type fall prevention device.

There is a vandal guard on the ladder with a missing bolt, the guard still protects from access.

**LADDER RECOMMENDATIONS:**

Exterior:

Replace the bolt on the vandal guard. Cost would be incidental to exterior painting.

**GEODESIC DOME CONDITIONS:**

The roof is an aluminum geodesic dome with caulked panels connected with hubs connecting roof supports. No damage to the panels or caulking was noted.

**MISCELLANEOUS CONDITIONS:**

There is an inoperable level indicator on the sidewall that attaches to a float in the wet interior with a cable. The cable does not route through the conduit properly, making the device inoperable.

**MISCELLANEOUS RECOMMENDATIONS:**

Remove the level indicator and seal openings in the roof. The cost would be incidental to exterior painting.

**DIXON ENGINEERING, INC.**  
**STEEL TANK FIELD INSPECTION REPORT**  
**RESERVOIR TANK**

DATE: November 5, 2014

OWNER: City of Lynchburg  
 CLIENT CODE: 46-61-01-11  
 TANK NAME: Candlers Mountain Tank #1 (East Tank)  
 LOCATION: Street: Candlers Mountain Rd. & Liberty Mountain Rd.  
           City: Lynchburg  
           State: Virginia  
 TANK SIZE: Capacity: 2,000,000 gallons  
           Diameter: 100 feet (estimated)  
           Height to overflow (HWL): 36 feet (estimated)  
           Sidewall height: 37 feet (estimated)  
 CONSTRUCTION: Welded  
           Type of structure: Reservoir  
           Type of roof: Aluminum Dome  
 DATE CONSTRUCTED: Unknown

COATING HISTORY	EXTERIOR	WET INTERIOR
DATE LAST COATED	<u>1999</u>	<u>1999</u>
CONTRACTOR	<u>Unknown</u>	<u>Unknown</u>
COATING SYSTEM	<u>Epoxy urethane</u>	<u>Epoxy</u>
SURFACE PREPARATION	<u>SSPC SP-6</u>	<u>SSPC SP-10</u>
COATING MANUFACTURER	<u>Unknown</u>	<u>Unknown</u>
COATING SAMPLES	<u>No</u>	<u>No</u>
HEAVY METAL	<u>No</u>	<u>No</u>

PERSONNEL: Inspector **Trevor Felton**, Top person **Eric Binkowski**,

Ground person **Tom Rounds**

TYPE OF INSPECTION: **Maintenance**

METHOD OF INSPECTION: **Dry**

DATE LAST INSPECTED: **2009**

### **SITE CONDITIONS**

Fenced: **Yes**

Site large enough for contractors equipment: **Yes**

Control building: **Yes**

Location: **Adjacent to tank**

Antenna control site: **No**

Site conditions: **Well maintained**

Neighborhood: **Rural**

To the North: **Woods**

To the East: **Woods**

To the South: **Another tank**

To the West: **Open**

Power lines within 50 feet: **No**

Site drainage: **Toward tank and away from tank**

Indications of underground leakage: **No**

Shrub, tree, etc. encroachment: **No**

### **EXPOSED PIPING:**

Location: **Adjacent to tank (in pit)**

Condition of structure: **Good**

Condition of structure: **Good**

Structure is: **Dry**

Altitude valve: **Yes**

Condition of coating: **Fair**

Describe coating: **Rust bleedthrough**

Condition of metal: **Good**

Piping comments: **Two concrete pipe supports have spalled and are deteriorating**

### **FOUNDATION**

Foundation exposed: **Yes**

Exposed height: **4-6 inches**

Exposed foundation condition: **Good**

Damage or deterioration: **Yes**

## **FOUNDATION**

Type of damage: **Cracks**

Severity: **Minor**

Crack location: **Random**

Total length of cracking: **2 feet**

Foundation coated: **Yes**

Coating condition: **Good**

Type of grout: **Caulk**

Condition: **Poor**

Caulk missing: **Yes**

Amount missing: **Cracked or loose almost entire circumference**

Indications of foundation settlement: **No**

Undermining of foundation: **No**

## **EXTERIOR COATING**

### **Sidewall:**

Lettering: **No**

Logo: **No**

Topcoat condition: **Good**

Previous coat condition: **Good**

Describe coating: **No significant coating deterioration**

Dry film thickness: **9-11 mils**

Coating adhesion: **4A**

Metal condition: **Good**

## **EXTERIOR APPURTENANCES**

### **Anchor bolts:**

**N/A**

### **Level indicator:**

Condition: **Poor**

Comments: **The level/float is stuck at 24 feet and the numbers are faded**

### **Overflow pipe:**

Coating condition: **Fair**

Metal condition: **Good**

Inside diameter: **12 inches**

Condition of screen: **Good**

## **EXTERIOR APPURTENANCES**

Percent of screen open: **100**

Flap gate: **Yes**

Design: **Screened**

Flap gate condition: **Good**

Air gap: **Yes**

Highest part of discharge to the ground distance: **18 inches**

Splash pad: **Yes**

Type: **Concrete pad and stone**

Condition: **Good**

### **Sidewall manway:**

Number: **2**

Size: **30 inches and 24 inches**

Gasket leaking: **No**

Hinged: **Yes**

Sealed with: **Bolted cover**

Coating condition: **Fair**

Metal condition: **Good**

### **Mud valve:**

**N/A**

### **Sidewall ladder:**

Coating condition: **Good**

Metal condition: **Good**

Height ladder starts above ground: **13 feet**

Toe clearance: **7 inches or greater**

Width of rungs: **16 inches**

Thickness of rungs: **3/4 inch**

Shape of rungs: **Diamond**

Fall prevention device: **Yes**

Type: **Rail**

Condition: **Good**

Cage: **No**

Sidewall ladder comments: **The vandal guard is missing a bolt**

### **Step-off platform:**

Dimensions: **36 x 60 inches**

Railing height: **42 inches**

## **EXTERIOR APPURTENANCES**

Midrail height: **16 inches and 28 inches**

Toe plate height: **4 inches**

Coating condition: **Fair**

Metal condition: **Good**

### **Stiffener:**

Coating condition: **Good**

Describe coating: **No significant coating deterioration**

Width: **17-21 inches (estimated)**

Connection to tank: **Good**

Metal condition: **Good**

Balcony comments: **Could not inspect screen around entire circumference due to small stiffener size**

### **Roof stair:**

Coating condition: **N/A**

Metal condition: **Good**

Width: **24 inches**

Roof ladder comments: **Stairs run only 9 feet up then there is a walkway**

### **Roof handrail:**

Orientation: **Along walkway to roof center**

Location: **One side of walkway, both sides of stairs**

Coating condition: **N/A**

Metal condition: **Good**

Railing height: **37 inches**

Railing width: **17 inches**

### **Roof hatches:**

Wet interior:

Number: **2**

Coating condition: **N/A**

Metal condition: **Good**

Neck diameter: **30 inches**

Shape: **Square**

Hatch security: **Lock**

## **EXTERIOR APPURTENANCES**

### **Bolted ventilation hatch:**

Coating condition: N/A

Metal condition: Good

Neck: 24 inches square

### **Roof vent:**

Number: 1

Type: Screened pressure-vacuum

Neck size: 24 inches square

Vent material: Aluminum

Coating condition: Not coated

Metal condition: Good

Screen condition: Good

Percent of screen open: 100

### **Aviation lights:**

N/A

## **WET INTERIOR COATING**

### **Sidewall:**

Topcoat condition: Good

Primer coating condition: Good

Describe coating: Spot coating breaks to substrate

Mineral deposits: Light

Metal condition: Good

Active pitting: Yes

Number of pits: Less than 25

Previous pitting: Yes

Number of pits: More than 100

Previous pit filling: No

Sidewall comments: Only approximately 25 spot breaks below the high water line and 50 spot breaks above, the failures above are mostly on welded plates

### **Tank bottom:**

Topcoat condition: Poor

Primer coating condition: Poor

Describe coating: Spot coating breaks to substrate

## **WET INTERIOR COATING**

Mineral deposits: **Light**

Metal condition: **Fair**

Active pitting: **Yes**

Number of pits: **More than 100**

Previous pitting: **No**

Previous pit filling: **No**

Bottom comments: **There are over 100 breaks with pitting**

## **WET INTERIOR APPURTENANCES**

### **Tank ladder:**

**N/A**

### **Cathodic protection:**

**N/A**

Clips and pressure fitting present: **Yes**

Location of Clips: **On floor**

Cathodic comments: **Controls are old from previous system**

### **Fill pipe:**

Diameter: **16 inches**

Height above floor: **5 inches**

Configuration: **Stubs at floor**

One way valves present: **No**

Deflector on end: **Yes**

Removable silt ring: **Yes**

Mixing system: **No**

Coating condition: **Good**

Metal condition: **Good**

### **Drain pipe:**

Diameter: **10 inches**

Height above floor: **5 inches**

Deflector over end: **Yes**

Removable silt ring: **No**

Coating condition: **Good**

Metal condition: **Good**

## **WET INTERIOR APPURTENANCES**

### **Overflow pipe:**

Type: **Weir box**

Coating condition: **Good**

Metal condition: **Good**

### **Sidewall beams:**

**N/A**

### **Columns:**

**N/A**

### **Baffle wall:**

**N/A**

Field Inspection Report is prepared from the contractor's viewpoint. It contains information the contractor needs to prepare his bid for any repair or recoating. The engineer uses it to prepare the engineering report. Cost estimates are more accurate if the contractor's problems can be anticipated. While prepared from the contractor's viewpoint, the only intended beneficiary is the owner. These reports are completed with diligence, but the accuracy is not guaranteed. The contractor is still advised to visit the site.



1) 2,000,000 gallon reservoir (Candlers Mountain Tank #1) located in Lynchburg, Virginia.

2) Typical foundation section with loose caulking at the baseplate.

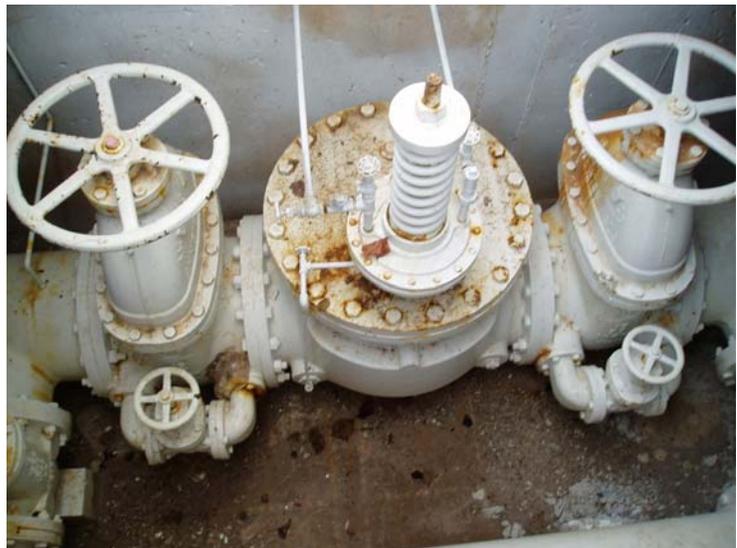


3) One of the bolted sidewall manways.



4) Overflow pipe with splash pad and flap gate.

5) Pit piping with some rust bleedthrough.

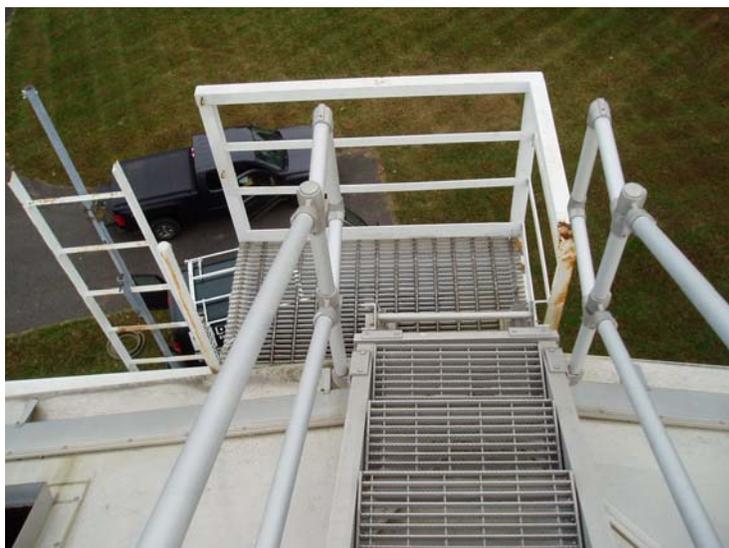


6) One of two damaged pipe supports in the pit.



7) Level indicator was inoperable.

8) Sidewall ladder with vandal guard.



9) Platform at the upper sidewall.



10) Coating failure on the platform railing.

11) Screen at the air gap between the roof and sidewall stiffener.



12) Roof hatch.



13) Roof stairs and railing.

14) Typical hub and roof panel section.



15) Frost free roof vent.



16) Interior roof.

17) Roof connection at the side-wall.

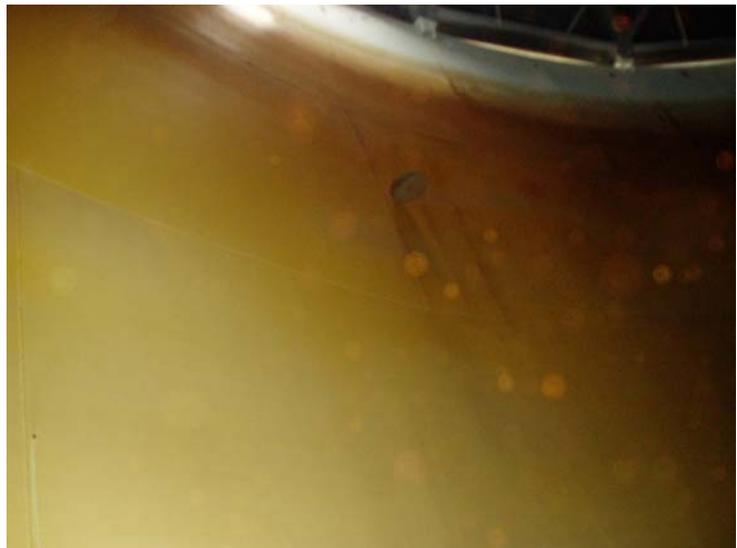


18) Coating failures at the top of the sidewall.



19) Coating failures on the upper sidewall.

20) Sidewall overview and damaged level indicator float.



21) Overflow weir box.



22) Pressure fitting on the side-wall.



23) Coating failures on the side-wall.



24) Floor overview.



25) Coating failures on the floor.

26) Spot coating failures on the floor.

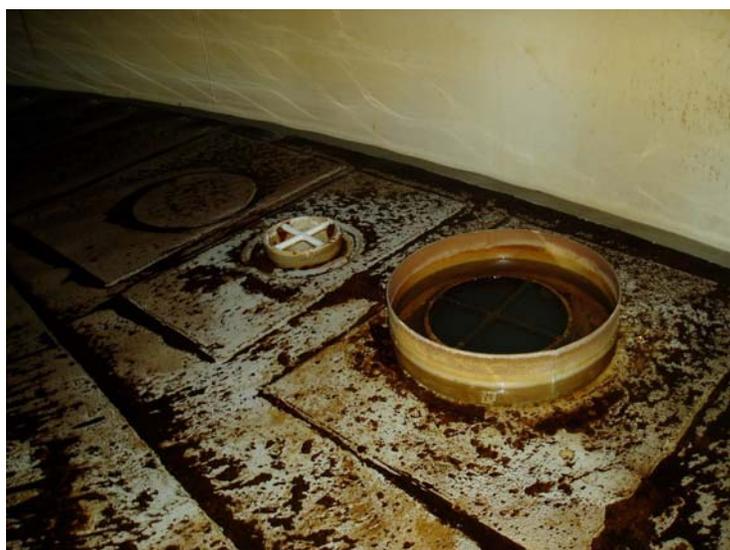


27) Cathodic protection attachment clip.



28) Coating failures on the floor.

29) Spot coating failure on the floor.



30) Fill line, draw line and drain line.