REHABILITATION ALTERNATIVES REPORT

FOR

CEDAR SPRINGS RESERVIOR DAM OUTLET WORKS
DAMID 040112

IN

WATER DIVISION 1
WATER DISTRICT NO. 4
BOULDER COUNTY, COLORADO

PREPARED FOR

CEDAR SPRINGS IMPROVEMENT ASSOCIATION
PO BOX 8
DRAKE, COLORADO 80514

PREPARED BY

GAUTHIERE ENGINEERING, INC.
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GREELEY, COLORADO 80634
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JULY 23, 2013

CERTIFICATE OF ENGINEER

I hereby certify that this Rehabilitation Alternatives Report for the **CEDAR SPRINGS RESERVOIR DAM** located in Larimer County, was prepared by me, or under my direct supervision, for the Owner thereof.

Gauthiere Engineering, Inc.

_____ 07/23/2013

John G. Gauthiere, P.E.
Colorado P.E. No. 22136

CEDAR SPRINGS RESERVOIR DAM
REHABILITATION ALTERNATIVES REPORT

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GENERAL

PURPOSE

The purpose of this report is to provide cost estimates and discussion of potential alternatives for rehabilitation of the outlet works of Cedar Springs Reservoir Dam. Recent inspections of the outlet works including the sluice gate, lift mechanism, vent pipe, and 8-inch corrugated metal outlet pipe indicate that these dam appurtenances are at the end of their useful life. This report is intended to compliment the inspection report prepared by Gauthiere Engineering, Inc. dated July 1, 2013 previously submitted to the dam owner and State Engineer's Office –Dam Safety Division.

BACKGROUND

Cedar Springs Reservoir is a 38 acre-foot impoundment covering approximately three surface acres at an elevation of 6,900 feet. The reservoir is utilized by the residents of Cedar Springs for various recreational aquatic activities. The reservoir is also intended to be used as a source of water for fire protection for the community. A "dry hydrant" exists on the west bank of the reservoir for filling fire tanker trucks. (The hydrant is in need of repair and appeared to be nonfunctional at the time of the inspection.) The availability of water for fire protection results in lower insurance costs for the residents of Cedar Springs. Because the lake is at high altitude, it is not unusual to experience surface ice on the lake approximately 1-foot thick. Various seepages and a 1,670-acre drainage area fill Cedar Springs Reservoir. Water is discharged from Cedar Springs Reservoir either through its spillway when the lake is full or from the 8-inch diameter corrugated metal outlet pipe as needed. Water discharged from the reservoir enters Cedar Creek, then flows to the Big Thompson River and eventually passes through the City of Loveland 13 miles downstream.

Records of the State Engineer-Dam Safety Division indicate that the dam was completed in 1969. A drawing dated June 30,1969 prepared by Engineer David Coleman, P.E., documented details of the dam and outlet gate. The drawing referenced the outlet gate to be a Model 50-10c manufactured by Armco. At the time of the inspection the gate and operating equipment were 44-years old. The last inspection performed by the Office of the State Engineer – Dam Safety Division dated December 5, 2012 stated that the outlet gate is not operable and the owner has not been able to open the gate for many years. Specifically, the SEO Inspection Report stated:

1. The valve stem is bent due to ice action.
2. Erosion is occurring around and under the support for the concrete valve pedestal.
3. The owner indicated the valve has not been operated in several years and its operability is unknown.
4. The corrugated metal pipe (CMP) outlet conduit has been in service for over 40 years. CMP is prone to corrosion/rusting and it is typical to see problems in a pipe of this age.

The required maintenance regarding the outlet works identified in the December 5, 2012 Office of the State Engineer – Dam Safety Division Inspection Report included:

"*The Dam Safety Rules and Regulations require the valve to be kept in operable condition so releases can be made for water rights administration, maintenance, and in case of an emergency. It is recommended that the condition of the outlet is accessed before attempting to operate the valve. This would include having a diver inspect the portion of the stem below water and an internal inspection of the outlet conduit*."

DISCUSSION

Undetected corrosion of corrugated metal pipe (CMP), among other problems, is one of the primary causes of dam failure in small dams. This issue, left undetected, can ultimately lead to the failure of the embankment and loss of the contents of the reservoir. Dam failure can result in economic loss, environmental damage, disruption of lifeline facilities (e.g. roads and bridges), and even loss of life.

The life expectancy for corrugated metal pipe (CMP) is generally accepted to be 10 to 35-years before perforation of the metal pipe wall occurs. The Cedar Springs Reservoir Dam CMP outlet is now 44-years old. Since the existing 8-inch CMP outlet pipe is nearing or at the end of its expected life, it is imperative that Cedar Springs Improvement Association plan for the rehabilitation or replacement of the existing 8-inch diameter corrugated metal outlet pipe.

Because of the small size of the outlet pipe (8-inch diameter) there are only two practical alternatives to rehabilitate or replace the existing pipe.

1. **Relining Outlet With Cast In Place Pipe (CIPP):** This method is acceptable only if the existing conduit is still in fair condition and is not in structural failure or perforated to the point of creating cavities and seepage paths within the dam. This method of rehabilitating the outlet is by far the lowest cost. The typical design criteria for the CIPP would be to design for direct burial and assume no strength in the existing conduit. The existing conduit only serves as a form for the new cast in place pipe. The estimated unit cost ($/LF) for rehabilitation of the existing 8-inch CMP will vary depending on whether a CIPP contractor is already mobilized to a town nearby on another project or if the CIPP contractor has to mobilized from a distant location. This unit cost of CIPP lining will generally vary between $50/LF to $150/LF of pipe lined. A preliminary construction cost estimate using the higher unit cost is as follows:

ESTIMATED CONSTRUCTION COST CIPP (PIPE RELINING) ALTERNATIVE CEDAR SPRINGS RESERVOIR DAM OUTLET WORKS REHABILITATION					
ITEM	**DESCRIPTION**	**UNIT**	**QTY**	**UNIT PRICE**	**COST**
1	**Mobilization**				
	Mobilization	LS	1	8,900	$ 8,900.00
2	**Access Roads**				
	Lower Road (From Wren to DS Toe of Dam)				
	Labor & Equipment	LS	1	12,000	$12,000.00
	Imported Fill (4" minus)	LS	1	4,500	$4,500.00
	Culvert (24' of 36" diameter)	LS	1	3,600	$3,600.00
	Upper Road (From DS Toe to Top of Dam)				
	Labor & Equipment	LS	1	12,000	$12,000.00
	Imported Fill (4" minus)	LS	1	4,500	$4,500.00
3	**Rehabilitate Primary Outlet**				
	Excavation and Backfill	CY	10	20	$ 200.00
	Reline Exist. 8" CMP	LF	140	150	$21,000.00
	8" Outlet Gate Valve, Lift, Stem and Grade Blocks & Staff Gage (Ice Damage Resistant)	LS	1	25,000	$25,000.00
	Outlet Wing Walls	LS	1	3,000	$3,000.00
	Outlet Structure Trash Rack (clean and paint)	LS	1	250	$ 250.00
	Sand Filter Diaphragm	LS	1	2,500	$2,500.00
4	**Riprap Erosion Protection**				
	Add 1.5' of Riprap to Upstream Face in Wave Zone Only (10' x 347')	CY	200	80	$16,000.00
5	**Miscellaneous**				
	Site Restoration	LS	1	3,000	$3,000.00
	Cofferdam and Water Handling	LS	1	5,000	$5,000.00
	Estimated Construction Subtotal				$121,450.00
	Contingencies @ 10%				$12,145.00
	Engineering (Plans, Specifications, Bidding Package)				$19,100.00
	Engineering Services During Construction				$10,000.00
	Estimated Project Cost				**$162,695.00**

2. **Open Cutting The Dam, Removal And Replacement Of The Existing Pipe:**

This method would be required if the condition of the existing outlet has failed structurally or has perforated and leaked to the point that some of the dam embankment has been lost creating voids within the embankment and potential seepage paths that would endanger the integrity of the dam. This method is very expensive compared to relining with the CIPP method.

ESTIMATED CONSTRUCTION COST REMOVE AND REPLACE OUTLET PIPE ALTERNATIVE CEDAR SPRINGS RESERVOIR DAM OUTLET WORKS REHABILITATION					
ITEM	**DESCRIPTION**	**UNIT**	**QTY**	**UNIT PRICE**	**COST**
1	**Mobilization**				
	Mobilization	LS	1	17,300	$ 17,300.00
2	**Access Roads**				
	Lower Road (From Wren to DS Toe of Dam)				
	Labor & Equipment	LS	1	12,000	$12,000.00
	Imported Fill (4" minus)	LS	1	4,500	$4,500.00
	Culvert (24' of 36" diameter)	LS	1	3,600	$3,600.00
	Upper Road (From DS Toe to Top of Dam)				
	Labor & Equipment	LS	1	12,000	$12,000.00
	Imported Fill (4" minus)	LS	1	4,500	$4,500.00
3	**Rehabilitate Primary Outlet**				
	Excavation and Backfill	CY	2,500	20	$50,000.00
	New 12" PVC C-900 Outlet Pipe	LF	140	50	$7,000.00
	Concrete Cradle for Outlet Pipe	LF	140	100	$14,000.00
	12" Outlet Gate Valve, Lift, Stem and Grade Beam & Staff Gage (Ice Damage Resistant)	LS	1	35,000	$35,000.00
	Outlet Structure w/Wing Walls	CY	12	1,000	$12,000.00
	Outlet Structure Trash Rack	LS	1	1,500	$1,500.00
	Outlet Structure & Headwall	CY	15	1,000	$15,000.00
	Sand Filter Diaphragm	LS	1	5,000	$5,000.00
4	**Riprap Erosion Protection**				
	Add 1.5' of Riprap to Upstream Face in Wave Zone Only (10' x 347')	CY	200	80	$16,000.00
5	**Miscellaneous**				
	Site Restoration	LS	1	25,000	$25,000.00
	Cofferdam and Water Handling	LS	1	15,000	$15,000.00
	Estimated Construction Subtotal				$249,400.00
	Contingencies @ 10%				$24,940.00
	Engineering (Plans, Specifications, Bidding Package)				$35,000.00
	Engineering Services During Construction				$18,500.00
	Estimated Project Cost				**$327,840.00**

3. The Null Alternative:

The null alternative is essentially a "no action" alternative and will ultimately result in either the possible catastrophic failure of the dam or a storage restriction that could be as low a gage height zero. Since the low level outlet is relatively small and could be prone to clogging or collapse, it is likely the Dam Safety will require that the dam itself be breached to prevent temporary refilling of the pond during storm events.

The null alternative has many negative aspects including the following:

- Loss of an important fire protection water resource.
- Fire insurance cost will likely increase.
- Loss of an aesthetic and recreational asset to the community.
- Additional cost associated with the breaching and removal of the dam and restoration of the site.
- Cost to remove sediment to prevent downstream contamination.
- Lower real estate values.
- Loss or abandonment of a water right which is decreed for domestic, stock watering, piscatorial, recreational, municipal and irrigation. The appropriation date is June 25, 1968. The Water Court Case Number is W-7530.

The estimated cost of the null alternative is as follows:

ESTIMATED COST OR LOST VALUE
NULL ALTERNATIVE
CEDAR SPRINGS RESERVOIR DAM OUTLET WORKS REHABILITATION

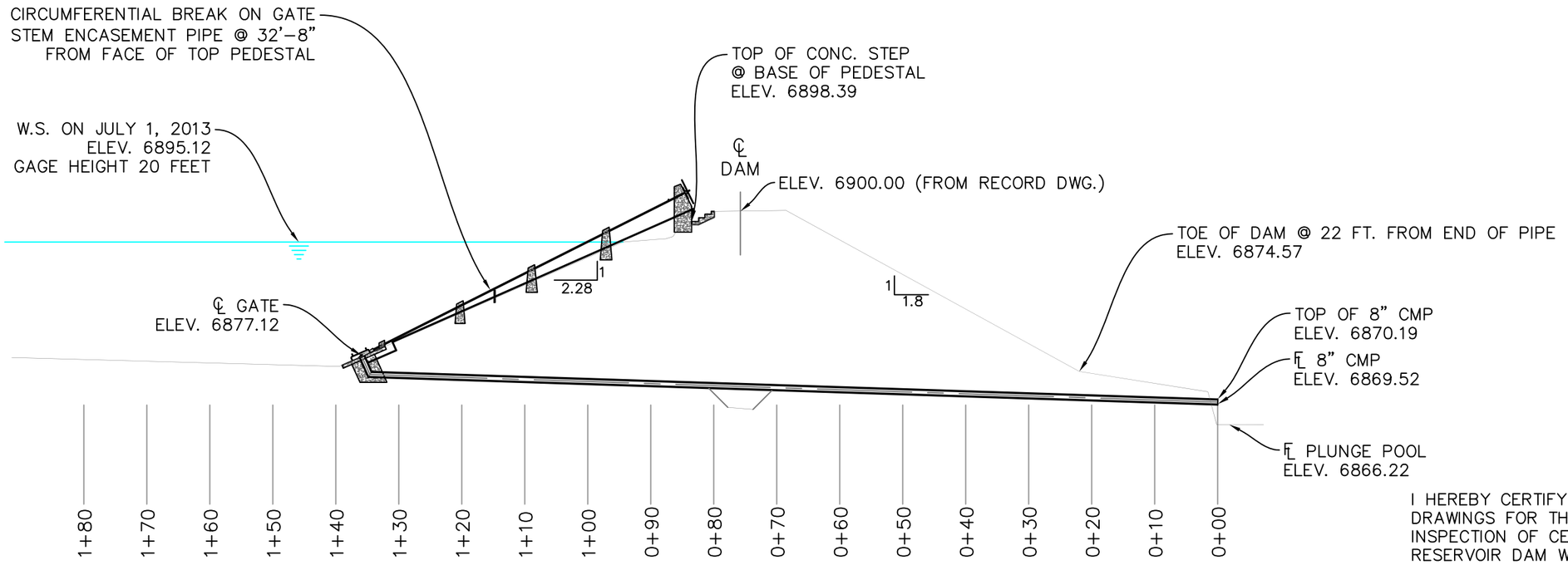
ITEM	DESCRIPTION	UNIT	QTY	UNIT PRICE	COST
1	**Breach Existing Dam**	CY	2,500	25	$62,500.00
2	**Access Road**				
	Lower Road (From Wren to DS Toe of Dam)				
	Labor & Equipment	LS	1	12,000	$12,000.00
	Imported Fill (4" minus)	LS	1	4,500	$4,500.00
	Culvert (24' of 36" diameter)	LS	1	3,600	$3,600.00
3	**Sediment Disposal**	CY	370	5	$1,850.00
4	**Stabilize the Immediate Area**	LS	1	15,000	$15,000.00
5	**Re-vegetate Former Impoundment**	SF	157,900	0.05	$7,895.00
6	**Restore Stream Channel**	LF	815	5	$4,075.00
7	**Replace Fire Protection Water Source**	LS	1	50,000	$50,000.00
8	**Permitting**	LS	1	2,500	$2,500.00
	Estimated Construction Subtotal				$163,920.00
	Contingencies @ 10%				$16,400.00
	Engineering (Plans, Specifications, Bidding Package)				$10,000.00
	Engineering Services During Demolition and Restoration Activities				$7,500.00
	Estimated Project Cost				**$197,820.00**

Not included in the Null Alternative cost estimate above is the loss of asset value for the water rights and the associated value of water storage if the reservoir is prohibited from storing water. At present, the cost of water rights cache-in-lieu charged by municipalities in Northern Colorado can be as high as $18,700 per acre-foot. While Cedar Springs Reservoir and its water right is a junior water right, it is definitely a valuable asset. Even at a discounted value of 25% of the current market (to account for the more junior nature of the 38.12 acre-foot water right and storage reservoir) the value of the water right and storage could be estimated at $4,675 per acre-foot. **At this discounted price the value of Cedar Springs water right and storage could be as high as $178,000.** The value of this water right will no doubt gain value in the future.

SUMMARY

The intent of this report is to provide information regarding the various alternatives for addressing maintenance issues of the Dam on Cedar Creek. The cost of the alternatives and potential loss in values have been estimated to assist the Board of Directors of Cedar Springs Improvement Association and all subsequent stakeholders in their efforts to plot a course of action to promote dam safety and to fulfill their fiduciary responsibility to Cedar Creek Homeowners.

While no alternative is low cost, maintaining the existing outlet by relining with cast-in-place pipe is by far the most economical. Considering the value of water storage and the associated water rights provided by Cedar Creek Reservoir Dam, the cost of dam maintenance is a reasonably attractive investment. Because of the age of the existing corrugated metal pipe under the dam, the Board is cautioned that delay in relining the existing CMP could result in the eventual inability to reline. If the existing CMP continues to degrade, the embankment in the vicinity of the pipe could be compromised, thus requiring one of the more costly alternatives to be implemented.



I HEREBY CERTIFY THAT THESE DRAWINGS FOR THE THE UNDERWATER INSPECTION OF CEDAR SPRINGS RESERVOIR DAM WERE PREPARED BY ME (OR UNDER MY DIRECT SUPERVISION) FOR THE OWNER THEREOF.

COLORADO REGISTERED
JOHN G. GAUTHIERE
22136
PROFESSIONAL ENGINEER

John D. Gauthiere
07/01/13

John G. Gauthiere, P.E.

NOTE:
1. 8" ø CMP OUTLET PIPE IS 135' LONG + 3' TURN UP (@ GATE) MEASURED ON JUNE 13 2013.

SCALE 1 INCH = 20 FEET

20 0 10 20 40

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Date: JULY 1, 2013
Scale: AS SHOWN
Drawn By: JGG
File: CEDAR SPRINGS DAM DRAWING.dwg

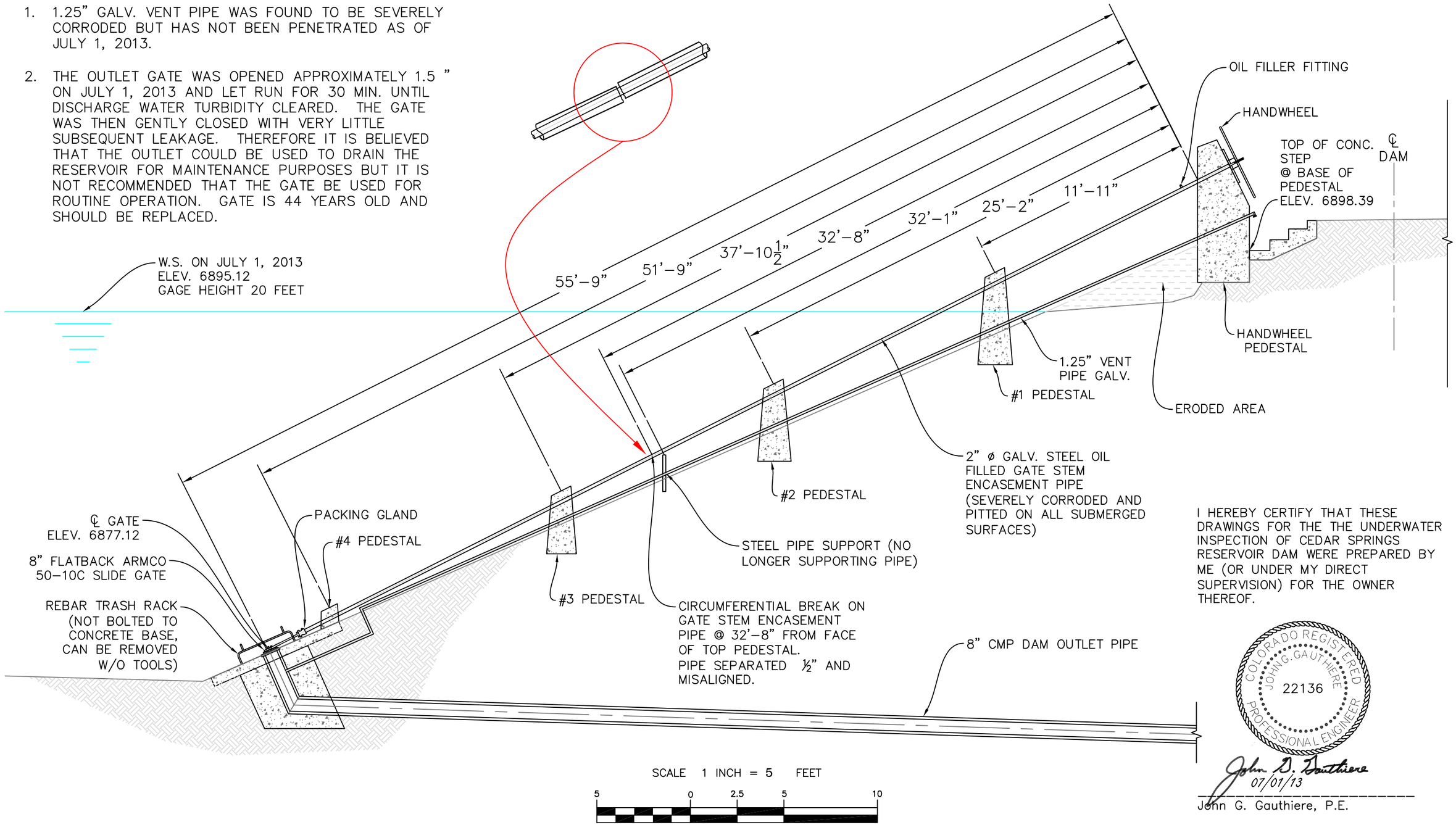
CEDAR SPRINGS DAM CROSS SECTION

Figure No. 1 of 2

NOTE:

1. 1.25" GALV. VENT PIPE WAS FOUND TO BE SEVERELY CORRODED BUT HAS NOT BEEN PENETRATED AS OF JULY 1, 2013.

2. THE OUTLET GATE WAS OPENED APPROXIMATELY 1.5 " ON JULY 1, 2013 AND LET RUN FOR 30 MIN. UNTIL DISCHARGE WATER TURBIDITY CLEARED. THE GATE WAS THEN GENTLY CLOSED WITH VERY LITTLE SUBSEQUENT LEAKAGE. THEREFORE IT IS BELIEVED THAT THE OUTLET COULD BE USED TO DRAIN THE RESERVOIR FOR MAINTENANCE PURPOSES BUT IT IS NOT RECOMMENDED THAT THE GATE BE USED FOR ROUTINE OPERATION. GATE IS 44 YEARS OLD AND SHOULD BE REPLACED.



SCALE 1 INCH = 5 FEET

5 0 2.5 5 10

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COLORADO REGISTERED JOHN G. GAUTHIERE 22136 PROFESSIONAL ENGINEER

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Scale: AS SHOWN
Drawn By: JGG
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CEDAR SPRINGS DAM DETAILS

Figure 2 OF 2