

**STRUCTURE CS-4**  
**INSPECTION DATE: 3/24/2020**



Double Barrel, 48" Diameter x 102' Long

Location:	FWMA
	Levee FWMA
Latitude:	27.8229 N
Longitude:	80.6909 W
Type:	Gated Culvert
No. Barrels:	Two
Inspection	
Start Date:	3/24/2020
End Date:	3/24/2020

TEAM MEMBERS	
Lead Engineer	Jeffrey O'Connor, P.E.
Dive Supervisor	Bo Green
Diver	Natasha Daniel
Diver – Standby	Aaron Willard
Dive Tender	Ben Harpel
Dive Tender	
Animal Control	TJ McDonagh
SJRWMD Agent	

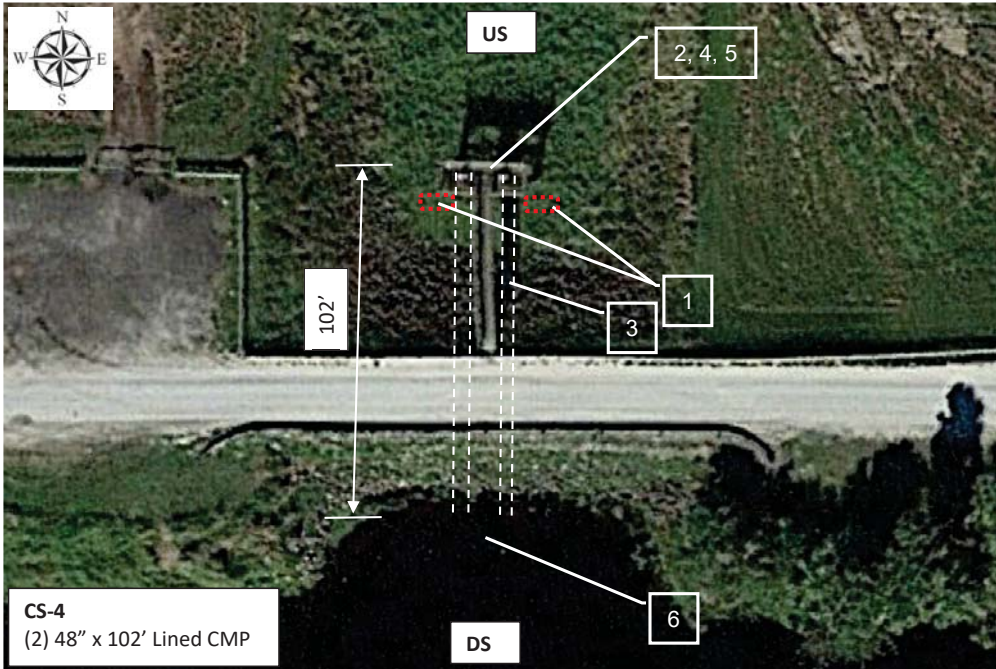
Respectfully Submitted,  
**UNDERWATER ENGINEERING SERVICES, INC.**  
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Jeffrey O'Connor, P.E. (FL 50914)  
Vice President  
Project Manager



Digitally signed by  
Jeffrey H O'Connor  
Date: 2020.06.25  
11:03:07 -04'00'

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**Aerial View of Structure**



No.	Item No.	Inspection Item	Rating	Deficiency
1	US3	Exposed erosion-control fabric	C-3	Two 8' x 5' areas of exposed erosion-control fabric near the concrete structure.
2	US152	Gate Guides	C-3	Moderate to major corrosion on isolated portions of the guide angles.
3	DS56	Shoaling/Scour	C-3	The east barrel has up to 2' of mud build up at 69' in from the downstream end.
4	US114	Structural Support	C-2	Minor concrete scaling for support frame.
5	US151, DS151	Structure Gates	C-2	Coating blisters and minor corrosion on both sides of gates.
6	DS2	Riprap	C-2	No riprap observed beyond 10' from bank but may be covered in mud.

### Structure Description and Method of Underwater Inspection

Structure CS-4 is a gated culvert comprised of two barrels, extending north (gated end) to south under Levee FWMA. The barrels are lined CMP, 48 inches diameter by 102 feet long. The north end has an access bridge supported by a buried abutment and the concrete structure frame.

The underwater inspection was performed by a 5-person dive team on March 24-25, 2020. The dive team worked from a dive trailer, using surface-supplied air, and accessed the structure areas from the bank.

The scope of services included the underwater inspection of the submerged structure components. The area extended 20 feet beyond the structure edges. There were no boat barriers.

The air temperature was 80 degrees F. and the weather was mostly clear. The underwater visibility ranged from 1 to 2 feet. The water level was unknown – there were no staff gauges present.

### Rating System

- C-1: No action needed
- C-2: Monitor condition at next dive inspection (5 years)
- C-3: Schedule repair/replacement (for routine items)
- C-4: Schedule repair/replacement (for safety or operational items)
- C-5: Repair/replace immediately (for structural items)
- C-6: Critical - Repair/replace immediately (for operational items)

### Summary of Observations

#### Items Rated C-5 and Above

There were no items rated C-5 and above.

#### Items Rated C-4

There were no items rated C-4.

#### Items Rated C-3

- Item US3: There are two areas of exposed filter fabric and no riprap. The areas are both 5' x 8' and are located just to the southeast of the east column and just to the southwest of the west column.
  - Recommended Action: Place new riprap in the areas of exposed filter fabric.
- Item US152: (1) Both sides of both gates have moderate to major corrosion with minor to moderate section loss in the vertical angles located just above the top gate block. The section loss is knife edging with losses of 1/2" to 3/4" on the leg over a 2" to 6" length of angle, with associated thickness loss. The vertical angle frame outside of this area has minor coating blisters and corrosion. (2) The west side frame of the west gate has an isolated area of heavy corrosion and knife edging located at the 2nd anchor from the top. The loss of section is 1.5" on the leg over a 12" high length. (3) The bolts for the gate frames all have moderate

corrosion on the bolt with up to 20% section loss, but the nuts are stainless steel and have no section loss. The top bolt on the west side of the east gate has 10% section loss with the nut also being carbon steel.

- Recommended Action: The gate frame areas with heavy corrosion and section loss should be cleaned and recoated and may need additional strength. The frame bolts should be replaced with either galvanized steel or with stainless steel with isolation materials.
- Item DS56: The east barrel has a build-up of mud up to 2' deep near 69' in from the downstream end.
  - Recommended Action: Remove the thick build-up of mud at 69' penetration.

#### Items Rated C-2

- Item US114: The concrete columns have minor scaling, up to 1/16" deep with exposed aggregate over 50% of the area, from the channel bottom to the construction joint at 6' above bottom. The lower concrete struts have minor scaling of 1/16" overall with isolated pitting of 1/4" and occasional 1/2" deep.
  - Recommended Action: Monitor concrete column for advanced scaling.
- Item US151: Both gates have coating blisters throughout and spotty minor corrosion covering 25% of the surface. Both gates have a higher concentration of pitting, up to 1/32" around the stem and deeper pitting on the edges.
  - Recommended Action: Monitor gate for coating loss and advanced corrosion and/or section loss.
- Item DS151: Both gates have coating blisters and minor corrosion nodules mostly around the outer edges covering 5% to 10% of the area.
  - Recommended Action: Monitor gate coating for increased coating loss and/or pitting underneath.
- Item DS2: No riprap found beyond 10' from shore, but area had up to 2.5' of mud.
  - Recommended Action: Monitor area downstream of culvert for future scour.



**PHOTOGRAPHS**

Item No.: US3 Exposed Erosion-Control Fabric	Rating: C-3	Photo Description: Area of exposed fabric
Deficiency: There are two areas of exposed filter fabric and no riprap. The areas are both 5' x 8' and are located just to the southeast of the east column and just to the southwest of the west column.		
Probable Cause: Most likely the riprap was never installed in these areas.		
Recommendation: Place new riprap in the areas of exposed filter fabric.		



Item No.: US152 Gate Guides	Rating: C-3	Photo Description: Corrosion on angle leg edges
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Deficiency: (1) Both sides of both gates have moderate to major corrosion with minor to moderate section loss in the vertical angles located just above the top gate block. The section loss is knife edging with losses of 1/2" to 3/4" on the leg over a 2" to 6" length of angle, with associated thickness loss. The vertical angle frame outside of this area has minor coating blisters and corrosion. (2) The west side frame of the west gate has an isolated area of heavy corrosion and knife edging located at the 2nd anchor from the top. The loss of section is 1.5" on the leg over a 12" high length. (3) The bolts for the gate frames all have moderate corrosion on the bolt with up to 20% section loss, but the nuts are stainless steel and have no section loss. The top bolt on the west side of the east gate has 10% section loss with the nut also being carbon steel.

Probable Cause: The corrosion was due to chemical attack from the water and isolated areas of galvanic corrosion due to contact of dissimilar metals.

Recommendation: The gate frame areas with heavy corrosion and section loss should be cleaned and recoated and may need additional strength. The frame bolts should be replaced with either galvanized steel or with stainless steel with isolation materials.



Item No.: DS56 Shoaling/Scour	Rating: C-3	Photo Description: Mud build-up in east barrel
Deficiency: The east barrel has a build-up of mud up to 2' deep near 69' in from the downstream end.		
Probable Cause: The build-up may be caused by debris under the mud.		
Recommendation: Remove the thick build-up of mud at 69' penetration.		



# **APPENDIX**

# **CHECKLISTS**



**Structure No. CS-4**

**UPSTREAM EROSION CONTROL**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
US1	Slope/Banks of Channel	1	No deficiencies noted		
US2	Rip Rap	1	No deficiencies noted		
US3	Exposed erosion-Control Fabric	3	There are two areas of exposed filter fabric and no riprap. The areas are both 5' x 8' and are located just to the southeast of the east column and just to the southwest of the west column [14:32].	Place new riprap in the areas of exposed filter fabric.	Most likely the riprap was never installed in these areas.
US4	Evidence of stone displacement (bedding stone)	1	No deficiencies noted		
US5	Channel Stabilization and erosion control	1	No deficiencies noted		

**UPSTREAM GENERAL**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
US50	Structural - General Concrete Condition	2	Refer to US114		
US51	Structural - General Metal Condition	3	Refer to US152		
US52	Structural - General Timber Condition	NA	Item not present		
US53	Construction Joints (Bolts, Welds)	1	No deficiencies noted		
US54	Channels for Stoplogs or Flashboards	NA	Item not present		
US55	Settlement	1	No deficiencies noted		
US56	Shoaling/Scour	1	No deficiencies noted		
US57	Fouling/Marine Growth	1	No deficiencies noted		
US58	Debris	NA	Item not present		
US59	Stilling Wells	NA	Item not present		
US60	Underwater Controls/Instruments	NA	Item not present		
US61	Fenders	NA	Item not present		

**UPSTREAM STRUCTURE**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
US100	Wingwalls	NA	Item not present		
US101	Buttresses (support arms for wall)	NA	Item not present		
US102	Abutments	NA	Item not present		
US103	Retention Walls	NA	Item not present		
US104	Headwall	NA	Item not present		
US105	Expansion/Construction Joints	1	No deficiencies noted		
US106	Sheetpiles and Bulkheads	NA	Item not present		
US107	Wales/Tiebacks	NA	Item not present		
US108	Intake Bays	NA	Item not present		
US109	Piers	NA	Item not present		
US110	Foundation	NA	Item not present		
US111	Weir/Weir crest	NA	Item not present		
US112	Baffles	NA	Item not present		
US113	Underwater Apron Slabs	NA	Item not present		

**Structure No. CS-4**

US114	Structural Support, Bracing or Frames	2	The concrete columns have minor scaling, up to 1/16" deep with exposed aggregate over 50% of the area, from the channel bottom to the construction joint at 6' above bottom. The lower concrete struts have minor scaling of 1/16" overall with isolated pitting of 1/4" and occasional 1/2" deep [13:18, 13:28, 13:51, 14:24].	Monitor concrete column for advanced scaling.	The concrete scaling is due to chemical attack from the water and possible long-term abrasion from flowing water.
US115	Culverts	NA	Buried		
US116	Risers	NA	Item not present		

**UPSTREAM GATES**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
US151	Structure Gate(s)	2	Both gates have coating blisters throughout and spotty minor corrosion covering 25% of the surface. Both gates have a higher concentration of pitting, up to 1/32" around the stem and deeper pitting on the edges [13:28, 14:02].	Monitor gate for coating loss and advanced corrosion and/or section loss.	The corrosion was due to chemical attack from the water and isolated areas of galvanic corrosion due to contact of dissimilar metals.
US152	Gate Guides and Gate Control	3	(1) Both sides of both gates have moderate to major corrosion with minor to moderate section loss in the vertical angles located just above the top gate block. The section loss is knife edging with losses of 1/2" to 3/4" on the leg over a 2" to 6" length of angle, with associated thickness loss. The vertical angle frame outside of this area has minor coating blisters and corrosion [13:35, 13:44, 14:06, 14:14]. (2) The west side frame of the west gate has an isolated area of heavy corrosion and knife edging located at the 2nd anchor from the top. The loss of section is 1.5" on the leg over a 12" high length [14:15]. (3) The bolts for the gate frames all have moderate corrosion on the bolt with up to 20% section loss, but the nuts are stainless steel and have no section loss. The top bolt on the west side of the east gate has 10% section loss with the nut also being carbon steel [13:35, 13:44, 14:06, 14:14].	The gate frame areas with heavy corrosion and section loss should be cleaned and recoated, and may need additional strength. The frame bolts should be replaced with either galvanized steel or with stainless steel with isolation materials. Monitor areas of gate frame, gate frame hardware and block hardware for advanced corrosion and/or section loss.	The corrosion was due to chemical attack from the water and isolated areas of galvanic corrosion due to contact of dissimilar metals.
US153	Gate Seals & Mating Surface	1	No deficiencies noted.		
US154	Cathodic Protection (entire structure)	NA	Item not present		
US155	Operator/Actuator Components	1	No deficiencies noted.		
US156	Emergency Closure Gates	NA	Item not present		
US306	Navigation Lock Miter Gates	NA	Item not present		

**Structure Name/No.: CS-4**

**DOWNSTREAM EROSION CONTROL**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
DS1	Slope/Banks of Channel	1	No deficiencies noted		
DS2	Rip Rap	2	No riprap found beyond 10' from shore, but area had up to 2.5' of mud [11:14].	Monitor area downstream of culvert for future scour.	Unknown if riprap was to be placed in area, or if it is present and just covered by mud.
DS3	Exposed erosion-Control Fabric	1	No deficiencies noted		
DS4	Evidence of stone displacement (bedding stone)	1	No deficiencies noted		
DS5	Channel Stabilization and erosion control	1	No deficiencies noted		

**DOWNSTREAM GENERAL**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
DS50	Structural - General Concrete Condition	NA	Item not present		
DS51	Structural - General Metal Condition	2	See DS151		
DS52	Structural - General Timber Condition	NA	Item not present		
DS53	Construction Joints (Bolts, Welds)	NA	Item not present		
DS54	Channels for Stoplogs or Flashboards	NA	Item not present		
DS55	Settlement	1	No deficiencies noted		
DS56	Shoaling/Scour	3	The east barrel has a build-up of mud up to 2' deep near 69' in from the downstream end 11:34].	Remove the thick build-up of mud at 69' penetration.	The build-up may be caused by debris under the mud.
DS57	Fouling/Marine Growth	1	No deficiencies noted		
DS58	Debris	NA	Item not present		
DS59	Stilling Wells	NA	Item not present		
DS60	Underwater Controls/Instruments	NA	Item not present		
DS61	Fenders	NA	Item not present		

**DOWNSTREAM STRUCTURE**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
DS100	Wingwalls	NA	Item not present		
DS101	Buttresses (support arms for wall)	NA	Item not present		
DS102	Abutments	NA	Item not present		
DS103	Retention Walls	NA	Item not present		
DS104	Headwall	NA	Item not present		
DS105	Expansion/Construction Joints	NA	Item not present		
DS106	Sheetpiles and Bulkheads	NA	Item not present		
DS107	Wales/Tiebacks	NA	Item not present		
DS108	Intake Bays	NA	Item not present		
DS109	Piers	NA	Item not present		
DS110	Foundation	NA	Item not present		
DS111	Weir/Weir crest	NA	Item not present		
DS112	Baffles	NA	Item not present		
DS113	Underwater Apron Slabs	NA	Item not present		
DS114	Structural Support, Bracing or Frames	NA	Item not present		
DS115	Culverts	1	No deficiencies noted		

**Structure Name/No.: CS-4**

**DOWNSTREAM GATES**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
DS151	Structure Gate(s)	2	Both gates have coating blisters and minor corrosion nodules mostly around the outer edges covering 5% to 10% of the area [10:40, 11:46].	Monitor gate coating for increased coating loss and/or pitting underneath.	The coating damage is from possible improper preparation or application, or age deterioration. The metal corrosion is due to chemical attack from the water.
DS152	Gate Guides and Gate Control	NA	Item not present		
DS153	Gate Seals & Mating Surface	1	No deficiencies noted		
DS154	Cathodic Protection (entire structure)	NA	Item not present		
DS155	Operator/Actuator Components	NA	Item not present		
DS156	Emergency Closure Gates	NA	Item not present		
DS157	Navigation Lock Miter Gates	NA	Item not present		
DS1000	Additional Items and Comments				