

Executive Summary

TO: Brent Soderlin, PE, CFM, Director of Public Works and Utilities, Littleton, Colorado (City)

FROM: Tim Phelan, PE

SUBJECT: Lee Gulch Flume

DATE: December 6, 2024

CC:

Benesch recently conducted an inspection of the structure supporting the Lee Gulch Flume located in St. Mary Park within Littleton, Colorado. The inspection report, provided in **Appendix A**, identified the following concerns:

- Corrosion, holes, and leaks in multiple locations throughout the flume deck.
- Corroded steel members supporting the flume.
- Spalled and scaled concrete and missing anchor nuts at the west abutment.
- Exposed foundations at Pier 5 with no undermining.
- Heavy vegetation growth under and around the structure.

Based on these observations, Benesch recommended repairs of the flume exhibiting holes and leaks that can affect underlying structural components from prolonged moisture exposure and corrosion of the steel members or deterioration of the concrete members. In addition, Benesch recommended removal of the vegetation under and around the structure may result in a compromised structure as the vegetation grows.

Given the apparent age of the structure, Benesch retained the services of DS Environmental Consulting to test the accessible materials of the flume structure for lead based paint. Their report, provided in **Appendix B**, concluded “Concentrations of lead in paint higher than the State of Colorado regulatory levels were not identified; therefore, no further “lead safe” work practices are required when disturbing, removing, or impacting the tested components. Some components could not be safely accessed and must be assumed to have LBP [lead based paint]. Additional testing is required if new materials are discovered or the scope of work changes.” Thus, “lead safe” work practices may be required when disturbing, removing or impacting components not accessible for testing given the vegetation and height of the structure.

It is Benesch’s understanding that the function of the flume to convey water will no longer be necessary in the near future, but the exact timeframe is currently in flux. To evaluate options of what to do with the structure once it has been decommissioned, the City requested Benesch to provide a rough order magnitude cost estimate for varying conditions to assist with their evaluation. It was also requested that Benesch consider the costs of maintaining the operable nature of the flume to convey water in some manner to be determined. **Appendix C** outlines the costs for the three conditions requested, as outlined below:

- 1) Repair the existing structure per the observations and recommendations provided in the inspection report. These costs identified the necessary expenses to address the concerns identified, such as install riprap around the exposed foundations of the pier, replace portions of the flume that leaked, install new lining to prevent leaks, clean and paint the corroded areas, remove vegetation in the vicinity, patch concrete areas, and install new anchor nuts.
- 2) Future standard maintenance costs to preserve the structure periodically (estimated to be approximately

every 10 years). These costs included painting the entire structure, removing vegetation in the vicinity as it regrows, and replacing assumed areas that are anticipated to leak over time should the flume continue to carry water.

- 3) Costs to disassemble and reassemble the structure to another location for prominent display within the park system. These costs were broken down into moving the truss and supports only, moving a single span of the flume support only, and miscellaneous elements that will need to be considered for the detachment and replacement of the structures. The total number of spans was considered as those that were not associated with being supported by concrete abutments or piers and provided a total price if all spans unsupported by abutments and piers were considered for displacement. Mechanical systems for pumping water through the flume were not considered in the cost estimate.

A 40% contingency was provided for the cost estimates to cover unknown factors that often occur when repairing or moving existing structures, to account for taxes, overhead, and profit, variability of current costs, as well as variability of future anticipated costs given the unknowns of when any work on the structure may occur. As stated, these costs are a rough order magnitude for comparison purposes and may be easily adjusted to account for such changes in costs or any known costs available to the City.

Please feel free to contact us with any questions about this project.

Respectfully submitted,

A handwritten signature in blue ink, appearing to read "Tim R. Phelan", followed by a horizontal line.

Timothy "Tim" R. Phelan, PE
Project Manager

Amar Jaishi, EIT, CBSI
Designer

Appendix A: Structure Inspection Report
Appendix B: Lead-Based Paint Inspection Report
Appendix C: Costs Estimates

Appendix A: Structure Inspection Report



Routine Inspection Flume Structure Inspection and Inventory Report

Bridge Key: Lee Gulch	Inspection Date 90: 07/30/2024	Sufficiency Rating: N/A	FO
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NBI Reporting ID:	Lee Gulch				Main Mat/Design 43A/B:	3	09	Bridge Cost 94:		\$0			
Region/Sect 2E/2M:	Reg 1		MSec 5		Appr Mat/Design 44A/B:	3	03	Roadway Cost 95:		\$0			
Tran Region 2T:	6	Greater Denver				Main Spans Unit 45:	1		Total Cost 96:		\$0		
County Code 3:	005	Arapahoe				Approach Spans 46:	4		Year of Cost Estimate 97:				
						Horizontal Clrnc 47:	6.3 ft		Brdr Brdg Code/% 98A/B:	-	-		
Place Code 4:	45255	Littleton				Max Span 48:	48.0 ft		Border Bridge No. 99:				
						Structure Length 49:	103.7 ft		Defense Highway 100:		0	No	
Route (On/Under) 5A:	1	Route On Structure				Curb Width L/R 50A/B:	0.0 ft	0.0 ft	Parallel Structure 101:		N	No bridge exists	
Signing Prefix 5B:	8	Other (describe)				Width Curb to Curb 51:	6.3 ft		Direction of Traffic 102:		0	No Vehicles	
Level of Service 5C:	0	None				Width Out to Out 52:	6.9 ft		Temporary Structr 103:				
Direction Suffix 5E:	0	N/A				Deck Area:	715.32 sf		Highway Systems 104:		0	Not on NHS	
Feature Intersected 6:					Min Clr ovr Brdg 53:	99.9 ft		Fed Lands Hwy 105:		0	Not Applicable		
Lee Gulch					Min Undrclr Ref 54A:	N	Not over hwy/RR	Year Reconstructed 106:					
Facility Carried 7:					Min Underclr 54B:	0.0 ft		Deck Type 107:		9	Other		
City Ditch					Min Lat Clrnce Ref R 55A:	N	Not over hwy/RR	Wearing Surface 108A:		0	None		
Alias Struc No. 8A:					Min Lat Undrclr R 55B:	0.0 ft		Membrane 108B:		9	Other		
					Min Lat Undrclr L 56:	0.0 ft		Deck Protection 108C:		0	None		
Parallel Struc No. 8P:					Deck Rating 58:	7	Good	Truck ADT 109:					
					Superstructure Rating 59:	7	Good	Truck Net 110:		0	No		
Location 9:					Substructure Rating 60:	7	Good	Pier Protection 111:					
St. Mary Park					Channel/Protectn Rtg 61:	7	Sparse Minor Dam	NBIS Length 112:		Y	Bridge Length		
Max Clearance 10:	99.9 ft				Culvert Rating 62:	N	Not Applicable	Scour Critical 113:		5	Stable (Calcs)		
Base Hwy Net 12:	0	Not on Base Ntwk				Operating Rtg Method 63:	5	No Rating	Scour Watch 113M:		N	No watch	
LRS Inv Route 13A:	0000000000				Operating Rating 64:			Future ADT 114:					
LRS Sub Route No 13B:	00				Operating Factor 64:			Year of Future ADT 115:					
Latitude 16:	39° 35' 49.64"				Inv Rating Method 65:	5	No Rating	CDOT Struct Type 120A:		SDT	Steel Deck Truss		
Longitude 17:	105° 01' 17.78"				Inventory Rating 66:			CDOT Constr Type 120B:		00	Not Appl/Unknown		
Detour Length 19:	1.0 mi				Inventory Factor 66:			Inspection Indic 122A:					
Toll Facility 20:	3	On Toll Free Road				Asphalt/Fill Thick 66T:	0.0 in		Inspection Trip 122AA:				
Custodian 21:	04	City/Municipal Hwy				Structure Evaluation 67:	3	Correct - Intoler.	Scheduling Status 122B:		0	Not applicable	
Owner 22:	04	City/Municipal Hwy				Deck Geometry 68:	N	Not Applicable	Maintenance Patrol 123:				
Functional Class 26:	19	Urban Local				Undrclr Vert/Horiz 69:	N	Not Applicable	Expansion Dev/Type 124:		O	None	
Year Built 27:	1901				Posting 70:	N	Not Applicable	rdg Rail Type/Mod 125A/B:					
Lanes On 28A:	00				Water Adequacy 71:	8	Deck > approach	Posting Trucks 129A/B/C:		-	-	-	
Lanes Under 28B:	00				Approach Alignment 72:	8	Desirable	Structure Rating Date 130:					
ADT 29:	0				Type of Work 75A:			Special Equipment 133:		00	None		
Year of ADT 30:	1900				Work Done By 75B:			Vert Clr N/E 134A/B/C:		X	99'	00'	
Design Load 31:	0	Unknown/Other				Lngth of Imprvmt 76:	0.00 ft		Vert Clr S/W 135A/B/C:		X	99'	00'
Apr Rdwy Width 32:	0.0 ft				Insp Team Indicator 90B:	Benesch		Vertical Clearance Date:		1/1/1901			
Median 33:	0	No Median				Inspector Name 90C:	AJAISHI		Weight Limit Color 139:		0	White	
Skew 34:	0.00°				Frequency 91:	24 months		Struct Billing Type:					
Structure Flared 35:	0	No Flare				FC Frequency 92A:			Userkey 1, Insp System:				
Safety Rail 36A/B/C/D:	N	N	N	N	UW Frequency 92B:			Userkey 4, Insp Sched:					
Rail Height 36H:	0.0 in				OS Frequency 92C:			Userkey 5, UW Sched:					
Hist Significance 37:	5	Not Eligible				FC Insp Date 93A:			Userkey 6, Pin Sched:				
Posting Status 41:	K	Bridge closed				UW Insp Date 93B:			Inspection Key:				
Service On/under 42A/B:	0	5			OS Insp Date 93C:								



Routine Inspection Structure Inspection and Inventory Report

Element Inspection Report

Inspection Date: 7/30/2024

Elm/Env	Description	Unit	Total Qty	% in 1	CS 1	% in 2	CS 2	% in 3	CS 3	% in 4	CS 4
60/1	Other Deck	(SF)	715	94%	670	2%	12	3%	25	1%	8
Deck is a steel open half cylinder flume with painted liner with (2) bolt bands at each joint and (1) intermediate bolt band at 3 feet spacing; painted gray. Span 3 north side near mid-point has a diversion with active leakage. Top: Mostly covered with water, no major deficiencies noted. Spans 1 and 2 mostly inaccessible due to fencing. Bottom: Paint is peeling off throughout, primarily along joints. Span 1 at Abutment 1 has area of active leakage with corrosion holes (2SF CS4). Span 2 near Pier 2 has 8 inch long tear/damage (1SF CS4). Span 3 along joint band north half has active leakage with corrosion holes on east side of diversion (3SF CS4). Span 3 east side of diversion has area of corrosion holes through metal liner for 12 feet (12SF CS2). Spans 4 and 5 have full length corrosion holes through metal liner with rust staining up to 1 foot wide (24SF CS3). Span 5 at Abutment 6 has active leakage with corrosion holes (2SF CS4). Span 5 near Abutment 6 has 8 inch area of liner damage (1SF CS3).											
107/1	Steel Open Girder	(LF)	112	0%	0	100%	112	0%	0	0%	0
(2) C-channel beams with frequent web splice plates welded to east beam and bolted to west beam; transverse bracing at 3 feet spacing; painted gray. Beams have R1 corrosion throughout (112LF CS2).											
120/1	Steel Truss	(LF)	96	0%	0	100%	96	0%	0	0%	0
Span 3 is a welded truss; painted gray. Truss chords, diagonals, and verticals have R1 corrosion throughout (96LF CS2).											
207/1	Steel Tower	(LF)	37	68%	25	32%	12	0%	0	0%	0
Steel trestles at all piers; painted gray. Trestles at Piers 2 and 3 are coated black from groundline and above up to 22 inches high. Trestle diagonals, horizontals, and verticals have R1 corrosion starting at groundline up to 3 feet high (12LF CS2).											
215/1	R/Conc Abutment	(LF)	14	64%	9	0%	0	36%	5	0%	0
Active water leakage along both abutments. Abutment 1 both ends at bearing has 6 inch x 8 inch x 6 inch deep spall with exposed rebar and anchors (2LF CS3). Abutment 6 has S3 scaling for 3 feet (3LF CS3).											
220/1	R/Conc Pile Cap/Footing	(LF)	28	100%	28	0%	0	0%	0	0%	0
All pier footings are covered in silt and not visible except Pier 5 footing. Pier 5 footing exposed up to 22 inch for full length with no undermining.											
311/1	Movable Bearing	(EA)	4	50%	2	0%	0	0%	0	50%	2
Moveable bearings at both abutments. Abutment 1 both bearings have missing anchor nuts and loss of bearing area up to 50% (2EA CS4).											
313/1	Fixed Bearing	(EA)	8	100%	8	0%	0	0%	0	0%	0
Fixed bearings at piers. No significant defects noted.											
326/1	Wingwall	(EA)	4	100%	4	0%	0	0%	0	0%	0
Concrete wingwalls monolithic with abutments. Wingwalls have S1-S2 scaling.											
501/1	Channel/Bank	(EA)	1	100%	1	0%	0	0%	0	0%	0
Channel flows south to north under Span 3. Erosion channel under Span 2 up to 18 inches deep at Pier 2 and 22 inches deep at Pier 3 exposing a black coating. Large grouted boulders and concrete wall with 24 inch outlet. Northwest side of channel has concrete weir. Northeast side of structure and across channel has flumes merge into inlet at outlet end. Heavy vegetation growth under and around structure.											



Routine Inspection Structure Inspection and Inventory Report

Element Inspection Report

Inspection Date: 7/30/2024

Elm/Env	Description	Unit	Total Qty	% in 1	CS 1	% in 2	CS 2	% in 3	CS 3	% in 4	CS 4
600/1	General Remarks										
Lee Gulch trail path along west side of flume. Outflow/diversion at northeast end of flume. Fence at west end of structure and fence posts are welded to trestle verticals.											

Maintenance Recommendations	Quantity	Date Recommended	Maintenance Category
Deck-Seal	8 SF	07/30/2024	High
Patch holes in steel deck to prevent water leakage.			
Channel-Remove Debris	1 EA	07/30/2024	High
Clear vegetation under and around the structure.			

Inspection Notes

Inspector(s): A. Jaishi, R. Spicer

Date: 07/30/2024

Time: 10:25 AM

Temp: 88°

Weather: Clear

Calm

Bridge Notes

Inventory route is west to east

South side is upstream


Superstructure is named Beam/Truss A to B from north to south; and truss nodes number upper (U) of lower (L) 0 to 8 from west to east

Substructure is numbered 1 through 6 from west to east

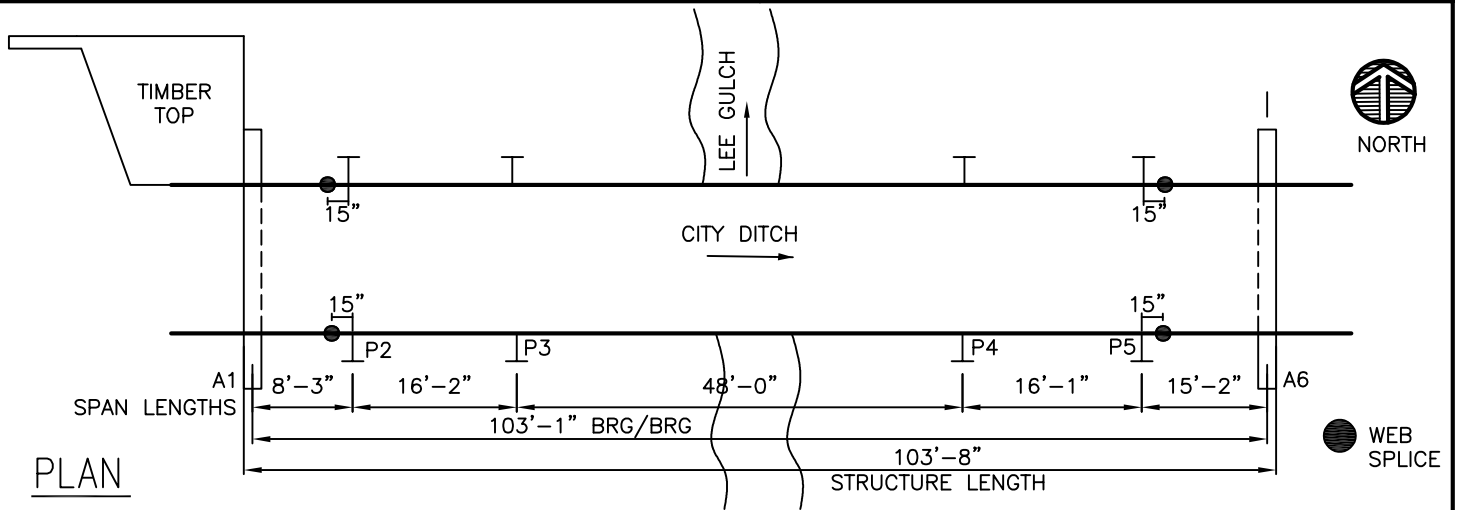
Scope:

☒ Routine ☒ Element ☐ Fracture Critical ☐ Underwater ☐ Other Special

Inspection Date: 07/30/2024

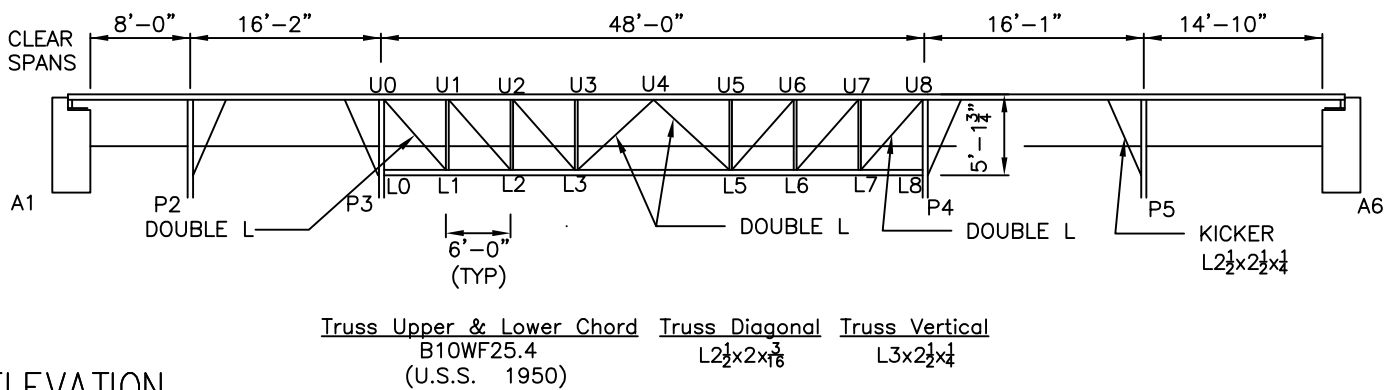

Inspector (Team Leader): AJAISHI

PLAN



ELEVATION

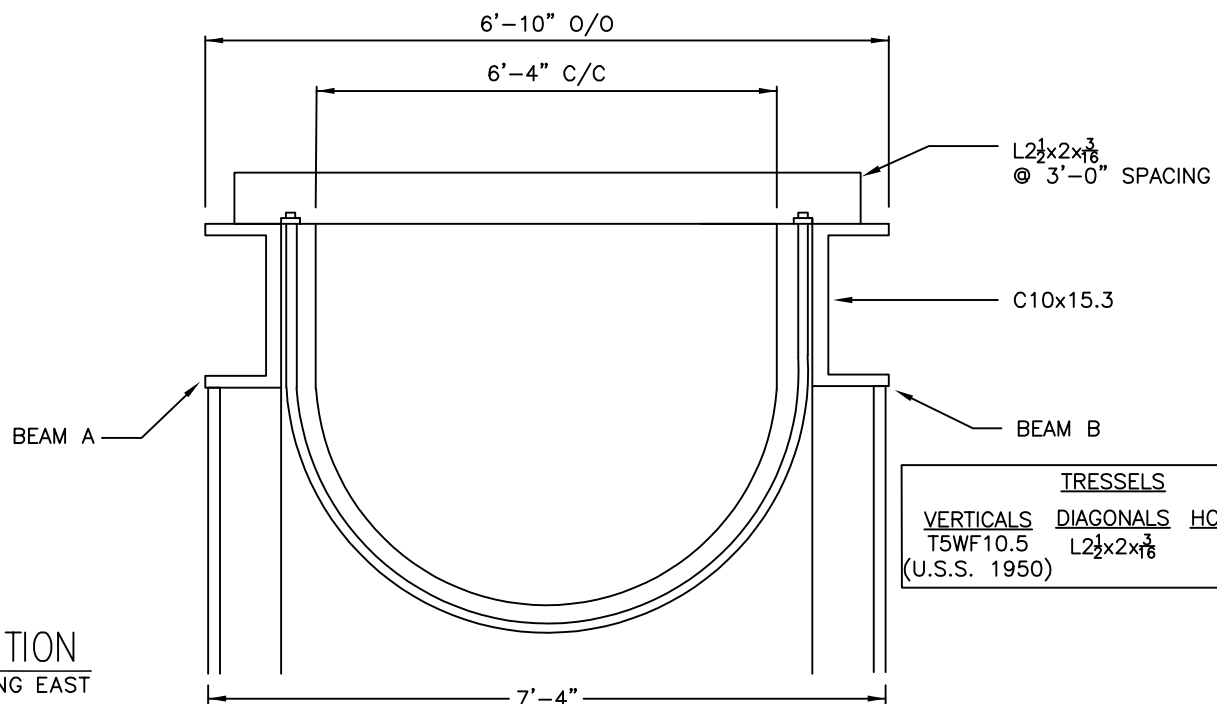
LOOKING NORTH



Truss Upper & Lower Chord B10WF25.4 (U.S.S. 1950)
Truss Diagonal L2 1/2 x 2 x 3/8
Truss Vertical L3 x 2 1/2 x 4

SECTION

LOOKING EAST



TRESTLES		
VERTICALS	DIAGONALS	HORIZONTALS
T5WF10.5	L2 1/2 x 2 x 3/8	L2 1/2 x 2 x 3/8
(U.S.S. 1950)		



Flume looking east.



Flume looking west.



Elevation looking north.



Elevation looking south.



Span 2 underside looking west.



Span 3 underside looking west.



Channel looking south upstream.



Channel looking north downstream.



Beam has R1 corrosion, typical.



Truss 3A lower chord has R1 corrosion, typical.



Span 2 near Pier 2 has area of tear and damage.



Span 3 active leakage at diversion with R4 corrosion holes.



Span 3 at joint has R4 corrosion holes with active leakage.



Span 3 deck underside has area of perforations through liner.



Span 4 underside has area of perforation through liner with rust stains.



A1 north end spall with exposed rebar and anchor and missing nut at bearing.



Trestle vertical at groundline has R1 corrosion, typical.



Abutment 6 has S3 scaling.



Abutment 1 general.



Pier 5 general.



Abutment 6 general.

Appendix B: Lead-Based Paint Inspection Report



“The trusted choice for your environmental & industrial hygiene needs.”

LEAD-BASED PAINT INSPECTION REPORT

Lee Gulch Flume

39°35'49.5"N 105°01'08.1"W

Littleton, CO

PRESENTED TO:

Benesch
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Project Manager
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INSPECTED BY:

Mr. Sean Work
DS Environmental
Cell: (720) 878-1741

A handwritten signature in blue ink that reads 'Sean'.

PROJECT DETAILS:

DS Job Number: 27627
Date of Inspection: October 22, 2024



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Avon, CO 81620

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APPENDIX A	XRF Data Table
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APPENDIX B	Inspector & Firm Certificates
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1.0 Introduction

Mr. Sean Work with DS Environmental Consulting (DS) performed a comprehensive lead-based paint (LBP) inspection and performed in situ X-Ray Florescence (XRF) testing to determine the presence of LBP on painted components of the Lee Gulch Flume, running roughly east to west, spanning Lee Gulch in Littleton, CO. The coordinates are 39°35'49.5"N 105°01'08.1"W.

The purpose of the inspection was to determine if any of the materials on the flume, or the immediate area around it, contains lead-based paint.

LBP was not found on the Lee Gulch flume; however, some components could not be accessed and should be considered to have LBP until tested.

Table 1 and Table 2 in Section 6.0 further details the materials that contain LBP and those that do not. The full table (Table 3), including all XRF readings, can be found in Appendix A.

2.0 Definitions

Lead-based Paint (LBP) is any paint having concentrations of lead greater than 1.0 mg/cm², which is also Colorado's action level.

Paint is any liquid mixture, usually of solid pigment in a liquid form, used as a decorative or protective coating. This includes, but is not limited to, primer, lacquer, polyurethane, wood stain, etc.

X-Ray Florescence (XRF) is a non-destructive analytical technique used to determine the elemental composition of materials. XRF analyzers determine the chemistry of a sample by measuring the fluorescent (or secondary) X-ray emitted from a sample when it is excited by a primary X-ray source.

3.0 Scope of Work

This inspection was comprehensive in its scope and included all areas and suspect, painted components on and in the immediate area of the flume. The LBP inspection did not constitute a hazard assessment.

Some components of the flume were inaccessible at the time of inspection; these materials must be assumed to have LBP until further testing is performed. Please refer to the photos in section 5.0 for more details.

*Should any material that would have been impossible to find during this inspection be discovered, that was not subject to this sampling, that material shall be assumed to be LBP if it is painted and must be sampled upon discovery.

4.0 Certifications

Mr. Work is a Colorado State Certified LBP Inspector, having EPA Accreditation #27686. DS Environmental Consulting is a Colorado State Certified Lead Evaluation Firm, license #16918. Mr. Work is certified to operate the Viken Pb200i XRF Lead Paint Spectrum Analyzers by the manufacturer (see Appendix B for certificates).

5.0 Overview of Findings

Table 1: Components that Contain LBP

No Components were found to contain Lead-based Paint.

Table 2: Components that Do Not Contain LBP

Read No.	Area	Structure	Paint Cond	Substrate	Paint Color	Lead (mg/cm ²)	Result
1	Flume West End	Deck	Damaged	Metal	Silver	0.0	Neg
2	Flume West End	Girder	Significantly Damaged	Metal	Silver	0.0	Neg
3	Flume West End	Truss	Significantly Damaged	Metal	Silver	0.0	Neg
4	Flume West End	Tower	Significantly Damaged	Metal	Silver	0.0	Neg
5	Flume West End	Tower	Intact	Metal	Black	0.0	Neg
6	Flume East End	Deck	Significantly Damaged	Metal	Silver	0.0	Neg
7	Flume East End	Girder	Significantly Damaged	Metal	Silver	0.0	Neg
8	Flume East End	Truss	Significantly Damaged	Metal	Silver	0.0	Neg
9	Flume East End	Tower	Significantly Damaged	Metal	Silver	0.0	Neg
10	Flume East End	Wing wall	Intact	Metal	Tan	0.0	Neg
11	Flume East End	Spanning Truss	Significantly Damaged	Concrete	Silver	0.0	Neg



Close-up of the deck. Negative



Close-up of a girder. Negative



This component is identified as the Truss in this report. Negative



The vertical supports are identified as Towers in this report; the towers on this flume had two types of paint, silver and black. The black paint is only present on the West end of the tower, near and under the ground.

Negative



The wingwall. Negative



These components are identified as spanning trusses in this report. Only one could be safely accessed due to overgrowth. Negative



The sluice gate and associated mechanism could not be safely accessed at the time of this inspection and is assumed to have LBP components. Assumed LBP



All components visible in this photo were not accessible due to a locked gate, and must be assumed to have LBP until tested. Assumed LBP

6.0 Equipment Information

LBP concentrations were obtained using a Viken Pb200i XRF Lead Paint Spectrum Analyzer, which is approved by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Housing and Urban Development (HUD) to determine the concentration of lead in paint.

The XRF was calibrated according to the manufacturer's Performance Characteristic Sheet (PCS). The XRF was calibrated using the calibration standard block of known 1.0 mg/cm² lead content as well as a standard block of known 0.0 mg/cm² lead content. Three (3) calibration readings of each block were taken before the inspection began as well as after the inspection was completed, every four hours of continuous use, and/or following a battery change.

7.0 Inspection & Testing Procedures

The LBP inspection and XRF testing were conducted by a State of Colorado accredited LBP Inspector qualified by experience, education, and training in approved LBP testing techniques. These procedures call for the visual inspection of the areas of concern and the collection of XRF readings for lead concentrations.

This inspection was performed in accordance with the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Housing and Urban Development (HUD) guidelines for lead-hazard inspections, as well as the State of Colorado Air Quality Control Commission Regulation No. 19 for the Control of Lead Hazards. The EPA's 40 CFR Part 745 Final Rule (January 5, 2001) set standards for the identification of dangerous levels of lead. The standards identify when lead-based paint, lead-contaminated dust, and lead-contaminated soil are hazards. It also establishes residential dust clean-up levels (post-abatement clearance levels) and set dust and soil sampling requirements. The lead-based paint readings were collected by XRF analyzation for the purpose of determining lead concentrations as mg/cm².

8.0 Conclusions & Recommendations

Concentrations of lead in paint higher than the State of Colorado regulatory levels were not identified; therefore, no further "lead safe" work practices are required when disturbing, removing, or impacting the tested components. Some components could not be safely accessed and must be assumed to have LBP. Additional testing is required if new materials are discovered or the scope of work changes.

9.0 Disclaimer & Limitations

This limited-scope inspection does not constitute a lead-hazard assessment. Other areas not tested and conditions existing outside this scope of work may contain lead concentrations above the regulatory action levels. Consequently, to determine whether lead-based paint exists within other areas of the building, a full lead-based paint inspection must occur.

10.0 Copyright Notice

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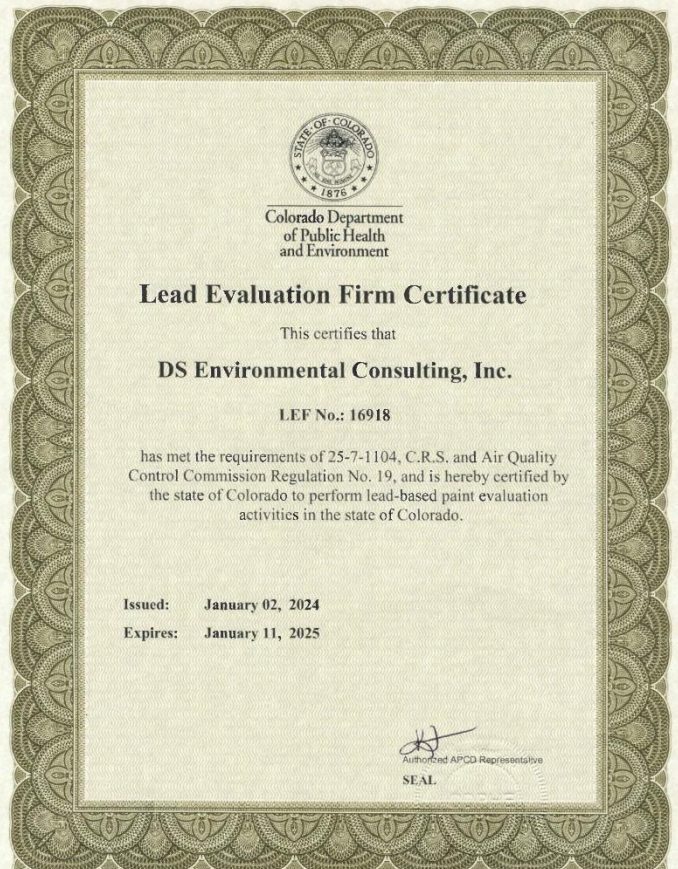
APPENDIX A: XRF READINGS

Pre-inspection Calibration – Known LBP Calibration Block						Average: 1.0	PASS
Pre -inspection Calibration – Known LBP Calibration Block							
Pre -inspection Calibration – Known LBP Calibration Block							
Pre -inspection Calibration – Known Negative Calibration Block						Average: 0.0	PASS
Pre -inspection Calibration – Known Negative Calibration Block							
Pre -inspection Calibration – Known Negative Calibration Block							
Read No.	Area	Structure	Paint Cond	Substrate	Paint Color	Lead (mg/cm²)	Result
1	Flume West End	Deck	Damaged	Metal	Silver	0.5	Neg
2	Flume West End	Girder	Significantly Damaged	Metal	Silver	0.1	Neg
3	Flume West End	Truss	Significantly Damaged	Metal	Silver	0.1	Neg
4	Flume West End	Tower	Significantly Damaged	Metal	Silver	0.1	Neg
5	Flume West End	Tower	Intact	Metal	Black	0.1	Neg
6	Flume East End	Deck	Significantly Damaged	Metal	Silver	0.1	Neg
7	Flume East End	Girder	Significantly Damaged	Metal	Silver	0.0	Neg
8	Flume East End	Truss	Significantly Damaged	Metal	Silver	0.1	Neg
9	Flume East End	Tower	Significantly Damaged	Metal	Silver	0.1	Neg
10	Flume East End	Wing wall	Intact	Metal	Tan	0.3	Neg
11	Flume East End	Spanning Truss	Significantly Damaged	Concrete	Silver	0.3	Neg
Post-inspection Calibration – Known LBP Calibration Block						Average: 1.0	PASS
Post -inspection Calibration – Known LBP Calibration Block							
Post -inspection Calibration – Known LBP Calibration Block							
Post -inspection Calibration – Known Negative Calibration Block						Average: 0.0	PASS
Post -inspection Calibration – Known Negative Calibration Block							
Post -inspection Calibration – Known Negative Calibration Block							

APPENDIX B: INSPECTOR & FIRM CERTIFICATES



Inspector Certification: 17285



Firm Certification: 16918




Viken (formerly Heuresis) Pb200i XRF Certification

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Appendix C: Cost Estimates

Cost Estimate Calculations_Lee Gulch

 <p>Version: 1</p>	Computed by:	APJ	Date:	12/2/2024	
	Checked by:	TRP	Date:	12/5/2024	Project No.: 1525-400003.01
	Project:	Lee Gulch Flume, Littleton, CO			
	Element:	Repair Cost Estimate			

Repair Recommendations	Maintenance Category	Date Recommende	Description	Unit	Cost/Unit		Quantity	Total	Notes	Quantity Basis
					Remove	Replace				
Stabilize and install riprap around Pier 5 Footing	Low	7/30/2024	RIPRAP (9 IN)	CY	\$ -	\$ 630.00	8.94	\$ 5,629.16	Width of Flume ~ 7' + 3' for footings + 10' extend beyond footings x half the distance between Piers 4 & 5 = (16'-1") x (1/2) x 2' depth of rip rap	Report
Patch holes on deck underside	High	7/30/2024	78 INCH EQUIVALENT CORRUGATED STEEL PIPE ARCH	LF	\$ 400.00	\$ 1,100.00	51.0	\$ 76,500.00	Spans with 3' sections of rusted through areas noted in report at 17 locations for replacement using similar pricing for corrugated steel pipe arch	Report
Install rubber liner throughout flume trough	High	7/30/2024	RUBBER LINER	SF		\$ 20.00	1048.9	\$ 20,978.60	Surface area of flume trough over full length, not existing	Report
Clean and paint corrosion on deck underside	High	7/30/2024	PAINT EXISTING STRUCTURE	SF	\$ -	\$ 25.00	1048.9	\$ 26,223.25	10.125' long curved section x 103.7 ft length remove corrosion and paint	Report
Clear vegetation under and around structure	High	7/30/2024	CLEARING AND GRUBBING	ACRE	\$ -	\$ 30,000.00	0.10	\$ 3,000.00	Removal of vegetation minimum area of 0.1 acre = 103.7 ft length = ~42' width on either side of tressel	Assumed
Forestry Services for Clearing and Grubbing	Low	7/30/2024	FORESTRY SERVICES	EA	\$ -	\$ 50,000.00	1.0	\$ 50,000.00	Verify with Littleton for Forestry Services Requirements	Report
Clean and paint corrosion on channel supports	Low	7/30/2024	PAINT EXISTING STRUCTURE	SF	\$ -	\$ 25.00	184.9	\$ 4,623.10	Paint 2 channels outside face = ~20" x 103.7 ft length	Report
Clean and paint corrosion on truss members	Low	7/30/2024	PAINT EXISTING STRUCTURE	SF	\$ -	\$ 25.00	892.3	\$ 22,307.75	Paint 2 sides of 12 diagonals 8' LG and 6 verticals 5.25' LG of Truss Chords	Report
Concrete Abutment Patch	High	7/30/2024	CONCRETE PATCHING ON VERTICAL SURFACES - CLASS 2	SF	\$ 100.00	\$ 400.00	9.67	\$ 4,833.33	Abutment 1 Concrete Patching 6" x 8" x 6" spalls and Abutment 6 Concrete Patching heavy abrasion for 3'	Report
Install Anchor Bolt	High	7/30/2024	INSTALL ANCHOR BOLT	EA	\$ -	\$ 250.00	2.00	\$ 500.00	Abutment 1 install anchor bolts	


Total \$ 214,595.19
 40% Contingency \$ 85,838.08 Contingency covers unknowns, taxes, future costs, etc.
Estimated Repair Cost \$ 300,433.26

 Version: 1	Computed by:	APJ	Date:	12/2/2024	Sheet:	
	Checked by:	TRP	Date:	12/5/2024	Project No.:	1525-400003.01
	Project:	Lee Gulch Flume, Littleton, CO				
	Element:	Maintenance Cost Estimate ~ Every 10 years				

Maintenance Recommendations	Description	Unit	Cost/Unit		Quantity	Total	Notes	Quantity Basis
			Remove	Replace				
Replace deteriorated sections of metal flume	78 INCH EQUIVALENT CORRUGATED STEEL PIPE ARCH	LF	\$ 400.00	\$ 1,100.00	6.0	\$ 9,000.00	Spans with 3' sections assumed at 2 locations for replacement using similar pricing for corrugated steel pipe arch per maintenance cycle	Report
Paint existing structure entirely	PAINT EXISTING STRUCTURE	SF	\$ -	\$ 25.00	2537.2	\$ 63,429.22	Paint Structure	Report
Clear vegetation in, under, and around structure	CLEARING AND GRUBBING	ACRE	\$ -	\$ 30,000.00	0.10	\$ 3,000.00	Removal of vegetation minimum area of 0.1 acre = 103.7 ft length = ~42' width on either side of tressel	Assumed
Replace rubber liner	RUBBER LINER	SF	\$ 5.00	\$ 20.00	1048.9	\$ 26,223.25	Matches surface area of flume trough	Report
Forestry Services for Clearing and Grubbing	FORESTRY SERVICES	EA	\$ -	\$ 50,000.00	1.0	\$ 50,000.00	Verify with Littleton for Forestry Services Requirements	Report

Maintenance costs are estimated to occur approximately every 10 years

Total	\$	151,652.47	
40% Contingency	\$	60,660.99	Contingency covers unknowns, taxes, future costs, etc.
Estimated Maintenance Cost	\$	212,313.45	

 Version: 1	Computed by:	APJ	Date:	12/2/2024	Sheet:	
	Checked by:	TRP	Date:	12/5/2024	Project No.:	1525-400003.01
	Project:	Lee Gulch Flume, Littleton, CO				
	Element:	Movement Cost Estimate				

Movement Recommendations	Description	Unit	Cost/Unit		Quantity	Total	Notes	Quantity Basis
			Remove	Replace				
Truss Quantities								
Replace deteriorated sections of metal flume	78 INCH EQUIVALENT CORRUGATED STEEL PIPE ARCH	LF	\$ 400.00	\$ 1,100.00	15.0	\$ 22,500.00	Spans with 3' sections of rusted through areas noted in report at 17 locations for replacement in truss using similar pricing for corrugated steel pipe arch	Report
Replace rubber liner on truss structure	RUBBER LINER	SF	\$ 5.00	\$ 20.00	485.5	\$ 12,138.05	Matches surface area of flume trough for truss length	Report
Paint existing truss structure entirely	PAINT EXISTING STRUCTURE	SF	\$ -	\$ 25.00	770.5	\$ 19,263.30	Paint Truss Structure	Report
New Foundations for Truss	CONCRETE CLASS D	CY	\$ -	\$ 900.00	6.1	\$ 5,466.67	New concrete foundations below Truss	Assumed
Disassemble and Reassemble Truss w/ 2 tressels	STRUCTURAL STEEL (REMOVE AND REPLACE)	LBS	\$ 10.00	\$ 10.00	7282.9	\$ 145,658.55	Move truss members to new location	Assumed
Disassemble and Reassemble Truss w/ 2 tressels	STRUCTURAL STEEL (NEW STEEL)	LBS	\$ -	\$ 20.00	728.3	\$ 14,565.86	Assume 10% of existing steel needs to be replaced/repared with new material	Assumed
Total to move the truss						\$ 219,592.42		
40% Contingency						\$ 87,836.97	Contingency covers unknowns, taxes, future costs, etc.	
Estimated Truss Movement Cost						\$ 307,429.39		

Typical Span Quantities								
Replace deteriorated sections of metal flume for a typical section	78 INCH EQUIVALENT CORRUGATED STEEL PIPE ARCH	LF	\$ 400.00	\$ 1,100.00	3.0	\$ 4,500.00	Spans with 3' sections of rusted through areas noted in report assumed at 1 location for replacement of typical span using similar pricing for corrugated steel pipe arch	Report
Replace rubber liner throughout span	RUBBER LINER	SF	\$ 5.00	\$ 20.00	162.7	\$ 4,067.09	Matches surface area of flume trough throughout typical span length	Report
Paint existing span structure entirely	PAINT EXISTING STRUCTURE	SF	\$ -	\$ 25.00	602.9	\$ 15,071.98	Paint Structure	Report
New Foundations for one Tressle	CONCRETE CLASS D	CY	\$ -	\$ 900.00	3.0	\$ 2,733.33	New concrete foundations below one tressel of span	Assumed
Disassemble and Reassemble typical span w/ 1 tressel	STRUCTURAL STEEL (REMOVE AND REPLACE)	LBS	\$ 10.00	\$ 10.00	1101.3	\$ 22,026.45	Move span members to new location	Assumed
Disassemble and Reassemble typical span w/ 1 tressel	STRUCTURAL STEEL (NEW STEEL)	LBS	\$ -	\$ 20.00	110.1	\$ 2,202.64	Assume 10% of existing steel needs to be replaced/repared with new material	Assumed
						Total to move one span	\$ 50,601.49	
						40% Contingency	\$ 20,240.60	Contingency covers unknowns, taxes, future costs, etc.
						Estimated Span Movement Cost	\$ 70,842.09	
						Total number of Spans	2.0	Does not include spans with abutments, new abutments omitted
						Total Cost for Number of Spans Above	\$ 141,684.18	

Miscellaneous Elements								
Clear vegetation in, under, and around structure as well as in path of movement	CLEARING AND GRUBBING	ACRE	\$ -	\$ 30,000.00	0.20	\$ 6,000.00	Removal of vegetation around existing and proposed areas	Aerial / Street View
Forestry Services for Clearing and Grubbing	FORESTRY SERVICES	EA	\$ -	\$ 50,000.00	1.0	\$ 50,000.00	Verify with Littleton for Forestry Services Requirements	Assumed
Engineering Design	ENGINEERING DESIGN	EA	\$ -	\$ 50,000.00	1.0	\$ 50,000.00	Verify with Littleton for Forestry Services Requirements	Assumed
						Total	\$ 106,000.00	
						40% Contingency	\$ 42,400.00	Contingency covers unknowns, taxes, future costs, etc.
						Estimated Cost	\$ 148,400.00	

Estimated Movement cost for the above scope and number of spans indicated \$ 597,513.57 Does not include spans with abutments, new abutments omitted from estimate